Appendix C

Notice of Preparation / Scoping Report

ESA

California Department of Toxic Substances Control
Santa Susana Field Laboratory

Scoping Report for the Program Environmental Impact Report

April 2014

Prepared for:

California Department of Toxic Substances Control

Prepared by:

Katz & Associates

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1.0 INTRODUCTION

The California Department of Toxic Substances Control (DTSC) is the lead state regulatory agency for the contaminated soil and groundwater remediation investigation and cleanup efforts at the Santa Susana Field Laboratory (SSFL). The 2,850-acre field laboratory is located approximately two miles south of Simi Valley in southeastern Ventura County, California. The project area includes the SSFL site and immediate surrounding vicinity. Within the site are four "administrative areas" (Areas I – IV) associated with three responsible parties (RPs), The Boeing Company (Boeing), the Department of Energy (DOE), and the National Aeronautics and Space Administration (NASA). A number of individual analyses have been or continue to be conducted by the RPs regarding conditions and remediation approaches for surface media (soil and related surficial media) and groundwater.

DTSC is responsible for making determinations on the final soil and groundwater investigation, and remedy selection, design, and implementation at SSFL. The California Environmental Quality Act (CEQA) specifies that a public agency must prepare an Environmental Impact Report (EIR) for any project it proposes to carry out or approve that may have a significant direct or indirect impact on the environment (Public Resources Code Section 21100[a]). DTSC determined that the SSFL site cleanup may have a significant impact on the environment and a Program EIR (PEIR) is necessary to fully evaluate potential environmental effects, including cumulative impacts, and alternatives for program-wide mitigation. The SSFL PEIR will analyze remediation of soils and groundwater, RCRA closure of three facilities and ongoing monitoring and maintenance of former RCRA impoundments, and demolition of Area IV buildings and associated infrastructure which will be implemented by the RPs. Except for the demolition of buildings and associated infrastructure in Area IV, these activities are remedial actions that will require approval by DTSC. The demolition of buildings and associated infrastructure in Area IV does not require DTSC approval. However, due to the location of, and anticipated timing for the demolition of the remaining SSFL Area IV buildings DTSC has elected to provide enhanced descriptions of the impacts of the planned removal/disposal actions.

To initiate the PEIR process, DTSC submitted a Notice of Preparation (NOP) to the Governor's Office of Planning and Research (OPR), State Clearinghouse (SCH) of the intent to prepare the PEIR. DTSC also distributed the NOP to all trustee and responsible public agencies, Tribal representatives with active involvement at the site, and other interested parties and stakeholders who have requested updates and notices about investigation and cleanup activities at SSFL.

As part of the PEIR preparation, CEQA requires a formal scoping and comment period to allow for public input on the scope and content of the environmental analyses to be included in the PEIR. All comments received by DTSC during the scoping process will be considered during the preparation of the Draft PEIR, as required by CEQA Guidelines, Section 15084(c). The Draft PEIR will contain a summary of the comments that pertain to the scope of the Draft PEIR and will identify the sections of the Draft PEIR where the comments are addressed. Comments that do not pertain to Draft PEIR impact analysis will not be addressed in the Draft PEIR.

This Scoping Report documents the scoping process, including NOP distribution, public comment process, public scoping meetings, and input received during the public comment period. Documentation of the NOP distribution, scoping activities, and NOP comments are provided in the appendices.

2.0 NOP AND SCOPING ACTIVITIES

The purpose of the scoping process is for early engagement of responsible agencies, trustee agencies, federal agencies, and interested organizations and individuals to identify environmental concerns to be addressed in the PEIR. More specifically, the lead agency informs other agencies and the public about the proposed project and environmental review process, and solicits input regarding the scope, focus, and content of the PEIR. As described in this section, the scoping process conducted by DTSC for the SSFL PEIR was initiated with the NOP and included a public comment period and public scoping meetings.

2.1 NOP COMMENT PERIOD AND DISTRIBUTION

The initial step in the CEQA process for the proposed project was to circulate the NOP. The NOP is a procedural document used to initiate interagency and public dialogue to help inform and determine the scope of the Draft PEIR impact analysis. Interested agencies and the public are invited to submit comments regarding the scope and content of the environmental information to be contained in the Draft PEIR for consideration by the lead agency.

On November 22, 2013, DTSC filed the NOP with the California Office of Planning and Research, which initiated the comment period for the NOP. Per CEQA Guidelines, Section 15082(b), the duration of the NOP comment period is a minimum of 30 days; however, DTSC allowed for a 45-day comment period concluding on January 10, 2014. The comment period was subsequently extended to allow additional time for public review and input, with the revised comment period concluding at 5:00 p.m. on February 10, 2014, providing a 75-day comment period. During the comment period, public scoping meetings were conducted by DTSC as described later in this section.

DTSC broadly announced the NOP, public scoping meetings and extended the comment period to allow interested agencies and the public to participate in the comment period. This was accomplished through the following:

- Mailings to over 4,400 contacts and email announcements to over 920 contacts on DTSC's email blast list, including copies of a public scoping meeting flier providing scoping period and meeting information
- Public notices in newspapers in the vicinities of the project area and public scoping meeting locations (Table 1)
- Information repositories containing the NOP as well as the public notice and multiple copies of the scoping meeting flier (Table 2)
- Project website postings (www.dtsc.ca.gov/sitecleanup/santa_susana_field_lab)

Documentation of DTSC's actions to disseminate the NOP and encourage involvement in the public comment period is provided in the appendices:

- Appendix A: Notice of Preparation
- Appendix B: Display Advertisement
- Appendix C: Public Scoping Meeting Flier

Table 1. Newspaper Public Notices for NOP and Public Scoping Meetings		
Newspaper	**Location**	**Run Date**
LA Daily News	Los Angeles, California	December 3, 2013
Ventura County Star	Ventura, California	December 3, 2013
Simi Valley Acorn	Simi Valley, California	December 6, 2013

Table 2. Project Information Repositories	
Location	**Address**
California State University, Northridge – Oviatt Library	1811 Nordhoff St. 2nd Floor, Room 265 Northridge, CA 91330
California Department of Toxic Substances Control - Chatsworth	9211 Oakdale Ave. Chatsworth, CA 91330
Platt Library	23600 Victory Blvd. Woodland Hills, CA 91367
Simi Valley Library	2969 Tapo Canyon Rd. Simi Valley, CA 93063

2.2 PUBLIC SCOPING MEETINGS

Depending on the nature of the PEIR, a public scoping meeting can be either an optional or required activity per CEQA. For projects of statewide, regional, or area-wide significance, CEQA specifies that the lead agency "shall conduct at least one scoping meeting" during which participants can assist the lead agency in determining the scope and content of the environmental information that the responsible or trustee agency may require (Public Resources Code Section 15082[c]). Public scoping meetings also help to accomplish early public consultation with persons or organizations potentially concerned with the environmental effects of the project, prior to Draft PEIR completion (Public Resources Code Section 15083).

Given the regional interests in the project, as well as DTSC's goals for public involvement, two public scoping meetings were conducted. In determining the meeting locations, DTSC assessed the distribution of potentially interested individuals and then identified nearby meeting facilities that would be convenient and accessible. The meetings were professionally facilitated and generally consisted of a presentation describing the meeting format, SSFL description and history, environmental analyses conducted to date, the PEIR and the CEQA process, and opportunities for public involvement. In addition, meeting participants were given the opportunity to comment verbally or in writing on the scope and content of the Draft PEIR. All verbal input was recorded by a court reporter. Written comment could be provided on available comment forms, or on an electronic comment form accessible at two laptop stations. Following the formal presentation and comment period, and as time allowed, the comment period adjourned and transitioned to a question and answer session specific to the CEQA process.

Table 3 summarizes the meeting locations, schedule, and attendance.

Table 3. Scoping Meeting Locations, Schedule, and Attendance				
Location	**Address**	**Date**	**Time**	**Attendance**[1]
Chatsworth, CA	Chatsworth High School Chancellor Hall 10027 Lurline Ave. Chatsworth, CA 91311	Tuesday, December 10 2013	6:00 - 9:00 p.m.	65
Simi Valley, CA	Simi Valley Senior Center Multi-Purpose Room 3900 Avenida Simi, Simi Valley, CA 93063	Saturday, December 14 2013	9:00 a.m. - 12:00 p.m.	45

1. Attendance figures are based on the number of people who signed in at the registration table. Actual attendance was slightly higher.

Both public scoping meetings followed the format described below:

- Registration, where attendees were given the option to provide contact information in a sign-in sheet, and could pick up copies of the NOP, SSFL PEIR fact sheet (December 2013), comment card, and speaker card (both comment card and speaker card provided space for written comments and questions)
- Presentation of meeting purpose and format (by facilitator member of the project team)
- Overview of DTSC (by DTSC project management team)
- Overview of SSFL description and history (by DTSC project management team)
- Overview of the proposed SSFL site cleanup project including its relationship to the other clean-up activities and processes (by DTSC project management team)
- Presentation of CEQA process and major issues identified to date to be addressed in Draft PEIR (by representatives of ESA, the environmental consultant)
- Reiteration of purpose of meeting, types of input solicited, and invitation for public comment (by DTSC and ESA)
- Formal, facilitated public comment session to allow attendees wishing to speak to fill out speaker cards, be called upon in the order cards were submitted, and provide verbal comments, limited to three-minutes each (upon completion of a first round, a second round was facilitated for those who wished to provide additional comment in a three-minute time slot; a third round was facilitated at the first scoping meeting); verbal comments were recorded by a court reporter (by facilitator member of the project team)
- Informal question and answer period following the formal comment session, to allow for audience questions, and responses from DTSC and ESA, specific to the CEQA process (by facilitator member of the project team)
- Summary of the scoping meeting, including how the input will be used in the CEQA process (by facilitator member of the project team)
- Communication of thanks for attendance and adjournment (by facilitator member of the project team)

Documentation of the public scoping meetings is provided in the following appendices:

- Appendix D: Public Scoping Meeting PowerPoint Presentation
- Appendix E: Public Scoping Meeting Handouts
- Appendix F: NOP Comments Received
    - Appendix F-1: Letters, Emails and Faxes
    - Appendix F-2: Public Scoping Meeting Comment and Speaker Cards
    - Appendix F-3: Transcripts of Verbal Comments from Public Scoping Meetings

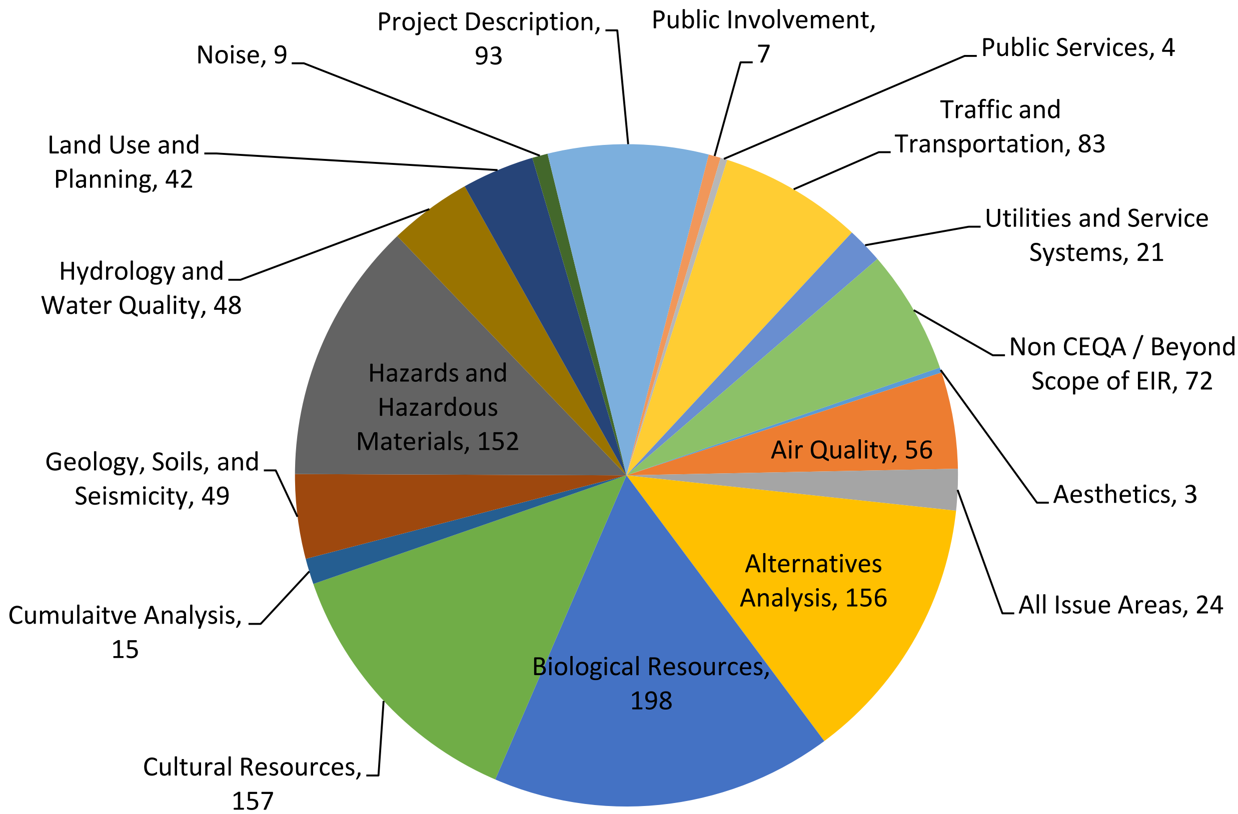
3.0 NOP COMMENTS

DTSC received a variety of comments during the public comment period for the NOP. As shown in Table 4, the comments are in the form of letters, emails, memo notes on comment cards, and speaker cards from the public scoping meetings, and the transcripts of verbal comments from the public scoping meetings. Figure 1 provides a summary of all comments received organized by the relevant chapter or issue area of the EIR. Appendix G provides comprehensive documentation of the comments.

Table 4. Forms of NOP Comments Received by DTSC

Form	Description
Letters, emails and memos	• Abraham Weitzberg • Albert J. Saur • Andre Van der Valk • Brian Sujata • California Native American Heritage Commission • California Natural Resources Agency, Department of Fish and Wildlife • California Natural Resources Agency, Department of Parks and Recreation • California Natural Resources Agency, Office of Historic Preservation • Chatsworth Neighborhood Council • Christian Kiillkkaa • Cindi Gortner • Clark Stevens • cleanuprocketdyne.org • Compass Rose Archaeological, Inc. • County of Ventura, Resources Management Agency • County of Ventura, Resources Management Agency, Planning Division • County of Ventura Transportation Department, Traffic, Advance Planning & Permits Division • David Swanson • Davis Gortner • De Anna Goldberg • Democratic Party of San Fernando Valley • Denise Duffield

Table 4. Forms of NOP Comments Received by DTSC	
Form	**Description**
	• Diana Dixon-Davis • Frederick Weniger • Governor's Office of Planning and Research State Clearinghouse and Planning Unit • Integrated Waste management Division, County of Ventura Public Works Agency • Joseph Maizlish • Lorraine Kurowski • Los Angeles – Ventura Cultural Research Alliance • Margery Brown • National Resources Defense Council • North Valley Democratic Club • Physicians for Social Responsibility Los Angeles • Poly Georgilas • Resource Conservation District of the Santa Monica Mountains • Richard Fish, Sr. • Rocketdyne Cleanup Coalition • Robert Dodge • Sandy Capaldi • San Fernando Valley Audubon Society • Santa Monica Mountains Conservancy • Santa Susana Mountain Park Association • Santa Ynez Band of Chumash Indians • Sharon Ford • South Coast Air Quality Management District • Southern California Federation of Scientists • SSFL Community Advisory Group • Stephen C. Reo • Stephen Schwartz • Strumwasser & Woocher • Sue Buckley • Teens Against Toxins • Transportation Department, County of Ventura Public Works Agency • United States Department of the Interior, National Parks Service • United States Environmental Protection Agency • Ventura County Air Pollution Control District • Ventura County Watershed Protection District, Planning and Regulatory Division • William Bowling • Woodland Hills Warner Center – Neighborhood Council
Comment Cards and Speaker Cards	• Chatsworth Public Scoping Meeting: 25 cards total • Simi Valley Public Scoping Meeting: 32 cards total
Transcripts of Verbal Comment at Public Meetings	• Chatsworth Public Scoping Meeting: 25 speakers • Simi Valley Public Scoping Meeting: 27 speakers



COMMENTS RECEIVED BY CEQA ISSUE AREA

Appendix A
Notice of Preparation

NOTICE OF PUBLIC COMMENT PERIOD

NOTICE OF PREPARATION FOR A
DRAFT PROGRAM ENVIRONMENTAL IMPACT REPORT
SANTA SUSANA FIELD LABORATORY SITE, VENTURA COUNTY, CALIFORNIA

PUBLIC COMMENT PERIOD: November 22, 2013 – January 10, 2014

Pursuant to Section 15082 of the California Environmental Quality Act (CEQA) guidelines, this is to notify the California Governor's Office of Planning and Research, CEQA Responsible Agencies, and interested parties that the California Department of Toxic Substances Control (DTSC) will prepare a Program Environmental Impact Report (EIR) for contaminated soil and groundwater remediation projects at the Santa Susana Field Laboratory (SSFL) site in Ventura County, California. In addition, DTSC is soliciting input from agencies, organizations, and the public on the scope and content of the environmental information to be included in the Program EIR.

DTSC is the lead state regulatory agency for making determinations on the final soil and groundwater investigation, remedy selection, design, and implementation at SSFL. The responsible parties of the various portions of SSFL include The Boeing Company (Boeing), U.S. Department of Energy (DOE) and the National Aeronautics and Space Administration (NASA). The project area includes the SSFL site and the immediate surrounding vicinity. The SSFL site is composed of four administrative areas (Areas I, II, III, IV), each with Solid Waste Management Units and Areas of Concern; and two buffer zones (Northern Buffer Zone and Southern Buffer Zone). The size, location, and current ownership of these areas are as follows:

- Area I is in the northeastern section of SSFL and includes 672 acres owned and being investigated by Boeing, as well as a 41-acre section in the northwestern part of Area I that is owned by the federal government and administered and being investigated by NASA.
- Area II is 404 acres located in the north central section of the SSFL site is owned by the federal government and administered and being investigated by NASA.
- Area III is 119 acres located to the west of Area II. It is owned and being investigated by Boeing.
- Area IV is 290 acres located in the northwestern section of the site. It is owned by Boeing, with a 90-acre section that is leased to the U.S. Department of Energy (DOE). The entirety of Area IV is being investigated by DOE.
- The Southern Buffer Zone is 1,143 acres located south of Areas 1 through IV. It is owned and being investigated by Boeing.
- The Northern Buffer Zone is 182 acres located north of Areas II, III, and IV. It is owned by Boeing, but is being investigated by DOE and NASA.

The proposed project includes the activities necessary to implement soil and groundwater remediation. The anticipated remediation approaches and methodologies for surface media (soil and related surficial media) will be further defined in Corrective Measures Study (CMS) work plans to be submitted by Boeing and comparable Soils Remedial Action Implementation Plans to be submitted by DOE and NASA for each of their respective areas at the SSFL site. The anticipated remediation approaches and methodologies for groundwater will be further defined by the Groundwater Remedial Investigation and CMS, being conducted by Boeing, DOE, and NASA. The Program EIR will establish a framework for "tiered" or project-level environmental documents to be prepared to address further development and refinement of remediation approaches and actions.

Probable environmental effects of the project may include adverse impacts involving hazards and hazardous materials, air quality, biological resources, traffic, cultural resources, geology, noise, hydrology and water quality. This list is not intended to imply any predetermined impacts, and may not include all the probable environmental effects. DTSC is soliciting input on specific issues, including possible mitigation measures, for consideration in the Program EIR.

Comments on this Notice of Preparation (NOP) must be postmarked, faxed or emailed to DTSC no later than 5:00 pm on January 10, 2014. Please send your comments to: Mark Malinowski, Project Manager, Department of Toxic Substances Control, 8800 Cal Center Drive, Sacramento, CA 95826; fax: (916) 255-3734; or via e-mail: DTSC_SSFL_CEQA@dtsc.ca.gov. You can also provide your oral comments or in writing at the public scoping meetings listed below.

SCOPING MEETINGS: DTSC will conduct two scoping meetings to provide the opportunity for the public to learn about the project and to share any concerns or comments they may have. The public may also submit comments during the NOP review period at the DTSC address shown above. The meetings will be held at the following locations and times:

Public Scoping Meetings

Date	Time	City	Address
12/10/13	6:00 p.m. to 9:00 p.m.	Chatsworth	Chatsworth High School Chancellor Hall 10027 Lurline Ave., Chatsworth, CA 91311
12/14/13	9:00 a.m. to 12:00 p.m.	Simi Valley	Simi Valley Senior Center Multi-Purpose Room 3900 Avenida Simi, Simi Valley, CA 93063

AVAILABILITY OF ENVIRONMENTAL DOCUMENTS: A copy of the NOP is available for review at the following locations:

Simi Valley Library
2969 Tapo Canyon Road
Simi Valley, California 93063
(805) 526-1735

California State University, Northridge
Oviatt Library, 2nd Floor, Room 265
Northridge, California
(818) 677-2285

Platt Branch Library
23600 Victory Blvd.
Woodland Hills, California 91367
(818) 340-9386

DTSC Regional Office
9211 Oakdale Avenue
Chatsworth, CA 91311
(818) 717-6522

CONTACT: If you have any questions or wish to discuss the project, please contact Marina Perez, DTSC Public Participation Specialist, at (818) 717-6569, toll free at (866) 495-5651 or Marina.Perez@dtsc.ca.gov. For media inquiries, please contact DTSC Chief of Media and Press Relations, Russ Edmondson, at (916) 323-3372 or Russ.Edmondson@dtsc.ca.gov.

ACCOMMODATIONS FOR DISABLED AND INFORMATION FOR THE HEARING IMPAIRED: The meeting rooms are accessible to people with disabilities. If translation services are needed or if additional accommodations for the disabled are needed, please notify Marina Perez at (818) 717-6569 or email to Marina.Perez@dtsc.ca.gov no later than one week before the meeting. TDD users can obtain additional information by using the California State Relay Service at 1-888-877-5378. Please ask to connect to Marina Perez at (818) 717-6569 regarding the SSFL site.

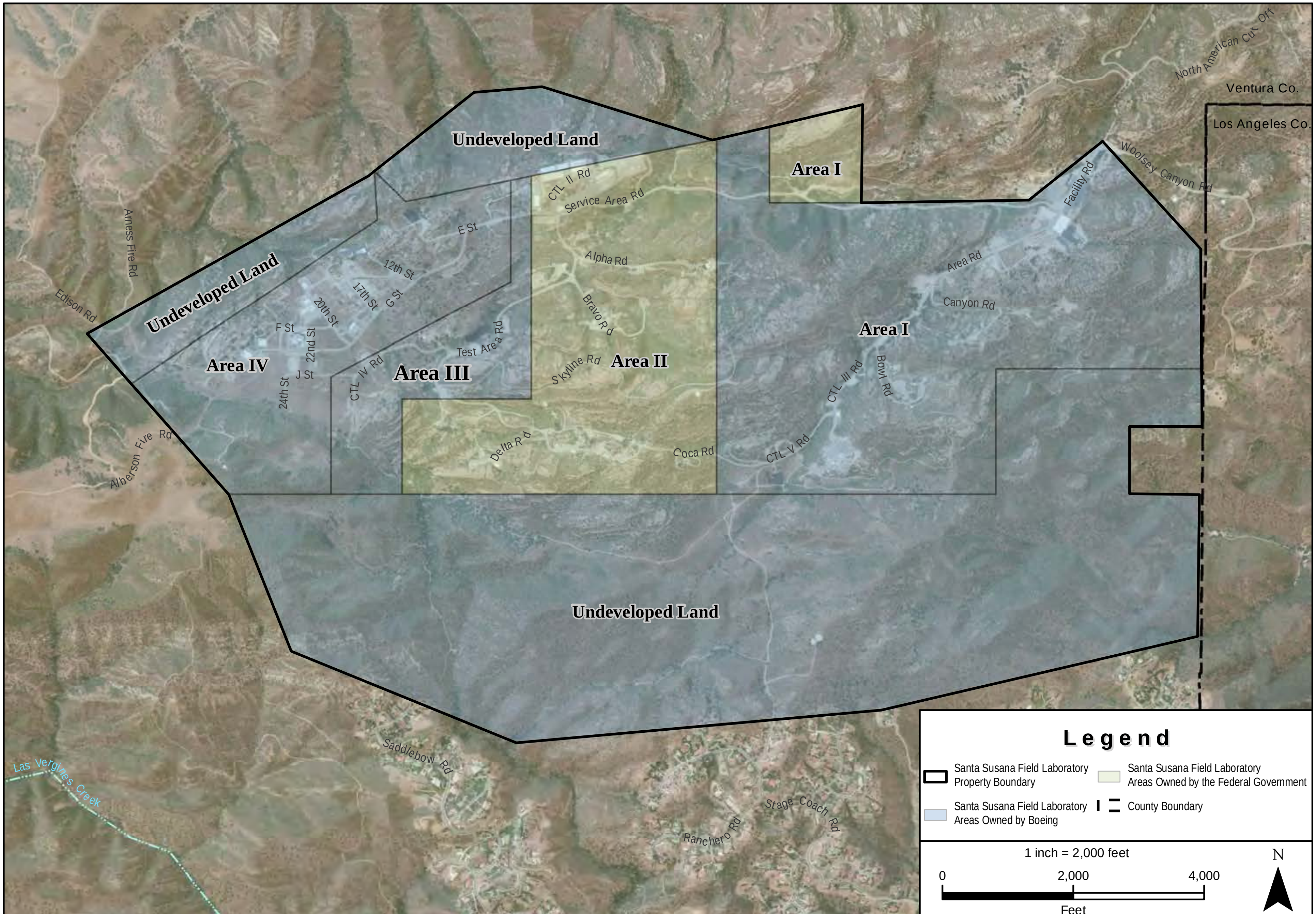
Santa Susana Field Laboratory

Map Creation Date: 11/18/2013

Background Source: ESRI Topographic, ESRI Terrain

Regional Location Map

Figure 1



Santa Susana Field Laboratory

Map Creation Date: 11/18/2013
Background Source: ESRI Bing Maps Aerial, ESRI Terrain

Regional Location Map

Figure 2

ESA PARUS CONSULTING, INC.

Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P. O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH # ______________

Project Title: Program Environmental Impact Report (PEIR) for Cleanup of the Santa Susanna Field Laboratory (SSFL)

Lead Agency: California Department of Toxic Substances Control — Contact Person: Mark Malinowski
Mailing Address: 8800 Cal Center Drive — Phone: (916) 255-3717
City: Sacramento — Zip: 95826 — County: Sacramento

Project Location: County: Ventura — City/Nearest Community: Santa Susana, CA
Cross Streets: Woolsey Canyon Road and N American Cutoff Road — Zip Code: ______
Lat. / Long.: — Total Acres: 2,850
Assessor's Parcel No.: ______ Section: ______ Twp.: ______ Range: ______ Base: ______
Within 2 Miles: State Hwy #: None — Waterways: None
Airports: None — Railways: ______ — Schools: None

Document Type:

CEQA: ☒ NOP ☐ Early Cons ☐ Neg Dec ☐ Mit Neg Dec ☐ Draft EIR ☐ Supplement/Subsequent EIR (Prior SCH No.) ______ Other ______

NEPA: ☐ NOI ☐ EA ☐ Draft EIS ☐ FONSI

Other: ☐ Joint Document ☐ Final Document ☐ Other ______

Local Action Type:

☐ General Plan Update ☐ General Plan Amendment ☐ General Plan Element ☐ Community Plan ☐ Specific Plan ☐ Master Plan ☐ Planned Unit Development ☐ Site Plan ☐ Rezone ☐ Prezone ☐ Use Permit ☐ Land Division (Subdivision, etc.) ☐ Annexation ☐ Redevelopment ☐ Coastal Permit ☒ Other Cleanup

Development Type:

☐ Residential: Units ______ Acres ______
☐ Office: Sq.ft. ______ Acres ______ Employees ______
☐ Commercial: Sq.ft. ______ Acres ______ Employees ______
☐ Industrial: Sq.ft. ______ Acres ______ Employees ______
☐ Educational ______
☐ Recreational ______
☐ Water Facilities: Type ______ MGD ______
☐ Transportation: Type ______
☐ Mining: Mineral ______
☐ Power: Type ______ MW ______
☐ Waste Treatment: Type ______ MGD ______
☒ Hazardous Waste: Type mixed
☐ Other: ______

Project Issues Discussed in Document:

☒ Aesthetic/Visual
☐ Agricultural Land
☒ Air Quality
☒ Archeological/Historical
☒ Biological Resources
☐ Coastal Zone
☐ Drainage/Absorption
☐ Economic/Jobs
☐ Fiscal
☒ Flood Plain/Flooding
☐ Forest Land/Fire Hazard
☒ Geologic/Seismic
☐ Minerals
☒ Noise
☐ Population/Housing Balance
☒ Public Services/Facilities
☐ Recreation/Parks
☐ Schools/Universities
☐ Septic Systems
☐ Sewer Capacity
☒ Soil Erosion/Compaction/Grading
☐ Solid Waste
☒ Toxic/Hazardous
☒ Traffic/Circulation
☒ Vegetation
☒ Water Quality
☒ Water Supply/Groundwater
☒ Wetland/Riparian
☒ Wildlife
☐ Growth Inducing
☒ Land Use
☒ Cumulative Effects
☐ Other ______

Present Land Use/Zoning/General Plan Designation:

Project Description: *(please use a separate page if necessary)*

The proposed project includes the activities necessary to implement soil and groundwater remediation. The anticipated remediation approaches and methodologies for surface media (soil and related surficial media) will be further defined in Corrective Measures Study (CMS) work plans to be submitted by The Boeing Company (Boeing) and comparable Soils Remedial Action Implementation Plans to be submitted by DOE and NASA for each of their respective areas at the Santa Susana Field Laboratory site. The anticipated remediation approaches and methodologies for groundwater will be further defined by the Groundwater Remedial Investigation and CMS being conducted by Boeing, DOE and NASA.

.Reviewing Agencies Checklist

Lead Agencies may recommend State Clearinghouse distribution by marking agencies below with an "**X**".
If you have already sent your document to the agency please denote that with an "S".

X	Air Resources Board		Office of Emergency Services
	Boating & Waterways, Department of	X	Office of Historic Preservation
	California Highway Patrol		Office of Public School Construction
X	CalFire		Parks & Recreation
X	Caltrans District # 7		Pesticide Regulation, Department of
	Caltrans Division of Aeronautics		Public Utilities Commission
	Caltrans Planning (Headquarters)	X	Regional WQCB # Los Angeles
	Central Valley Flood Protection Board		Resources Agency
	Coachella Valley Mountains Conservancy		S.F. Bay Conservation & Development Commission
	Coastal Commission		San Gabriel & Lower L.A. Rivers and Mtns Conservancy
	Colorado River Board		San Joaquin River Conservancy
	Conservation, Department of	X	Santa Monica Mountains Conservancy
	Corrections, Department of		State Lands Commission
	Delta Protection Commission		SWRCB: Clean Water Grants
	Education, Department of	X	SWRCB: Water Quality
	Energy Commission		SWRCB: Water Rights
X	Fish & Wildlife Region ____		Tahoe Regional Planning Agency
	Food & Agriculture, Department of		Toxic Substances Control, Department of
X	General Services, Department of		Water Resources, Department of
X	Health Services, Department of		
	Housing & Community Development		Other ____
X	Integrated Waste Management Board		Other ____
X	Native American Heritage Commission		

Local Public Review Period (to be filled in by lead agency)

Starting Date November 22, 2013 Ending Date January 10, 2014

Lead Agency (Complete if applicable):

Consulting Firm: Environmental Science Associates	Applicant: Department of Toxic Substances Control
Address: 626 Wilshire Blvd, Suite 1100	Address: 8800 Cal Center Drive
City/State/Zip: Los Angeles, CA 90012	City/State/Zip: Sacramento, CA 95826
Contact: Deanna Hansen	Phone: 916-255-3717
Phone: 213-599-4300	

Signature of Lead Agency Representative: Mark Malinowski [signature] **Date: Nov. 18, 2013**

Authority cited: Section 21083, Public Resources Code. Reference: Section 21161, Public Resources Code.

Appendix B
Display Advertisement

Santa Susana Field Laboratory Environmental Impact Report

Department of Toxic Substances Control

Public Scoping Meetings — Dec. 10 and 14, 2013

The California Department of Toxic Substances Control (DTSC) invites the public to provide comments on the issues and alternatives to be considered in a Draft Program Environmental Impact Report (PEIR) for environmental cleanup at the Santa Susana Field Laboratory site in Ventura County.

Please Join Us

CHATSWORTH

Tuesday, Dec. 10, 6 to 9 p.m.
Chatsworth Charter High School*
Chancellor Hall
10027 Lurline Ave.
Chatsworth, CA 91311

Enter on Lurline Ave. near Lemarsh St.

**This meeting is neither sponsored by nor is it in any way connected with the Los Angeles Unified School District.*

SIMI VALLEY

Saturday, Dec. 14, 9 a.m. to 12 p.m.
Simi Valley Senior Center
Multi-Purpose Room
3900 Avenida Simi
Simi Valley, CA 93063

Notice to Hearing Impaired Individuals: TDD users may use the California Relay Service at 1-888-877-5378.

Comments on the scope of the Draft EIR can be submitted at the public scoping meetings, or postmarked, faxed or emailed to:

Mark Malinowski, Project Manager
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826
Fax: 916-255-3734
Email: DTSC_SSFL_CEQA@dtsc.ca.gov

For more information, visit www.dtsc.ca.gov/SiteCleanup/Santa_Susana_Field_Lab

All comments must be postmarked or received by DTSC no later than 5 p.m., Jan. 10, 2014 for consideration in the PEIR development.

TRANSGENDER STUDENT LAW

Sample signature verification due Jan. 8

By Canan Tasci
canan.tasci@langnews.com
@ChinoValleyNow on Twitter

County registrars of voters are in the process of verifying if 614,311 signatures collected by opponents of a transgender student law will be enough to qualify for a statewide referendum.

The Secretary of State's Office has received signatures from the Privacy for All Students coalition who want voters to decide if transgender students should use school facilities based on the gender they identify with.

The nonprofit group has rallied to stop the law that they say will expose boys and girls to the opposite sex's private areas, and as a result, privacy rights for all students would be violated.

Signed by Gov. Jerry Brown in August, the School Success and Opportunity Act, AB1266, would allow transgender students in the state's public schools — kindergarten through 12th grade — to use bathrooms and locker rooms and participate in sports based on the gender they identify with. Advocates against the bill are hoping to freeze the law, which goes into effect Jan. 1, and instead let California voters decide what to do with it.

"This is a very real attack by people who have been organized to do nothing but attack our community for years and years, and their focus on transgender students is rather despicable," said John O'Connor, executive director of Equality California.

"They're going after perhaps the most vulnerable people in our community. It is really important to us and the coalitions of organizations that are working on this together to protect this law."

Calls and emails to Privacy for All Students were not returned on Monday.

All signatures were submitted Nov. 10 and counties had eight working days to determine a raw count of signatures submitted and report their findings to the Secretary of State.

The Secretary of State has since directed counties to begin a random sample verification of signatures.

County registrars will have until Jan. 8, to complete a random sample of 3 percent or 500 signatures, whichever is greater, and report their results, according to the Secretary of State Debra Bowen's website.

In order for the referendum to qualify for the ballot the statewide random sample total needs to have 555,236 valid signatures.

Of the 58 counties, Mono and Tulare had no signatures, while Alpine had one.

The following counties — Los Angeles with 130,978, San Diego with 72,542 and San Bernardino with 63,348, had the highest number of signatures.

Palmdale

FROM PAGE 1

Nov. 27, Mooney wrote Palmdale has an "established history of racially polarized voting" and ordered it to hold a special election coinciding with statewide primaries June 3.

"The Latino and African American citizens of Palmdale deserve to have their voices heard in the operation of their city," Mooney wrote.

Though the Census shows Palmdale is almost 60 percent Hispanic, and 15 percent African-American, only one Hispanic and one African-American have been elected to its council since the 1970s.

R. Rex Parris, the lawyer for the plaintiffs and mayor of neighboring Lancaster, said the ruling should "break the stranglehold" of the political "machine" that "controls" Palmdale.

"Palmdale has very clear areas where Hispanics and African-Americans represent the majority but they've never been able to get anyone elected to the council because their city has been run by a group of very few people for the last 25 years who control all the campaign funding," Parris said.

He said the ruling could set a precedent for Anaheim and Whittier, as well as school districts in Santa Clarita and Lancaster, which have also been sued for holding at-large elections.

Neighborhood Legal Services Executive Director Neal Dudovitz, who was not involved in this case but represented minorities who accused both Palmdale and Lancaster of harassing them over federal housing assistance vouchers, hailed the ruling.

"Given the very recent history of discrimination in Palmdale, we are encouraged that the court is enforcing those laws that protect minorities and ensure a more fair representation that is reflective of the diversity of the Antelope Valley," Dudovitz said.

But Palmdale deputy city attorney Noel Doran denied minorities in Palmdale have been disenfranchised.

"The city believes it's in the best interest of our citizens to elect their council members at large, as opposed to being able to select only one council member (their district representative)," he said.

Palmdale held elections only last month, putting Frederick Thompson and Tom Lackey on the council through 2017. Steven Hofbauer and Mike Dispenza were supposed to remain in office through 2015.

Under Mooney's ruling, however, all would have to be removed by July 9. If they want to stay, they would have to run for re-election.

Doran found it ironic that Parris is suing Palmdale when Lancaster also has at-large elections, and that the ruling would prevent Thompson — an African-American — from keeping his seat on the council. He said the city plans to appeal as soon as a ruling is finalized.

Santa Susana Field Laboratory Environmental Impact Report
Department of Toxic Substances Control

Public Scoping Meetings — Dec. 10 and 14, 2013

The California Department of Toxic Substances Control (DTSC) invites the public to provide comments on the issues and alternatives to be considered in a Draft Program Environmental Impact Report (PEIR) for environmental cleanup at the Santa Susana Field Laboratory site in Ventura County.

Please Join Us

CHATSWORTH
Tuesday, Dec. 10, 6 to 9 p.m.
Chatsworth Charter High School*
Chancellor Hall
10027 Lurline Ave.
Chatsworth, CA 91311
Enter on Lurline Ave. near Lemarsh St.

**This meeting is neither sponsored by nor is it in any way connected with the Los Angeles Unified School District.*

SIMI VALLEY
Saturday, Dec. 14, 9 a.m. to 12 p.m.
Simi Valley Senior Center
Multi-Purpose Room
3900 Avenida Simi
Simi Valley, CA 93063

Notice to Hearing Impaired Individuals: TDD users may use the California Relay Service at 1-888-877-5378.

Comments on the scope of the Draft EIR can be submitted at the public scoping meetings, or postmarked, faxed or emailed to:
Mark Malinowski, Project Manager
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826
Fax: 916-255-3734
Email: DTSC_SSFL_CEQA@dtsc.ca.gov

For more information, visit www.dtsc.ca.gov/SiteCleanup/Santa_Susana_Field_Lab

All comments must be postmarked or received by DTSC no later than 5 p.m., Jan. 10, 2014 for consideration in the PEIR.

Donation

From **Page 1** —

Councilmember Glen Becerra.

Kolarek, who works with foundation board members Brian Iverson and Brian Miller to put the event together each year, said he's excited to see the donation amount grow.

"I know how difficult it is right now in this economy to maintain our business," Kolarek said. "All these dealerships jumped on board and that means a lot when we're all trying to watch what we spend. We couldn't do this without (the dealerships). It's a great way to see us all work together."

Each dealership donates money for cars sold during the months of September and October. Kolarek said the amount donated by each dealership varies since each handles a different volume of customers. The County Schools Federal Credit Union also donates money for any cars that it finances.

On Dec. 3, members of SVEF held a luncheon at Lost Canyons Golf Club and presented each dealership owner with a plaque as a way of giving thanks for their efforts.

The foundation also thanked Time Warner Cable, which donated air time for a local television commercial about the fundraiser, featuring board president Jill Haney. This was the first year the foundation created a commercial as a way to advertise the event.

In 2011, Driving Education raised about $8,000, and in 2012, it raised more than $9,700. With the addition of this year's funds, the charity event has gathered close to $29,000 for the Education Foundation.

This year's amount increased despite the participation of fewer dealers than in the past. Last year, Simi Valley Chevrolet and Kirby Chrysler Jeep Dodge Ram were part of Driving Education, but both dealerships sat out this year because of changes in ownership. Kolarek hopes the dealerships will join again next year.

Iverson said the money from Driving Education goes back into classrooms in the form of the foundation's enhancement grants that can provide needed supplies, funds for class projects or new learning programs.

Darrell Coletto, owner of 1st Nissan, along with Simi Valley Ford owner Larry Hibbler, have each personally donated to SVEF for as long as they can remember. They joined the fundraising campaign in 2012 because they liked the idea of a collective donation.

"These are our kids and we want to be able to help them have a better future," Coletto said.

Bodies

From **Page 1** —

A resident in the neighborhood saw one of the bodies lying in a frontyard early Tuesday morning and, believing someone had been injured, called the Ventura County Fire Department, Shannon said. Ventura County Fire officials arrived on the scene, found two bodies on separate lawns at about 7 a.m. and requested police assistance.

According to an SVPD press release, the initial investigation conducted by the SVPD detectives unit determined there were no outstanding suspects or threats to the community.

"The neighborhood that the two were in is normally a very safe and quite neighborhood," Shannon said.

SVPD Cmdr. David Livingstone said the fact that no witnesses have been found is strange.

"No one heard anything," he said. "Usually when there's a shooting in a quiet neighborhood like this, we will get multiple calls, so this is kind of peculiar."

Livingstone said detectives are looking at the department's phone records for the area to see if any prior conflict between the man and the woman had been reported.

Detectives are still investigating and ask anyone with information to contact the SVPD detectives unit at (805) 583-6969. Those who wish to remain anonymous can call the Ventura County Crime Stoppers hotline at (800) 222-8477.

Public safety briefs

OXNARD

Demonstrator says police targeted him

Francisco Romero said he was one of hundreds of Oxnard residents who marched Oct. 13 to protest police brutality.

The march, which he partly organized, marked the anniversary of the officer-involved shooting of bystander Alfonso Limon Jr. and the deaths of others, including Robert Ramirez, in June 2012.

Romero said that weeks after the protest, police mailed him five citations alleging that he obstructed traffic and failed to yield.

"These citations are an attempt by the Oxnard Police Department to derail and otherwise silence our growing community protest," Romero said at news conference Monday outside the Ventura Courthouse.

Romero later appeared in court, where he pleaded not guilty to the jaywalking charges. Romero's attorney, James P. Segall-Gutierrez, asked court Commissioner William Redmond for a jury trial but was denied. Romero was ordered to appear again in court Jan. 22.

Oxnard police could not be reached for comment Monday.

Man hospitalized after truck hits him

A man was taken to St. John's Regional Medical Center in Oxnard after being struck by a truck near the intersection of Simon Way and Vineyard Avenue in Oxnard, officials said.

The accident occurred just after 6:15 p.m. Monday, according to the California Highway Patrol. The condition of the man was unknown.

The Ventura County Fire Department and 14 units of the CHP answered the call. According to the CHP website, the victim was unresponsive at the scene.

VENTURA COUNTY

Deputies examine El Rio stabbing

Deputies are investigating a stabbing Sunday night in El Rio, officials said.

The Ventura County Sheriff's Office responded to reports of a stabbing about 7:30 p.m. near Rose Avenue and Simon Way, officials said.

Investigators discovered that a man was walking in the area when he was assaulted. The victim later noticed a cut he got during the assault and told police about the incident.

Deputies seek driver after chase, crash

Law enforcement officials said they were searching for a man who led police on a chase in a stolen car early Monday before he ran into an orchard in Somis.

One of three injured passengers in the car was arrested on a previous warrant, officials said.

The incident began about 1:25 a.m., when deputies from the Moorpark Police Department tried to stop a vehicle on a traffic violation near state Highway 118 and Mira Sol Drive in Moorpark, according to authorities.

As a deputy tried to make contact with the driver, he sped off, officials said. Ventura County sheriff's deputies chased him.

The driver led officials on a fast chase west on 118, sometimes traveling close to 95 mph, officials said. He crashed into a guardrail near Mesa Union School and La Vista Avenue, officials said.

After crashing through the guardrail, the vehicle crossed the road and came to rest upright on a dirt embankment, authorities said.

As the pursuing deputies pulled up to the scene, the driver got out of the vehicle and ran into an orchard.

Deputies extricated three Simi Valley men: Luis Ponce, 27, Anthony Fernandez, 18, and Richard Gomez, 20. All were taken to the Ventura County Medical Center for treatment, officials said.

During an investigation by the Special Enforcement Detail Gang Investigators of Thousand Oaks, Gomez was arrested on a previous warrant for felony vehicle theft, authorities said.

The sheriff's K-9 team and a sheriff's helicopter joined deputies in a search. The Sheriff's Office and California Highway Patrol are investigating the incident.

The driver is wanted on suspicion of felony vehicle theft, felony evading and felony hit-and-run.

Anyone with any information about the incident may call Sgt. Eric Tennessen at 532-2716 or Crime Stoppers anonymously at 800-222-8477.

Local briefs

OXNARD

Festival to celebrate Christmas treat

The Recreation and Community Services Department and Pacific View mall will present the Oxnard Tamale Festival from 9 a.m. to 6:30 p.m. Saturday at 500 S. C St.

Visitors may choose from 14 tamale vendors. There will be cooking demonstrations by the Oxnard College Culinary Arts Program, arts and crafts booths and eating contests.

For more information visit http://www.oxnardtamalefest.com, or call 385-8081.

Forum to have info on housing rights

A free workshop on housing rights will take place Tuesday night in Oxnard.

The session, hosted by the city of Oxnard and the Housing Rights Center, will address discrimination, security deposits, rent increases, evictions, repairs and rights and responsibilities of landlords and tenants.

The meeting will run from 6-8 p.m. in Meeting Room B of the Oxnard Public Library, 251 S. A St.

To RSVP call Marlene at 800-477-5977, ext. 1105.

THOUSAND OAKS

CLU names dean for new seminary

California Lutheran University has appointed a dean for Pacific Lutheran Theological Seminary, which will merge with the Thousand Oaks college in January.

The Rev. Karen Bloomquist will oversee the seminary in Berkeley. She succeeds Phyllis Anderson, who is retiring as the seminary's president.

Bloomquist is a former director at the Lutheran World Federation, which represents Lutherans in 79 countries. She also is an ordained minister who has taught at other seminaries and been active in global interfaith and humanitarian efforts.

Bloomquist received her master's degree in divinity from Pacific Lutheran. She has a bachelor's degree in sociology and religion from St. Olaf College in Minnesota and a doctorate in theology from Union Theological Seminary in New York.

The merger of CLU and the seminary became official last month when it was approved by the Western Association of Schools & Colleges.

Pacific Lutheran will still be a full seminary, but the schools will share faculty and develop shared programs.

VENTURA COUNTY

Orchestra to play holiday selections

The Channel Islands Chamber Orchestra will perform with KuanFen Liu, artistic director, and Eric Boulanger, violin soloist.

"A Baroque Holiday," will be at 3 p.m. Saturday at Studio Channel Islands Art Center, 2222 Ventura Blvd. Tickets are $20 in advance or $25 at the door. To RSVP, visit StudioChannelIslands.org or call 383-1368.

A second concert will be at 3 p.m. Sunday at Ventura First United Methodist Church, 1368 E. Santa Clara St. A $20 donation is appreciated. It's free for youths 18 and younger. For more information call 643-8621.

Staff reports

PARADE from 3A

"There are a lot of nice people, and we're really enjoying ourselves."

Ken Bianchi, a former rear commodore at the yacht club, said: "This is one of the best parades we've had in many, many years because of the weather and the boats. We probably have about 12 boats out there, and if the weather is bad, there might be about six, seven boats. This is a huge turnout tonight."

Nora Hall lives on the lake but said she was at the event for the first time.

"We usually miss it, and it's, 'Oh, there they go,'" Hall said. "This year it's really exciting because we're here."

After the parade, the Westlake High School choral group A Class Act sang holiday songs under the direction of Alan Rose, and then children were treated to a visit by Santa and Mrs. Claus.

Wendy Wolf, of Camarillo, said she might make the parade a tradition. She brought her 6-year-old, Hannah Nicoloff, last year and decided to return.

"I really like the small-town feeling of it," Wolf said. "It's fun and a nice way to spend an evening."

"I liked the Santa boat with the reindeer," Hannah said.

The judges agreed.

Carol Kirschbaum, rear commodore of the Yacht Club, announced the winners. The sleigh with Rudolph and the eight reindeer won first place for best theme.

Mark Niles owns the boat, but about 20 people worked on the project, and decorating the craft took six hours. Shareece Veraldi and Beverly Burr came up with the idea, and Bob Cous designed the reindeer with the lights.

"It wasn't just the boat; it was the reindeer on the kayaks, which took a lot of engineering and separate lights," Niles said.

A Hollywood boat won the award for most creative, and a Grinch boat took most enthusiastic.

TRUST from 3A

the sale.

"We're going to recommit to our mission of research and education. I'd like to do something that services all of Ventura County, but ultimately the university would have the final recommendation," Smith said.

The research education center Smith envisions would provide classroom space, an auditorium for symposiums and a lab to help farmers test crops. Smith said he wants to put those services under one roof somewhere in the county.

"When farmers get a sample on the field, they send it out to Salinas, Davis or Riverside, and the turnaround time for results can be up to three weeks. But they need to know tomorrow or in a few days what's affecting their field," Smith said.

The 35.8-acre property up for bid is at the southeast corner of Saticoy Avenue and Telegraph Road. It has been leased for growing row crops but has all the approvals necessary for construction to begin in three phases.

The minimum bid for the entire property is set at $18 million, $4 million for the first phase, according to officials.

The UC Hansen Trust Specific Plan, approved in 2008, calls for 131 single-family homes, 34 condos and 24 farmworker apartments. The project includes the equivalent of a 6-acre park and open space spread throughout the property.

The university determined now would be a good time to sell the property because the local housing market has improved, Sheehan said.

Some of the proceeds from the sale of the property will also support another area of land owned by the university known as the Faulkner Farm in Santa Paula, which has an agricultural learning center. The 27-acre property was purchased by the UC Hansen Fund in 1997, and it serves as the main venue for the agricultural and educational activities of the fund. The Hansen Agricultural Research and Extension Center offers programs that promote agricultural literacy and research and programs for youths. The university plans to introduce more mid- to long-range programs at the center by next year, Smith said.

In 2010, the UC Hansen Trust board recommended that the farm be sold because it no longer met the trust's goal: to put Hansen's money to use for the benefit of agriculture in the county. Since then, Smith said, the university has made it its mission to extend their education and outreach programs at the Faulkner Farm.

Bids are due by 5 p.m. Dec. 12 at the UC office in Oakland. The university will consider offers on an all-cash basis or with credit terms, and it is offering to finance up to 70 percent of the purchase price for up to three years.

To request a bid package contact the Dyer Sheehan Group at 805-653-8100 or paul@dyersheehan.com.

Appendix C
Public Scoping Meeting Flier

Santa Susana Field Laboratory Environmental Impact Report

Public Scoping Meetings – **Dec. 10 and 14, 2013**

The California Department of Toxic Substances Control (DTSC) is preparing a Draft Program Environmental Impact Report (PEIR) to assess alternatives for environmental cleanup at the Santa Susana Field Laboratory site in Ventura County.

DTSC will host two public scoping meetings in December to provide information on the PEIR preparation process and to invite public comments on the scope of the environmental issues and the alternatives to be considered in the Draft PEIR.

We Appreciate Your Input!

Comments on the scope of the Draft PEIR can be submitted at the public scoping meetings, or postmarked, mailed or faxed no later than 5 p.m., Jan. 10, 2014 to:

Mark Malinowski, Project Manager
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826
Fax: 916-255-3734
Email: DTSC_SSFL_CEQA@dtsc.ca.gov

For more information, visit
www.dtsc.ca.gov/SiteCleanup/Santa_Susana_Field_Lab

All comments must be postmarked or received by Jan. 10, 2014 for consideration in the PEIR development.

Department of Toxic Substances Control

PUBLIC SCOPING MEETINGS

CHATSWORTH

DATE
Tuesday, Dec. 10, 2013

TIME
6 to 9 p.m.

LOCATION
Chatsworth Charter High School*
Chancellor Hall
10027 Lurline Ave.
Chatsworth, CA 91311
Enter on Lurline Ave. near Lemarsh St.

SIMI VALLEY

DATE
Saturday, Dec. 14, 2013

TIME
9 a.m. to 12 p.m.

LOCATION
Simi Valley Senior Center
Multi-Purpose Room
3900 Avenida Simi
Simi Valley, CA 93063

Notice to Hearing Impaired Individuals: TDD users may use the California Relay Service at 1-888-877-5378.

*This meeting is neither sponsored by nor is it in any way connected with the Los Angeles Unified School District.

Appendix D
Public Scoping Meeting Power Point Presentation

California Environmental Protection Agency

Department of Toxic Substances Control

Santa Susana Field Laboratory (SSFL) Site

Notice of Preparation Scoping Meeting for the Draft Program Environmental Impact Report (PEIR)

December 2013

Ground Rules

Please...

- Silence all mobile phones, PDAs, tablets and electronics
- Limit cross conversation during the meeting
- Treat other people with the same level of respect you expect from others
- Photography, sound and video recording may occur
  - If you do not wish to be filmed or photographed please inform the photographer/videographer directly

Agenda

- Introduction
- Presentations
  - Project Background
  - CEQA PEIR Process
- Verbal Comments
- Conclusion of Formal Scoping Meeting
- CEQA Process Q&A (time permitting)

Meeting Team

- Ray Leclerc, DTSC Project Director
- Mark Malinowski, DTSC Project Team Manager
- Deanna Hansen, Environmental Science Associates
- Joan Isaacson, Katz & Associates
- Additional Team Members

California Environmental Protection Agency
Department of Toxic Substances Control

The California Department of Toxic Substances Control (DTSC) is the state agency responsible for environmental protection, investigation, and cleanup.

This is a CEQA Scoping Meeting

A Scoping Meeting is…

- Opportunity to provide comments regarding the type and extent of environmental analyses to be undertaken
- First of many opportunities for the public to comment on the proposed project
- Opportunity to learn about the CEQA process

Purpose of the Scoping Meeting

DTSC requests your input on the scope of the PEIR for the Santa Susana Field Laboratory (SSFL) Site Cleanup:

- What environmental effects should be addressed in the PEIR?
- Do you have ideas for project alternatives or mitigation measures?

Information collected during scoping will be used to develop the PEIR

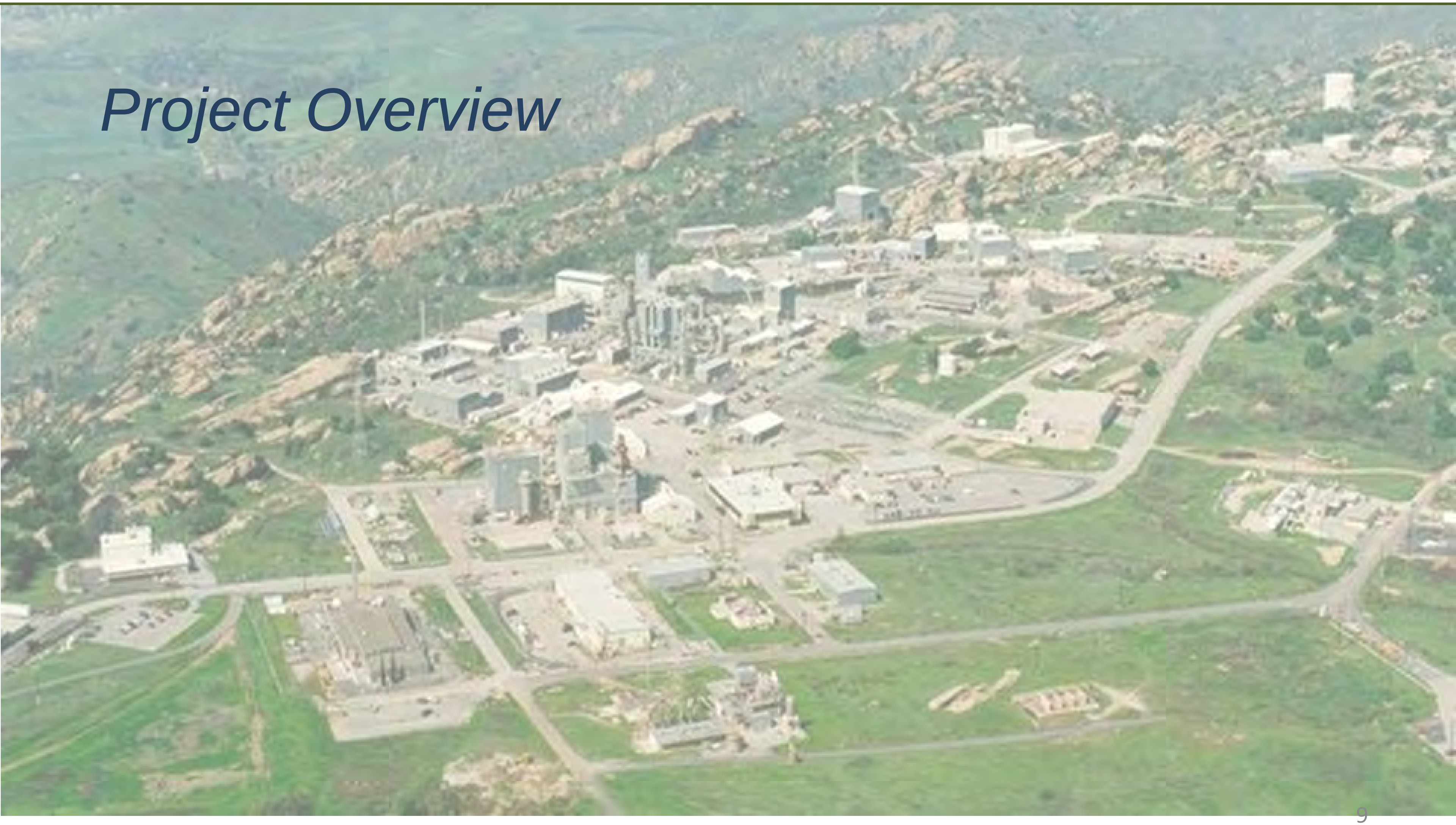
Notice of Preparation (NOP) Scoping Meeting

How to provide a comment

- Provide comment during public comment period at this meeting
  - Please fill out speaker card and give to meeting staff
  - Please be concise and limit comments to 3 minutes so all participants have an opportunity to speak
  - A court reporter will document all verbal comments
- Complete a hard copy comment card
  - DTSC staff can read comments for people who don't want to speak
- Enter a written comment on a laptop at this meeting
- Submit a comment via mail, fax, or email by January 10, 2014

Department of Toxic Substances Control
SSFL Site

Project Overview



Regional Location

About SSFL

- Former rocket engine test and nuclear power research facility
- ~2,850-acre field laboratory site
- Currently the focus of a comprehensive environmental investigation and cleanup program, conducted by Boeing, DOE, and NASA
- Cleanup and investigation is overseen by DTSC

SSFL History

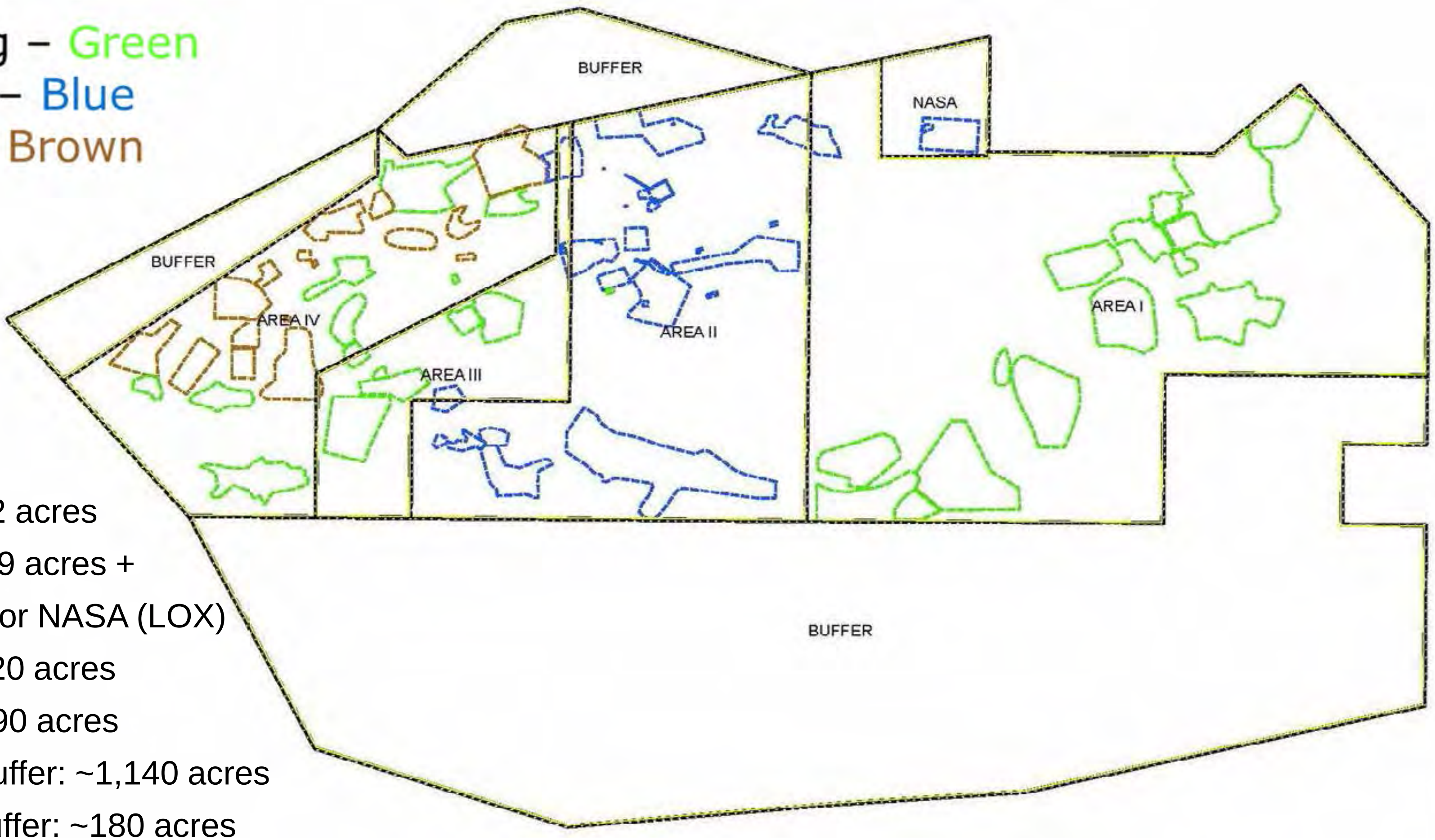
- Development started in 1947 by North American Aviation.
- In 1954, majority of the site was acquired.
- The undeveloped areas to the south acquired in 1968 and 1976, and to the north in 1998.
- Research, development, and testing for liquid-fueled rocket engines (1950-2006)
- Nuclear research & development conducted on the site (1954 to 1988)

SSFL History

- Rocket engines flushed with organic solvents, primarily trichloroethylene.
- Landfills, burn pits, machining operations, testing laboratories.
- DOE's Energy Technology Engineering Center (ETEC) - nuclear reactors and related liquid metals testing.

SSFL Areas and Sites

Boeing – Green
NASA – Blue
DOE - Brown



Area I: ~672 acres

Area II: ~409 acres +
 ~41 acres for NASA (LOX)

Area III: ~120 acres

Area IV: ~290 acres

Southern Buffer: ~1,140 acres

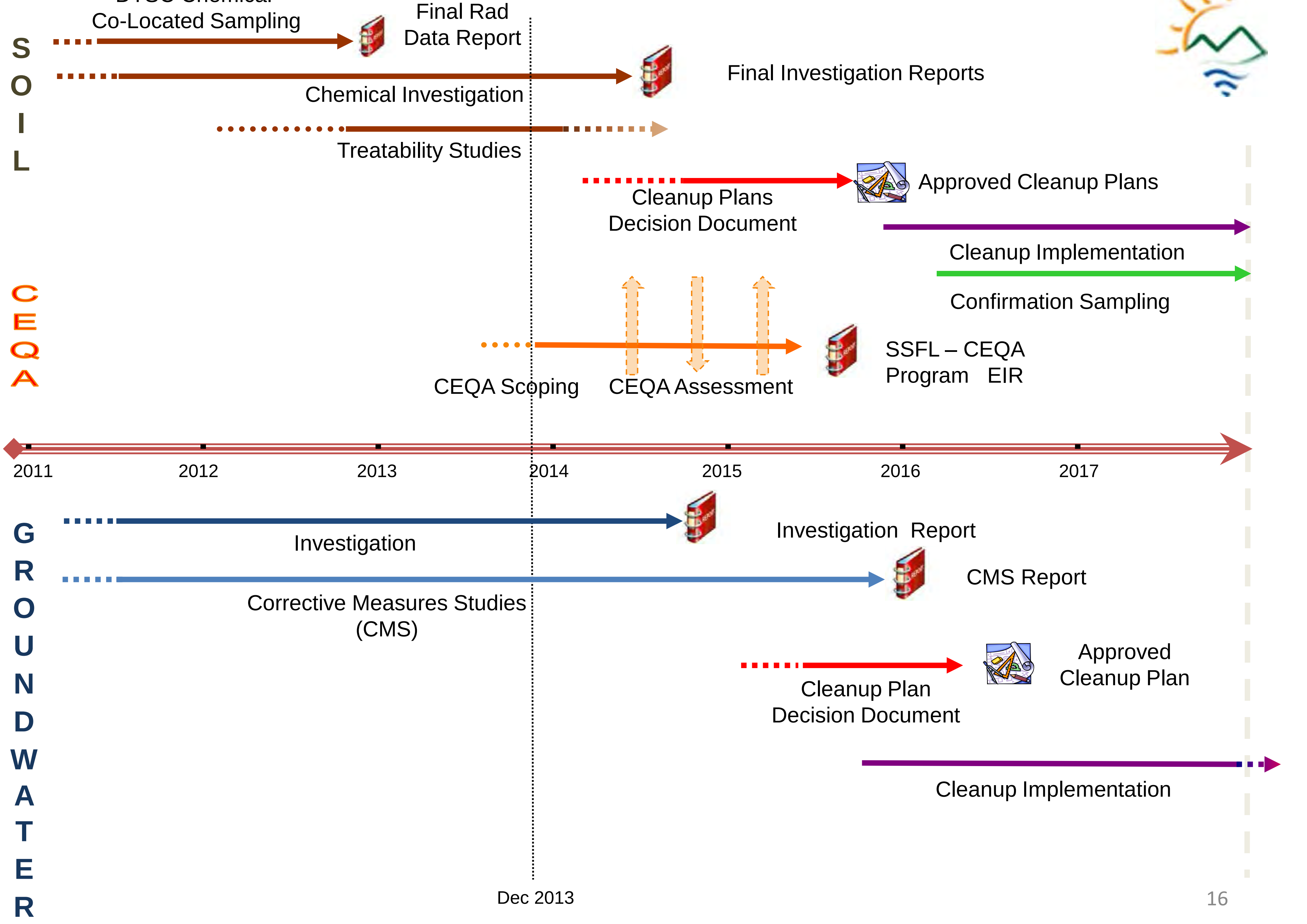
Northern Buffer: ~180 acres

SSFL is ~ 2,850 acres

The Proposed Project

The proposed project includes the activities necessary to implement soil and groundwater remediation for the SSFL site.

Generalized SSFL Project Timeline



Department of Toxic Substances Control
SSFL Regulatory History

- Since 1991: Site under DTSC RCRA Corrective Action Process
- Consent Order (August 2007)
  - Boeing / DOE / NASA
  - Soil (Boeing) and groundwater (all three parties)
  - Clean-up to acceptable risk levels
  - Soils clean-up or construction of remedy to be complete in 2017
  - Groundwater clean-up actions in place by 2017

Department of Toxic Substances Control SSFL Regulatory History

- Administrative Orders on Consent (Dec 2010)
  - Separate AOCs for DOE and NASA
  - Requires soil cleanup to background or reporting limit levels (some exceptions)
- Groundwater is responsibility of all three responsible parties
  - Covered under 2007 Consent Order

SSFL Site-wide Issues—CEQA

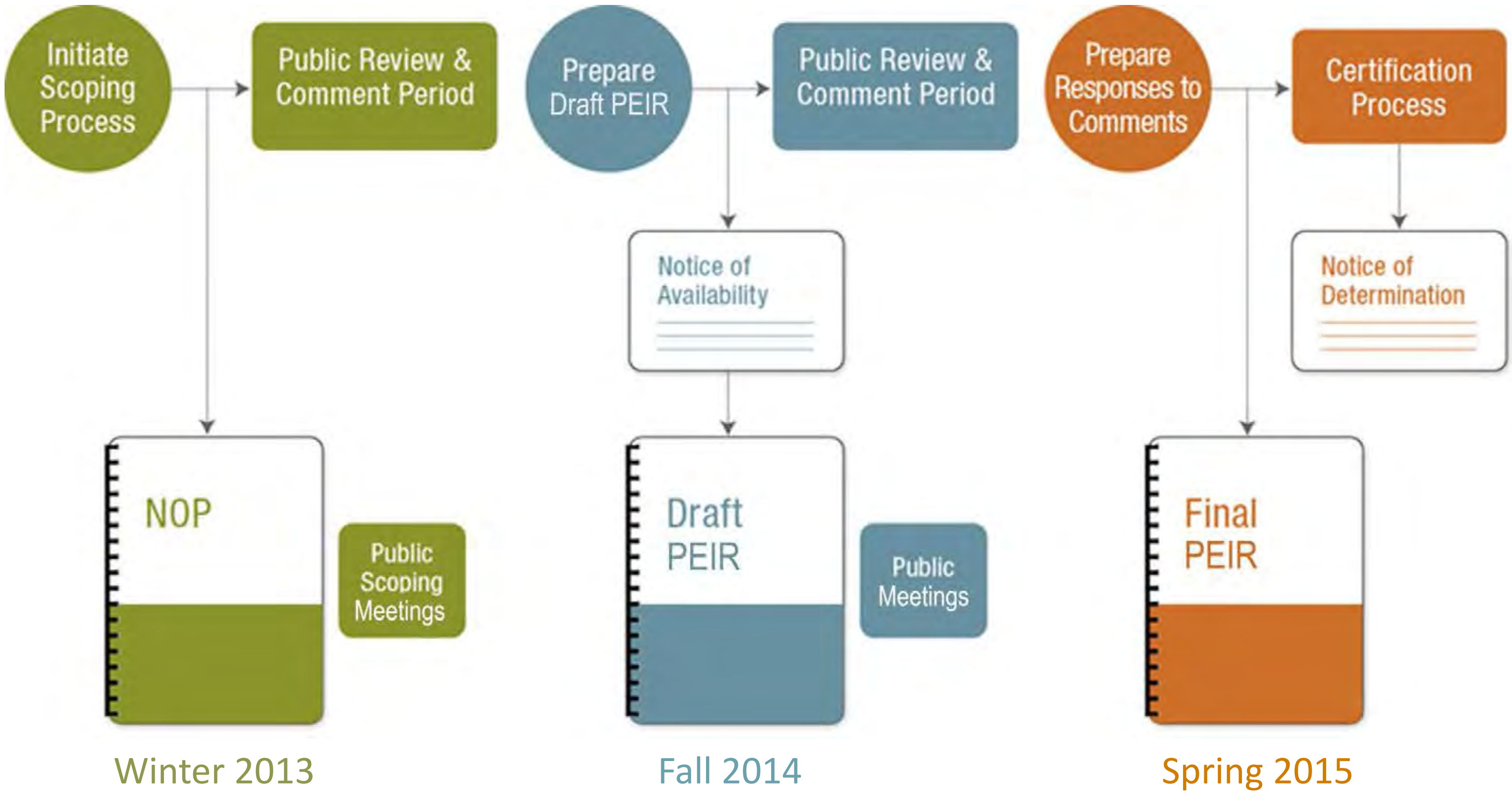
- Working with DOE and NASA to integrate the federal NEPA (National Environmental Policy Act) information with the state CEQA (California Environmental Quality Act) processes and documents

Overview of CEQA PEIR Process

California Public Resources Code Section 21100[a]

- California Environmental Quality Act (CEQA) requires DTSC to prepare an Environmental Impact Report (EIR) for any project it proposes to carry out that may have a significant impact on the environment
  - Informs the public and decision makers about potential environmental impacts
  - Identifies ways to avoid or reduce potential impacts

CEQA Process for a PEIR



Project Under Review

- The PEIR will analyze potential environmental effects associated with soil and groundwater remediation activities at the project site.

What is a Program EIR (PEIR)?

An EIR prepared on a series of related actions that can be characterized as one large project.

The SSFL soil and groundwater remediation activities are related:

- Geographically (SSFL site)
- As parts of related actions (soil and groundwater cleanup)
- As individual activities carried out under the same regulatory authority (DTSC)

Advantages of a PEIR

- Ensures full consideration of cumulative impacts
- Allows DTSC to consider program-wide mitigation measures early on

PEIR Topics

The PEIR will evaluate short-term/construction impacts and long-term/operational impacts related to:

- Aesthetics
- Air Quality
- Biological Resources
- Cultural Resources
- Geology, Soils & Seismicity
- Greenhouse Gas Emissions
- Hazards & Hazardous Materials
- Hydrology, Groundwater & Water Quality
- Land Use
- Noise
- Population & Housing
- Public Services
- Traffic & Transportation
- Utilities

CEQA Alternatives

- CEQA requirement to evaluate a range of reasonable alternatives to the project
  - Attain most of the basic project objectives
  - Avoid or substantially lessen significant effects of the project
  - Not required to consider alternatives which are infeasible

PEIR Analysis

DTSC's PEIR will be based on information obtained from many sources

- Treatability Studies/Soils Feasibility Study — Boeing, DOE, and NASA
- Groundwater Investigation and Corrective Measures Study — Boeing, DOE, and NASA
- On-going monitoring efforts
- Site-specific resource studies (e.g., biology, cultural resources)
- Agency input
- Tribal outreach and communication
- Public input

Meeting Purpose

- Purpose is to gather input on the content of the PEIR
- DTSC is interested in your input on:
  - What environmental effects should be addressed in the Program EIR?
  - Do you have ideas for project alternatives or mitigation measures?
- The PEIR analysis will respond to these comments

Public Comments

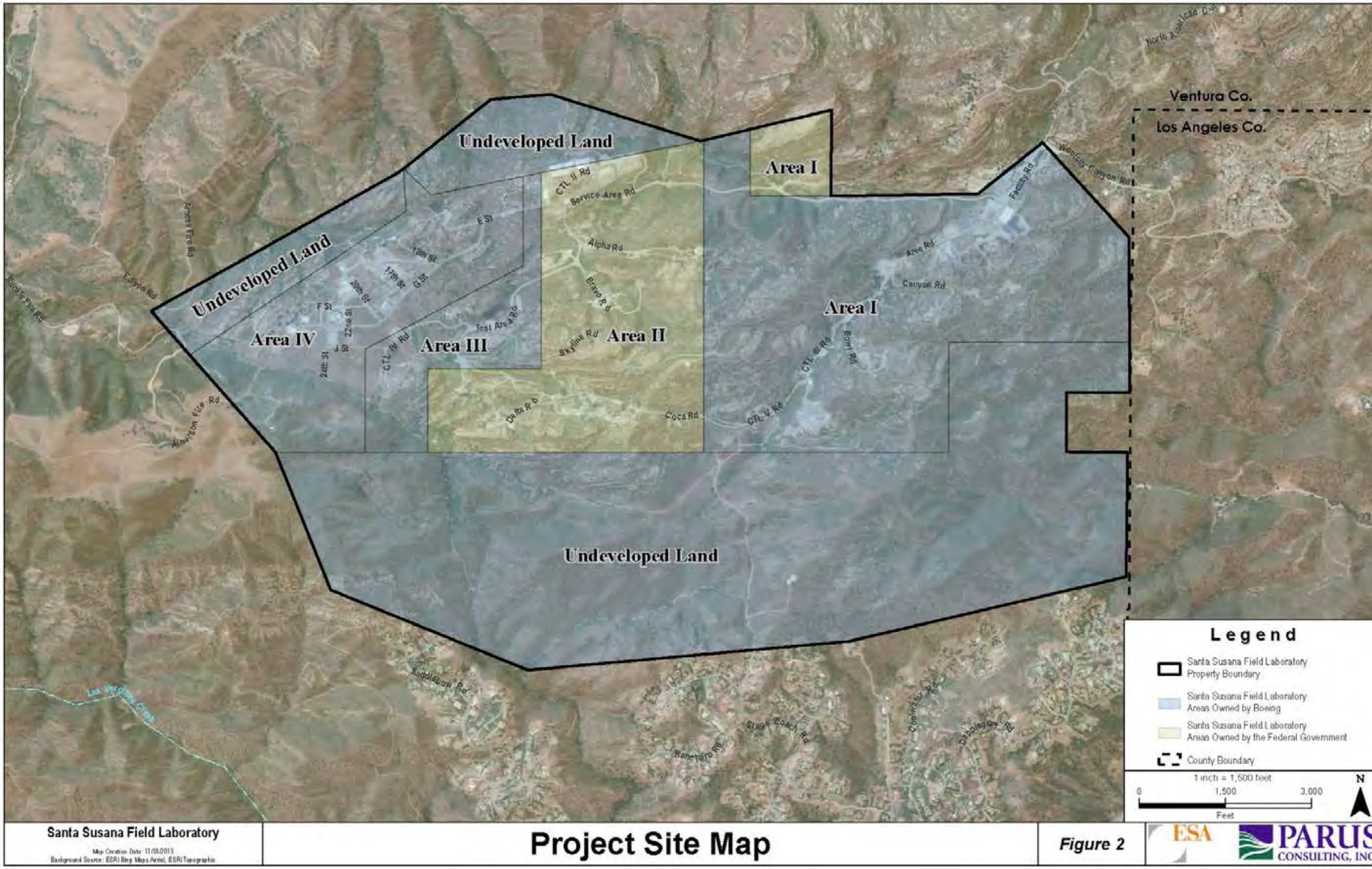
- How to provide a comment
  - Provide comment during public comment period at this meeting
    - Please fill out speaker card and give to meeting staff
    - Please be concise and limit comments to 3 minutes so all participants have an opportunity to speak
    - A court reporter will document all verbal comments
  - Complete a hard copy comment card
    - DTSC staff can read comments for people who don't want to speak
  - Enter a written comment on a laptop at this meeting
  - Submit a comment via mail, fax, or email by January 10, 2014

PEIR Topics

Issues to be addressed in the PEIR:

- Aesthetics
- Air Quality
- Biological Resources
- Cultural Resources
- Geology, Soils & Seismicity
- Greenhouse Gas Emissions
- Hazards & Hazardous Materials
- Hydrology, Groundwater & Water Quality
- Land Use
- Noise
- Population & Housing
- Public Services
- Traffic & Transportation
- Utilities
- Project Alternatives

Public Comments



Community Involvement

- Monthly SSFL Progress Report via email
- http://www.dtsc.ca.gov/sitecleanup/Santa_Susana_Field_Lab/
- Ongoing Community Meetings/Calendar
- Community Notices aka Fact Sheets, Public Notices, E-list, etc.
- For questions regarding SSFL and Community Involvement contact marina.perez@dtsc.ca.gov

Information Repositories

Simi Valley Library

2969 Tapo Canyon Road

Simi Valley, California 93063

(805) 526-1735

Platt Branch Library

23600 Victory Blvd.

Woodland Hills, California 91367

(818) 340-9386

California State University, Northridge

Oviatt Library, 2nd Floor, Room 265

Northridge, California

(818) 677-2285

DTSC Regional Office

9211 Oakdale Avenue

Chatsworth, CA 91311

(818) 717-6522

DTSC WEBSITE

http://www.dtsc.ca.gov/SiteCleanup/Santa_Susana_Field_Lab/

End of Presentation

Thank you for your participation.

CEQA Process Q&A

Questions Regarding CEQA Process?

Appendix E
Public Scoping Meeting Handouts

COMMENT FORM

State of California
Department of Toxic Substances Control
Santa Susana Field Laboratory
Program Environmental Impact Report
Scoping Meeting

Comments must be postmarked or received by **5 p.m., January 10, 2014** to be considered in the Draft Program Environmental Impact Report. Comments may be submitted at the scoping meetings, or postmarked, faxed or emailed to the address below.

Meeting Location: ______________________________ Date: ________________________________

Please Print

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OPTIONAL:

Name: ____

Affiliation (if applicable): ____

Mailing Address: ____

____

Email Address: ____

Please give this form to one of the project team representatives or submit by **5 p.m., January 10, 2014** to:

Mark Malinowski, Project Manager
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826
Fax: **916-255-3734**
Email: **DTSC_SSFL_CEQA@dtsc.ca.gov**

DTSC mailings are solely for the purpose of keeping persons informed of DTSC activities. Mailing lists are not routinely released to outside parties. However, they are considered public records, and if requested, may be subject to release.

Once you are ready to submit this form, please notify one of the project team members and they will save and submit your comments.

ELECTRONIC COMMENT FORM

State of California
Department of Toxic Substances Control
Santa Susana Field Laboratory
Program Environmental Impact Report
Scoping Meeting

Chatsworth Charter High School Chancellor Hall – December 10, 2013

All comments must be received by **5 p.m., January 10, 2014** to be considered in the Draft Program Environmental Impact Report. Comments may be submitted at the scoping meetings and via mail, fax or email.

Please type your comments in the box below:

OPTIONAL:

Name:

Affiliation (if applicable):

Mailing Address:

Email Address:

Once you are ready to submit this form, please notify one of the project team members and they will save and submit your comments.

ELECTRONIC COMMENT FORM

State of California
Department of Toxic Substances Control
Santa Susana Field Laboratory
Program Environmental Impact Report
Scoping Meeting

Simi Valley Senior Center Multi-Purpose Room – December 14, 2013

All comments must be received by **5 p.m., January 10, 2014** to be considered in the Draft Program Environmental Impact Report. Comments may be submitted at the scoping meetings and via mail, fax or email.

Please type your comments in the box below:

OPTIONAL:

Name:

Affiliation (if applicable):

Mailing Address:

Email Address:

Michael Burns

Department of Toxic Substances Control
Consultant Team

Bobbette Biddulph

Department of Toxic Substances Control
Consultant Team

Deanna Hansen

Department of Toxic Substances Control
Consultant Team

Jason Ricks

Department of Toxic Substances Control
Consultant Team

Cristina Gispert

Department of Toxic Substances Control
Consultant Team

Paige Anderson

Department of Toxic Substances Control
Consultant Team

Sarah Spano

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Consultant Team

Karen Snyder

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Consultant Team

Joan Isaacson

Department of Toxic Substances Control
Consultant Team

Marina Perez

Department of Toxic Substances Control

Mark Malinowski

Department of Toxic Substances Control

Richard Hume

Department of Toxic Substances Control

State of California
Department of Toxic Substances Control

Santa Susana Field Laboratory
Program Environmental Impact Report
Scoping Meeting
Chatsworth Charter High School Chancellor Hall – December 10, 2013

Name (Please print)	**Affiliation** (If applicable)	**Email Address**

State of California
Department of Toxic Substances Control

Santa Susana Field Laboratory

Program Environmental Impact Report

Scoping Meeting

Chatsworth Charter High School Chancellor Hall – December 10, 2013

Name (Please print)	**Affiliation** (If applicable)	**Mailing Address** (Street, City, State, Zip)

State of California
Department of Toxic Substances Control

Santa Susana Field Laboratory
Program Environmental Impact Report
Scoping Meeting
Simi Valley Senior Center Multi-Purpose Room – December 14, 2013

Name **(Please print)**	**Affiliation** **(If applicable)**	**Email Address**

State of California
Department of Toxic Substances Control

Santa Susana Field Laboratory
Program Environmental Impact Report
Scoping Meeting
Simi Valley Senior Center Multi-Purpose Room – December 14, 2013

Name **(Please print)**	**Affiliation** **(If applicable)**	**Mailing Address** **(Street, City, State, Zip)**

SPEAKER CARD

State of California
Department of Toxic Substances Control
Santa Susana Field Laboratory
Program Environmental Impact Report
Scoping Meeting

If you plan to ask a question or make a statement, please fill in the information below and submit the card when requested to do so. If you would like us to read your question or statement, please let us know. When speaking, please limit your comments to three minutes. Thank you.

Date: ____________________

Name: ________________________________ Affiliation: ____________________________

Question/Comment:

SPEAKER CARD

State of California
Department of Toxic Substances Control
Santa Susana Field Laboratory
Program Environmental Impact Report
Scoping Meeting

If you plan to ask a question or make a statement, please fill in the information below and submit the card when requested to do so. If you would like us to read your question or statement, please let us know. When speaking, please limit your comments to three minutes. Thank you.

Date: ____________________

Name: ________________________________ Affiliation: ____________________________

Question/Comment:

Appendix F
NOP Comments Received

Appendix F1
Letter, Emails, and Faxes

Dale Till

From: Abe Weitzberg <aweitzberg@att.net>
Sent: Friday, December 20, 2013 5:19 PM
To: DTSC_SSFL_CEQA
Cc: Malinowski, Mark@DTSC
Subject: CEQA Scoping Comments
Attachments: Written CEQA Scoping Commments0001.pdf

Attached are my written comments.

Abe

____
Abe Weitzberg phone: 818-347-5068
5711 Como Circle mobile: 301-254-9601
Woodland Hills, CA 91367

To: Mark Malinowski, Project Manager
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826
Via email: DTSC_SSFL_CEQA@dtsc.ca.gov

Date: December 20, 2013

Subject: CEQA Scoping Comments

The following is an augmented version of the comments I made at the first scoping meeting. It can be used to replace any transcript that you may have.

- My name is Abe Weitzberg and I am former worker, resident of Woodland Hills and a member of the SSFL Community Advisory Group.
- The issue before us is very clear. The proposed SSFL Cleanup Project is well defined by the 2007 Consent Orders covering all of the site groundwater and the soil in the Boeing area, and the 2010 Consent Orders covering soils in the NASA and DOE areas.
- The environmental impacts of the proposed project can be well understood from the recent NASA DEIS and the 2003 DOE Environmental Assessment.
- The NASA DEIS showed the severe environmental impacts of a 2010 AOC cleanup in their area, with 500,000 cubic yards of soil removal and trucking, destruction of the ecosystem and Native American Cultural Resources, plus health effects to neighboring communities. EPA commented that such soil waste was excessive and NASA should consider a risk-based cleanup.
- Recent DOE information indicates that the soil removal numbers for their 2010 AOC cleanup would be much larger than NASA's numbers. Adding in the estimates for Boeing and DOE soil removal, it is likely that the proposed project would require the removal of about 2,000,000 cubic yards of soil. This is clearly unacceptable.
- The 2003 DOE EA showed that a cleanup essentially to Suburban Residential, similar to that required by the 2007 Agreements would have far less impact. Similarly the NASA DEIS stated that a Suburban Residential cleanup would greatly reduce the amount of soil removal.
- A letter from Dan Hirsch and his Workgroup supporters to Debbie Raphael on September 24, 2012 credits Rick Brausch with negotiating the 2010 AOCs for DTSC. What it doesn't say is that the AOC's were signed without considering, or more accurately, by ignoring, the significant technical concerns of the staffs of DTSC, DOE, and NASA. The validity of these concerns is now evident from the consequences of the proposed 2010 AOC cleanup. It should also be noted that in sworn testimony during the SB-990 lawsuit, both Rick Brausch

and Mark Malinowski of DTSC stated that the 2007 agreements were protective. In other words, the 2007 agreements would allow the construction of houses and fulltime residency at SSFL.

- CEQA requires the evaluation of the environmental effects of a proposed project and states that a project may not be approved as submitted if feasible alternatives or mitigation measures are able to substantially lessen the significant environmental effects of the project.
- In the case of SSFL, a cleanup to the 2007 orders is clearly feasible and it will significantly reduce the environmental impacts of the cleanup. As such, it must be included in the DTSC Environmental Impact Report.
- We know that there are community and political forces advocating exclusion of any alternatives other than the 2010 AOCs for NASA and DOE soil. I see this as a direct violation of the CEQA requirements.
- I strongly request that all viable alternatives be evaluated and documented in the forthcoming Environmental Impact Report.
- Community members who support strict adherence to the AOCs continue to ignore facts on the ground and urge DTSC to violate CEQA just as they coerced NASA into violating NEPA. I trust DTSC will follow CEQA and ignore the false statements made by some community members.
    - The AOCs require compliance with all State and Federal laws.
    - Cs-137, Sr-90 and Pu-239 are found off-site because they are fallout nuclides, not because they come from site activities.
    - The Oakland breast cancer study identifies four locations statewide that have higher rates of breast cancer diagnoses than average in California. They are Marin County, San Mateo County, northern Orange County, and an area from Oxnard to Beverly Hills that happens to include SSFL. These are all high income areas and most likely have a much higher rate of breast exams than the average California area. There is no correlation made between the study results and SSFL.
    - Area IV has been previously cleaned to essentially residential standards and EPA found only about 10 sample locations with higher levels. This lack of substantial radiologic contamination is ignored and misstated by many of the community members.
    - Those who claim that hundreds of thousands of deaths will occur from the contamination remaining at SSFL have no basis for their claims. DTSC states that there is no offsite risk and this point must be strongly reiterated.
- The AOCs require cleanup to background or detect level, even though there may be no risk associated with the cleanup level for each of ~450 potential contaminants. This must be changed to a risk-based cleanup. At a minimum, the EIR must evaluate risk-based cleanup

scenarios, so that that the community can be informed about the various impacts to them and their environment and compare them to the purported benefits of the different cleanup scenarios. There is nothing sacrosanct about an AOC cleanup and it must be treated like any other project and have a full and open evaluation.

Thank you,

Abraham Weitzberg, Ph.D.
5711 Como Circle
Woodland Hills, CA 91367

5416 Manton Avenue
Woodland Hills, CA
91367
February 6, 2014

Mark Malinowski
SSFL Project Manager
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826

Dear Mr. Malinowski:

This is written in response to the invitation for public comment on the scope of the Environmental Impact Statement that the California Department of Toxic Substances Control will prepare regarding the clean-up of the Santa Susana Field Laboratory property. I am writing this comment on behalf of myself only and not on behalf of any organization or group that I am a member of. I was employed as a Senior Engineer at Atomics International from 1955 until 1965. The company was very concerned about employee safety. Employees and visitors alike wore film badges whenever they were close to any operating nuclear reactor. By close, I mean within the same building as such a reactor. We did not wear film badges outdoors away from such buildings. Nuclear radiation detectors indicated that such areas were safe and that persons in such areas were not in any danger of such radiation. I am now in my 91st year and still enjoy good health. I am evidence that tends to contradict the notion, widely held since about 2005, that in 1959 there was a disastrous "partial nuclear meltdown" at the sodium cooled reactor, also known as SRE. You probably have read reports written at the time by several Atomics International employees that detail the actual damage to fuel elements that occurred due to partial plugging of some of the coolant tubes with consequent overheating of the fuel elements. According to these reports, radioactive fission products that escaped from the damaged fuel elements were retained in the sodium coolant and in the carbonaceous clots that caused the plugging. When the reactor was started up again the following year with new fuel elements, the project chose to use the same coolant (sodium), mainly because the coolant contained so much radioactive material that it couldn't be disposed of.

In summary, my firm belief is that, although there was an accident that required the reactor to be shut down and fuel elements and pieces of fuel elements removed, there was no significant radioactive contamination of the site. In addition, the accident happened 55 years ago. Any radioactive debris left from the operation of the reactor would have mostly decayed by now. Any radioactive material present must be the result of natural causes, such as the creation of radioactive Carbon-14 and Tritium in the upper atmosphere, and continuing fall-out from recent and former nuclear weapons testing in the atmosphere.

For that reason I am opposed to any "clean-up" based on the idea of removing as much as two feet of top soil from the whole area, hauling it away in trucks through residential areas, and hauling replacement soil in to replace the removed soil. In addition to nuclear reactor activities at the Field Laboratory there was a big program of rocket engine testing and development. Various solvents and fuels were unavoidably deposited on and in the soil near the test stands. These solvents are not radioactive and therefore do not decay. The problem is that they can get into the ground water and eventually appear in drinking water provided to residents near the

Field Laboratory. It may be necessary to put in place a permanent or long-term program of ridding drinking water of these poisonous trace substances. Trucking top soil away seems to be an ineffective solution to removing poisonous organic compounds from drinking water if the point of entry to the water table is tens or hundreds of feet below the surface.

I understand that your agency, the DTSC, is under compulsion to consider seriously the trucking away of all the top soil. Another government agency, NASA, was required to consider just two clean-up options in its draft EIR: carting off all the top soil or nothing. I urge you to consider many possible means of clean-up and remediation, with special care to schemes that do not involve massive replacement of top soil.

Sincerely yours,

Albert J. Saur

Albert J. Saur
(Ph.D., U Illinois 1951)

Mariah Mills

From:	Albert Jackson Saur [alsaur@igc.org]
Sent:	Thursday, February 06, 2014 5:27 PM
To:	DTSC_SSFL_CEQA
Cc:	Chris Rowe
Subject:	Comment about scoping EIR for SSFL clean-up
Attachments:	Mark Malinowski.docx

Dear Mr. Malinowski

I have put together some of my thoughts about the scope of an environmental impact statement that the DTSC will prepare regarding the "clean-up" of the Santa Susana Field Laboratory. I am attaching it as a WORD document to this e-mail. I will also mail a copy to you by the USPS.

Albert J. Saur, Ph.D.

Mark Malinowski, Project Manager

Department of Toxic Substances Control

Dear Sir:

This is written in response to the invitation for public comment on the scope of the Environmental Impact Statement that the California Department of Toxic Substances Control will prepare regarding the clean-up of the Santa Susana Field Laboratory property. I am writing this comment on behalf of myself only and not on behalf of any organization or group that I am a member of. I was employed as a Senior Engineer at Atomics International from 1955 until 1965. The company was very concerned about employee safety. Employees and visitors alike wore film badges whenever they were close to any operating nuclear reactor. By close, I mean within the same building as such a reactor. We did not wear film badges outdoors away from such buildings. Nuclear radiation detectors indicated that such areas were safe and that persons in such areas were not in any danger of such radiation. I am now in my 91st year and still enjoy good health. I am evidence that tends to contradict the notion, widely held since about 2005, that in 1959 there was a disastrous "partial nuclear meltdown" at the sodium cooled reactor, also known as SRE. You probably have read reports written at the time by several Atomics International employees that detail the actual damage to fuel elements that occurred due to partial plugging of some of the coolant tubes with consequent overheating of the fuel elements. According to these reports, radioactive fission products that escaped from the damaged fuel elements were retained in the sodium coolant and in the carbonaceous clots that caused the plugging. When the reactor was started up again the following year with new fuel elements, the project chose to use the same coolant (sodium), mainly because the coolant contained so much radioactive material that it couldn't be disposed of.

In summary, my firm belief is that, although there was an accident that required the reactor to be shut down and fuel elements and pieces of fuel elements removed, there was no significant radioactive contamination of the site. In addition, the accident happened 55 years ago. Any radioactive debris left from the operation of the reactor would have mostly decayed by now. Any radioactive material present must be the result of natural causes, such as the creation of radioactive Carbon-14 and Tritium in the upper atmosphere, and continuing fall-out from recent and former nuclear weapons testing in the atmosphere.

For that reason I am opposed to any "clean-up" based on the idea of removing as much as two feet of top soil from the whole area, hauling it away in trucks through residential areas, and hauling replacement soil in to replace the removed soil. In addition to nuclear reactor activities at the Field Laboratory there was a big program of rocket engine testing and development. Various solvents and fuels were unavoidably deposited on and in the soil near the test stands. These solvents are not radioactive and therefore do not decay. The problem is that they can get into the ground water and eventually appear in drinking water provided to residents near the Field Laboratory. It may be necessary to put in place a permanent or long-term program of ridding drinking water of these poisonous trace substances. Trucking top soil away seems to be an ineffective solution to removing poisonous organic compounds from drinking water if the point of entry to the water table is tens or hundreds of feet below the surface.

I understand that your agency, the DTSC, is under compulsion to consider seriously the trucking away of all the top soil. Another government agency, NASA, was required to consider just two clean-up

options in its draft EIR: carting off all the top soil or nothing. I urge you to consider many possible means of clean-up and remediation, with special care to schemes that do not involve massive replacement of top soil.

Sincerely yours,

Albert J. Saur
(Ph.D., U Illinois 1951)

CHATSWORTH NEIGHBORHOOD COUNCIL
P.O. Box 3395, Chatsworth, CA 91313-3395
Voice: (818) 464-3511 Fax: (818) 464-3585
http://chatsworthcouncil.org

February 6, 2014

Mr. Mark Malinowski, Project Manager
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826
By email to: DTSC_SSFL_CEQA@dtsc.ca.gov

Comments of Chatsworth Neighborhood Council on
NOTICE OF PREPARATION FOR A
DRAFT PROGRAM ENVIRONMENTAL IMPACT REPORT
SANTA SUSANA FIELD LABORATORY SITE, VENTURA COUNTY, CALIFORNIA
Dated November, 2013

Dear Mr. Malinowski,

The Chatsworth Neighborhood Council has considered the attached letter written by the Santa Susana Mountain Park Association related to the Santa Susana Field Laboratory cleanup, and encourages the Department of Toxic Substances Control to consider the various issues raised in that letter as the Program Environmental Impact Report is prepared.

The Chatsworth Neighborhood Council is very concerned about the impacts of the Santa Susana Field Laboratory cleanup within Chatsworth.

Sincerely,

ANDRE VAN DER VALK

President

enclosures (PEIR Comment Letter by SSMPA, and attachments)

Santa Susana Mountain Park Association

Dedicated to the Preservation of the Simi Hills and Santa Susana Mountains

P.O. Box 4831
Chatsworth, CA 91313-4831
ssmpa.com

January 8, 2014

Mr. Mark Malinowski
Project Manager
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826
DTSC_SSFL_CEQA@dtsc.ca.gov

Comments of Santa Susana Mountain Park Association on
NOTICE OF PREPARATION FOR A
DRAFT PROGRAM ENVIRONMENTAL IMPACT REPORT
SANTA SUSANA FIELD LABORATORY SITE, VENTURA COUNTY, CALIFORNIA
dated November 2013

SUMMARY:

DTSC's PEIR must supply much still-missing information.

1. Responsible Parties (RPs) need guidance on situations and actions that depend on vague language in the 2010 Administrative Orders on Consent (AOCs) that govern the cleanup. DTSC must provide RPs with an authoritative and binding interpretation of the language of the AOCs.

2. The PEIR must specify expected outcomes for cultural resources, both archeological and architectural.

3. The PEIR must include analysis of all practical levels of cleanup, in addition to the "cleanup to background" alternative, to comply with CEQA.

   DTSC's PEIR document must include a CEQA analysis that balances cleanup goals under various scenarios, including costs (both financial and environmental). Additionally, the DTSC PEIR must provide information on what soils are to be removed in culturally sensitive areas, and what cultural resources will remain after the cleanup, as DTSC has sole authority to make these decisions under the AOCs.

4. The PEIR must specify how to obtain replacement soil that will meet the requirements in the AOCs.

5. The PEIR must clearly specify cumulative impacts of all related concurrent projects; viz., the NASA, DOE and Boeing cleanups.

6. The PEIR must include comprehensive surveys and mitigation methods for plants.

ESSENTIAL POINT OF SSMPA's COMMENTARY:

DTSC must define, specify, and provide important information to all RPs. The PEIR must provide to decision makers adequate, clear and specific information to make informed decisions on how an environmentally responsible cleanup should proceed.

COMMENTS:

1 Guidance on AOC Language and on Site-Specific Guidelines

1a. The AOCs signed by DOE and NASA charged DTSC with oversight authority for the cleanup.[1a] DTSC must provide the RPs with a binding, authoritative interpretation of certain vague requirements in the AOCs. The RPs must learn what SSFL-situation-specific rules will govern decisions and actions for the cleanup.

1b. DTSC must provide guidance to the RPs governed by the AOCs on many subject areas before the RPs can complete their DEISs and EISs. Of major consequence for every decision is the requirement under the AOCs that at least 95% of any soil that has ANY amount of contamination over background level must be removed.[1b] This ambiguous requirement has pervasive impact on every item discussed below.

1c. DTSC does not expect to deliver its Draft PEIR until sometime in late 2014. The RPs need information from the PEIR to complete their own valid EISs that can be used as decision making guides. Does this schedule not call into question the feasibility of the AOC-mandated completion date of 2017 for the NASA and DOE managed cleanups? Can the governing AOCs therefore any longer be considered 'binding'?

1d. The NASA Associate Administrator for Mission Support Directorate notes that NASA will be assisting DTSC in its CEQA analysis estimated to be complete by the end of 2015, but also notes that analysis will be restricted to the single AOC cleanup level.[1d.1] **(**See **Attachment 1.)** To the best of our knowledge, both NEPA and CEQA set standards for environmental considerations that must be addressed in environmental documents, and contracts that are inconsistent with those laws do not trump NEPA and CEQA provisions. The NEPA and CEQA analyses must consider all options, not the single path set by the AOCs.[1d.2] When will DTSC's actual PEIR, including CEQA considerations, be issued as a draft? When will it be issued in final form? It appears these documents are scheduled after the supposed start of execution of the cleanup to the constraints of the AOCs. That is not our understanding of how CEQA and environmental policy should work. Even Rick Brausch, then DTSC project director for the SSFL cleanup, acknowledged in the July 2011 PPG meeting, that CEQA and other environmental laws still apply and indicated DTSC would follow the laws' requirements. However, DTSC's public start date for the PEIR is now two years behind the suggested schedule he mentioned in July 2011. [1d.3]

1e. There are many environmental cleanup projects in the U.S. They "all" (as far as anyone knows) MUST operate according to federal and state EPA laws that were passed by legislators concerned with protecting the environment. Operating under EPA processes means any toxic cleanup MUST evaluate multiple reasonable alternatives. The NASA and DOE SSFL cleanups were forced to be uniquely different from other projects, because the AOCs were signed before any EIS-type document. Why the difference? [1e] See **Attachment 2.** How is the different treatment of these projects explained? We can fathom no reasonable explanation.

SSMPA advocates a cleanup based on scientific results, testing and standards, not political pressures.

---

2 PEIR Must Specify Expected Outcomes for Cultural Resources

2a. DTSC must interpret the AOCs on the handling of Native American cultural resources. The AOC language is vague in its definition of Archaeology, defining it as “Artifacts.” They must be “formally recognized as Cultural Resources”.[2a] What does “Artifacts that are formally recognized as cultural resources” mean? Who needs to recognize what to meet that odd definition? Interpretive guidance is critically needed, because the Burro Flats Cave area, registered in the National Register of Historic Places, is primarily on the NASA property. In addition, where archaeological surveys on DOE property have been done, perhaps 20 archeological sites have been located that have not been formally recorded. We expect similar indications of past Native American Use based on tribal commentary and the proximity of the Boeing property to the Burro Flats Cave complex and the Bell Canyon creek area that also is a major archeological site. The future of Burro Flats and related nearby Native American areas is yet to be articulated by DTSC. An artifact is generally understood to represent a movable, historically used, significant object. Given that definition, the Burro Flats Cave itself could be eliminated by the language in the AOCs, as well as bedrock mortars that are part of the NRHP recorded site, which are also very significant. An explanation of how the Burro Flats Cave, and nearby related sites, including sites such as found on the DOE property and elsewhere in the project, will be treated must be provided by DTSC in the PEIR.

In addition to the specific language quoted above, the AIPs that address this area for the AOCs, indicate that no more than 5% can be excluded and any acceptance of an exception is subject to DTSC’s oversight and approval. Please explain what that means on a specific basis, naming sites under consideration and the boundaries of each site (or artifact), particularly since there is significant sampling data now available to make appropriate decisions.

2b. At the August 28, 2013, public comment session on the NASA DEIS, a NASA representative indicated they have been told the Cultural Resource definition in the AOC means the National Register of Historic Places (only). Under that definition, the Burro Flats site (CA-VEN-1072) is exempt from cleanup. Why would NASA indicate any portion of this site is to be cleaned? Has DTSC overridden the AOC under its global override authority? This discrepancy highlights the problem of “Who controls the cleanup?” We do note, however, that DTSC still has not clarified the definition of Artifact, so the Burro Flats site may still be subject to cleanup under the AOC; since this site may still be subject to cleanup due to vague language, we object to cleanup of the Burro Flats site, as it is an identified and registered National Register of Historic Places area, and as it is an identified Indian Sacred Site. What position will DTSC take on this very particular property, in addition to our prior more generic request for clarification?

What are the contamination levels at the archaeological sites, and in particular the Burro Flats parcel, slated for cleanup? What safeguards will be put in place to reduce impacts to the Burro Flats parcel, as to dust, and impacts due to changes to surface water runoff when RPs choose not replace removed soil?

2c. DTSC's PEIR must provide information on how the boundaries of the archaeological sites on the property have been determined. What survey methods were used? When was that done? What was found on the site? How was it tested? At what depth? When was it surveyed? What will DTSC do with an artifact a RP found in that survey, or a midden area that would not qualify as an artifact (that surely would be "contaminated")?

2d. Only a pedestrian survey of site boundaries was done. Are additional pedestrian studies, and more detailed studies needed in the area where soil is to be removed? Comments submitted by professional archaeologists indicate the survey methods used by NASA were very inadequate due to large distances between areas evaluated, far in excess of accepted practices. Will a more adequate archaeological evaluation be required, and if so in what areas? A comprehensive survey using soil sampling techniques must be undertaken to determine the true size of the District. The Burro Flats Archaeological District extends outside the borders of Area II into Area III and possibly into Area IV. This site should not be segmented between the 3 RPs, but should be looked at holistically as part of the entirety of the Cultural Resources of SSFL. New, detailed surveys of this site must be accomplished prior to making irreversible decisions to "clean up" this exceptional and irreplaceable Indian Sacred Site**.**

An adequate definition and description of the Burro Flats site must be created and reviewed with all RPs, as they all will have the most critical role in site cleanup or preservation. An additional boundary dilemma with the Burro Flats site and the National Register of Historic Places (NRHP) is that as of 1972, the NRHP site is 25 acres. Since the NASA DEIS recognizes only 17 acres as the site, where are the boundary differences? Does the NRHP boundary exclude or include the 0.65 acres that is to be cleaned up? What is protected under the NRHP, and what should be protected as part of VEN-1072? **Please also address how a 25 acre NRHP site (plus other sites) will be treated, considering the total area NASA proposes to clean up is approximately 105 acres (page 2-17 of NASA DEIS), and the maximum exception is 5%.** DTSC must take the lead in answering such questions.

The steps in 2b, 2c, and 2d are all necessary to define the Burro Flats site. Again we see the same problem **–** DTSC must advise what can be excluded from the cleanup. The RPs must provide information on what they will exclude, given an updated DTSC interpretation. And here, on the single site that is already NRHP certified, the boundaries must be established, and the site still needs a detailed evaluation by a qualified archaeologist, and careful and limited testing must be done to provide information on contamination of any part of the site. The approach that DTSC and the RP's, especially NASA, will take to an Indian Sacred Site must be incorporated in the decision. All this information needs to be provided and presented, with proposed resolutions, in DTSC's PEIR, and NASA's EIS.

2e. What will be done with newly discovered archaeological Artifacts found in the process of the cleanup, that are not "culturally recognized"? How will these items be preserved or protected?

2f. DTSC must interpret the AOC on the handling of Architectural Structures (NASA project) that are eligible historic structures (rocket engine testing facilities). Three structures at each of the Alpha, Bravo and Coca test stand areas have been found eligible under NRHP and SHPO (nine total structures). [2f] What contamination has been found in the soils under the test stands? Have testing boreholes been drilled under these structures? What has been found?

2g. Will DTSC allow some or all of these historic structures to remain?

2h. Since test stands are not "artifacts", but are recognized as significant historic structures under Section 106, NRHP and SHPO, what will happen to these structures? How will the 5% exception for "artifacts" under the AOC's be applied to the NASA parcel that has the greatest quantity of cultural resources? What will be allowed to remain considering this limitation and other considerations?

2i. The standards established by Section 106 (reproduced below) provide a mandate to seek ways to avoid or mitigate adverse effects on historic properties. Both NASA and DTSC need to indicate their intention for these structures that could be irreparably destroyed and a key part of our country's rocket history thereby forever lost. Because the NASA property holds key remnants of our country's space and rocket development, consideration of the possible end use of the property as a park should be incorporated in the preservation decisions. If the NASA parcel ultimately is joined with the larger Boeing parcel that is expected to become a park, preservation of appropriate NRHP and SHPO-eligible structures to inspire future generations should be given a much higher priority. These decisions should be documented in Alternatives presented in DTSC's PEIR and NASA's re-issued DEIS.

Appendix C, Section 5.1 of NASA's DEIS is reproduced in part below (emphasis added):

"The enabling legislation for Section 106 is contained in 36 CFR 800, "Protection of Historic Properties." The Section 106 process entails three basic steps:

1. Identify historic properties potentially affected by the undertaking.
2. Assess adverse effects on historic properties.
3. Seek ways to avoid, minimize, or mitigate adverse effects on historic properties."

2j. Prepare and present a cost/benefit analysis for preserving and maintaining the historic structures and Districts. Include contamination analysis (soil and building), as well as costs and benefits identified in the study, to make informed decisions about which to preserve, and which can be preserved and be safe for visitors. We encourage special attention to Coca V and Alfa III and their associated blockhouses, as those were targeted early as preferred candidates for preservation, if preservation choices ultimately are necessary.

2k. With respect to all cultural resources, please provide information for the groundwater and surface water effects due to soil mitigation. Specifically include consideration of the effect of all reductions in site soils resulting from only partial replacement of removed soils, including collateral re-contamination and other effects from flooding and silt runoff due to soil changes.

The impacts anticipated to archaeological cultural resources from removal of soil from parcels within the designated archaeological site must be reviewed and disclosed in the PEIR.

The impacts anticipated to archaeological cultural resources from removal of soil from parcels outside of the designated archaeological site, but within the cleanup study areas must be reviewed and disclosed in the PEIR.

The impacts anticipated to the historic test stands (Alpha, Bravo, Coca) from removal of soil from parcels within the designated historic area must be reviewed and disclosed in the PEIR.

The impacts anticipated to the historic test stands (Alpha, Bravo, Coca) from removal of soil from parcels outside of the designated historic area, but within the NASA DEIS study area, must be reviewed and disclosed in the PEIR.

---

3 PEIR Must Include Consideration of Alternative Cleanup Levels

3a. Exclusion of any possible cleanup alternatives, except the expected cleanup approach, would be a momentous detriment to the usefulness of the PEIR, and likely invalidate it under CEQA. The PEIR must **not** exclude from consideration reasonable alternatives supported by authorized standards of the State of California including cleanup to Suburban Residential, Commercial/Industrial, and Recreational levels, for any of the RP's.

3b. DTSC's PEIR must include reasonable alternatives, presenting comparison of costs and all related effects on transportation, biological resources, cultural resources, soil, water, and air.

3c. A discussion of alternatives should include what DTSC will have the RPs do if the Appeals Court supports the lower court decision, which will have the effect of stating that a special, negotiated cleanup standard is not permissible at SSFL under California law. An explanation should be provided to explain why the public should pay for a cleanup that is inconsistent with the law, and why local residents should be subjected to significant environmental contaminants from emissions, disturbed soil and related fugitive dust effects, and surface water runoffs that are greatly increased by unavoidable consequences of a background level cleanup of the site. See, in **Attachment 4**, the text of the District Court decision filed May 5, 2011, which prohibits DTSC from compelling compliance with SB990.[3c] The AOCs appear to operate as substitutes for a questionable law, but the justification for its position requiring a "background level cleanup" on this important site is very unclear. That DTSC and political pressure seem to have required signature of the AOCs by NASA and DOE shortly before this decision was issued in May 2011 is very significant. We believe all decision makers and the public are entitled to see the effects of all alternatives.

4 PEIR Must Clearly Specify Requirements for Soil Cleanup

4a. DTSC's PEIR must fully address how appropriate backfill soil will be sourced. DTSC must give guidance on how soils that must match the specific background levels for SSFL will be identified. Source sites from which sufficient quantities of such soils may be obtained must be identified. This is a very important issue because if adequate replacement soils cannot be located, alternative solutions, including on site treatments clearly should be allowed, and the overall approach to the cleanup may need to change.

4b. The PEIR must explain why or how any soil replacement plans may remove significantly more soil from the site as will be backfilled. Can permanent reduction (by non-backfilled removal) of thousands of cubic yards of soil be deemed appropriate mitigation?

Will DTSC allow NASA's proposal in their DEIS to not replace 2/3 of the removed soil? What will happen with soil replacement on the DOE parcel, if not all removed soil needs to be replaced? What amounts of soil are to be removed on the Boeing parcel and what replacement is to be used on that parcel?

4c. Surface water runoff effects resulting from any substantial reduction in surface soils must be reviewed, explained, and disclosed in the PEIR, if DTSC anticipates accepting NASA's proposal to replace significantly less soil than it removes. Consideration of any as-yet not publicly disclosed similar shortage in replacement soil by DOE also needs to be incorporated in DTSC's commentary and disclosure. It is well settled that a reduction in permeable surfaces (typically associated with development) causes significantly increased runoffs. What will be the runoff effects of the decreased soil in a year with average rainfall? What is expected when rainfall is significantly over average levels?

4d. "Onsite" (*ex situ* and *in situ* treatment) soil cleanup is a promising alternative to soil removal, where appropriate. Yet, the AOCs seem to prohibit this and state the only allowable method for soil cleanup is removal.[4d] DTSC must explain how this seeming contradiction is possible based on the AOC language. The "leave in place" remediation alternative should be considered in the NEPA and CEQA analysis because such a remediation approach would entail significantly less environmental impact, by reducing soil excavation, hauling, and soil replacement.

4e. The PEIR should include a review of Environmental Justice which generally looks at the impacts to lower income and minority populations that will be affected by soil hauling activities. Furthermore the PEIR should address such demographics in the areas that are proposed to receive, and then permanently live with possible effects from the contaminated material, such as Buttonwillow, Kettleman, and Beatty. The adequacy of the identified sites to accept the combined material volumes needs to be incorporated in the PEIR, and if inadequate, alternative solutions need to be incorporated

4f. At the August 28, 2013, public comment session on the NASA DEIS, it was disclosed the haul trucks are merely covered with tarps when traveling with contaminated material. We request that the Department of Toxic Substances Control ensure much more complete protection for all communities along transport routes from the contaminated material that the AOCs require to be removed. Better alternatives for reduced dust from the trucks and containment of all materials, including dust from bumps as the material is trucked, need to be developed and implemented.

4g. Is remediation in a project like this where buildings are removed, adequate where a flat landscape is left after remediation? Should remediation include providing topographic restoration or variable elevations/topography, such as the site originally had?

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5 PEIR Must Define and Disclose Cumulative and Combined Impacts

5a. The combined impacts of all concurrently operating SSFL projects regarding traffic and transportation-related pollution must be made specific in the PEIR.

5b. What transportation routes will be used by all the RPs? Will they use the same or different haul routes?

5c. What will the transportation emissions be for all projects combined? What will be the total effect on all communities?

5d. The number of trucks on all projects, travelling on Woolsey Canyon during daylight hours must be disclosed, as well as twilight and night truck traffic volumes for all projects combined. This disclosure should be presented in a table format, and specify the anticipated number of incoming and outgoing trucks in one hour increments during weekdays and weekends (if applicable), for all projects to present a realistic understanding of the traffic impact. Include a column for worker arrivals and departures from the site. Provide hour of the day in the rows, and in columns show incoming and outgoing traffic for each of NASA, DOE, Boeing. Combine all workers for all projects in the last set of columns for cumulative incoming and outgoing traffic.

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6 PEIR Must be Complete Regarding Plants

6a. DTSC's PEIR must answer questions such as: How many plants of each type are involved? How many coast live oak (*quercus agrifolia*) trees will be removed or otherwise endangered? How many western sycamores? Santa Susana tarplants?

6b. What steps will DTSC require the RPs to take, over what period of time, to regenerate sensitive species? For example, we do not believe Santa Susana tarplant is part of the seed mix specified for replanting. How will plantings be monitored to encourage regrowth?

6d. What steps will DTSC require the RPs to take to eliminate introduction of invasive species as off-site soil is brought in as part of the soil replacement? How will plants be affected by re-filling the site with less soil than was removed? How will the segmented cleanup and backfills affect the overall health of this habitat, which in many areas is uniquely undisturbed by the major metropolitan community next door?

CONCLUSION AND CLOSING COMMENTS:

We believe the preceding comments taken as a whole make it clear that DTSC's PEIR must conform to all applicable environmental laws including CEQA and NEPA. DTSC's PEIR must deliver guidance to the RPs for virtually every decision affecting cultural resources and key soil removal approaches. Additionally, it is dangerous to adhere to the 2017 completion date for cleanup that the AOCs arbitrarily mandate, especially when one considers the delay in starting work on this PEIR, and the time expected for a final EIR to be prepared. A hurried cleanup will likely become an irrevocable mistake, due to significant negative impacts to soil and cultural resources that may occur. DTSC and the RPs must determine and agree to robust decision-enabling guidelines, and the PEIR must evaluate multiple reasonable alternatives.

The target date for completion of the cleanup must be extended. The current target date of 2017 has become unrealistic; DTSC has not yet provided an EIR, and DOE has not moved forward beyond initial scoping hearings. Cleanup needs to be performed after environmental documents are prepared, not before they are prepared.

A revised target date of 2020 will permit meaningful evaluation, compliant with CEQA processes, of multiple, reasonable cleanup alternatives and their impacts. An orderly and logical cleanup can then be executed responsibly, thereby avoiding unwarranted destruction of irreplaceable cultural and natural resources.

SSMPA looks forward to seeing your responses to our comments in upcoming environmental documents and asks that you seriously consider them. We primarily represent Chatsworth and West Hills, two areas that will be most affected by the tens of thousands of truckloads of materials that are required to be moved by the AOCs. In a manner similar to that voiced so clearly by the NASA Inspector General[7], we too, have great difficulty seeing that cleanup to special, pre-emptive AOC standards is of any tangible benefit to anyone. (See **Attachment 6.**) But we certainly see the detriment to communities local and remote, and we see the huge governmental costs all taxpayers will pay.

Please be assured that we resolutely support cleanup of SSFL to "reasonable" levels. We believe the "Suburban Residential" cleanup standard, set by the 2007 Consent Orders, is a very reasonable cleanup level, significantly exceeding requirements, if the land will become open space, as almost all who are familiar with the property desire.

Sincerely,

Teena A. Takata
President, Santa Susana Mountain Park Association
P. O. Box 4831
Chatsworth, CA 91313-4831

About **Santa Susana Mountain Park Association**:

Santa Susana Mountain Park Association is a 41 year-old non-profit organization based in Chatsworth, Los Angeles, California.

We represent approximately 700 members and concerned citizens, and we partner with many organizations to promote ecological and recreational quality in Southern California.

SSMPA's mission is to preserve and protect the Simi Hills, Santa Susana Mountains, and surrounding open space.

ATTACHMENTS: TABLE OF CONTENTS

References

1a Docket No. HSA-CO 10/11 - 038 ADMINISTRATIVE ORDER ON CONSENT FOR REMEDIAL ACTION, section 5.19.1, http://ssfl.msfc.nasa.gov/documents/governance/NA_DTSC_Final_AOC_Dec_2010.pdf retrieved 8/20/2013

Docket No. HSA-CO 10/11 – 037 ADMINISTRATIVE ORDER ON CONSENT FOR REMEDIAL ACTION, section 7.19.1, http://www.etec.energy.gov/Library/Cleanup_and_Characterization/SSFL_DOE_AOC_Final.pdf retrieved 1/7/2014

1b Agreement in Principle between The National Aeronautics and Space Administration and the State of California, p. 1-2 http://ssfl.msfc.nasa.gov/documents/governance/NASA_DTSC_Final_AOC_Dec_2010.pdf retrieved 8/20/2013

Agreement in Principle between The U.S. Department of Energy and the State of California, p. 1-2 http://www.etec.energy.gov/Library/Cleanup_and_Characterization/SSFL_DOE_AOC_Final.pdf retrieved 1/7/2014

1d.1 Audit Report: NASA's Environmental Remediation Efforts at the Santa Susana Field Laboratory, Report No. IG-13-007, Feb. 14, 2013, p. 33 http://oig.nasa.gov/audits/reports/FY13/IG-13-007.pdf retrieved 8/20/2013

1d.2 U. S. District Court Central District of California, Case CV-10-04839-JFW (MANx), Plaintiff the Boeing Company's Statement of Uncontroverted Facts and Conclusions of Law, p. 36-37 http://www.dtsc-ssfl.com/files/lib_boeinglawsuit%5Clegaldocs/64849_Boeing_statement_uncontroverted_facts.pdf retrieved 8/20/2013

1d.3 Partial Transcript from July 2011 DTSC PPG meeting, discussing the interaction of AOCs and CEQA and other environmental laws (emphasis added). Attachment 7

1e U. S. District Court Central District of California, Case CV-10-04839-JFW (MANx), Plaintiff the Boeing Company's Statement of Uncontroverted Facts and Conclusions of Law, p. 35-37

2a Agreement in Principle between The National Aeronautics and Space Administration and the State of California, p. 1

Agreement in Principle between The U.S. Department of Energy and the State of California, p. 2

2f NASA DEIS, Appendix C, Draft Cultural Resources Study, 3.3.2 Historic Architectural Resources, p. C-38-39

3c U. S. District Court Central District of California, Case CV-10-04839-JFW (MANx), Judgment Pursuant to Fed. R. CIV. p. 1-2 http://www.dtsc-ssfl.com/files/lib_boeinglawsuit%5Clegaldocs/64933_DTSCvTheBoeingCoJudgement05-05-2011.pdf retrieved 1/7/2014

4d Agreement in Principle between The National Aeronautics and Space Administration and the State of California, p. 2

Agreement in Principle between The U.S. Department of Energy and the State of California, p. 3

7 Audit Report: NASA's Environmental Remediation Efforts at the Santa Susana Field Laboratory, Report No. IG-13-007, Feb. 14, 2013, p. 10

2

NASA's Environmental Remediation Efforts at the Santa Susana Field Laboratory Actions for Response to OIG Recommendation	
Action	**Estimated Completion Date**
Working with DTSC to establishing appropriate cleanup standards (called Look-up Tables in AOC).	Summer 2013
Follow outcome of SB-990 law suit appeal.	Ongoing; decision expected in 2013
Follow Tribal interest and demands.	Ongoing; TBD
Through the NEPA process, thoroughly evaluating the impacts from a "cleanup to background" and attempting to minimize those impacts.	Spring 2014
Assist DTSC to evaluate impacts to a "cleanup to background" through its CEQA process.	Winter 2015
Seek cost-effective cleanup methods. This will be an ongoing process to examine various technologies.	Winter 2015

Again, thank you for the opportunity to review and comment on the subject draft report. If you have further questions or require additional information on the Agency's response to the subject draft report, please contact Olga M. Dominguez at 202-358-2800 or e-mail olga.m.dominguez@nasa.gov.

Woodrow Whitlow, Jr.

Woodrow Whitlow, Jr.

cc:
Assistant Administrator for Strategic Infrastructure/Ms. Dominguez
Director, Environmental Management Division/Mr. Leatherwood

ATTACHMENT 1

Uncontroverted Fact	Boeing Evidence, DTSC Response
	SSFL site should be cleaned up to a stricter standard than would be required under generally applicable State law? MR. ROBINSON: Objection; lack of foundation. THE WITNESS: No.
104. If SB 990 could not be applied to all of the contamination at SSFL, it would not be possible to "sum" the risks for the entire site and to develop "cumulative risk" assessment as required by SB 990.	• **Not Disputed**
105. There is no technical, scientific, or environmental basis to single out SSFL for more onerous cleanup procedures than apply to other contaminated sites in California.	***<u>Boeing's Evidence</u>*** • Malinowski Dep. [28:22] – [29:3] ("Q. Is there anything that you can identify about the SSFL site that poses a more significant threat to public health than other sites in the state? … [A.] I am not aware of any imminent threat that is posed by SSFL at this point based on the available information I've had."); • *Id.* at [95:21] – [96:1] ("Q. Does the chemical contamination that is present at SSFL pose a different risk to the public or the environment than the similar chemical contamination found on the other industrial sites in the state? … [A.]

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Uncontroverted Fact	Boeing Evidence, DTSC Response
	No.”); • *Id.* at [96:2] – [96:11] (“Q. … Am I correct that there are also other sites in the state that contain radiological contamination? A. Yes. Q. Is there anything about the radiological contamination that is present at SSFL that poses a different risk to the public or the environment than radiological contamination present at other sites in the state of California? A. Not to the best of my knowledge, no.”); • *Id.* at [136:2] – [136:17] (“Q. … [I]s there anything about either the chemical or radiological contamination at SSFL that, in your view, would justify applying a different approach to the cleanup at SSFL than at other sites in the state? … [A.] … No. Q. … Is there anything else about the site other than the chemical or radiological contamination, and putting aside SB 990 for the moment, that would, in your view, justify applying a different approach to the cleanup at SSFL than at other sites in the state? … [A.] No.”); • Brausch Dep. [107:17] – [107:22] (Q. Can you identify any reason to conclude that the SSFL site should be cleaned up to a stricter standard than would be required under generally applicable State law? … A. … No.”).

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ATTACHMENT 2

Uncontroverted Fact	Boeing Evidence, DTSC Response
	DTSC Response **Disputed.** Objection: Defendant objects to Statement of Fact # 105 in that it mischaracterizes the witnesses' testimony cited [above] – the witnesses did not testify that there is no technical, scientific or environmental basis to single out SSFL for more onerous cleanup procedures that apply to other contaminated sites in California.
106. McClellan Air Force Base, roughly the same size as SSFL, is seven miles from Sacramento and is contaminated with all of the same contaminants listed in SB 990, many in higher concentrations, including TCE.	***Boeing's Evidence*** • Malinowski Dep. [26:3] – [26:23] (McClellan Air Force Base close to major population centers); • *Id.* at [28:7] – [28:9] ("[A.] McClellan Air Force Base was the most polluted Air Force Base out of all the Air Force. It ranked the highest."); • *Id.* at [34:9] – [36:16]; • *Id.* at [101:11] – [102:12]; • *Id.* at [128:11] – [134:24] (higher concentrations of volatile organic compounds than SSFL); • *Id.* at [141:11] – [141:16]; • *Id.* at [144:6] – [148:22] ("… Q. In your view, is the McClellan Air Force Base a fairly similar site to the SSFL site in terms of the contamination that is present? A. The types of contamination, yes. … Q. There was TCE as well; is that right? A. Yes.);

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Uncontroverted Fact	Boeing Evidence, DTSC Response
	• Greger Dep. [68:7] – [68:16]; • Bowers Decl. ¶¶35, 50, 53, 55, 58, 64; • Ex. 6 to Bowers Decl., *Public Health Assessment, McClellan Air Force Base, Sacramento, Sacramento, California* at 1-5 (Agency for Toxic Substances and Disease Registry 1994); • Ex. 7 to Bowers Decl., *McClellan Air Force Base Administrative Record 6504* at 2-1 (EPA 2008); • Ex. 8 to Bowers Decl., *McClellan Air Force Base (Groundwater Contamination)* at 2, 3, 7 (U.S. EPA Region 9); • Ex. 9 to Bowers Decl., *Five Year Review; Former McClellan Air Force Base, California*, July 2009, at 3-1 (MWH Americas, Inc.); • Ex. 10 to Bowers Decl., *Proposed Plan for Soil Cleanup, McClellan AFB Parcel C-6* at 3 (EPA October 2008). ***DTSC Response*** **Disputed.** Objection: Witnesses lack personal knowledge. Comparisons between the amount of contaminants at the SSFL and those detected at other sites in California lacks the necessary foundation (*i.e.*, a complete characterization of the SSFL site); see State's. SUF, ¶ 117.

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Uncontroverted Fact	Boeing Evidence, DTSC Response
107. Lawrence Livermore National Laboratory, more than twice the size of SSFL, is 48 miles from San Francisco and is a DOE laboratory used for nuclear weapons and other research. It is contaminated with all of the same contaminants listed in SB 990. Among other things, it has had higher historical concentrations of TCE and tritium than SSFL.	***Boeing's Evidence*** • Malinowski Dep. at [101:11] – [102:12]; • *Id.* at [163:13] – [163:24] (Lawrence Livermore close to major population centers); • *Id.* at [169:7] – [175:16] ("Q. Is the list of contaminants at the Lawrence Livermore National Laboratory similar to the list of contaminants of concern at SSFL?... A. Looking both together?... I would say they're similar, yes."); • *Id.* at [173:5] – [173:16] ("Q. [I]s there anything about [Lawrence Livermore National Laboratory] that would support taking a different approach to the cleanup than at SSFL? … [A.] No."); • *Id.* at [175:12] – [175:16] ("Q. Is it fair to say that the principal contaminants of concern at Lawrence Livermore National Laboratory are found in higher concentrations than the same contaminants found at SSFL? A. For those that I am aware of, yes."); • Bowers Decl. ¶¶32, 39, 48-49, 51-53, 58, 60, 62; • Ex. 4 to Bowers Decl., *Site-Wide Record of Decision Lawrence Livermore National Laboratory Site 300* at pages 1-1, 2-1, 2-2, 2-4, 2-5, 2-6, 2-8, and 2-9, and Tables 2.5-1, 2.5-2, 2.5-3, 2.5-4, and 2.4-1 (DOE July 2008).

Uncontroverted Fact	Boeing Evidence, DTSC Response
	DTSC Response **Disputed.** Objection: Witnesses lack personal knowledge. Comparisons between the amount of contaminants at the SSFL and those detected at other sites in California lacks the necessary foundation (*i.e.*, a complete characterization of the SSFL site); see State's. SUF, ¶ 117.
108. The Pratt & Whitney/UTC site is twice as large as SSFL and located 14 miles south of San Jose. It was formerly used for the manufacture and testing of rocket engines, including the development, manufacturing, and testing of solid propellant rocket motors and propellants. The site has many of the same contaminants as SSFL and has had higher historical concentrations of key contaminants, including TCE and perchlorate.	***Boeing's Evidence*** • Malinowski Dep. at [175:24] – [178:21] ("… Q. Are the principal contaminants of concern that are found at the United Technologies Corporation Pratt & Whitney site higher than the concentrations of the similar contaminants found at SSFL? A. For those that I'm aware of, yes…."); • *Id.* ("Q. Can you think of any reason to apply a different cleanup process or different cleanup rules at the Pratt & Whitney United Technologies site than at SSFL? A. No."); • Bowers Decl. ¶¶ 32, 34, 48, 53, 54, 58, 65; • Ex. 1 to Bowers Decl., *Revised Human Health and Ecological Risk Assessment Work Plan* at 2-1, 4-24 (ARCADIS Aug. 2009); • Ex. 3 to Bowers Decl., *Closure Plan – Former Open Burning Facility* at 1-15 through 1-17 (ARCADIS June 2010);

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Uncontroverted Fact	Boeing Evidence, DTSC Response
	• Ex. 5 to Bowers Decl., Order No. R2-2004-0032 Revision to Final Site Cleanup Requirements; United Technologies Corporation at 2, 9 (California Regional Water Quality Control Board 2004). ***DTSC Response*** **Disputed.** Objection: Witnesses lack personal knowledge foundation. Comparisons between the amount of contaminants at the SSFL and those detected at other sites in California lacks the necessary foundation (*i.e.*, a complete characterization of the SSFL site); see State's. SUF, ¶ 117.
109. SB 990 will result in a substantially more burdensome, time consuming, and expensive cleanup process than that required under generally applicable law, resulting in years of delay in the cleanup schedule, and the unnecessary expenditure of hundreds of millions of additional dollars, which will be allocated between Boeing and the federal	***Boeing's Evidence*** • Whipple Decl. ¶¶22–31; • Lenox Decl. ¶¶34–36; • Bowers Decl. ¶¶71–76; • Rutherford Decl. ¶¶48–51; • Brausch Dep. [201:19] – [205:17]; • Rainey Dep. [38:23] – [39:24]. ***DTSC Response*** **Disputed.** Objection: Defendant objects to Statement of Fact # 109 in that what is "required under generally applicable law" is a conclusion of law. Defendant further objects that the witnesses lack personal knowledge of how much the cleanup will cost, as

Uncontroverted Fact	Boeing Evidence, DTSC Response
government.	the characterization of the site has not been completed. *See* State's. SUF, ¶ 117. Defendant further objects that the expert witnesses cited by Boeing lacked sufficient facts upon which to base their opinion about the cost of the cleanup because the characterization of the site is incomplete.
110. DTSC has made no attempt to determine whether any potential benefit SB 990's cleanup procedures might have on public health and safety would outweigh the significant potential adverse consequences.	• **Not Disputed**
111. SB 990 will require a substantial amount of additional soil to be removed from the site than under generally applicable law.	***Boeing's Evidence*** • Bowers Decl. ¶¶74–75; • Whipple Decl. ¶¶32–34; • Brausch Dep. [286:5] – [286:24]; • Rainey Dep. [91:2] – [91:17]; • *Id.* at [108:15] – [109:13]. ***DTSC Response*** **Disputed.** Objection: Defendant objects to Statement of Fact # 111 in that what is required under "generally applicable law" is a legal conclusion. Defendant further objects that the witnesses lack foundational

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Uncontroverted Fact	Boeing Evidence, DTSC Response
	personal knowledge of how much the cleanup will cost, as the characterization of the site has not been completed. *See* State's SUF, ¶ 117. Defendant further objects that the expert witnesses cited by Boeing lacked sufficient facts upon which to base their opinion about the amount of soil to be removed because the characterization of the site is incomplete.
112. Soil removal on a scale necessary to comply with SB 990 would require numerous additional dump-truck round trips through the community, greatly increasing the risk of traffic deaths and illness from pollution by diesel particulates.	***<u>Boeing's Evidence</u>*** • Whipple Decl. ¶¶32–34; • Bowers Decl. ¶¶77–80; • Brausch Dep. [293:15] – [294:17] ("Q. And am I correct that there is some risk to the public associated with additional trucking of soil from a site away from the site? A. Yes. … Q. … What is the nature of that risk? A. As I understand it, any time you have vehicular activity on a road, you have some measure of risk associated with accident rates and those sorts of risks that come to bear. Q. Also, diesel particulates? A. Sure. You have emissions from vehicles that travel on the roads."); • Rainey Dep. [91:2] – [92:23]; [107:10] – [109:10]. ***<u>DTSC Response</u>*** **Disputed.** <u>Objection:</u> Defendant objects that the witnesses

Uncontroverted Fact	Boeing Evidence, DTSC Response
	lack foundational personal knowledge of how much the cleanup will cost, as the characterization of the site has not been completed. *See* State's SUF, ¶ 117. Defendant further objects that the expert witnesses cited by Boeing lacked sufficient facts upon which to base their opinion about the amount of soil to be removed because the characterization of the site is incomplete.
113. The excavation activities required to comply with SB 990 would destroy considerably more of the existing ecological habitat at SSFL than would otherwise occur.	***Boeing's Evidence*** • Bowers Decl. ¶74, 75. ***DTSC Response*** **Disputed.** Objection: Defendant objects that the witnesses lack foundational personal knowledge to testify about the quantification of ecological habitat that will be affected by SB 990's cleanup standard because it cannot be determined in the absence of a complete site characterization. *See* State's SUF, ¶ 117. Defendant further objects that the expert witnesses cited by Boeing lacked sufficient facts upon which to base their opinion about the amount of habitat that might be destroyed because the characterization of the site is incomplete.
114. The method by which contamination is released into the environment at a	• **Not Disputed**

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Uncontroverted Fact	Boeing Evidence, DTSC Response
particular site has no relevance to the appropriate future land-use assumption or the amount of residual contamination that can safely remain at that site at the end of the cleanup.	

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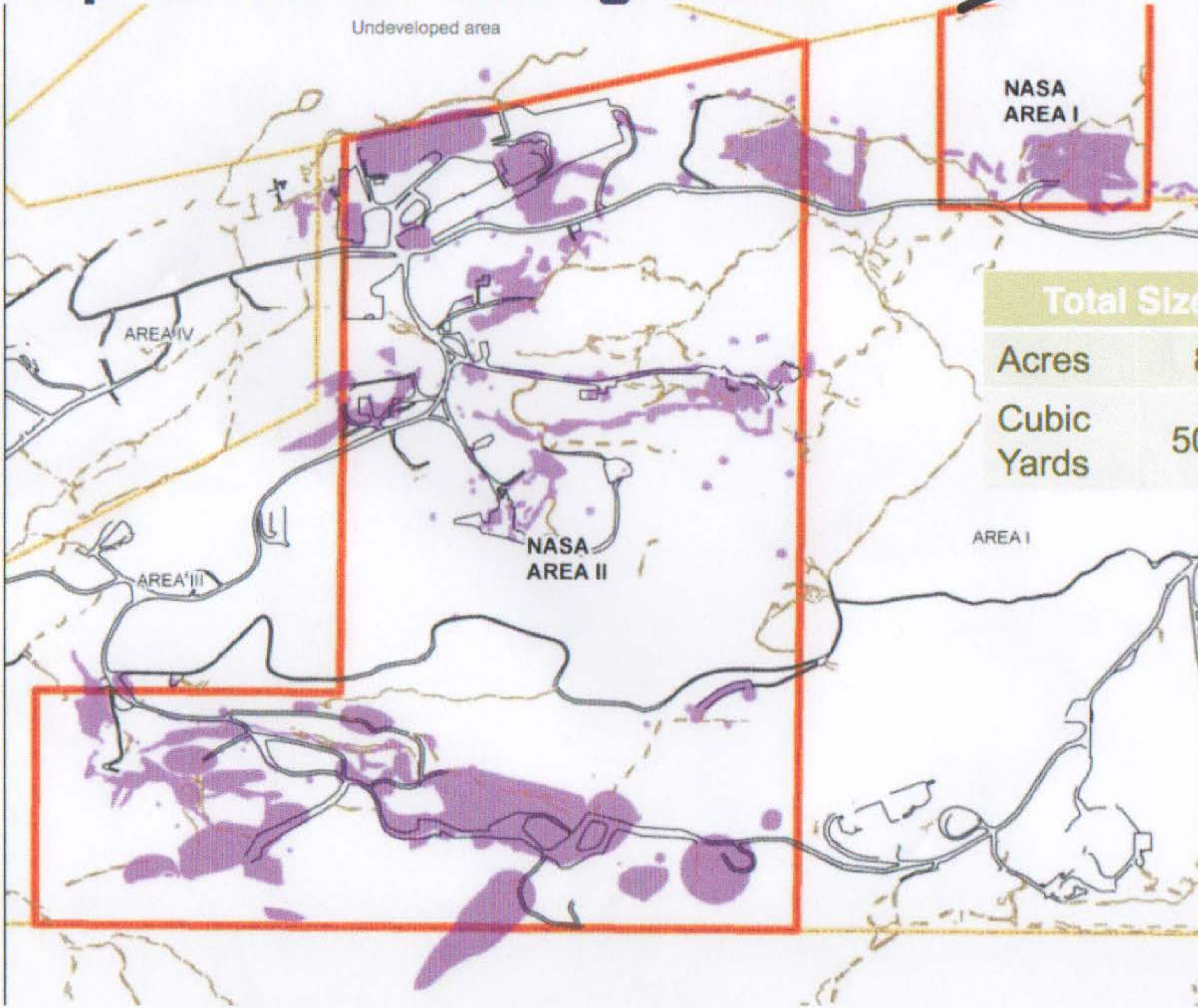
Cleanup Areas for Background

$200 M !



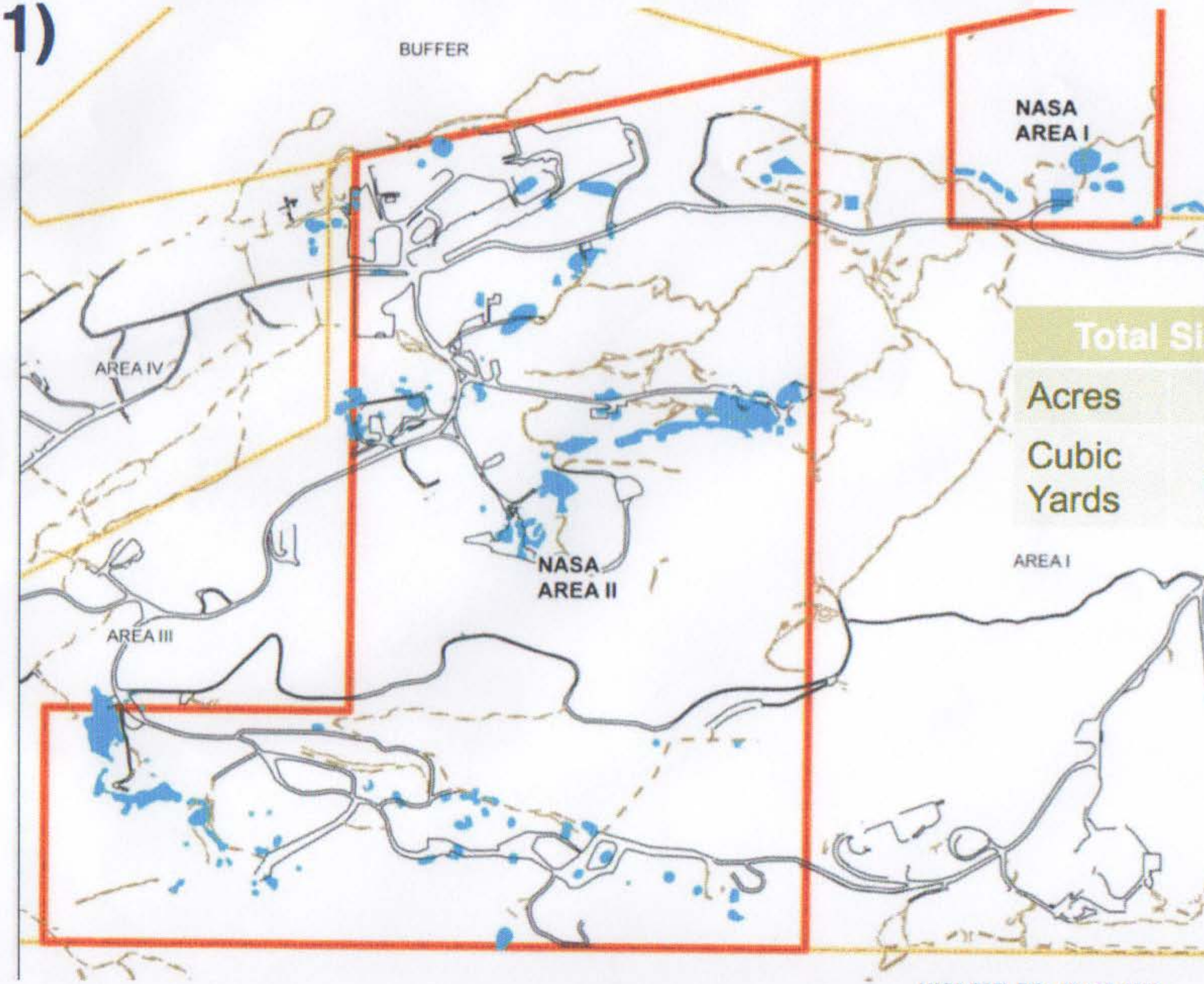
Total Sizes	
Acres	85
Cubic Yards	502K

ATTACHMENT 3

National Aeronautics and Space Administration

$ 80 m

Cleanup Areas for Suburban Residential (Alt 1)



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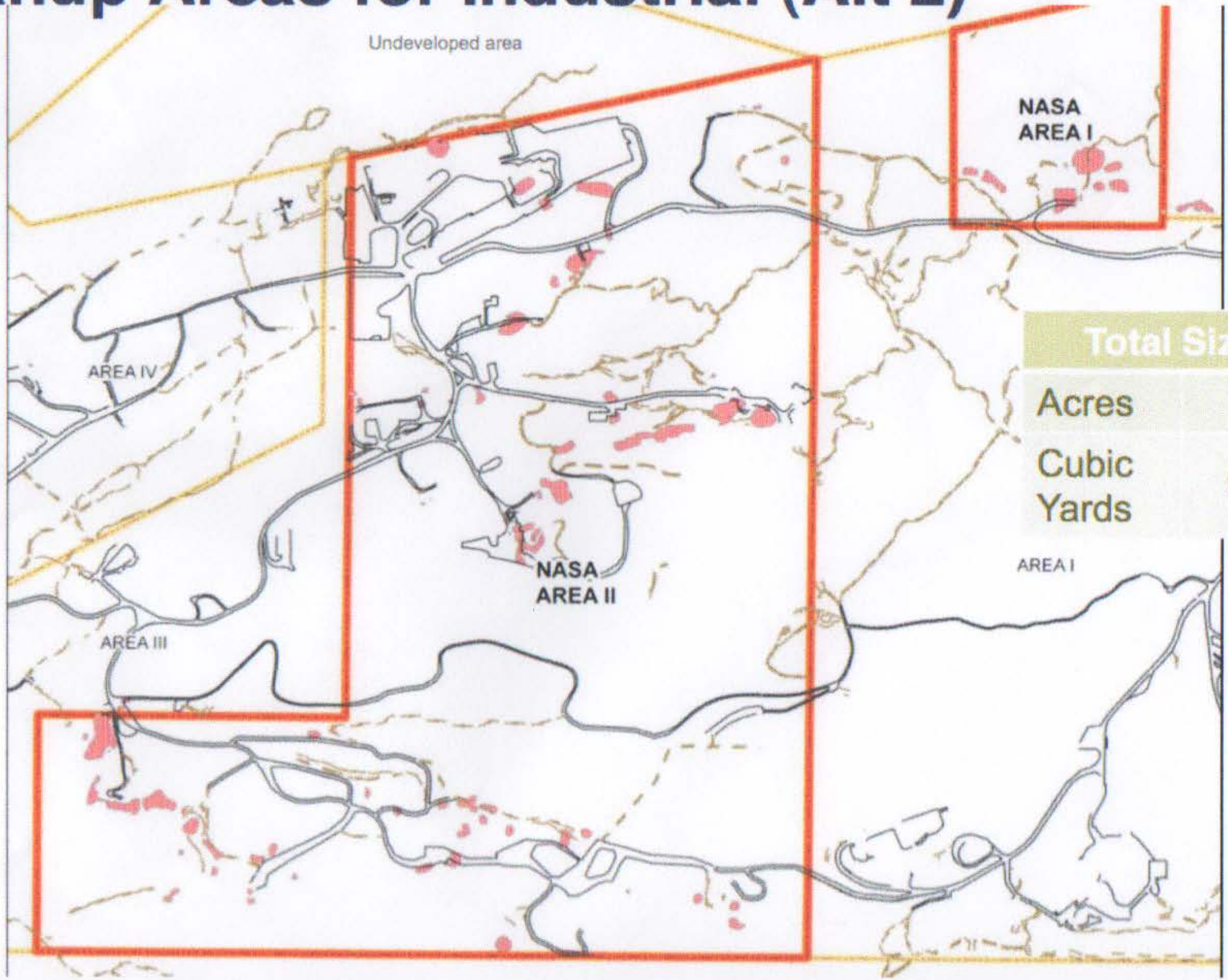
Cubic Yards	182K

ATTACHMENT 3

National Aeronautics and Space Administration

$ 40 m

Cleanup Areas for Industrial (Alt 2)



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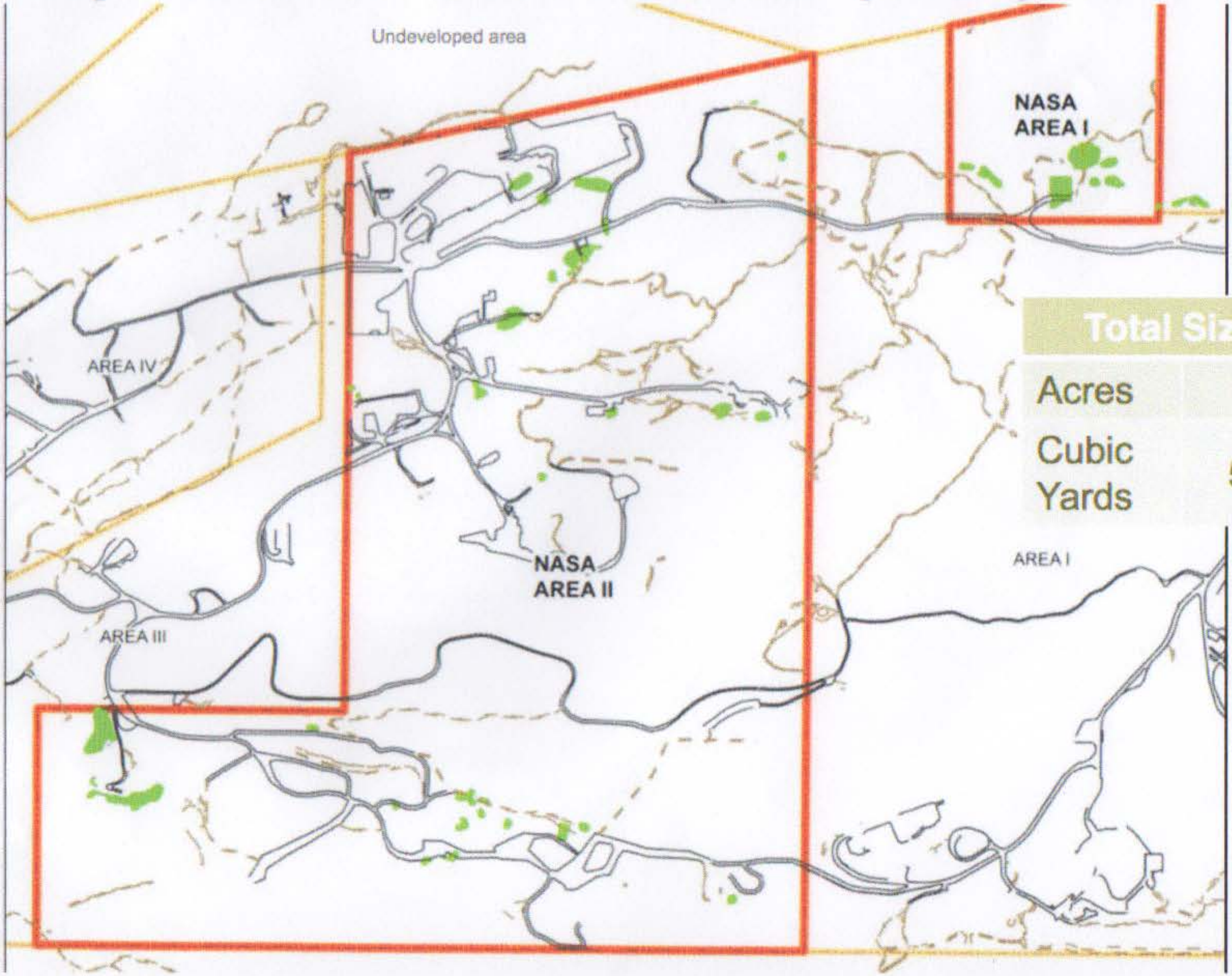
Cubic Yards	92K

ATTACHMENT 3

National Aeronautics and Space Administration

Cleanup Area for Recreational (Alt 3) $25M



Total Sizes	
Acres	6
Cubic Yards	58K

ATTACHMENT 3

cost. For example, the difference in making the site suitable for residential use versus achieving background levels is approximately $133 million. DTSC officials told us they believe NASA's cost estimate for achieving background levels is overstated, but NASA officials insist their estimates are based on the effort that would be required to meet the 2017 deadline and the exposure levels the DTSC previously required in the 2007 Consent Order.

Table 2: Cleanup Levels and Associated Soil Removal and Cost Estimates

Cleanup Level	Estimated Amount of Soil to be Removed (cubic yards)	NASA's Estimated Cost
Background (required under AOC)	502,000	$209 million
Residential	182,000	$76 million
Industrial	92,000	$37 million
Recreational (expected future land use for SSFL)	58,000	$25 million
No Action	Not Applicable	Not Applicable

Source: NASA presentation to the community surrounding the SSFL.

Interests of Outside Parties Played a Significant Role in NASA's Cleanup Decision. Although the NASA Administrator ultimately agreed to the AOC, other NASA officials involved in discussions about the Santa Susana cleanup expressed reservations about the terms of the agreement, with one senior official writing "…be advised that I believe [the AOC] to be inappropriately written and executed and sign it with reservations." According to NASA officials, input from members of Congress and local California leaders as well as advice from the CEQ played a significant role in the Agency's decision to agree to the terms of the AOC and in its subsequent decision to exclude clean-up alternatives other than background levels from further consideration in the NEPA process.

NASA, Boeing, and DOE officials told us that political interest in the SSFL cleanup is rooted in a long history of community distrust about the Federal Government's activities at the site, particularly the nuclear testing and research the Government conducted there in the 1950s. According to DOE officials, a partial meltdown of one of the nuclear reactors at DOE's portion of the site in 1959 has been a longstanding focus of public attention and suspicion from anti-nuclear groups.[26] DTSC officials also cited community distrust as one of the reasons California has taken a particularly aggressive approach to the SSFL cleanup.

As part of the NEPA scoping process, NASA identified five possible alternatives for remediation of the soil at the SSFL site, including cleaning to residential and recreational use standards. However, NASA's inclusion of the full range of possible clean-up alternatives caused concern among DTSC officials and California political leaders. The

[26] In fall 2012, the EPA released preliminary results showing lingering radiological contamination in the DOE-managed portion of the SSFL.

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Table 1 shows the various cleanup or remediation levels possible for a site like the SSFL and the underlying assumptions associated with each level.

Table 1: Definition of Cleanup Level

Cleanup Level	Definition (Assumptions for Establishment of Exposure Limits)
Background	Returns the environment to its natural state prior to the introduction of contaminants.
Residential	Assumes that an adult or child could live on the remediated site 24 hours per day, 350 days per year, for 30+ years without adverse health impacts.
Industrial	Assumes workers could remain on the remediated site for 8 to 10 hours per day, 250 days per year over a 25-year period without adverse health impacts.
Recreational	Assumes that an adult or child could be exposed several hours per day for about 50 days per year over a 30-year period without adverse health impacts.

Source: NASA SSFL Fact Sheet

NASA Signed Consent Orders with State of California Governing Remediation at the SSFL. NASA has been involved in cleanup activities at the SSFL since at least the early 1980s. In August 2007, NASA, Boeing, and DOE signed a Consent Order for Corrective Action with the DTSC under which the Agency committed to clean up groundwater and soil in the portions of the SSFL it administers to "residential" exposure levels. According to the Federal district court that heard Boeing's legal challenge to SB 990, it is undisputed that cleanup to the residential level will fully protect human health and environment. Shortly after this Consent Order was signed, the California legislature enacted California Senate Bill (SB) 990, which imposes a stricter clean-up standard than the Consent Order.

In December 2010, NASA entered into another agreement with DTSC known as the Administrative Order of Consent for Remedial Action (AOC).[16] Under the terms of the AOC, NASA agreed that the 2007 Consent Order would continue to govern its cleanup obligations related to groundwater at Santa Susana (i.e., residential level), but the Agency would be required to clean the soil to the more stringent "background" level. NASA further agreed that soil cleanup at the site would be completed by 2017. According to a press release issued by the California EPA at the time, the AOC "meets the high bar set by Senate Bill 990 which requires the entire SSFL property to be cleaned up to stringent and protective standards, and places the cleanup of both chemical and radioactive contamination under the oversight of DTSC."

[16] Under California state law, an Administrative Order of Consent is an agreement signed by the DTSC and an individual, business, or other entity through which the violator agrees to take the required corrective actions or to refrain from an activity.

ATTACHMENT 3

Wilmer Cutler Pickering Hale and Dorr LLP
350 South Grand Avenue
Los Angeles, California 90071

UNITED STATES DISTRICT COURT
CENTRAL DISTRICT OF CALIFORNIA

THE BOEING COMPANY, Plaintiff, v. LEONARD ROBINSON, in his official capacity as the Acting Director of the California Department of Toxic Substances Control, Defendant.	Case No. CV 10-04839-JFW (MANx) **JUDGMENT PURSUANT TO FED. R. CIV. P. 54(b)**

The Court having granted Plaintiff The Boeing Company's Motion for Summary Judgment based on its determination that there were no genuine issues as to any material fact and that Plaintiff was entitled to judgment as a matter of law on Counts One, Two, and Three of the Amended Complaint, IT IS NOW, THEREFORE, HEREBY ORDERED, ADJUDGED, AND DECREED that judgment is entered in this action as follows:

1. Judgment is entered in favor of Plaintiff The Boeing Company as to Counts One, Two, and Three of the Amended Complaint.

2. California Senate Bill 990 ("SB 990"), codified at Cal. Health & Safety Code § 25359.20, is declared invalid and unconstitutional in its entirety under the Supremacy Clause of the United States Constitution.

ATTACHMENT 4

3. Defendant in his official capacity as Acting Director of the California Department of Toxic Substances Control ("DTSC") and any successors, as well as any officers, agents, servants, employees, or attorneys acting for or on behalf of DTSC, or persons in active concert or participation with any such person or DTSC, are hereby enjoined from enforcing or implementing SB 990.

4. The Court finds that there is no just reason for delay of the entry of final judgment. In light of this finding, final judgment for Plaintiff is entered pursuant to Rule 54(b) as to Counts One, Two, and Three of the Amended Complaint. Counts Four through Nine of the Amended Complaint, which seek the same relief sought in Counts One, Two, and Three, are stayed pending further order of the Court.

The Clerk is ordered to enter this Judgment.

DATED: May 5, 2011

HON. JOHN F. WALTER
UNITED STATES DISTRICT JUDGE

Wilmer Cutler Pickering Hale and Dorr LLP
350 South Grand Avenue
Los Angeles, California 90071

FEBRUARY 14, 2013

AUDIT REPORT

OFFICE OF AUDITS

NASA'S ENVIRONMENTAL REMEDIATION EFFORTS AT THE SANTA SUSANA FIELD LABORATORY

OFFICE OF INSPECTOR GENERAL

National Aeronautics and Space Administration

REPORT NO. IG-13-007 (ASSIGNMENT NO. A-12-011-01)

ATTACHMENT 5

Final report released by:

Paul K. Martin
Inspector General

Acronyms

AOC	Administrative Order of Consent
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
DTSC	California Department of Toxic Substances Control
EIS	Environmental Impact Statement
EMD	Environmental Management Division
EPA	Environmental Protection Agency
FY	Fiscal Year
GSA	General Services Administration
NEPA	National Environmental Policy Act
OIG	Office of Inspector General
RCRA	Resource Conversation and Recovery Act
SB	Senate Bill
SSFL	Santa Susana Field Laboratory
TCE	Trichloroethylene

OVERVIEW

NASA'S ENVIRONMENTAL REMEDIATION EFFORTS AT THE SANTA SUSANA FIELD LABORATORY

The Issue

The Santa Susana Field Laboratory (Santa Susana or SSFL) is located on 2,850 acres in the Simi Hills of Ventura County, California, approximately 30 miles northwest of downtown Los Angeles. First opened in 1948 in what was then a remote area, the facility was for many years the site of research efforts on civilian use of nuclear energy by the Department of Energy (DOE) and rocket testing for defense and space exploration by the United States Air Force (Air Force) and NASA.[1] Over the years, these activities resulted in radiological and chemical contamination of the soil and groundwater at the site.

NASA is responsible for administering 451.2 acres in two areas of the SSFL site, which includes 41.7 acres of Area I and all 409.5 acres of Area II. The Boeing Company (Boeing) owns and operates the remainder of the SSFL, and the DOE leased property in Area IV from Boeing. The Santa Susana site is home to at least 10 species of sensitive plants and at least 5 species of sensitive wildlife, as well as the Burro Flats Painted Cave, which contains pictographs and petroglyphs created by early Native Americans.

For many years, the Santa Susana facility has been the subject of considerable attention from anti-nuclear activists, environmentalists, and the public. From the mid-1950s until the mid-1990s, DOE and its predecessor agencies conducted civilian nuclear research and energy development projects at the SSFL.[2] A partial meltdown at one of the nuclear facilities in 1959 led to a release of radioactive contaminants.

Although radioactive contamination remains a concern in the DOE portion of the SSFL, the primary contaminant in the NASA-administered areas of the site is trichloroethylene (TCE), a nonflammable, colorless liquid identified as a potential carcinogen. NASA and the Air Force used large quantities of TCE to clean rocket engines, and prior to the early 1960s when catch basins were installed, allowed the substance to run freely onto the ground. While the Air Force was a large contributor to the TCE contamination, NASA – as the current administrator of the property – has assumed responsibility for the cleanup.

[1] The area has become much less remote over time. More than 500,000 people currently live in southern Ventura County, California, where the SSFL is located.

[2] DOE's predecessor agency was the Atomic Energy Commission.

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NASA, like all Federal agencies, is required to comply with laws and regulations that govern cleanup of contaminants left behind from Agency activities.[3] Generally, these laws require responsible parties to conduct risk assessments to identify and evaluate the threat that contaminants pose to human health and structure their remediation efforts based on the results of those assessments. One of the principal factors considered in this type of assessment is the reasonably foreseeable use of the affected property, such as agriculture, housing, industry, or recreation. Each scenario assumes future users will be exposed to some amount of residual contamination at the site, with greater assumed exposure requiring a more stringent cleanup standard. The various clean-up levels potentially applicable to a site like the SSFL include background, residential, and recreational.[4]

Boeing has publicly stated that it intends to preserve its portion of the SSFL site – by far the largest section – for use as open space parkland upon completion of cleanup activities. Similarly, NASA officials told us that the anticipated future use of the NASA portion of the SSFL site is for recreation.

NASA has been involved in cleanup activities at the SSFL since at least the early 1980s. In August 2007, NASA, Boeing, and DOE signed consent orders with California's Department of Toxic Substances Control (DTSC) agreeing to clean up groundwater and soil at the SSFL to residential exposure levels. Shortly thereafter, in October 2007, California Senate Bill No. 990 (SB 990) was enacted. SB 990 applies only to the SSFL and requires that the site be restored to either a "suburban residential" or a "rural residential (agricultural)" level, whichever will produce the lower permissible residual concentration for each contaminant. The legislation specifically prohibits the sale, lease, or other transfer of the property unless DTSC certifies that the land has undergone complete remediation.

In November 2009, Boeing filed a Federal lawsuit challenging SB 990 as violating the U.S. Constitution. In April 2011, a judge in the United States District Court for the Central District of California ruled in Boeing's favor and declared the law unconstitutional. The State of California appealed that decision and oral arguments are expected before the U.S. Court of Appeals for the Ninth Circuit in early 2013.

In December 2010, NASA entered into a second agreement with the DTSC known as the Administrative Order of Consent for Remedial Action (AOC). Under the terms of the AOC, NASA agreed that the 2007 consent order would continue to govern its cleanup obligations related to groundwater at Santa Susana, but the Agency would be required to

[3] The three primary environmental laws are the National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321-4347; the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §9601 et seq.; and the Resource Conservation and Recovery Act of 1976, 42 U.S.C. §6901 et seq.

[4] Background level means returning the site to its natural state prior to the introduction of contaminants. Residential level assumes that an adult or child could live on the remediated site 24 hours per day, 350 days per year, for 30+ years. Recreational level assumes that an adult or child could be exposed several hours a day for about 50 days per year over a 30-year period without adverse health effects.

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return the soil to its original state before any testing activities occurred – referred to in the AOC as "background" levels. NASA further agreed that it would complete soil cleanup to this standard by 2017.

To comply with the 2010 Order, NASA budget requests include proposed funding increases of approximately $30 million per year from fiscal years (FYs) 2014 through 2017 (an additional $120 million total for the 4 years). NASA estimates that cleanup costs for Santa Susana to the AOC standard could cost at least $200 million. In contrast, estimates to clean the site to a standard suitable for residential and recreational use are in the range of $76 million and $25 million, respectively. Santa Susana is not the only pending environmental remediation project at NASA. According to Agency environmental management officials, several other projects pose greater risks to human health and the environment than Santa Susana.

The AOC includes a provision for NASA to follow the National Environmental Policy Act (NEPA), which requires the Agency to complete an Environmental Impact Statement (EIS) for its cleanup activities at Santa Susana.[5] As part of this process, NASA initially identified five possible alternatives for remediation of the site, including cleaning to residential and recreational use standards. However, NASA's inclusion of alternatives other than cleanup to background levels caused concern among DTSC officials and California political leaders.

In May 2012, DTSC sent a letter to the NASA Administrator to request that "NASA modify its…process to align itself with…a cleanup of the site to background levels…in compliance with the AOC" rather than evaluate less stringent cleanup alternatives. In addition, Senator Barbara Boxer from California asked the Council on Environmental Quality (CEQ), a White House office that coordinates Federal environmental efforts and works closely with agencies in the development of environmental policies, whether NASA was legally required to consider cleanup options other than background level. After the CEQ advised the Senator that there was no such requirement, NASA limited its EIS process to consideration of only one cleanup standard – background levels.

Given the high cost of the SSFL cleanup and the unusual legal underpinnings of the AOC, we examined whether NASA's plans to clean up environmental contamination at Santa Susana conform with the laws and standards that generally govern such remediation efforts and provide the best value to the taxpayer. Details of the audit's scope and methodology are in Appendix A.

Results

NASA has agreed to clean its portion of the Santa Susana site to a level that exceeds the generally accepted standard necessary to protect human health in light of the expected

[5] An EIS is a detailed evaluation of the Agency's proposed action and possible alternatives. The public, other Federal agencies, and outside parties may provide input into development of an EIS and are afforded an opportunity to comment on the resulting draft EIS.

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future use of the site. Moreover, the cleanup is likely to cost the taxpayers significantly more than the cleanup effort NASA agreed to in its 2007 Consent Order with the State of California – a remediation level itself that was more stringent than what would be required based on the expected use of the site. Although the precise outlines of the cleanup effort and therefore its ultimate cost have not been finalized, NASA estimates that cleaning the SSFL to background levels could cost more than $200 million, or more than twice the cost to clean it to residential levels and more than eight times the cost to clean it to a recreational use standard. In addition, because cleanup to background levels may require highly invasive soil removal, there is a risk that such a cleanup would result in significant damage to the surrounding environment and to archeological, historical, and natural resources at the site.

Management Action

We recommend that the Administrator, with the assistance of the Associate Administrator for Mission Support, reexamine the Agency's current plans for cleaning the NASA-administered portion of the Santa Susana site and ensure that its environmental remediation is conducted in the most cost-effective manner in keeping with the expected future use of the property.

In accordance with our usual practice, we provided NASA with a draft of this report and requested the Agency respond to our recommendation. Typically, the Agency indicates whether it concurs with our recommendation and describes any corrective actions it plans to undertake to meet the intent of the recommendation. However, in this case NASA declined to indicate whether it agreed or disagreed with our recommendation.

Rather, after noting that NASA "fully appreciates" our recommendation, the Associate Administrator stated that the Agency will continue to work with the DTSC and local community stakeholders "within the requirements" of the AOC and at the same time will "make every effort to implement a [cleanup] program that will achieve both cost avoidance and protection of cultural and natural resources." In addition, the Associate Administrator noted several recent developments that may affect how the AOC is interpreted and implemented. (See Appendix F for Management's Response).

Although we are encouraged by NASA's pledge to work toward a cleanup that achieves cost avoidance and preserves cultural and natural resources, it is not clear that the Agency can achieve the most appropriate and cost-effective remediation effort given the constraints of the current AOC. Accordingly, our recommendation remains unresolved and we will continue to monitor the Agency's efforts to clean the Santa Susana site.

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NASA COMMITTED TO AN EXCESSIVE AND UNNECESSARILY COSTLY CLEANUP

NASA has agreed to clean its portion of the Santa Susana site to a level that exceeds the generally accepted standard necessary to protect human health in light of the expected future use of the site. Moreover, the cleanup is likely to cost taxpayers significantly more than the cleanup effort NASA agreed to in its 2007 Consent Order with the State of California – a remediation level that was more stringent than what would be required based on the expected use of the site. Although the precise outlines of the cleanup effort and therefore its ultimate cost have not been finalized, NASA estimates that the cost to clean the soil to background levels could exceed more than $200 million. This is more than twice the cost to clean the site to residential levels and more than eight times the approximately $25 million NASA estimates it would cost to clean the site to a recreational use standard.[25] In addition, because cleanup to background levels may require highly invasive soil removal, there is a greater risk that such a cleanup may result in significant damage to the surrounding environment as well as to archeological, historical, and natural resources at the site.

NASA's Remediation Plan Commits the Agency to a Cleanup Standard Not Based on Risk to Health. Environmental cleanup standards generally are set after measuring the risks to human health in light of the expected future use of the property. While Boeing is cleaning its portion of the SSFL site – by far the largest section – to residential cleanup standards, it has publicly stated that it intends to preserve the site for use as open space parkland upon completion of its cleanup activities. Although final disposition of the NASA-administered portions of the SSFL lies with the GSA, NASA officials said they also expect the Agency's portion will ultimately be used for recreation. According to NASA, DOE, and EPA officials and in light of this expected land use, a normal NEPA process – where the full range of alternatives would be identified and evaluated prior to deciding on the course of action – would likely have led to a decision to clean the area to a less stringent standard than background levels. Although California officials have not yet established the specific criteria necessary for NASA to achieve background levels for the various contaminants at the site, these levels are expected to approximate the natural concentrations that would have been found in the soil prior to any rocket testing activities.

Less Costly Cleanup Alternatives Exist. NASA estimates potential costs of more than $200 million to clean its portion of the SSFL site to background levels to meet the terms of the AOC. This compares to $76 million to make the site appropriate for residential use and $25 million for recreational use. As shown in Table 2, the possible scenarios for NASA's remediation efforts at the SSFL site vary considerably in effort required and in

[25] The estimates above are for the soil cleanup at SSFL based on the 2010 AOC. They do not include the cost of groundwater cleanup, which is still governed by the 2007 agreement.

ATTACHMENT 6

PPG Member Requested Transcript
July 2011 PPG Meeting
Aug. 31, 2011 ***(Bold/Italic emphasis points added)***

Chris Rowe: I just I'm I appreciate that you did make some changes; I just felt that there needed to be some clarification because, um, people were interpreting things, saying that Rick stated that there was no necessity for an EIS; that it was redundant; I'm getting these kind of emails and so I was wondering if there is any way Rick could clarify what he said.

Lewis Michaelson: [to Rick Brausch] You want to do that one now?

Rick Brausch: Yea, I can.

Lewis Michaelson: Ok, good.

Rick Brausch: Honestly, I can't remember exactly what I said. I mean, it was in the stream of a conversation or at least a presentation. Um, what, as I look at the summary, like I said, my recollection was you were talking about the necessity of it in the sense of sequencing, the concern being that the EIS being done before work was, characterization was completed would be a difficult sequencing and a project schedule issue. Um, ultimately, at the end of the day, the EIS and the EIS obligation is on DOE. As a state agency, DTSC does not have an obligation under NEPA. The federal agencies themselves do, and in fact, DOE can speak much more to DOE than this, but they are under court order by a federal judge to perform an EIS and at this point, that is the standing rule. The AOC does mention that there will be work between DOE and the plaintiffs in that case to seek necessary or adequate relief to make sure the AOC's provisions can be carried out. In some sense, that's probably as far as I know what's going on between the plaintiffs and DOE and I invite DOE to maybe make further comment on that but that is, clarification-wise, if I overspoke it, again from DTSC's perspective, we are not subject to or parties – subject to NEPA or parties to the lawsuit.

Barbara Tejada: I think there's some confusion. EIRs and EISs follow a very similar trajectory, and in fact, joint documents can be prepared that covers both of them. There are some slight differences, but it doesn't involve a whole lot of extra work. That work is going to have to be done through the EIR/CEQA process anyway and I think there's a lot of confusion. The AOC does not stand in, so to speak, for the environmental process. Regardless of what the AOC, I think just directs that we will follow CEQA rather than NEPA and the processes are very similar so I don't understand why we're trying to separate them and say 'well, we don't, we shouldn't have to do this because we're going to do that.' They're so similar we could combine them and there's my two cents.

Rick Brausch: ***What they [AOCs] do not do, as we've talked about at least at some length and will talk about more as this process unfolds, these do not bypass obligations to DTSC under CEQA. Similarly, they do not bypass obligations for DOE and NASA under NEPA. Those laws ultimately still govern and pertain. Endangered Species Act still pertains. Historic preservation requirements still pertain. A laundry list of other existing laws and requirements that aren't listed here still apply to this.*** What it means to this is within the parameters and constructs of those laws as they exist, we have to navigate to accomplish this particular goal that we've negotiated with DOE and NASA. Again, they integrate the Agreements in Principle, the cleanup to background levels as it's been laid out in the agreements does talk about some very specific parameters that are allowances, and in fact, things that which we heard loud and clear through the public comment process which we felt it was necessary and important for us to integrate. We recognize that in order for us to minimize some of the impacts of that soil transportation down the mountain side that I think has been put out there as being of particular concern. On-site treatment, in-place treatment, has got to be an option that we fully assess and understand but it also has to be allowed under this and that is accommodated under the agreement. However, contaminated soils won't be allowed to be left. So what we're talking here is if there are ways in which you can treat it on in place or on site to accomplish the same goal that is something that we need to look at and integrate into the plan.

Teena Takata: Rick, it always sounds good when you talk about it, but when we look at documents or comment on documents, we don't always get the same kind of response.

Lewis Michaelson: Teena, can you clarify what you mean by response?

Teena Takata: You commented that the AOCs are binding and enforceable, [Rick Brausch: Mm hmm] and then you talk about protection for formally recognized archeological sites artifacts and several community members as well as an archeologist commented on that when we had the opportunity to do public comments, and basically, we were flipped off in that process.

Lewis Michaelson: Could you be more specific when you say 'flipped off' because I don't know what that means.

Teena Takata: We commented on the AOCs that it was a meaningless definition; that it did not recognize did not specify the world heritage site on the site that is the Burrow Flats Caves and it does not did not address various different types of artifacts that the archeologist on site are finding on a daily basis, [Lewis Michaelson: Ok] and um, there's basically cuz none of those are recognized artifacts, which is the limit of the definition in the AOC [Rick Brausch: It's the limits to the definition in the exception is explicitly spelled out exception.]. Correct.

Rick Brausch: ***What was explained, the attempt to explain, was that the AOC does not supersede any other state or federal law that provides a protection so just because it isn't explicitly stated as an exception, does not mean that it doesn't have other elements that govern and will reflect and ensure that it's protected.***

Lewis Michaelson: So would you look at that in CEQA? Is that one of the things you would examine?

Rick Brausch: That is one of the features. Definitely we're looking at all archeological, cultural, historic and other, you know, environmental resources that we need to be aware of. The idea is to have the archeological assessments done.

Teena Takata: And based on my background as a businessperson, because I'm a CPA in my day job and I specialize in tax so I sit and I read tax law all the time and I read contracts all the time. The AOCs are contracts, and in general, I don't see in the world where in the business world where contracts are drafted that don't acknowledge the impacts of other things and don't provide as part of the language in the contract the possibility that they may change due to those other impacts. And here, the AOC document actually is in conflict with those things in several areas.

Rick Brausch: Well, actually, we can probably go into this further, but there are provisions in the AOC which talk specifically about the effect of other laws and requirements on the AOC and in fact, was meant to be the additional capture of anything not explicitly stated in the AOC. Again, we this was in going through this with our attorneys, we wanted to make sure we didn't bypass any of those necessary and required protections that we are obligated to follow.

Lewis Michaelson: So, Teena, if I may, I think what's important here is that that's been heard, that's been expressed, and rather than prejudging what that impact will be, the whole purpose of this marathon is as these studies are done, as the cleanup plan is developed, as the exceptions are made, your job as stakeholder who care about different resources is to stay in touch watch and see but all I can say at this point, Rick is saying that he feels confident that these things will not be overlooked because they were not explicitly named and it will be up to you as a stakeholder to watchdog that, right?

Teena Takata: I am watching. I think part of the frustration from the sideline is there is we were just comparing the CEQA timeline and it's kind of the one thing on this thing that's changed from the prior meeting. It's moved up a year so we won't see the effects of CEQA until um, until immediately before the soil cleanup is implemented.

Rick Brausch: Well, forgive the graphic. I mean, ultimately, the graphic is intended to show the evolution of the CEQA process. I can't say that the solid line is any reference point in the process other than that it's when you're going to see a lot more substance to CEQA than some of the earlier stages.

Lewis Michaelson: I also assume there's a Draft EIR before there's a Final EIR?

Rick Brausch: Again, we're envisioning a lot of the scoping and other sorts of individual assessment activities that will become elements to the full-on EIR to be developed in that timeframe. So, again, forgive the imperfections of the graphics that, again, I'm a scientist and not a graphic artist. We do our best, but again, ***the idea is to demonstrate that CEQA is going to be engaged and we're focusing on we're hoping to start that process late this year as we start the scoping.*** We're going to start and sit down with you guys and envision what it is that all needs to take place.

Lewis Michaelson: [To Rick] So you expect to do a full analysis of the potential impacts of cleanup on historic resources, correct?

Rick Brausch: Yea, as well as archeological, as well as endangered species and any other feature that CEQA requires.

Teena Takata: As well as plain old dirt? As well as oak trees? As well as the whole environment? [Rick Brausch: Yes] Many of us have walked in what has been referred to as the moonscape between the SSFL and Sage Ranch and the waterway and have been very distressed that basically, you know, it's been gutted and it really doesn't look like the remediation is very significant; it just got carved out. So, um, we're looking forward to seeing something happen that's a lot better when we [Rick Brausch: I'm not sure of any CEQA that was done on that one].

Chris Rowe: There was and it was a waiver. I've had my card up a long time.

Lewis Michaelson: Well, Chris. You're in the order. I'm calling on people in the order in which they…Teena, are you done?

Teena Takata: Yes.

Statement of
The Southern California Federation of Scientists
at DTSC Scoping Hearing for the
Draft Programmatic Environmental Impact Report
for the Santa Susana Field Laboratory
December 10, 2013

My name is Brian Lindquist and I am appearing here today on behalf of the Southern California Federation of Scientists (SCFS). SCFS was organized in the early 1950s as the Los Angeles Chapter of the Federation of American Scientists, founded by former Manhattan Project scientists concerned about the nuclear threat. SCFS is an interdisciplinary organization of scientists, engineers, technicians, and scholars dedicated to providing independent scientific and technical analyses and expertise on issues affecting science, society, and public policy. SCFS has been involved in matters related to SSFL since 1979, when it provided technical assistance related to disclosures of the partial nuclear meltdown that occurred in 1959 at SSFL. For over thirty years, SCFS has been involved in providing technical assistance to the communities near the site on matters related to cleanup of the SSFL chemical and radioactive contamination from decades of rocket and reactor testing. An SCFS representative has served for approximately two decades as a community representative on the SSFL Inter-Agency Work Group overseeing the cleanup of the site and on the SSFL Advisory Panel that oversees health studies of the affected workers and neighboring communities.

SSFL is heavily contaminated from decades of reactor and rocket testing, sloppy practices, improper waste disposal, spills and releases. At least four of the nuclear reactors suffered accidents. The SNAP-8ER and SNAP-8DR reactors experienced substantial fuel damage. The AE-6 released fission gases. And in 1959, the SRE suffered a partial meltdown, with one third of its fuel experiencing melting. Radiation levels went off-scale. None of the reactors had a containment structure to prevent radiation release. In the case of the SRE partial meltdown, radioactivity was intentionally pumped out of the reactor vessel and vented into the environment for weeks.

Other accidents and releases contributed to widespread radioactive chemical contamination. There were several fires involving radioactive materials at the "Hot Lab," where high level radioactive waste—irradiated nuclear fuel—was decladded. And for many years the facility burned radioactive and chemical wastes in open burn pits, resulting in airborne release of contaminants and contamination of air, soil, groundwater and surface water.

The other operational areas of the site were no more environmentally prudent. Tens of thousands of rocket tests resulted in widespread chemical contamination involving volatile organic compounds (VOCs) such as TCE, as well as semi-volatiles, perchlorate, heavy metals, PCBs, and dioxins and furans, to name just a few. Again, contamination of soil, groundwater, surface water, and other environmental media resulted from the environmentally damaging practices.

Critically for the scoping of the EIR being considered today, this pollution has not remained solely on site. Much has been migrating to offsite areas, where it poses a risk to the neighboring communities. Failure to clean up SSFL fully, as promised in the Administrative Orders on Consent (AOC) and as required by longstanding federal and state law, would result in continuing risk to the health of neighboring communities.

Perchlorate, a component of solid rocket fuels that disrupts human development and which contaminates much of SSFL, has been found to have migrated offsite and contaminates roughly a third of wells in Simi Valley monitored for it. Half a million gallons of TCE, a carcinogen, were dumped directly onto the ground and now contaminate groundwater; TCE has also migrated offsite. Annual monitoring reports for surface water contamination show rain carrying off toxic materials offsite, at levels exceeding health-based benchmarks and other limits, hundreds of times in recent years.

A study by the UCLA School of Public Health found elevated cancer death rates among both the nuclear workers and the rocket workers from exposures to these toxic materials. Another study by UCLA found that the rocket testing had led to offsite exposures to hazardous chemicals by the neighboring population at levels exceeding EPA standards. A study performed for the federal Agency for Toxic Substances and Disease Registry found elevated cancer rates in the offsite population associated with proximity to SSFL.

It is therefore with heavy heart that the Southern California Federation of Scientists testifies here today about the necessary scope of the Programmatic EIR for cleanup of SSFL. It appears to us, as longtime participants in efforts to get this polluted site fully cleaned up, as it appears to so many others, that something has gone seriously wrong at DTSC under the current management. Until the present Director took office, DTSC was acting diligently to carry out the legally binding Administrative Orders on Consent (AOCs) for the cleanup of the DOE and NASA portions of the site, and to rigorously enforce longstanding law for full cleanup of the remaining Boeing portions. Since then, however, she has removed the SSFL Project Director and replaced him with personnel far more amenable to relieving the Responsible Parties of their cleanup obligations, and undertaken a whole range of other actions to undermine the AOCs and past requirements for full cleanup by Boeing as well.

This scoping session is but the latest example. The AOCs require the cleanup of Area IV and the Northern Buffer Zone, Area II and NASA's portion of Area I, to background—in other words, to remediate all contamination that can be detected, restoring the polluted land to its state before it was polluted. They require that any environmental review be limited to HOW to carry out the cleanup to background required by the AOC, not WHETHER to comply.

However, rather than specifying in the scoping notice that the project is, for the DOE and NASA parts of SSFL, cleanup to background as required by the AOCs, and that the alternatives that will be examined are alternative ways to carry out that required project, DTSC has issued a notice saying that the EIR will be on cleanup alternatives. Not a word can be found in the notice acknowledging the AOCs and DTSC's legal obligation to carry them out.

When NASA a year or two ago tried to pull the same shenanigans at its EIS scoping hearings, there was an outcry from the community and elected officials—and from DTSC. The DTSC Director sent a couple of very strong letters to NASA saying that to perform an environmental review dealing with cleanup alternatives that would violate the AOC would in itself violate the AOC. The DTSC Director sent out an email to the community about the uproar and said she would fly back to Washington, D.C. to get NASA back into compliance with the AOC. And indeed, NASA had to back down.

Now DTSC is doing precisely the same thing it correctly accused NASA of doing—violating the AOCs by trying to create an EIR on cleanup alternatives that would breach the AOC. Verbal assurances of commitment to the legally binding AOCs notwithstanding, DTSC's conduct creates the clear appearance of capture by Boeing and actions that undermine the cleanup requirements for this site.

We recognize that the AOCs apply to the above-identified portions of SSFL, and that the remaining portions controlled by Boeing are handled separately. But there also DTSC through this scoping notice appears intent on breaking the law and allowing Boeing to walk away from most of its cleanup obligations. Under longstanding state and federal law—and we are not here talking about SB990, currently under appeal, but the general laws that govern toxic cleanups—DTSC must assure cleanup to potential future land use, which is to be based largely on current zoning. The site is zoned agricultural, sometimes referred to as rural residential. Scoping an EIR to violate that law as well would violate CEQA and DTSC's obligations. Yet that seems to be what DTSC is pressing to do, at Boeing's direction.

Boeing and its surrogates—and some of them no doubt are here today—have been pushing for far less protective cleanup standards that would leave the great majority of the contaminated soil uncleaned up, with continued migration of pollutants to the nearby communities. For example, were Boeing's proposed supposed suburban residential standards to be employed for the radioactive contamination (levels by the way that are approximately 150), NONE of the 500 locations where EPA has identified radioactive contamination at SSFL would be cleaned up. NONE. That is what they are pushing for, and what DTSC seems to be enabling as an agent of Boeing.

For the NASA property, NASA itself admits that if the open space standard were used instead of the AOC requirements, 90% of the contaminated soil would not be cleaned up. 90%.

Thus violating the AOCs, as pushed by Boeing and its surrogates, would leave the great majority of the contamination available for continued migration offsite. It must be made clear that even if one were to declare SSFL permanently uninhabitable into eternity and restrict access to open space uses like day hikes, that does no good whatsoever to the people nearby. One is not going to declare their neighborhoods uninhabitable, force them from their homes, and make their communities into open space. The issue is the protection of the offsite population, and leaving the contamination at the source not cleaned up by the fiction of saying the land might some day become a park would only place the residents who live offsite at perpetual increased risk of cancer and health effects.

SCFS's recommendations, thus, are:

1. Comply with the law. Cease acting as a captured regulatory agency, captured by the polluters you are supposed to be regulating. Fully protect public health. Carry out the AOCs completely for the NASA and DOE parts of the property, and as to Boeing's remaining parts, follow existing law and past DTSC policy by requiring cleanup to current zoning, which is agricultural/rural residential. Play no games with input assumptions to cleanup levels, as pushed by Boeing; clean up the non-AOC Boeing parts to the agricultural/residential default Preliminary Remediation Goals.
2. The project description must thus be:
   a. For the DOE and NASA parts of the property, cleanup to background as required by the AOCs.
   b. For the Boeing remainder, cleanup to the agricultural/rural residential standard as required by longstanding law, regulation, and past DTSC decisions about this property.
3. Alternatives in the EIR must be limited to alternative ways to carry out the above legally binding requirements. Environmental impacts and mitigations must be limited to the alternatives that comply with the AOCs for the NASA and DOE portions and to the current zoning-based cleanup for the Boeing remainder.
4. The hype about truck traffic, used by Boeing and its allies to try to block the cleanup, needs to be dealt with honestly. Even NASA's exaggerated own numbers show only about 3 trucks per hour; if dispersed over the three routes it had identified, only one an hour. The EIR should identify how many vehicular trips to and from the site have already occurred, during the decades of intense operation. Alternatives of natural gas-powered trucks, electric trucks, alternative routes, and dispersing the trucks over the different routes to reduce impacts to any one route should be examined. Staggering the NASA, DOE, and Boeing cleanups should be considered, even if that means a bit of slippage for one or more of them for the current deadline, so that trucks from all 3 cleanups are not travelling during the same period. Additionally, use of rail should be honestly assessed, including improving fire roads out of SSFL that can be taken to rail spurs with little or no passage by residences. Rail is generally much cheaper, with less energy usage and greenhouse gas production. But at the end of the day, the risk to the community of not cleaning up this toxic mess far exceeds the nuisance of a few trucks an hour.
5. The hype about "moonscaping" the property, also disingenuously used by Boeing and its allies to frustrate the cleanup, needs to be dealt with honestly as well. Based on NASA's EIS, even with its exaggerated numbers, only about 2% of SSFL would be cleaned up in areas of native vegetation, almost all of that manzanita. Only about 0.6% of SSFL would involve cleanup of what Fish & Wildlife described as priority habitat, specified as two types of scrub brush. And the AOCs have exceptions for endangered and threatened species, and a separate exception for unanticipated circumstances, so in fact extremely little if any undisturbed land would be cleaned up. The contamination occurred primarily in areas which were heavily disturbed in the first place to build reactors, rocket test stands, and the like.
6. Provide extensive, detailed description of the contamination the poor practices by NASA, DOE, and Boeing and its predecessors have created over decades. Identify in detail what the site characterization has found as to what contaminants are found, in what

concentrations, in what areas, in each environmental medium. Give us solid details about the groundwater contamination. Tell us about each violation or exceedance of surface water discharges leaving the site with contaminants about benchmarks. Detail which dioxins have been found, in what concentrations, in what soil, and to what depth; and the same for all the other toxic materials found.

Not cleaning up the toxic contamination would result in perpetual releases of contaminants from the site, whenever the wind blows, carrying resuspended toxic material to the communities nearby; whenever the rain falls, surface runoff will continue to carry hazardous material offsite at levels that are deemed unsafe.

DTSC signed with DOE and NASA legally binding Administrative Orders on Consent, committing to cleanup its contamination to background. It promised to require cleanup of the remaining Boeing portion to the agricultural/rural residential standard established in local land use zoning. DTSC should fully live up to its commitments. DOE, NASA and Boeing and their predecessors contaminated this site in the middle of these communities, and DTSC and its predecessors, through weak enforcement, allowed the contamination to occur. DTSC promised to require full clean it up; it must meet its promises, completely, and without equivocation.

Thank you.

Mariah Mills

From: Malinowski, Mark@DTSC
Sent: Tuesday, February 11, 2014 1:01 PM
To: DTSC_SSFL_CEQA
Cc: Perez, Marina@DTSC
Subject: FW: SSFL CAG Consensus Comments to PEIR NOP.
Attachments: CAG CONSENSUS DTSC SSFL PEIR NOP Comments 10Feb14.pdf

From: Brian Sujata [mailto:brian.sujata@gmail.com]
Sent: Tuesday, February 11, 2014 11:57 AM
To: Perez, Marina@DTSC
Cc: Malinowski, Mark@DTSC; Alec Uzemeck; Christian Kiillkkaa Kiillkkaa; hays.linda@att.net
Subject: SSFL CAG Consensus Comments to PEIR NOP.

Marina,

I have been asked to remove Christian Kiillkkaa's name from the subject document. Also, Lynda Hayes has asked to have her name added to the same document.

This document represents the consensus of fifteen CAG members. I would like it to accurately represent the membership who agree with its content.

The attached revised document has been edited to remove one name and add another. No other changes have been made.

On behalf of the SSFL CAG I request the comments I submitted yesterday morning be replaced with the attached document.

I apologize for any inconvenience this matter has caused.

Best regards,

Brian Sujata
Co-Chair, Technical Committee

February 10, 2014

Mark Malinowski
Project Manager
Department of Toxic Substances Control
California Environmental Protection Agency
8800 Cal Center Drive
Sacramento, CA, 95826

Subject: Santa Susana Field Laboratory Community Advisory Group Comments to the Notice of Preparation, Program Environmental Impact Report, Santa Susana Field Laboratory Site, Ventura County, California.

Mr. Malinowski,

The comments presented here represent the consensus of opinions shared by the undersigned Santa Susana Field Laboratory Community Advisory Group members. We have collaborated on its writing and negotiated our comments across the diversity of our viewpoints. We acknowledge that strong individual opinions exist within our well-informed group and that some members may have specific comments regarding the PEIR which they will share with you on an individual basis.

We appreciate the opportunity to provide comments to the Notice of Preparation, Program Environmental Impact Report (PEIR) which will provide an exhaustive consideration of project alternatives and support critical decision-making towards the completion of the environmental restoration of the SSFL.

The comprehensive CEQA evaluation of the SSFL cleanup arrives some twenty-five years after the U.S. EPA completed their CERCLA Preliminary Assessment/Site Investigation of the site.[1] Since 1989, the site has been subject to extensive and continuous environmental investigation: monitoring of the surface water discharge from the site, the installation of roughly 350 shallow and deep wells to study the nature and movement of the underlying site groundwater, the impacts to soil from the historical operations intensively have been studied within 135 areas of interest and a comprehensive characterization of radioactive material releases within a 290 acre portion of the 2,850 acre site. The SSFL been exhaustively investigated over the past two and a half decades.

---

[1] U .S . EPA. 1989. Summary review of preliminary assessment/site inspections of Rockwell International, Santa Susana Field Laboratory. Ecology and Environment, Inc., contractor to U.S. EPA.

The Department of Toxic Substances Control signed agreements with the two Federal departments involved with the site requiring impacted soils to be cleaned to background. A number of neighbors and community environmental advocates objected to the cleanup plan recently tendered by one agency; similar objections are likely when the other government agency reveals its plans in the near future. As of this writing, the cleanup plan for SSFL entails an arbitrary and capricious cleanup standard applied to roughly one quarter of the site, with a different risk-based cleanup process for the balance of SSFL, including all of the impacted groundwater.

To our knowledge, the DTSC-advocated cleanup requirement being applied at SSFL has not yet been implemented at any location to the extent proposed. We are disappointed with the current mandate, especially since DTSC staff have stated under oath that "there is no technical, scientific, or environmental basis to single out SSFL for more onerous cleanup procedures than apply to other cleanup sites in California.[2]" Santa Susana is a site having a great wealth of biological and cultural features, a diverse parkland for future generations much of which will be needlessly sacrificed if the current cleanup plan is allowed to proceed.

The PEIR has the ability to iron out the disparities between the various cleanup standards and processes at SSFL since DTSC will contemplate the "secondary effects, cumulative impacts, broad alternatives, and other factors that apply to the program as a whole."[3] The following comments are respectfully submitted in the interest of contributing to the success of the Programmatic Environmental Impact Report for the SSFL:

- The DTSC must maintain a science-based decision making approach, sensitive to cultural issues and reject political influence and non-technical input.
- The PEIR should begin with a programmatic analysis of the corrective measure objectives including cumulative impacts as a core document which is then appended to incorporate the analysis of later CEQA projects as the program progresses towards completion. Regardless of the chosen implementation method, the PEIS must provide for the incremental review of documents to maximize stakeholder involvement.
- The environmental restoration activities undertaken should be consistent with the designated future land use of the SSFL site.
- The SSFL must have one site-wide cleanup policy for the surficial media rather than a arbitrary cleanup standard for part of the site and a risk-based cleanup standard for the remainder.

[2] U. S. District Court Central District of California, Case CV-10-04839-JFW (MANx), Plaintiff the Boeing Company's Statement of Uncontroverted Facts and Conclusions of Law, p. 36-37 http://www.dtscssfl.com/files/lib_boeinglawsuit%5Clegaldocs/64849_Boeing_statement_uncontroverted_facts.pdf, retrieved 8 January 2014.
[3] See 14 CCR 15168(d)(2).

- The activities undertaken to support the characterization and environmental restoration of SSFL must be similar to that conducted at other sites within California.
- The DTSC must analyze and present the risks and benefits of a practical range of cleanup limits to the public.
- Please communicate with the public to the degree above and beyond that required by law.
- Consider the mitigation of negative project outcomes by performing the cleanup of SSFL consistent with future land use.
- Any culturally sensitive site which is deemed necessary to destroy must be subject to investigation and study by qualified persons before disturbing the site in order to elucidate the prehistoric context of the site and to determine its significance.
- The PEIR should consider the novel approach of relaxing the cleanup standard in discrete locations to protect high-priority cultural and/or biologically sensitive areas and apply an alternative involving minimal mitigation when considered in light of the extensive site characterization and future use of the property.
- The individual mature trees identified for removal to facilitate the cleanup should be identified within the EIR documents.
- Support the on-site treatment of impacted soil if the process can be shown not to have negative consequences on the environment.
- The various risks to all exposed resulting from remedial actions involving the removal of soils from SSFL should be communicated. Further, clean fill materials must be identified prior to any soil removal actions begin.
- Determine and explain the risks of the proposed actions involving soil removal by communicating the incremental risks (both off-site and that remaining on-site) resulting from the differing cleanup standards applied to similar cleanup sites in California.
- Include the assessment of negative impacts to off-site landfill disposal facilities, the need for new or expanded landfill capacity and the environmental justice impacts to the surrounding communities.
- Include the assessment of negative impacts to the on- or off-site borrow pit supplying replacement soil to the Santa Susana Field Laboratory remedial action areas.
- Air pollution and dust dispersion effects on the local population and those living near the transportation routes must be determined and clearly communicated to the community.
- Spent gun cartridges originating from historic (i.e., over 50 years ago) movie making activities are found within SSFL. These artifacts represent a culturally valuable link to the past that must be identified and preserved as a resource.
- The scope of the SSFL PEIR should include the regulatory closure (and possibly the post-closure) of the Radioactive Materials Handling Facility (RMHF) and the demolition of former

radiological buildings, if required by CEQA. The removal of the remaining radioactive materials from within the RMHF must be a program priority.

- The Department of Toxic Substances Control should expedite the regulatory closure of the RMHF and the demolition of the remaining non-useful buildings in Area IV.

Thank you for the opportunity to provide our comments to you. We look forward to working with you and your staff to craft a cleanup plan for the Santa Susana Field Laboratory site that does more good than harm.

Sincerely,

Ross Berman, Thousand Oaks
Richard Brandlin, Arcadia
Sam Cohen, Solvang
Diane Dixon-Davis, Chatsworth
Sharon Ford, North Hollywood
Poly Georgilas, Bell Canyon
Lynda Hayes, Saugus
Mike Kuhn, Simi Valley
John Luker, Chatsworth
Brian Sujata, Thousand Oaks
Barry Seybert, West Hills
Alec Uzemeck, Simi Valley
Kathy Weiner, Simi Valley
Abe Weitzberg, Woodland Hills
Ronald Ziman, Bell Canyon

ABOUT THE SSFL CAG: The SSFL Community Advisory Group (CAG) was formed in 2013 by the California Department of Toxic Substances Control in accordance with California law. The CAG provides a public forum for stakeholders to discuss issues and concerns relating to the environmental investigation and restoration of the former rocket engine and nuclear-development facility. Its volunteer members represent a cross-section of interested and affected neighbors from the surrounding communities.

February 10, 2014

Mark Malinowski
Project Manager
Department of Toxic Substances Control
California Environmental Protection Agency
8800 Cal Center Drive
Sacramento, CA, 95826

Subject: Comments to the Notice of Preparation, Program Environmental Impact Report, Santa Susana Field Laboratory Site, Ventura County, California.

Mr. Malinowski,

Thank you for the opportunity to provide comments regarding the Notice of Preparation for the Santa Susana Field Laboratory Program Environmental Impact Statement. My comments presented here augment those submitted under my name as a member of the SSFL Community Advisory Group.

I request the PEIR scope include the entire CEQA review for the remaining environmental restoration activities at Santa Susana. The PEIR framework must include the remediation of the entire site, both soils and groundwater, demolition of the remaining non-DOE owned buildings (if required) and the regulatory closure (and possible post closure) of the RCRA-permitted Radioactive Materials Handling Facility (RMHF). The PEIR has the possibility to serve the community and the project well by deploying a hub and spoke organization with overarching programmatic issues at the center followed by the individual project analysis. This approach provides an organized and logical procession that will encourage the public's understanding and participation. I ask that you choose and implement such as system.

The Department of Toxic Substances Control has the opportunity to identify priorities leading to the completion of the environmental restoration effort. Common to the goal of project completion is the reduction of risk, both in terms of risk to schedule and risk to human health and the environment. The RMHF poses the most significant risk to a timely and safe completion of the SSFL site restoration. But first the RMHF must have an approved closure plan, which requires a CEQA review.

The remaining radioactive materials at the RMHF are contained in difficult to reach locations which will typically require building demolition to access and removal. The razing of RMHF will pose significant challenges since the operation will take place within a region characterized to a site-specific background for radionuclides. Any fugitive release of radioactive materials from the RMHF foot print will result in a demonstrable smear with impacts to cost, schedule and perhaps even initiate litigation. An additional concern is that the footprint of the RMHF represents the largest (non-outcrop) area excluded from the EPA survey, yet it lies in an area known to be impacted with radioactive materials. The soils underneath the asphalted yard may also be impacted which will have negative consequences to the project cost and schedule. If there is bad news coming, I would prefer to get it as soon as possible. Don't you?

For the reasons discussed above, the DTSC must work with the Department of Energy to advance the regulatory closure of the RMHF. A systematic review of the remaining program scope would be helpful in the appraisal of risks and benefits to be balanced with the schedule demands. An honest program review often results in the unintended consequence of realizing opportunities and improvements.

The extent of environmental restoration challenges at SSFL are matched only by the beauty of the site. Please take the extra effort to leave your accomplishments for the delight (and not disappointment) of future generations.

Best regards,

Brian Sujata

Brian Sujata
Thousand Oaks, California

February 10, 2014

Mark Malinowski
Project Manager
Department of Toxic Substances Control
California Environmental Protection Agency
8800 Cal Center Drive
Sacramento, CA, 95826

Subject: Santa Susana Field Laboratory Community Advisory Group Comments to the Notice of Preparation, Program Environmental Impact Report, Santa Susana Field Laboratory Site, Ventura County, California.

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Sincerely,

Ross Berman, Thousand Oaks
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Diane Dixon-Davis, Chatsworth
Sharon Ford, North Hollywood
Poly Georgilas, Bell Canyon
Christian Kiillkkaa, West Hills
Mike Kuhn, Simi Valley
John Luker, Chatsworth
Brian Sujata, Thousand Oaks
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Alec Uzemeck, Simi Valley
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State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
South Coast Region
3883 Ruffin Road
San Diego, CA 92123
(858) 467-4201
www.wildlife.ca.gov

EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

January 9, 2014

Mr. Mark Malinowski, Project Manager
Department of Toxic Substance Control
8800 Cal Center Drive
Sacramento, CA 95826
DTSC_SSFL_CEQA@dtsc.ca.gov

Subject: Notice of Preparation for a Draft Program Environmental Impact Report, Santa Susana Field Laboratory Site, Ventura County, California

Dear Mr. Malinowski,

The Department of Fish and Wildlife (Department) has reviewed the Notice of Preparation for the above-referenced Draft Program Environmental Impact Report (DPEIR) for contaminated soil and groundwater remediation projects at the Santa Susana Field Laboratory site.

The following comments have been prepared pursuant to the Department's authority as trustee agency with jurisdiction over natural resources affected by the project (California Environmental Quality Act, [CEQA] Guidelines §15386) and pursuant to our authority as a Responsible Agency under CEQA Guidelines Section 15381 regarding those aspects of the proposed project that come under the purview of the California Endangered Species Act (Fish and Game Code §2050 et seq.); Native Plant Protection Act (Fish and Game Code Section 1900 et seq.); and Fish and Game Code Section 1600 et seq. The Department also provides these comments as state trustee agency with jurisdiction over the conservation, protection and management of fish, wildlife, native plants and habitat necessary for biologically viable populations of those species (Fish and Game Code §1802; Fish and Game Code § 711.7(a)).

Project Description

The proposed project (Project) includes actions to remediate soil and groundwater contamination associated with past activities at the now-closed Santa Susana Field Laboratory (SSFL) and adjoining areas. Department of Toxic Substance Control (DTSC) is the lead state regulatory agency; responsible parties for various portions of the Project area include The Boeing Company (Boeing), Department of Energy (DOE) and the National Aeronautics and Space Administration (NASA).

The proposed project would involve the development of Corrective Measures Study (CMS) work plans to be submitted by Boeing and comparable Soils Remedial Action Implementation Plans to be submitted by DOE and NASA for each of their respective areas at the SSFL site. Anticipated remediation approaches for groundwater would be further defined by the Groundwater Remedial Investigation and CMS, being conducted by Boeing, DOE and NASA. The program EIR would establish a framework for "tiered" or project-level environmental documents to be prepared to address further development and refinement of remediation approaches and actions.

Site Description

The SSFL covers approximately 2,850 acres and is located on the top of the Simi Hills, south of Simi Valley and west of Chatsworth. The project area occupies hilly terrain with extensive sandstone rock outcrops and intervening localized valleys. Ephemeral and intermittent drainages carry runoff to adjacent downslope areas- the area is the headwaters of Bell and Dayton Creeks. The project vicinity supports essential habitat for the state-listed rare plant, Santa Susana tarplant (*Deinandra minthornii*), a perennial sub-shrub and local endemic typically found on sandstone outcrops and soils derived from sandstone; and occupied and/or federally-designated Critical Habitat for the endangered Braunton's milkvetch (*Astragalus brauntonii*). General habitats in the project area include chaparral, coastal scrub, oak woodland/forest, riparian, seeps/springs and rock outcrop habitat types and features. A variety of sensitive wildlife species have been previously documented in or near the project area and utilize various on site and neighboring habitats. Crevices, ledges, and cavities associated with the sandstone outcrops are unique physical habitat features exploited by both sensitive and non-sensitive wildlife species. Two California Fully Protected Species (ringtail, *Bassariscus astutus*; white-tailed kite, *Elanus leucurus*) were previously observed on site.

Comments and recommendations

Remediation activities under the proposed project have the potential to adversely affect on-site and off-site biological resources and could include removing contaminated soil and transporting it off site, importing backfill from off site, collecting and treating groundwater in the soil and rock by installing systems of wells and pipes, dewatering seeps and springs, installing and maintaining infrastructure, and related ground- and habitat-disturbing activities.

To enable the Department to adequately review and comment on the proposed project, we recommend the following information be included in the PDEIR:

1. A complete, recent assessment of flora and fauna within and adjacent to the project area, with particular emphasis upon identifying endangered, threatened, rare and/or locally unique species and sensitive habitats including:

   a. A thorough, recent floristic-based assessment of special status plants and natural communities, following the Department's Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities (see http://www.dfg.ca.gov/habcon/plant/). The Department recommends that California Natural Diversity Data Base (CNDDB) Field Survey Forms be completed and submitted to the CNDDB to document survey results.

      The Department recommends that floristic, alliance- and/or association-based mapping and vegetation impact assessments be conducted at the Project site and neighboring vicinity. The vegetation classification for the Santa Monica Mountains National Recreation Area and environs overlaps with the project area and should be used to assist in identifying the vegetation setting and habitat conditions within the SSFL vicinity, as appropriate (Keeler-Wolf and Evens, 2006). The Manual of California Vegetation, second edition, should also be used to inform this mapping and assessment (Sawyer et al. 2008). Adjoining habitat areas should be included in this assessment where site activities could lead to direct or indirect impacts offsite. Habitat mapping at the alliance level will help establish baseline vegetation conditions and is necessary to develop habitat restoration goals and targets for areas subject to disturbance and remediation impacts.

b. A complete, recent assessment of sensitive fish, wildlife, reptile, amphibian and invertebrate species. Seasonal variations in use within the project area should also be addressed. Recent, focused, species-specific surveys, conducted at the appropriate time of year and time of day when the sensitive species are active or otherwise identifiable, are required. The Department recommends that California Natural Diversity Data Base (CNDDB) Field Survey Forms be completed and submitted to the CNDDB to document survey results.

c. Rare, threatened and/or endangered species should include all those species which meet the related definition under the CEQA Guidelines (See Cal. Code Regs., tit. 14, § 15380).

The PDEIR should address locally rare plant and animal species that have been identified in Ventura County and are currently listed as Locally Important Species. These lists have been developed in consultation with local experts and represent local and regionally rare species that are not represented on state-wide or national lists. Species on these lists are considered to generally meet the definition of rare, threatened or endangered, as defined in the California Environmental Quality Act (CEQA) Section 15380. The lists are updated annually through a documented process of consulting with local and regional experts. The current lists can be found at this link: http://www.ventura.org/rma/planning/conservation/locally-important-species.html

d. The Department's Biogeographic Data Branch in Sacramento should be contacted at (916) 322-2493 (www.dfg.ca.gov/biogeodata) to obtain current information on any previously reported sensitive species The Department also recommends that biological survey data and observations from previous assessments at the SSFL be included as background information for current assessment purposes.

e. The Department generally considers biological field assessments for wildlife to be valid for a one-year period and assessments for rare plants may be considered valid for a period of up to three years. Some aspects of the proposed project suggest that remediation activities could occur across of a variety of timeframes, so periodic survey updates may be warranted for certain sensitive taxa.

2. A thorough discussion of direct, indirect, and cumulative impacts expected to adversely affect biological resources, with specific measures to offset such impacts. This discussion should focus on maximizing avoidance, and minimizing impacts.

   a. CEQA Guidelines Section 15125(a) direct that knowledge of the regional setting is critical to an assessment of environmental impacts and that special emphasis should be placed on resources that are rare or unique to the region.

   b. A cumulative effects analysis should be developed as described under CEQA Guidelines, Section 15130. General and specific plans, as well as past, present, and anticipated future projects, should be analyzed relative to their impacts on similar plant communities and wildlife habitats.

c. Impacts to native birds potentially affected by the proposed project should be fully evaluated including proposals to remove/disturb existing structures, native habitats and ornamental landscaping and other nesting habitat. Impact evaluation may also include such elements as migratory butterfly roost sites and neo-tropical bird and waterfowl stop-over and staging sites. All migratory nongame native bird species are protected by international treaty under the Federal Migratory Bird Treaty Act (MBTA) of 1918 (50 C.F.R. § 10.13). Sections 3503, 3503.5 and 3513 of the California Fish and Game Code prohibit take of birds and their active nests, including raptors and other migratory nongame birds as listed under the MBTA. The Department can provide additional guidelines for development of effective construction-related bird nesting and breeding avoidance measures.

d. Active Breeding and/or Nest. If the nesting season cannot be avoided and construction or vegetation removal occurs between March 1st to September 15th (January 1st to July 31st for Raptors), the Permittee will do one of the following to avoid and minimize impacts to nesting birds[1];

1) Implement a 300 foot minimum avoidance buffers for all passerine birds and 500 foot minimum avoidance buffer for all raptors species. The breeding habitat/nest site shall be fenced and/or flagged in all directions. The nest site area shall not be disturbed until the nest becomes inactive, the young have fledged, the young are no longer being fed by the parents, the young have left the area, and the young will no longer be impacted by the project.[2]

2) Develop a project-specific Nesting Bird Protection Plan (Plan). The Plan should be submitted to the Department and the lead agency for review. The Plan should include detailed methodologies and definitions to enable a qualified Department-approved avian biologist to monitor and implement nest-specific buffers based upon the life history of the individual species; species' sensitivity to noise, vibration, and general disturbance; individual bird behavior; current site condition (screening topography, vegetation, etc.), and anticipated project-related construction and staging activities. This Nesting Bird Protection Plan should be supported by a Nest Log for tracking each nest and the survivorship of nestlings and fledglings. The Nest Log should be submitted to the Lead Agency and the Department at the end of each week.

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[1] Qualified avian biologist shall establish the necessary buffers to avoid take of nest as defined in FGC 3503 and 3503.5.

[2] NOTE: Buffer area may be increased if any endangered, threatened, or CDFW species of special concern are identified during protocol or pre-construction presence/absence surveys.

3) The Project Proponent may propose an alternative plan for avoidance of nesting birds for Department and lead agency's review.

4) The project area has potential to support a wintering population of burrowing owl (*Athene cunicularia*), a California Species of Special Concern and migratory bird species. Burrowing owl may utilize rodent burrows, or on-site crevice and ledge-type habitats in rock outcrops. The Department recommends the project area be evaluated for wintering owls prior to ground disturbing activities. Winter use should be evaluated annually to ensure birds are detected and protected from project activities during roosting or breeding. The Department recommends the project area be evaluated by a Department-approved biologist to determine the suitability of habitat areas for burrowing owl, consistent with the Department's science-based recommendations in Appendix C (see DFG, 2012). Further coordination with the Department is recommended based upon the results of this assessment.

e. Impacts from project activities that will result in disturbances to habitat that may provide maternity roosts for bats (e.g., rock outcrops and cavities, tree cavities, under loose bark, buildings), should occur outside of the bat breeding season which generally runs from March 1-August 31. Bats are considered non-game mammals and are afforded protection by state law from take and/or harassment, (Fish and Game Code § 4150, California Code of Regulations, § 251.1). Several bat species are also considered special status species and meet the CEQA definition of rare, threatened or endangered species (CEQA Guidelines §15065). The Department has specific recommendations we can provide for avoiding direct impacts to bats during the removal of structures and trees. Should maternity or bat roost sites be located in the project area, consultation with the Department is recommended to determine appropriate methods for avoidance and habitat replacement.

f. The project area and vicinity has potential to support western spadefoot (*Scaphiopus hammondii*), a California Species of Special Concern. Known occupied habitat areas in/near seasonal wetlands are present approximately ½ mile west of the project area (CDFW files). The Department recommends that a habitat assessment be conducted to locate suitable potential habitat in and near the project area. Due to proximity to known breeding pools, suitable potential habitat in the project area should be protected from project-related impacts, including any local watershed areas that contribute to sustaining the seasonal wetland feature(s). Western spadefoot adults also occupy burrows or other subterranean aestivation sites outside breeding wetlands, and travel between such locations. Dewatering activities associated with ground water remediation could adversely affect aestivating western spadefoot by reducing soil moisture and humidity in subterranean areas.

3. A range of alternatives should be analyzed to ensure that alternatives to the proposed project are fully considered and evaluated. Alternatives which avoid or otherwise minimize impacts to biological resources, should be included. Groundwater treatment technologies should be evaluated relative to their potential for impacts to sensitive biological resources, native vegetation, rock outcrop structural features and associated habitats; technologies with fewer species and habitat impacts should be selected where feasible.

a. Mitigation measures for project impacts to sensitive plants, animals, and habitats should emphasize avoiding or otherwise minimizing direct and indirect project impacts.

b. The Department recommends the proposed project develop species-specific protection and mitigation plans for key sensitive biological resources.

   1. Ringtail/Outcrop Features- The Department can not authorize the take of any fully protected species as defined by state law. (See Fish & G. Code, §§ 3511, 4700, 5050, 5515.) The Department advises the lead agency and project proponent that take of any species designated as fully protected under the Fish and Game Code is prohibited. The Department recognizes that certain fully protected species are documented to occur within the vicinity of the project or that such species have some potential to occur on or in the vicinity of the project due to the presence of suitable habitat. These fully protected species include the ringtail cat (*Bassariscus astutus*). In order to avoid take of ringtail, the Department recommends a knowledgeable biologist locate and map all potential ringtail suitable caves and crevices in outcrop areas. This assessment should include searches for reptile hibernacula, bat roosting and colony sites; bird nesting areas and dens utilized by San Diego desert woodrat (*Neotoma lepida intermedia*), a California Species of Special Concern. Once these areas are located, appropriate buffers should be established in consultation with the Department in order to prevent the location(s) from being adversely affected by human activity or damaged by groundwater borings, wells, and excavations.

   2. Santa Susana tarplant- The Department recommends that sufficient information be provided in the PDEIR to enable us to evaluate project impacts to this sandstone endemic and its native insect pollinators. Population estimates should be made and occupied habitat should be mapped in sufficient detail to allow an evaluation of the proposed project's direct and indirect impacts. We recommend that areas of high quality habitat for Santa Susana tarplant be identified and protected from project-related impacts. To ensure that tarplants are identified and avoided during project activities to the maximum extent feasible, a dedicated biological monitor approved by the Department should be on site to establish avoidance areas and track impacts.

      A Santa Susana tarplant restoration plan should be prepared for Department review and approval- this plan should detail how tarplant habitat adversely affected by the project would be restored to conditions suitable for tarplant and other appropriate on-site native species. Enhancement of existing Santa Susana tarplant habitat in locations outside remediation areas through effective weed management could be considered as additional mitigation to address habitat loss and project impacts.

   3. Braunton's milkvetch- The Department is particularly concerned about the potential for the proposed project to impact the federally endangered Braunton's milkvetch. Known populations and potentially suitable habitat areas with soils capable of supporting seed bank are known to occur in the project area. Disturbance of the dormant seed bank supporting an undetected population of Braunton's milkvetch in Area IV in 2010 resulted in adverse impacts to Braunton's milkvetch where plants emerged from dormant seed stimulated by artificial vegetation clearing, and then were subsequently severely herbivorized by on-site mule deer. A specific conservation strategy for Braunton's milkvetch should be developed in consultation

with the Department to ensure this endangered species is not impacted by project activities.

4. Malibu baccharis- This imperiled shrub (state ranked S1 very threatened) occurs in very low numbers at a handful of sites in the Santa Monica Mountains/Simi Hills area. It was not identified on site in Area IV during previous project-related surveys but numerous individuals were subsequently observed to have been cut down for gamma testing in 2010.

   The Department requests that focused surveys be conducted to ensure that all Malibu baccharis are detected. An effective conservation strategy should be developed, in consultation with the Department, to protect this local endemic in the project area. We also recommend a comprehensive seed collection be undertaken for restoration purposes.

c. The proposed project is likely to result in temporary, long term and/or potentially permanent adverse impacts to natural vegetation, physical habitat features and local native soils in areas subject to soil and groundwater remediation. Where impacts cannot be avoided, restoration of the treated area following remediation is necessary to re-establish habitats, protect watersheds and maintain site hydrology.

   The Department recommends that local on-site propagules from the SSFL project area and nearby vicinity be collected and used for restoration purposes. On-site seed collection should be initiated in the near future in order to accumulate sufficient propagule material for subsequent use in future years. On-site vegetation mapping at the alliance and/or association level should be used to develop appropriate restoration goals and local plant palettes. Reference areas should be identified to help guide restoration efforts. Specific restoration plans should be developed for various project components as appropriate. Restoration objectives should include protecting special habitat elements or recreating them in areas affected by the project; examples could include retention of woody material, logs, snags, rocks, and brush piles (see Mayer and Laundenslayer, 1988 for a more detailed discussion of special habitat elements).

d. The proposed project has potential to introduce new weeds to the SSFL site from off-site locations and for on-site weeds in ruderal locations to expand into areas disturbed by soil and groundwater remediation. Should topsoil or backfill be imported from off site, weed seeds and non-local plant propagules could be present in the material. On-site weeds in ruderal areas will pose an ongoing threat to efforts to revegetate nearby disturbed areas, and could reduce re-establishment of shrub and tree-dominated communities, exacerbating long term erosion. Equipment and personnel are also potential sources of weed contamination, and could move weeds within the project area during work activities.

   The Department recommends that protocols be developed to address weed invasion, establishment and spread in the project area. On-site biological monitors should inspect equipment and personnel to ensure compliance with protocols. The California Invasive Plant Council has useful protocols for addressing weed invasion for land managers (http://www.cal-ipc.org/ip/prevention/landmanagers.php.

Additional weed control in habitats outside remediation areas could serve to further offset impacts by enhancing onsite native habitat conditions.

e. The Department generally does not support the use of relocation, salvage, and/or transplantation as mitigation for impacts to rare, threatened, or endangered plant species. Department studies have shown that these efforts are experimental in nature and largely unsuccessful.

f. The proposed project is anticipated to result in clearing of natural habitats that support many species of indigenous wildlife. To avoid direct mortality, the Department recommends that qualified biological monitors approved by the Department be on site prior to and during ground and habitat disturbing activities to move out of harm's way special status species or other wildlife of low mobility that would be injured or killed by grubbing and remediation activities. It should be noted that the relocation of on-site wildlife does not constitute effective mitigation for the purposes of offsetting project impacts stemming from habitat loss.

g. The proposed project has the potential to introduce or increase a variety of hazardous features which could trap, displace or lead to death of wildlife. Examples of features problematic for on-site wildlife include, but are not limited to the following: open vertical and horizontal pipes; open trenches and exposed excavation areas; pipe networks; Best Management Practices to control erosion using gabions or non-biodegradable meshes; night lighting; stockpiled vegetation and soils; tarping; trash, garbage and open containers; vents on sheds and buildings; and oil leaks from heavy equipment. These aspects of the proposed project should be evaluated to reduce or eliminate risks to wildlife. The Department can provide additional recommendations to reduce these types of hazards.

h. The proposed project has the potential to introduce drilling muds (bentonite) where wells are drilled for groundwater remediation activities. Drilling muds can be hazardous to wildlife and lethal to aquatic life if the mud reaches stream channels. The PDEIR should address the use of drilling muds and include measures to ensure this material is confined to sites of use, removed when complete and not otherwise placed in locations where it could wash into stream channels.

i. The project area supports significant biological resources and is located adjacent to a regional wildlife movement corridor. The project area contains habitat connections and supports movement across the broader landscape, sustaining both transitory and permanent wildlife populations. On-site features which contribute to habitat connectivity should be evaluated and maintained. Aspects of the project could create physical barriers to wildlife movement from direct or indirect project-related activities. Indirect impacts from lighting, noise, dust and increased human activity may displace wildlife in the general area.

j. The proposed project would potentially increase traffic on local roads leading to and from the SSFL site. Local vehicle access routes traverse a local and regional wildlife movement corridor and also go through local open space areas and natural preserves. The proposed project therefore has potential to substantially increase wildlife roadkill associated with truck and construction traffic on local roads. Roadkill could be reduced by- a) including enforced time restrictions that limit construction personnel and truck travel to full daylight hours only, thereby avoiding dawn and dusk when movement activity is high; and b) limiting speeds to 25 mph or less.

4. Take (including possession) of any endangered, threatened, or candidate species that results from the project is prohibited, except as authorized by state law (Fish and Game Code, §§ 2080, 2085.). Consequently, if the Project, project construction, or any project-related activity during the life of the project will result in take of a species designated as endangered or threatened, or a candidate for listing under the CESA, the Department recommends that the project proponent seek appropriate take authorization under CESA prior to implementing the project. Appropriate authorization from the Department may include an incidental take permit (ITP) or a consistency determination in certain circumstances, among other options (Fish and Game Code §§ 2080.1, 2081, subds. (b),(c)). Early consultation is encouraged, as significant modification to a project and mitigation measures may be required in order to obtain a CESA Permit. Revisions to the Fish and Game Code, effective January 1998, may require that the Department issue a separate CEQA document for the issuance of an ITP unless the project CEQA document addresses all project impacts to CESA-listed species and specifies a mitigation monitoring and reporting program that will meet the requirements of an ITP. For these reasons, biological mitigation monitoring and reporting proposals should be of sufficient detail and resolution to satisfy the requirements for a CESA ITP.

5. The project vicinity supports aquatic, riparian, and wetland values (including springs and seeps). The area is known to support ephemeral and intermittent stream channels which carry runoff and sediment to downstream and off site habitats. Some stream channel areas and wetlands are likely to be adversely affected by soil and groundwater remediation activities; associated alterations in hydrology and sedimentation processes could directly or indirectly adversely affect additional habitat areas, including off site and/or downstream. Project-related changes in drainage patterns, runoff, and sedimentation should be evaluated in the PDEIR.

   A jurisdictional delineation of streams and wetlands should be conducted for the purposes of identifying state-defined wetlands. Wetlands in the state of California are addressed in various Fish and Game Commission policies, and the state definition of wetlands relies upon the United States Fish and Wildlife Service wetland definition and classification system (Cowardin, et al. 1979). All wetlands and watercourses, whether seasonal, intermittent, ephemeral, or perennial, should be retained and provided with substantial setbacks which preserve the riparian and aquatic habitat functions and values while maintaining their ability to support wildlife populations. In the project vicinity, herbaceous vegetation, woody vegetation and woodlands also serve to protect the integrity of ephemeral channels and help maintain natural sedimentation processes; therefore, the Department recommends effective setbacks be established to protect riparian habitat and vegetated buffer areas adjoining drainages. In areas where avoidance of stream channels is infeasible, the Department recommends restoration of remediated areas.

   a. The Department has regulatory authority with regard to activities occurring in streams or lakes that could adversely affect any fish or wildlife resource. For any activity that will divert or obstruct the natural flow, or change the bed, channel, or bank (which may include associated riparian resources) or a river or stream or use material from a streambed, the project applicant (or "entity") must provide written notification to the Department pursuant to Section 1602 of the Fish and Game Code. Based on this notification and other information, the Department then determines whether a Lake and Streambed Alteration (LSA) Agreement is required. The Department's issuance of an LSA Agreement is a project subject to CEQA. To facilitate issuance of a LSA Agreement, if necessary, the environmental document should fully identify the potential impacts to the lake, stream or riparian resources and provide adequate avoidance, mitigation, monitoring and reporting commitments for issuance of the LSA Agreement. Early consultation is recommended, since modification of the proposed project may be required to avoid or reduce impacts to fish and wildlife resources. Again, the failure to include this analysis in the project's environmental impact report could preclude the Department from relying on the Lead Agency's analysis to issue a LSA Agreement without the Department first conducting its own analysis, as Lead Agency for subsequent or supplemental analysis for the project.

b. The Department recommends the project proponent consider entering into a master streambed agreement which would provide an overall programmatic approach to streambed impacts and mitigation. A master agreement under Fish and Game Code Section 1605 may be appropriate given the programmatic nature of the proposed project and the likelihood that further refinements in remediation approaches and actions are anticipated.

Thank you for this opportunity to provide comments. Please contact Ms. Mary Meyer, Senior Environmental Scientist (Specialist) at (805) 640-8019 or Mary.Meyer @wildlife.ca.gov, if you should have any questions and for further coordination on the proposed project.

Sincerely,

Edmund Pert
Regional Manager
South Coast Region

ec: Ms. Betty Courtney, Santa Clarita
Ms. Mary Meyer, Ojai
Mr. Ali Aghili, Los Alamitos
Mr. Jeff Humble, Ventura
Mr. Dan Blankenship, Santa Clarita
State Clearinghouse, Sacramento

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10 February 2014

Mark Malinowski
Project Manager, Department of Toxic Substances Control
8800 Cal Center Drive, Sacramento, CA 95826
DTSC_SSFL_CEQA@dtsc.ca.gov

Comments of **Christian Kiillkkaa** on the:

NOTICE of preparation for a
DRAFT PROGRAM ENVIRONMENTAL IMPACT REPORT
SANTA SUSANA FIELD LABORATORY SITE,
VENTURA COUNTY, CALIFORNIA (*dated November 2013*)

Dear Mark,
Thank you for the opportunity to comment on the DTSC PEIR Scoping for the SSFL site remediation, mitigation, and restoration project.

The PEIR needs to investigate and supply much still-missing data, alternatives/options, decision making criteria, remediation and restoration specifications, and information from site wide to discrete-site specific scales, to direct and support an environmentally responsible cleanup.

Submitting this at the close of the period, I will focus on several issues not seen elsewhere, regarding the native habitat and flora, and minimizing site disturbance while sufficiently remediating contaminants for the health of all living things.

1. The PEIR needs to include comprehensive site wide surveys of plant communities/habitats, individual mature oaks (*Quercus* spp.), Sycamores (*Platanus racemesa)*, Willows (*Salix* spp.), and other trees, large woody shrubs, and other native flora species present. Currently the RPs each have differently formatted biota/habitat data, that do not integrate across the artifical boundaries of the four areas and two buffer zones.

2. The PEIR needs protection protocols to be developed to prevent and minimize damage to existing native flora, from dormant bunch grasses through landmark oaks, and the habitat ecologies they are within.
3. Therefore, the PEIR needs to determine locations and necessary

capacities of staging areas, preferably where non-native flora species dominate in formerly disturbed areas. These are for equipment and supplies storage and in transit staging, personnel doing the cleanup work, to minimize native species damage and destruction.
The PEIR needs to determine locations of on-site (non-*in situ*) remediation projects, following the same siting criteria.

3. The PEIR needs non-native flora species to be surveyed, seasonal 'more invasive' periods identified, control/elimination protocols for designated invasive species developed, and maintenance requirements determined beyond mitigation. The designated invasive species will be opportunistic first colonizers in the cleanup's disturbed soils, retarding native species, and needing implementable maintenance specifications.

4. The PEIR needs to minimize the destruction of habitats and existing soil profiles, through in-situ remediation and achievable health standards applicable site wide for all three RPs, and doable for DOE/NASA via careful AOC modifications using health/risk based standards.

5. The PEIR needs to discourage and minimize use of the cavalier "destroy and restore" paradigm. The destroyed complex ecological systems of the site will not be easily or actually restored with hydromulch, planted cuttings, and a limited term maintenance contract. That only creates a naturalistic and tenuous landscape installation.

6. Therefore the PEIR needs to address that the loss of indigenous topsoil, microbes and fungi, roots, ephemeral annuals through dominant woody plants, insects, amphibians, and ground dwelling, avian, and all other fauna are an ecological interdependent system that cannot be restored after the destruction of currently planned DOE, NASA, and Boeing 'dig and haul' strip-mining, or from massive on site non-*in situ* technologies. At best an incremental and difficult restoration process can be begun, with a long term commitment and funding.

7. Therefore the PEIR needs to emphasize that the nurturing of destroyed

and healing of injured habitats is an intensive long term stewardship and/or funding commitment by the RPs. It has a timeline and success rate more similar to deep groundwater remediation than 2017 completion certificates.
Just as surgically penetrating the skin is done reticently in healing modalities, so disturbing the soil surface and its biota should be a reluctant last option.

8. Other areas of sincere concern to me have already been well addressed in PEIR Scoping Commentaries submitted to DTSC by Christina Walsh/Cleanuprocketdyne, and by the Santa Susana Mountain Park Association/SSMPA. The entirety of their submittals has an excellent accuracy regarding topics I also need included in the scoping phase.
I only ask that when they are addressed (*at those submittals, not here*), that it be in a manner comprehendible beyond those authors, to the non-specialist public, such as myself.

Again, thank you for this opportunity to contribute.

Sincerely, Christian Kiillkkaa
christiankiillkkaa@gmail.com

for identification only:

California Native Plant Society--CNPS
Los Angeles / Santa Monica Mountains Chapter board member

SSFL CAG
Communications Committee Chair, charter member

Dale Till

From: Christina Walsh <cwalsh@cleanuprocketdyne.org>
Sent: Sunday, January 05, 2014 7:59 PM
To: Leclerc, Ray@DTSC; Malinowski, Mark@DTSC; Raphael, Debbie@DTSC; DTSC_SSFL_CEQA; Carpenter, Paul@DTSC; King, Buck@DTSC; Seckington, Tom@DTSC; tom.skough@dtsc.ca.gov; Rainey, Laura@DTSC; Grutzmacher, Raymond@DTSC; Rodriquez, Matthew@EPA
Cc: ssflcag@yahoogroups.com; ssflcaginside@yahoogroups.com (yahoo)
Subject: PEIR Comments from Christina Walsh cleanuprocketdyne.org
Attachments: PEIRScoping.pdf; Comments on Draft EIS submitted by Christina Walsh.pdf; MIP-finaldraft Attachment A.pdf

Dear Ray and Mark,
Please find attached my comments on the current PEIR for Santa Susana Field Laboratory, as well as attachments that include recent submissions to the related DEIS process that include a recommended modification in principle to make the AOC agreements workable and protective of both public health AND the environment, as well as my previous comments related to the NASA proposed cleanup actions that fall within this state-level review and ask that they be considered here within the CEQA process.
Thank you and happy new year.
Sincerely,
Christina Walsh
818-922-5123
cleanuprocketdyne.org

Christina Walsh, 8463 Melba Avenue, West Hills, CA 91304
Executive Director, cleanuprocketdyne.org
Ph: 8189225123 email: cwalsh@cleanuprocketdyne.org

January 5, 2014

Mr. Mark Malinowski
Project Manager - Santa Susana Field Laboratory
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826

Re: PEIR Scoping Comments
Santa Susana Field Laboratory

Dear Mark,

Thank you for the opportunity to provide comment and articulate concerns about the proposed cleanup actions at Santa Susana Field Laboratory. I appreciate the opportunity for these considerations to be heard and evaluated and hope that reasonable solutions may evolve.
I request that a robust examination/review of CEQA criteria be considered in evaluation of the proposed cleanup actions, and best mitigation practices as applicable. It is crucial that an in-depth review of all concerns articulated by the people directly affected by the proposed actions be considered, as well as mandates to protect public health as set forth in the signed and legally binding agreements for corrective action.

Introduction
I live at the two-mile mark in West Hills from the site. When I first got involved in 2001, and founded cleanuprocketdyne.org to begin an effort to inform the surrounding public of the issues and decisions being made throughout the investigative process. I ran an environmental advocacy museum for several years to that end, and was deeply involved as a public stakeholder throughout the Area IV Radiological Survey[1] and Background Study as well as substantive technical comments on each of the prior RCRA subarea group reports. I am also the SSFLCAG petitioner and currently serve as a CAG member and co-chair to the communications committee of the SSFL Community Advisory Group.

Summary:
Based on the following CEQA categories, I believe it is necessary to weigh carefully the impacts caused by the proposed actions, and make efforts to the maximum extent possible to reduce those potential impacts on surrounding crucial wildlife and natural habitats, cultural resources in and around the site, as well as to the surrounding public during the cleanup process.

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[1] http://cleanuprocketdyne.org/cleanuprocketdyne.org/Welcome_files/EPA_recognition_Walsh_cleanuprocketdyne.pdf

CEQA categories cont.

Aesthetics

The State Parks website defines as follows: "cultural landscape is an umbrella term that includes four general landscape types: historic designated landscapes, historic sites, and ethnographic landscapes which are defined in the National Park Service, Preservation Brief 36, Protecting Cultural Landscapes (Brief 36). "geographic area, including both cultural and natural resources, and the wildlife and domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or *aesthetic* values."
In the case of the proposed actions as described in the recent NASA DEIS, the proposal includes removing the top two feet of soil over 105 acres to include trees and all habitat. To me, this is extremely excessive in comparison to what would be needed under suburban residential standards that would allow people to live on the site. It is confusing to see the proposed actions only include absolute destruction, or no action at all. It is of great concern to see federal entities put such important resources at risk needlessly to conform to political pressure. We hope that the voices of the surrounding communities direction affected by the proposed actions will be sincerely considered in the process.

Biological Resources

I do not wish to destroy what we have worked so many years to protect.
I think there are reasonable mechanisms using US EPA Risk Assessment Guidance to make remedy decisions so we know when to stop digging, and when it is important to continue for the purpose of protecting human health and the environment. There must be balancing mechanisms to make "near background" decisions that protect surrounding and existing habitat that isn't otherwise at risk. Please use all tools and mechanisms available to assist in making responsible "stop dig" decisions so that precious environmental habitat, as well as cultural resources are not needlessly destroyed.

Geology, Soils, Seismicity

Based on soil quality requirements in the AOC, it may be problematic to find suitable fill soil, and part of that consideration should consider soil quality as far as clay content, shale, etc. so that appropriate native vegetative growth will be supported by the soil profile of the import soils. Mechanisms to make such decisions should be further developed, as large volumes will likely be required.

Traffic and Transportation

I request decision-making mechanisms that are transparent to the public to assist in reducing impacts through the use of in-situ treatment where feasible and effective, so that "treat first" for the purposes of minimizing the soil-volumes requiring off-site disposal, are employed. These transportation oversight mechanisms should be developed and implemented with clear goals of reducing traffic, emissions, and dust impacts to the surrounding public, as well as to the receiving communities. Stop work policies during school traffic hours of 7-8am and 3-4pm should be considered.

Noise from traffic and activities will be most felt by the folks who live on Woolsey Canyon. While there are not many residents there, the impacts will be deeply felt by those residents and consideration of start time and time between trucks should be examined and implemented.

Public Services

Preservation of national space history and cultural resources for the purpose of educating future generations in cultural, historical, anthropological, and archeological academic research and educational development.

Hydrology, Groundwater, and Water Quality

- Deed Restriction
- Current Permit Requirements
- California's non-degradation policy and mandate to protect groundwater resources

Air Quality

- Dust particulates[2] from truck diesel emissions as well as from excavation activities across the site during remedy actions will have short-term negative health impacts to local residents who suffer from asthma and other respiratory problems during the cleanup action.
- Special consideration of local community notification should be given for potential air-quality impacts, during excavation and high-wind days, so that residents can choose indoor activities during those periods.

Cultural Resources

Entire site has been identified as a "Traditional Cultural Landscape/Property" according to California Executive Order W-26-92

Additional site locations recently discovered and brought to the attention of responsible parties[3], confirms the potential presence of additional cultural resources not previously known. This underscores the importance of consideration of the sacred site designation and potential impacts by unnecessary excavation that does not further protect public health.

Project Involvement Background

The CAG petition (2010), which I circulated and filed when I saw a lack in community driven process (over eighteen months), as was available through Chapter 6.8 of the health and safety code. I felt the petition was necessary so that a greater shared understanding of the facts can be achieved and hopefully assist in making reasonable and responsible protective decisions that are careful to benefit all surrounding communities and not pit one against another.

Because of the complexities involved at the site, and the site history, public discussion has in the past been very difficult and charged, in part, due to the wide range in public understanding of the details surrounding the issues.

Political Influence

The continued political influence on the project has been very frustrating to many, and as a local resident who feels the impacts that will be incurred during the cleanup actions directly, it seems that our concerns are often dismissed in favor of political influence or pressures expressed by lobbyist groups. I appreciate the opportunity to articulate concerns related to the proposed actions, the timing, the cumulative impacts of the three cleanup projects happening simultaneously with the same deadline, and the lack of technical direction

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2 Volatile organic compounds (VOCs) and particulate matter (PM) contained in these products penetrate deep into the lungs and can trigger asthma attacks or worsen respiratory illnesses.
http://www.vcapcd.org/pubs/Factsheets/50WaysfactSheet.pdf

3 Site visitation with C. Walsh – Paul Costa, Boeing; Ray Corbett, JMA 12/20/13

provided within the settlement AOC agreement being implemented for two of the three parties.
I think this also underscores the need to combine the EIR and EIS process and that it should consider all demolition activities also taking place at the site for the purpose of final remediation.

One of the key findings in the recent court ruling related to Area IV demolition practices, was not that it was unsafe, but that procedure was not followed and lack of transparency precluded a proper CEQA review and analysis, and mechanism for public comment to be received. This ruling and the ongoing headlines emphasize the need for transparency and rule of process, as well as the balancing of actions and impacts of those actions as set forth in the California Environmental Quality Act.
That process must include discussions of how to reasonably implement the requirements of the signed AOC(s) so that we have agreements that can actually be implemented, carried out, and completed. We've waited a long time, and need to find sound solutions so that we don't just give our problems to someone else. Our safety is not more important than someone else's, so we need to be responsible about what we dig up, how we do it, and where we put it.

<u>Scientific and defensible solutions</u>
There is no room in science for "all or nothing" and in my opinion, this process must examine every alternative process that allows for reduction of soil-volume excavated. We must consider all potential methods of reducing this burden on landfills, which are very limited, problematic in their own right, and should not be needlessly filled with soils that do not require movement/impact. In my opinion, we must consider what is actually harmful and really concentrate on that, and on the migration and exposure pathways that are most vulnerable and we must do our best to make it safe while balancing that will protecting the existing environment where an open-space end-use exposure pathways should be considered before needlessly destroying environmental habitat, cultural resources and artifacts that cannot be undone. Based on the magnitude of the groundwater impacts, and the years of operation, it is questionable, whether total remediation can be achieved even if we dig forever. First we must question the wisdom in a pure "removal" approach, as those materials have to be disposed of, and require massive transportation needs that carry their own impacts. I hope we can balance what must be removed, with what CAN be treated in place. I think we must balance these issues and be realistic about expected results. If deed restrictions for future use are needed, they must be considered, carefully so that we don't accidentally put more people in harms' way. Conversely, we cannot use such leave-in-place mechanisms as an excuse to fail to resolve what can be resolved. Careful consideration that involves the informed and affected public are needed to finally gain acceptance of whatever solution is finally determined. Certainly, it is expected that the solution will be a complex compilation of multiple solutions. Some solutions, will work well in some areas, and not work as well in other areas. For this reason, simple "background" is not adequate do address the many complexities involved in the many chemical and radioactive constituents of concern that remain at the site and require attention.

The lesson I continue to learn throughout the 14 years of my involvement, is that often times, it is the newcomer who brings a new approach, concern, or point to the surface in a way that is necessary to further the greater understanding for the community and provide a necessary paradigm shift in approach to difficult solutions.

If we are to reach responsible objectives of cleanup, we must collaborate with an informed community for the best decisions forward. That means a civil process where people have the tolerance to allow other comments to be made without trying to "unsay" or counter other individuals. It would be beneficial to have a guideline that promotes discussion of issues, and not labeling or names/individuals.

Appropriate Public Process of PEIR Scoping Review

It is crucial that all comments received within the deadline are weighed and considered based on context of concerns from people directly affected by the proposed actions. It is inappropriate to consider comments that disparage or dismiss the concerns of others. The purpose is to hear all concerns and consider them based on scientific and regulatory merit. I hope for a very close review of the CEQA Guidelines and requirements for evaluation considering the many diverse views that exist in the concerned and affected public.

The hostility-level has risen to a level of pitting people with cancer against other people in the community who also want to feel safe, but also worry about property values declining from anxieties resulting from those concerns. I feel this is inappropriate, insensitive, and also counter-productive. The "blame" issue makes the volatility difficult to navigate both for the community member, as well as the decision-makers. We ask that you navigate it carefully and consider both the previous impacts as well as the need to protect what is there today. This division is certainly not productive, and does not assist toward a solution that meets the needs of the diverse surrounding public and perhaps a rule of only providing concerns about issues, or ideas about solutions at the mic, so that personal attacks and ridicule are not allowed as tools to dismiss or marginalize the concerns of others who share in the potential impacts from the proposed actions at the SSFL. All need to be heard fairly and in a civil atmosphere in order for the PEIR process to serve the purpose it was intended under the California Environmental Quality Act [CEQA].

During scoping meetings the effort to un-say comments made by other people has risen to an unacceptable level, where I believe that all views must be considered. It is my hope that the written comments received, will receive sincere consideration and not be out-weighed by robo-messages sent as we've seen in the response to the DEIS where thousands of identical comments were received within minutes of each other. This has the affect of drowning out legitimate voices of community members who participate in good faith and deserve to be heard, and have their comments considered within the process. Hearing others make statements that certain voices should be dismissed as "not representative" when clear influences from political lobbyists to drown out the legitimate concerns of the residents surrounding the site who will be directly affected by the proposed actions has gone largely un-checked for decades. It is inappropriate and should be carefully navigated within the diverse set of views that exist within the stakeholder community. We are allowed to disagree, but the continued disparaging of other groups/individuals who may not share the same views, should not be tolerated within this process that falls under California state law.

Additional "process" considerations:

The recent draft PA distributed by NASA for the purpose of making changes to the proposed actions within the NASA portions of the property based on discussions within the federal section 106 process with "consulting parties" which represent various views from within the local community.

In a recent email from the NASA representative, we were told that the deadline for comments on the PA would be extended from January 10, to January 17th to allow for more time over the holidays to complete comments on the document, but as a result of the delay in the deadline, the final PA would not be included in the DEIS record of decision [ROD]. This underscores the importance of timing and need to combine the federal EIS and state EIR processes. This is commonly done when responsible parties and regulatory decisions cross boundaries between state and federal guidelines/law as is the case here, with a site, where most of the site is owned by a private party (answerable to the state regulatory process), and federal parties (DOE and NASA) who are answerable to federal requirements.

The purpose of the reporting and evaluation process in CEQA as well as the RCRA and CERCLA investigative processes, is to "inform" various reviews with information provided from the massive amounts of data collected about the site. If important decision points are not included in the final Environmental Impact Statement, that omission will potentially alter down-the-road decisions. In this case, there are a great many people who have articulated concern over demolition of the test stands, and the PA provides a process to potentially save Alfa and Bravo. This opportunity might fall through the cracks if it is not included in the decision making portion of the EIS (meaning the ROD Record of Decision)

Given the recent decision regarding the importance of CEQA for the demolition process for Boeing, I think it is equally important to give the same close examination to the decisions being made to implement the AOC agreements, which are signed by the federal parties with the state's Department of Toxic Substances Control.

Recent treatability studies being carried out at Bravo are greatly appreciated and offer potential solutions to work around test stands and preclude demolition of historic structures (Alfa and Bravo test stands and control structures, respectively). In order to meet the needs of a concerned public who, both individually, and representing many groups, has repeatedly articulated concern over the demolition of these historic structures that represent Man's travel to another world, and should therefore be included in the CEQA review that is taking place.

I am concerned that the effort made to address historic issues through the Section 106 federal process will not be adequately evaluated in the bigger picture if the Programmatic Agreement [PA] is not included in the PEIR/DEIS process.

The fact that the Letter of Intent from the federally recognized Santa Ynez Band of Chumash Indians also indicates an agreement that Alfa and Bravo should be saved, and would provide for a place where our space history can be preserved for future generations to see, learn about, honor, and respect.

I request that every effort be made to include the PA within the final DEIS document as a crucial decision-point needed for full evaluation of considerations developed in the 106 process to ensure inclusion of the record of decision [ROD] as indicated for preservation purposes.
I hope consideration to preserve national history (Alfa and bravo) as well as making potential provisions for preserving part of COCA perhaps at another location such as a Space Museum (Smithsonian).

That is how we preserve things for the future: we have to make them care about it. For that to be possible, they have to know about it.

Potential Political Interference
We want a real solution that actually happens. No one is protected by a paper cleanup that may be a political win, but if it cannot be implemented successfully and responsibly, then modifications MUST be considered to be consistent with the intent of the AOC: to finally resolve the problem and make the surrounding communities safer from this impact that has burdened the neighboring communities for many decades.

Time is part of the equation that defines Risk: Concentration x Time exposed, [with toxicity and exposure methods considered], = Risk

Like most people involved, cancer has touched my family very deeply and I would not wish that on anyone. The body-burden for cancer is already so high, and that doesn't excuse any adding to that burden by pollution venting to the sky or pouring down the mountain. It also doesn't mean I want revenge on the surrounding environment that doesn't make anyone any safer.

> We cannot want to truck away the mountain (I hope). I think we must understand that is only moving the problem elsewhere and we have to balance the burden here, with the burdens on other communities and local impacts to surrounding communities.
> Protecting existing open-space habitat is important to me, and such large contiguous open-spaces are few and far between and should be protected. We all want to be safe and we need to consider sustainable solutions that don't over burden local neighbors, landfill communities, or the remaining site with hazard.
> Balance is the key and that is why I believe we need a comprehensive PEIR that considers tangible solutions.

I want my neighbors all around the site to be safe, not only for the future, but also during the excavation and hauling process that will likely take several years. I want health-risk assessment because I want sensitive potential receptors to contamination present to be addressed, whether it be human health OR ecological health.

<u>Legal Agreements Signed and application to "real world"</u>
I appreciate the agreements signed and feel that they are needed to guide the process. Having said that, it is also important to understand that the 2010 AOC signed by DOE and NASA was a "settlement" and written on a legislative and policy level, and did not have any CEQA review, and does not adequately prescribe steps forward considering the complex array of contaminants at the site (several hundred chemicals and radioisotopes) and the fact that a "simple settlement" cannot adequately address the many concerns identified about the site, and the challenges to cleanup as well as to preservation of sacred prehistoric native American sites, and protection of habitat, and ecological resources throughout the 2800 acre site. Limited modifications to make it possible to protect the things that the AOC set out to protect are necessary for the purpose of implementation.

Cancer concerns in surrounding neighborhoods should also not be dismissed OR used, as an excuse to make punitive decisions that wind up impacting/harming local habitat more than is necessary to protect human and ecological health.

This area is a natural and crucial wildlife corridor and contiguous to one of the last large open spaces in Los Angeles and Ventura Counties. While we cannot draw the line between the cancer incidents identified in several studies, it should be considered that added toxicity burden from the site is also unacceptable, and these are well known harmful contaminants. Unnecessary impacts to the surrounding communities as well as on the environment itself is unacceptable and must be remedied to the maximum extent practical and reasonable. By utilizing health risk decision-making mechanisms, the over-excavation of soil requiring disposal can be avoided.

I think we do understand that we live in an environment full of contaminants, and we can be realistic about this issue, but it should not be used as an excuse to accept discharge of added burdens from the SSFL. Unnecessary impacts to the existing environment, which do not improve the health conditions in a meaningful way, should also be avoided. It is crucial that the AOC's be modified to allow for proper and responsible decision-making that considers risk, and exposure pathway (existing or future), and not allow for needless destruction of the environment.

It is my opinion that exposure pathways should be the primary focus in navigating remedies across the site, as well as confirmation sampling decisions, so that hazard levels and potential pathways to human and ecological receptors are prioritized and over excavation and burdening of landfill communities that do not benefit health-protection are avoided.

Footprint reduction of contaminants from the field lab is the responsibility of the RPs [responsible parties] and when we talk about 'every time it rains' as a reason to go to such a severe solution, we must also remember that it's been raining for fifty years and we need to consider where those contaminants have gone as well and be realistic about the current *reach* of the proposed remedy solutions. The community has been deeply concerned about this for decades, especially when we see wildfire blow right through the site (2005 Topanga Fire burned 70% of the vegetation at the site), so the idea of contaminants blowing in the wind is a very real one, even today. We also need to be practical and agree that we need to protect what we can, and that balance (especially because of the spotty history where we don't know where everything went), should be carefully navigated. We should then agree that limitations on future use should also be put in place if leave-in-place monitored attenuation is utilized. This may be in the form of institutional controls and deed restrictions so that more people and wildlife are not put in harms way unnecessarily.

It should be acknowledged that all EPA regulated cleanup projects use some form of risk-assessment guidance to make "stop-dig" decisions and this project should be no different. It is important that over-excavation and unnecessary damage to the environment is avoided to the maximum degree practicable. Disposal of contaminated soils should follow these guidelines:

> Soils contaminated with chemical contaminants above local background:
> Hazardous wastes to licensed Class 1 hazardous waste disposal facilities only
> Non-hazardous waste to licensed Class 2 or subtitle D compliant Class 3 disposal facilities only
>
> In addition to meeting the above disposal requirements, all soils must also meet the waste acceptance criteria for the receiving facility." These statements indicate that receiving requirements should be considered; where the AOC as currently interpreted, is mandating that all 'above- local-background' soils regarding radiological impacts should be considered LLRW, which is NOT consistent with "waste acceptance criteria for the receiving facility.

When these regulatory levels conflict, priority should be given to the requirements stated by the 'receiving' facility, as required and applicable by law. This is where the impact of the decision will be most strongly felt and that should be given priority consideration in that decision process. This is particularly important here, as the AOC was not designed to make precedent decisions for other sites, and certainly did not receive CEQA review, nor was it written with technical feasibility in mind. It actually says so within the agreement itself, and is understood as a compromise after 18 months of failed negotiations for the purpose of implementing the currently existing cleanup agreement [Riley '07 Consent order for Corrective Action].

> *That doesn't make it right; it makes it a settlement that still must adhere to law, including the California Environmental Quality Act*

General concerns about proposed cleanup remedy selection based on agreements signed and concerns identified by the public:

<u>Bell Creek</u>

I have fought to protect the creeks and ensure they are safe. [4] We cannot be draining the mountain of water,

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or starving riparian habitats because of groundwater contamination and MUST think about smarter solutions that protect the future as well as the past.
They are both important and MUST be balanced. Every shovel we dig up, has to go somewhere, so this idea that anything above non-detect has to be hauled away to a different community is unfair and certainly not ethical to over burden other communities with our waste.[5] Considering the requirement levels that are severe, and in my view, to a level that doesn't make us [surrounding residents] any safer. In fact, the added emissions, dust, etc. will potentially ADD risk, not subtract it. We have to balance it so that the long-term solution is responsible and long lasting, and that short-term impacts are weighed and not allow for destruction of sensitive habitat.

We have examples such as the Area IV burn-pit that show us that it isn't the end of the solution when you haul the soil away. In this case, the new clean soil has now been re-contaminated by the contaminated groundwater below it. We remove it again, and contaminate it again? VOC impacts must be addressed differently so that a long-lasting solution can be achieved.
The current treatability study for VOC Vapor Extraction being studied at the Bravo portion of the site is greatly appreciated, and it is my hope that such treatment alternatives will be implemented site-wide wherever it is considered beneficial to improve soil conditions at the site, and to avoid unnecessary excavation impacts, where cleanup can otherwise be accomplished in situ through this process. This presents a promising future for potentially saving historic structures that have VOC impacts nearby. I hope these alternative approaches prove effective and can be implemented on a larger scale across the site to improve groundwater and impacted soil conditions at the site.

We have to be smarter than that. We have to think about the most important impacts to the future, and properly address them according to US EPA risk assessment guidance.

In this weeks meeting we learned that the 8000 cubic yards that went from happy valley to building 359 for treatment (in situ onsite) was approximately 500 truckloads. 500 trucks. 500, but they didn't leave the site. Imagine half a million cubic yards and how many trucks that is, so the realities of how to move that much soil, and the traffic, emissions, dust, impairments, hazards involved are staggering. Related to traffic and hazards to local children going to and from school, I think serious consideration of a transportation moratorium between 7-8am and 3-4pm to avoid the additional school traffic and kids on the roads at that time. Similar considerations for the receiving end are also important. The small communities surrounding Buttonwillow and Kettleman are incredibly affected by the same impacts that we get, but much more noticeable.

I want you to consider in situ alternatives as well as modifying existing agreements [on a limited basis][6] to reflect the deadlines as previously agreed on the AIP to mean that alternative methods need only be completed (construction) by 2017 because it was understood that the completion of these longer-term treatment methods take longer than driving a truck down the road, and in order to be considered (as a method of reducing that footprint on landfills already heavily burdened with needed expansion).

In consideration of vast and rare natural habitats that exist at the site including areas of riparian and oak woodland and all the wildlife species and migratory species supported by this crucial corridor, I want you to score or rank the various areas of proposed action so that areas that are relatively undisturbed by man, and support wildlife are protected where possible, by using health risk assessment tools and guidance to make

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6 DEIS and Modification in Principle comment documents included as attachments herein.

responsible decisions for preservation.

In consideration of the valuable sacred Chumash cultural sites, archeological sites, and sensitive habitat and plant species sites, as well as those where historic activities related to man's race to space, preservation potential should be considered with each historically designated structure. If it is possible to perform cleanup activities around test stands and other historic structures related to mans research and travel from this world to another, every effort to preserve Alfa and Bravo test stands and historic supportive structures to preserve history for future generations should be considered.

I want you to consider US EPA Risk Assessment Guidance to make responsible decisions to avoid over-excavation and unnecessary damage to the surrounding environment.

Detailed concerns and comments based on substantive CEQA review and purpose:

<u>Aesthetics</u>
Of the 2850 acres at the site, there are many portions that would be excavated severely (including oak trees over 105 acres of the top two feet according to the potential impacts detailed in the NASA DEIS for their portion of the site [Area II] which is 455 acres, so nearly one fourth of the site would require the top two feet of soil be removed for the AOC mandated requirements. In order to meet the needs of the community, who has expressed serious concerns about the impacts of the proposed over-excavation that goes far beyond protecting human health or the environment, I ask that you do an in-depth review of all CEQA categories of potential impact based on the concerns raised by the diverse surrounding communities. Compared to requirements for suburban residential standards (where residents would be allowed to live ON the site), this seems too extreme and should be balanced with the existing contoured landscape.

Aesthetics, according to State Parks[7] should apply here, to the "view shed," both from the sacred sites, and to include them from the larger surrounding sacred areas, looking inward.
This further demonstrates the importance of preserving the local habitat in a healthy way, and should be considered when pumping down groundwater elevation levels beyond the root systems that exist, making the current very serious drought conditions even worse for the already strained eco-system.

<u>Biological Resources</u>
I do not wish to destroy what we have worked so many years to protect.

I think there are reasonable mechanisms using US EPA Risk Assessment Guidance to make remedy decisions so we know when to stop digging, and when it is important to continue for the purpose of protecting human health and the environment. Statements made by PSR's doctor representative, who spoke at the scoping-hearing resonated deeply with me when he discussed the toxicity values of various radionuclide's including plutonium. It is crucial that we weigh those differences responsibly to ensure that all precautions are taken regarding soil removal and soil movement, and open storage during the course of each of the excavations, which will likely occur simultaneously throughout the site to accommodate the requirements of the agreement(s) signed.

[7] The State Parks website defines as follows: "cultural landscape is an umbrella term that includes four general landscape types: historic designated landscapes, historic sites, and ethnographic landscapes which are defined in the National Park Service, Preservation Brief 36, Protecting Cultural Landscapes (Brief 36). "geographic area, including both cultural and natural resources and the wildlife and domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values."

Please focus on what is hazardous, and not just remove all soil. If strict "everything goes" policies are employed, more than necessary will be disturbed, raising potential risk to workers involved in the process, as well as potentially to surrounding residents through dust inhalation during these massive excavation(s) in the proposed action(s). Those decisions must be based on human and ecological health, and balance both. We should focus on migration pathway potentials when we consider the thousand-foot relief between the site and the people below, especially given the potential excavation erosion problems that will exist from the steep topography.

Riparian Habitat has been jeopardized in lower down-gradient areas due to groundwater pump-and-treat systems discharging treated water to a different watershed than that of the pump locations resulting in conditions severely exacerbated by recent drought conditions and endangering the habitat more long-term as a result which includes rare plant species that is listed not the Native Plant Society "of special concern" list [Humboldtus Lillium]

Oak Woodlands Habitat due to root system water deprivation based on lowering the groundwater levels to prevent seeps from emerging [WS9a local seeps emerge at est. 1000ppb in TCE and also contain degradation products of TCE]. Unintended consequences of lowering groundwater levels more widely have potential effects to protected oak trees that will not be evident until it may be too late to correct, other than with mitigation. I believe that replant programs for mitigation are inadequate when considering the 200 subspecies supported by these trees.

Protection of Oak Trees in Ventura County

Unnatural plastic [laundry hamper sized] bins used to water "wildlife" in the absence of natural flow, as was typical prior to groundwater pumping should not be allowed. This is also a consideration for hazards to wildlife/ecological receptors as these watering buckets make for hunting opportunities that may provide added advantage to predator species (coyote) who are very resourceful and work in teams. This may offset the sensitive balance to the wildlife corridor that is so important for migratory species as well.

This was previously observed by LA Regional Water Control Board and Department of Wildlife staff, who at the time, asked that it be discontinued during one of our site-visit discussions earlier last year. I am confused as to why this practice continues today, despite this previous promise by Boeing staff and ask that wildlife considerations be evaluated here before this practice continues.

<u>Proposed actions under DEIS submitted by NASA</u>[8]

When I consider the potential impacts of the cleanup based on the currently proposed actions, I want you to address in this process in order to meet my needs and those of the concerned and affected residents surrounding the site that will feel the impacts of the potential actions, I think first of the natural environment and the proposed action to remove the top two feet of over 105 acres of the NASA portion alone. When we know that isn't necessary for the purpose of health protection, it's troubling to understand why folks would insist on that? I am concerned about the potential dust from excavation when we are talking about such massive amounts. I was certainly someone who previously doubted how much soil would require removal under the AOC. I have researched it carefully, and the volumes are astronomical and require that we re-think potential in-situ solutions so that we don't needlessly burden local roads, as well as those in the communities where disposal soils will go.

8 Comments submitted on DEIS for NASA portions, as well as defined Modification in Principle are included as attachments herein.

We have seen from recent history, that local landfills often run into problems including bankruptcy where there is no responsible party for monitoring and handling of hazardous waste issues. This has been found at landfills both in California and other states. For this reason, extreme caution in disposal sorting practices so appropriate solutions are met, that do not become problematic later for someone else.

Geology, Soils, Seismicity

Altered soil profile of imported fill-soil may impact success of restoration efforts related to supporting local riparian and oak woodland vegetation. Vegetative growth support patterns within the cleanup zones and should be carefully considered and monitored. Based on soil quality requirements in the AOC, it may be problematic to find suitable fill soil, and part of that consideration should consider soil quality as far as clay content, shale, etc. so that appropriate native vegetative growth will be supported by the soil profile of the import soils. Mechanisms to make such decisions should be further developed, as large volumes will likely be required.

Use of soils from the same geological formation will increase the likelihood that it will support local vegetative growth. Please use fill-locations from within the Chatsworth and Santa Susana geological formations wherever possible.

Excavation work done in and around the vicinity of known faults (burro flats, happy valley, shear zone, coca fault and delta structure) should consider all potential migration pathways and soil stabilization efforts in steep areas need to have policies in place for rain-events so that potential erosion of contaminated soils currently in-place, or in staging areas during the course of an excavation process period be reduced or eliminated. Considering the toxic nature of many of the contaminants, this process must be transparent and extremely diligent to protect both down gradient residents as well as the eco-system that might otherwise be unintentionally exposed to previously buried material.

Any discoveries of anomalies that are not consistent with the expected findings within the work plan and current sampling 'spider maps', should be provided by notification to DTSC and the public within 24 hours of discovery.

Traffic and Transportation - estimated truck activities over the course of several years will be increased substantially with all three RPs operating their "remedy action plans" simultaneously. It may be beneficial to extend the deadline on the AOC and Consent Order cleanups by two years for the purpose of staggering the truck activities so the impacts to the surrounding communities both locally and at the receiving end of the process are minimized.

Decision mechanisms for in-situ treatment potential opportunities so that "treat first," for the purposes of minimizing the volumes requiring off-site disposal should be developed and implemented.

By only removing what needs removing, and leaving in place for contour and fill purposes, the soils which do qualify, significant reductions of potential impacts from proposed actions can be achieved. [i.e. soil-sorting to remove metals before perchlorate in situ treatment, as done in prior 'Happy Valley bio treatment']

Noise from traffic and activities will be most felt by the folks who live on Woolsey Canyon. While there are not many residents there, the impacts will be deeply felt by those residents and consideration of start time and time between trucks should be examined and implemented.

Public Services
Preservation of national space history and cultural resources for the purpose of educating future generations in cultural, historical, anthropological, and archeological academic research and educational development.

Water Services provided from tanks, which reside on the property and serve drinking water to local residents, should be protected from unnecessary impact.[9]

Hydrology, Groundwater, and Water Quality

- Deed Restriction
- Current Permit Requirements
- California's non-degradation policy and mandate to protect groundwater resources

Groundwater concerns:
Initial indications that remedies might not achieve remedial action objectives should trigger remedy optimization and/or the introduction of new remedies that achieve more rapid contaminant concentration reduction and containment. It maybe necessary to implement new remedies more than once, and that should be considered within the remedy plan proposed.

Passive treatment systems for groundwater and surface water should be incorporated into the drainages using natural contours in order to minimize impacts the wildlife in need of water for survival and should not impede the access of water for the wide variety of species supported by the habitat area(s).
I believe that active groundwater treatment and control is needed and should follow protocols to ensure that water is returned to the aquifer zone it is pumped from so that the surrounding understory and tree system remains healthy.

- Continued deprivation of water will alter the visual landscape so important to the cultural landscape and "view shed." Recent pump tests from RD10 indicated response to pumping more than 1000 feet away, and therefore supports the need to distribute treated water back to the local zone that it is sourced from.
- Ineffective water bins to supplement "wildlife" water source needs in the absence of natural flow reduced from groundwater pumping, as was evidenced by prior to groundwater pump and discharge practices [Ws9a to Outfall 1 instead of Outfall 2], should not be allowed to continue. We were told during regional board visits that practice had stopped but it was recently observed at the site on December 20th. This is also a consideration for hazards to wildlife as these watering buckets make for hunting opportunities that may provide added advantage to predator species (coyote) who are very resourceful and work in teams. This may offset the sensitive balance to the wildlife corridor that is so important for migratory species as well.
- Groundwater remediation should not be avoided because of predictions that treatment and/or removal will not achieve drinking water standards throughout contaminated aquifers. Decisions should be based upon difficulties encountered only after good-faith efforts have been made.

There may be areas within the site boundary, in which active remediation is unable to achieve satisfactory aquifer-wide cleanup in a reasonable time frame. While I do not support spending vast amounts of time and money achieving minimal contaminant (and thus risk) reduction, I do believe remedial objectives must include long-lasting containment considering longer flow patterns that may reach populations several years

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[9] Bell Canyon water supply stored in tanks in SSFL Southern Buffer Zone

of decades in the future.

- Protective remedial action objectives must consider down-gradient potential future impacts and efforts to reduce migration flow pathways while protecting existing riparian habitat that depends on groundwater levels remaining consistent with historical levels in order to support under-story species as well as local oak woodland habitat which rely on consistent depth to groundwater to support root development in very topographically sensitive zones.
- Regardless of the particular alternative endpoint (technical impracticability waiver, transition to passive remediation, etc.), where cleanup is not expected to achieve complete aquifer‑wide cleanup, planned remedies should nevertheless maximize the protection of public human-health and the ecological environment.
- Detailed site-specific objectives should be further developed with the informed input of surrounding affected communities with potential migration pathways addressed and thoroughly investigated.
- Remedies that temporarily or permanently leave contamination in place as repeatedly suggested by responsible parties when discussing the immense groundwater impacts present at the site, must be accompanied with planned remedy and future remedy actions and monitoring plan for potential migration to neighboring communities that may not occur before the cleanup deadline.
- Due to potential impacts to new clean replacement soils that are brought to the site, by the remaining contaminated groundwater below soils remediated at the site, alternative long-term strategies should be discussed and shared as early as feasible with the informed and affected surrounding communities for meaningful solutions that address the complex groundwater impacts present at the SSFL site.
- Additionally, long term monitoring strategies, in consultation with the surrounding affected public should also be discussed with multiple alternative options that utilize all modern technologies available.
- Appropriate restrictions on land and water use should be put in place as early in the investigative process as practical.
- Regardless of the pace of groundwater restoration, it is essential to prevent exposures to unsafe levels of toxic substances with interim measures as deemed appropriate from monitoring data which should be shared with the affected public. Prevention of exposures should not be used as an excuse to slow or halt groundwater remediation. The elimination of pathways, such as drinking water or vapor inhalation, does not in itself eliminate the obligation to remediate groundwater.
- Currently, residents of Simi Valley drink a percentage of groundwater that babies are probably the most sensitive potential exposure receptor if breast milk is supplemented with formula made with this water.
- The timely completion of groundwater remediation is heavily dependent on activities at the early stage of any project, including the development of a comprehensive yet flexible conceptual site model and full delineation of groundwater contamination. This should include offsite impacts to the northeast as well as to the south where TCE degradation products have been found at the top of Bell Creek indicative of potential plume frontal edge migration offsite.

Air Quality

Dust particulates[10] from truck diesel emissions as well as from excavation activities across the site during

10 Volatile organic compounds (VOCs) and particulate matter (PM) contained in these products penetrate deep into the lungs and can trigger asthma attacks or worsen respiratory illnesses. http://www.vcapcd.org/pubs/Factsheets/50WaysfactSheet.pdf

remedy actions will have short-term negative health impacts to local residents who suffer from asthma and other respiratory problems during the cleanup action.

Special consideration of local community notification should be given for potential air-quality impacts, during excavation and high-wind days, so that residents can choose indoor activities during those periods. This can be similar to regular smog air-quality notifications and can perhaps be accomplished by providing for air monitoring during all excavation work activities, as well as disposal days where truck activity is high. Efforts to reduce air-quality impacts, such as active water monitoring during open excavation and covering of all staging areas for loading and transportation quality control should be considered.
Stop work policy, during winds in excess of 15mph should be considered with tarp-covering of all open excavations for all rain and wind events during activities.
Dust particulate estimates from the American Lung Association as well as consultation for potential warnings to local residents should be considered.

Cultural Resources
http://174.143.86.82/files/lib_correspond/agreements/64711_FINAL_NASA_Agreement_in_Principle.pdf

> "Native American artifacts that are formally recognized as Cultural Resources" as phrased in the Agreement in Principle which the AOC is based upon showing unquestionably, that the word, "artifact" in intended to include all recognized cultural resources and therefore should be interpreted to include burro flats cave panel [the primary resource which NASA has stated in the DEIS may potentially be impacted], new cave panel, and all artifacts identified during previous and current survey(s). Notably, the AIP further states, "This process should not be inconsistent with any guidance that EPA may issue pertaining to the practice of implementing a not to exceed background cleanup approach." and therefore MUST include Risk Assessment Guidance and mechanisms to avoid replacing near background soils with other near background soils offering no improvement to the environmental condition, except to devastate the existing habitat.

There is a new site, that is not as elaborate as the burro flats cave panel, but also has pigmented designs similar in nature to Chumash drawings and cave paintings found within the region. It is widely understood that the Chumash native tribe as history of 16,000 years in the area, and specifically, to the south of SSFL in Bell Canyon was a known village site. It is documented within the archeological reports [11] that the burro flats site is related to the known village area. Additionally, the new site demonstrates and supports the statement made by the federally recognized tribe [Santa Ynez Band of Chumash Indians letter of intent] that the entire site is, and should be considered a sacred site. The presence of additional features, [as well as the 18 additional findings made during the Area IV Archeological Survey done by JMA in 2010 for EPA] indicates further likelihood that other additional sites may exist.
An effort to include local tribal representatives in further review/examination and survey of the site is appropriate given the new findings, and their potential significance to Chumash cultural resources within the region.

Entire site identified as a "Traditional Cultural Landscape/Property" according to California Executive Order W-26-92

As indicated by the federally recognized tribe letter of intent[12], the entire SSFL site must be analyzed as a

[11] Radiological Survey of Area IV in 2012 included archeological survey prepared by JMA.
[12] Letter sent to GSA/NASA regarding federal excess procedures to transfer federal portions to another party through

traditional cultural landscape. Additional findings are recent as 2013 indicate the potential presence of additional sites and require careful navigation.

The lead agency has a duty to prepare an Environmental Impact Report ("EIR") to assess the potential environmental effects of the proposed project and identify mitigation measures that could reduce or avoid potential environmental impacts. CEQA Guidelines at 14 CCR 15121(a).[13]

CEQA provides for the protection of unique archaeological resources and historic resources. PRC secs. 21083.2 and 21084.1. A project with an effect that may cause a substantial adverse change in the significance of a historic resource is a project that may have a significant effect on the environment. 14 CCR sec. 15064.5(b). Thus the lead agency has a duty to avoid substantial adverse changes to historical and cultural resources.
California Executive Order W-26-92 affirms that all state agencies shall recognize and, to the extent possible, preserve and maintain the significant heritage resources of the State as observed by the Governor's Office of Planning and Research (OPR).[14]

<u>AUTHORITY TO IDENITFY CULTURAL RESOURCES</u>
According to CEQA, historical resources are presumed to be historically or culturally significant for the purposes of CEQA evaluation.[15]
Even if a resource has been identified as significant pursuant to one of these mechanisms, a lead agency has the discretion to determine whether the resource may be a historical resource for the purpose of CEQA. Id. The CEQA Guidelines further clarify the authority of a lead agency to determine the presence of historically significant resources:

"Any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant to in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California may be considered to be an historical resources, provided the lead agency's determination is supported by substantial evidence in light of the record."

On this basis, I am submitting evidence of a new, not previously identified cultural resource that has been brought to the attention of Boeing, and according to aforementioned CEQA guidelines, must also be presented to lead regulator.
I request that this finding be considered as potentially contributing to further understanding of pre-historic

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GSA, the Santa Ynez Band of Chumash Indians declaring the site as a traditional cultural landscape according to California Executive Order W-26-92. Letter sent by the Tribal Chairman, Vincent P. Armenta regarding the "...commitment to protecting Native American cultural sites at the SSFL while working with all other stakeholders and neighbors to the SSFL property to ensure the cleanup of the site" and further expresses concern that adequate value of the site for its significance to the US Space Program based on more than 30,000 rocket tests that occurred at the site (Parks letter from Santa Ynez Band of Chumash Indians dated November 15, 2012). Further indicated by the letter of intent sent by the Tribe, is acknowledgement of historical significance of test stands being more than 50 years old.

13 The lead agency must consider direct physical changes in the environment and reasonably foreseeable indirect changes in the environment which may be caused by the project and to mitigate or avoid the significant effects on the environment of projects whenever feasible. Public Resources Code (PRC) Secs. 21083.2 – 21084.1 and 21002.1; CEQA Guidelines at 14. CCR Sec. 15064(d).
14 See Tribal Consultation Guidelines (Interim), March 1, 2005 at p. 7. California state law includes a variety of provisions that promote the protection and preservation of Native American cultural places.
15 PRC Sec. 21084.1.

culture and must be protected as should surrounding areas from potential impacts of demolition, excavation, traffic, and treatment activities. Native American representatives should be invited to provide comment on best practices for security, protection as well as ceremonial/religious access for tribes upon request.

Photograph by Christina Walsh 2013

I believe that the presence of this additional site further underscores the importance of careful and close scrutiny of potential impacts to these and other potential previously undiscovered resources present at the SSFL site.
It must be understood that today's property boundaries are not necessarily consistent with ancient prehistoric uses that should be protected where feasible.

I applaud the current treatability study for VOC removal at Bravo because it can also provide for a solution that allows history to continue to stand (if feasible). If in situ mechanisms can be utilized to help preserve national history for future generations, I think those should seriously be considered as a potential solution that can augment and support the necessary excavations where alternative treatment is not feasible.

Additional observation and research from local archeological sources indicate the possibility of astrological features depicted within the imagery. This may suggest a witnessing of an event such as an ancient comet, as depicted in the burro flats imagery. Lighting affects including change to color hue during different parts of the day, season and year, may indicate additional spatial relationships between these sites, which are relatively close in proximity.

Considering the solstice light features of the other site, additional interpretation from native cultural experts would be helpful in understanding whether the time-span between them is in months, years, or centuries, suggesting a potentially longer presence of multiple tribes in the area than previously appreciated. Cultural educational development is recommended.

In consideration of these potentially meaningful new findings, I hope for a "treat first" policy in decision-making, for the purpose of maximum potential protection of unknown cultural resources. I believe this should be utilized to minimize soil movement where possible. If applied throughout the site activities, it could result in significant reductions in soil movement and reduction in consequential impacts to surrounding residents from dust, emissions, traffic, and soil erosion problems can be achieved. I think this should be a project goal.

Appropriate application of the following guidelines:

CEDQ Guidelines at 14 CCR sec. 15064. 16
CEQA Guidelines at 14 CCR at Sec. 15064.517

CULTURAL LANDSCAPES INTERPRETATION

The Department of State Parks has interpreted historic resources to include "cultural landscapes" and has looked to federal guidance interpreting the National Historic Preservation Act18 to define what resources may be designated a cultural landscape. See www.parks.ca.gov/default.asp?page_id=22854

The State Parks website defines as follows: "cultural landscape is an umbrella term that includes four general landscape types: historic designated landscapes, historic sites, and ethnographic landscapes which are defined in the National Park Service, Preservation Brief 36, Protecting Cultural Landscapes (Brief 36). "geographic area, including both cultural and natural resources and the wildlife and domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values."19

Included in a list of themes in California history that is recognized as cultural resource deficiencies in the State Parks System:

> Settlement and Subsistence Patterns; Special Adaptations and Environmental Management; Trade and Movement; and Ideology (e.g. sacred sites, petroglyph and pictograph sites, intaglios).

Based on personal experience at the site, and discovering a new potential significant site within the site boundaries indicating further supporting evidence that the span of this traditional cultural landscape does indeed incorporate the entire site as additional findings [dozens] were recently found during the Boeing archeological survey, which is currently being completed.

Assumptions that open-space land throughout the property MAY contain the presence of unidentified cultural resources and/or artifacts must be considered at every potential ground disturbance endeavor throughout the cleanup investigation and remedy process.

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16 CEDQ Guidelines at 14 CCR sec. 15064.

Generally, a resource shall be considered by the lead agency to be "historically significant" if the resource meets the criteria for listing in CRHP, which include the following:

> Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage; Is associated with the lives of persons important in our past; Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or has yielded, or may be likely to yield, information important in prehistory or history.

17 Thus, provided there sufficient evidence, there is authority to identify resources of historic significance even if such historic resources have not been previously identified. In fact, in light of the recommendations regarding the protection of traditional tribal uses, the lead agency appears to have an obligation to evaluate ongoing traditional tribal uses as significant historic resources in the CEQA process.

18 (16 U.S.C. sec. 470, et seq.)

19 Brief 36 also notes that subsistence of often a component of the landscape.

John Romani, an archaeologist who has studied the site in detail elaborates the Burro Flats site as: "… unquestionably ceremonial in nature, although its true complexity awaits proper analysis of the archaeological data. The site has a Late Period component, based on the presence of Spanish trade beads. Although glass trade beads can by no means suffice to confidently date the rock art… the well-preserved appearance of these pictographs does show that at least the most recent superimposition (i.e. of the bright red pigment) is probably of recent origin".[20]

Cultural Resource Protection Measures

It is recommended that during future characterization and remediation activities at the SSFL, a strict "flag-and-avoid" approach be maintained for all prehistoric archaeological sites within the SSFL. In addition, an archaeologist and Native American monitor should monitor future projects that involve ground disturbing activities. Though not included in the scope of this project, for future efforts at the SSFL, it would be important to obtain temporal information regarding newly discovered sites.[21] Radiocarbon dating of artifacts would provide direct information about the temporal relationships of various activities, prehistoric land use, or cultural adaptations to the environment over time were obtained. Obtaining this chronological data would significantly facilitate a fuller understanding of the nature of cultural changes through time in the study area. For example, radiocarbon dates obtained on shellfish fragments and bone would provide direct evidence of when certain sites were occupied. This information would provide a better understanding of the nature and timing of prehistoric cultural adaptations to the SSFL landscape.

Greenhouse Gas Emissions

Truck diesel emissions - use of natural gas trucks for disposal activities as well as the transportation involving "fill" soil. Potential staggering of disposal transportation process by extending the remedy deadline by two years would provide some relief from emission impacts to local communities. It is recommended that the deadline order put the AOC mandated deadlines [DOE and NASA] last, to provide more time to accomplish more stringent levels and to modify deadline language to include potential for alternative in situ treatment that would reduce trucks significantly because that soil would not be transported offsite.

Land Use

Deed Restrictions due to groundwater impacts that are said to potentially take 50,000 years to remediate according to federal District Court Judge who set aside SB990 partially on that basis. Deed restriction to restrict structures due to potential health threats from groundwater VOC vapor intrusion as a potential risk pathway to local receptors should be considered.

Future Land Use:

For consideration: First Chumash National Park - additional cultural resources recently identified indicate a strong presence of ancient Chumash rock art and must be protected and stewarded by the tribes. If National Park Service works in consultation for operational purposes with the tribes, the tribes should be considered "lead operator/custodian of land.

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20 (Romani, et al. 1988:112)

21 JMA Archeological Survey, 2010 for EPA

Population and Housing

Restrict new population in this area by restricting development of surrounding large parcels due to potential later exposure from groundwater impacts at the site. These considerations should also be evaluated for nearby developments such as Runkle and Dayton Canyon(s).

Utilities

Existing infrastructure for utilities and water storage currently exists at the site, and may be used for the purpose of irrigation for mitigation measures for restoration activities following excavations, and should be retained, instead of demolished so that other water storage at the site is not needed, or at least minimized. Utility infrastructure including water distribution pipes, fire suppressant water resources during fire season, and other potential resources such as fire department training activities and other resources that currently exist should be considered before demolition as those resources are needed for community resource purposes. Sustainability practices such as "LEED" standards should be considered for recycling efforts throughout the cleanup actions.

Hazards and Hazardous Materials

Hazards to surrounding public come primarily from traffic, emissions, dust from trucks and from excavation. Considering the very toxic substances that are being removed from the site, open land-scars from excavation should be tarped during rain events and heavy wind events to minimize dispersion of fugitive dust from the project areas. Active dust suppression should be implemented during all times of open excavation, and "burrito-wrap" process for covering trucks.

Environmental Justice

The argument that "everything must go" must be balanced with potential impacts on where it goes and the remaining results based on removing all the soil over such a large area. In the case of chemical contaminated soils, vast amounts will likely be taken to Buttonwillow and Kettleman landfills, which will require expansion of these landfills and cause undue impacts on these small low-income agricultural communities where residents are already bearing an unfair burden on the basis of keeping our communities safe. Every impact related to dust; emissions and traffic will also impact the receiving communities.

There is a long history of regulatory problems with landfills where the local communities are often low-income and without political resources. Some of these facilities that store disposed hazardous waste have gone bankrupt where there is no remaining responsible party. We must be mindful of impacts to the receiving communities as well as those of the communities that surround the SSFL so that our problem doesn't unnecessarily become someone else's problem in the future.

Thank you for the opportunity to provide comment of concerns and questions related to the cleanup process at Santa Susana. Your efforts to oversee and implement a final remedy cleanup are greatly appreciated by the surrounding communities and I hope our efforts to work collaboratively with responsible parties and regulatory decision makers for a responsible protective cleanup that also protects the living environment that exists today.

Sincerely,

Christina Walsh

Executive Director,
Cleanuprocketdyne.org

Attachments: \MiP Modification in Principle, recently submitted DEIS Comments for NASA portion.

Cc: Ray LeClerc, Debbie Raphael, Paul Carpenter, Tom Skough, Tom Seckington, Buck King, Andrew Bain, Laura Rainey, Raymond Grutzmacher, Craig Cooper, Greg Dempsey, Michael Montgomery, Administrator Bolden, Matthew Rodriquez, Cassandra Owen, David Hung, Senator Fran Pavley, Louise Rishoff, Congresswoman Julia Brownley, Senator Barbara Boxer, Mitchell Englander, Sheila Keuhl, David W. Dassler, Paul Costa, Art Lennox, Steve Shestag, Thomas Gallacher, Thomas Johnson, John Jones, Olga Dominguez, Allen Elliott, Peter Zorba, Randy Dean, Merrilee Fellows, Jason Glasgow, Jennifer Groman, Kamara Sams, Marina Perez, Zenzi Poindexter, Greg Hyatt, Dan Hirsch, Dr. Edward C. Krupp, Dr. Shana Hormann, Mati Waiya, Luhui Isha Waiya, Chester King, Gwen Romani, Dan Larsson.

Santa Susana Field Laboratory affected communities represented by individuals signed herein:
Prepared by: Christina Walsh, with collaborative contributions from individuals listed
8463 Melba Avenue, West Hills, CA 91304 8189225123
This letter is digitally signed by the distribution of individuals listed on the signature pages 44-46 where contact information is available upon request for verification purposes, but omitted here from public copy for privacy purposes that this is part of a public document process.

Substantive Comments on Draft EIS submitted to

Mr. Allen Elliott
Program Director, NASA
Marshall Space Flight Center
MSFC AS01, Building 4494,
Huntsville, AL 35812

And via email to: msfc-ssfl-eis@mail.nasa.gov

Related to:
NASA Portion of the Santa Susana Field Laboratory
Potential cleanup impacts based on current mandate according to guiding AOC [Administrative Order on Consent for Corrective Action 2010]

Presented to: SSFL CAG September 18th, 2013
Community Advisory Group
as appointed by State through H&S Chapter 6.8

Dear Mr. Elliott,
Please find my comments related to the DEIS describing the proposed actions:

Primary concerns regarding presentation of DEIS document:

We want a real cleanup, not a paper solution that never happens…

1. DEIS Provides too narrow of a range of alternatives, allowing for only an "all or nothing" approach that is certain to either devastate the environment we are supposed to be protecting, or fails to complete a cleanup of any kind. Neither of these approaches are acceptable to the surrounding affected public or to the surrounding natural environment according to CEQA. Why are these decisions being made now, ***before*** CEQA review is done by the State?
2. NASA proposing destruction of an entire habitat and state they will potentially impact the Sacred Cave Paintings site and other existing artifacts, as well as the test stands that represent a significant part of our National Space History.

   a. This is unnecessary and goes far beyond the requirement by law to protect human health and the environment. In fact, it further threatens to impact human health and the environment by proposing to move unnecessary volumes of soil that go far beyond EPA health risk requirements. It is also likely to be difficult to find replacement soils that will qualify under the currently written specifications of "local background."

3. NASA fails to employ all parts of the AOC by failing to acknowledge the exception clauses designed to protect and address these issues specifically which qualify under the stated exceptions.
   a. By choosing to ignore one directive of the AOC while also over-simplifying others, **demonstrates a need for limited modification to the AOC agreement** so that a workable, implementable cleanup may be achieved that is measurable. People want to be protected from added risk.
   b. AOC Severability and Modification clauses provide for a limited modification to allow for a responsible cleanup that maintains human health protection as defined by US EPA Suburban Residential PRGs and existing health-risk data being completed for a health-risk assessment on the same deadline ('07 Consent Order for Corrective Action).
4. We thank NASA for showing what "Background Bright-line Cleanup" really looks like:
   a. This is NOT what surrounding affected-residents want as this solution causes unnecessary impacts to the surrounding communities, the ecology and puts the archeological and historic sacred assets at risk without benefit of a measurable improvement to public health. This is not what we can afford to consider when responsible health protective solutions that don't add these unnecessary impacts are available and should be considered.
      i. An approach that does not consider health-risk, fails to consider the impact of removing/disturbing soils that ***do not*** present a health risk.
      ii. Why fill landfills with soils that do not present a health risk?
      iii. What is the impact of that disturbance in the way of trucks, traffic, dust, and unnecessary impacts on these sacred sites?
      iv. Why is mitigation of these potential impacts not being more closely evaluated and presented?
      v. How can these considerations be made if health-risk is not considered in the process?
   b. As pointed out by Dr. Ronald Ziman's comments, "there is nothing in the letter you received from CEQ requires you to exclude other

alternatives. It simply states alternatives need not be mandatorily included. I have to believe that [Senator] Barbara Boxer, who has fought both for the environment and at the same time, the "strictest cleanup ever" in the interest of public health, has been misled and is not working at odds with her own core environmental principles."[1]

<u>Primary concerns regarding communication of NASA decisions affecting the cleanup</u> process and impact on historical and archeo-astronomy related and cultural sacred sites:

We don't want to destroy the natural environment and ecology and sacred archeological sites we are trying to save…

The purpose of CEQA and NEPA are to prevent the solution from being worse than the problem it proposes to solve. There are ways to do this right, responsibly, and protective of human health and the environment without destroying the site. Using *<u>traditional risk-based parameters</u>* to weigh and compare with LUT values will provide for removing only what presents a risk, and thereby reducing the soil excavation burden significantly and being compliant with the law.

1. This "**all or nothing**" proposal goes far beyond protection of human health and the environment and therefore cannot be considered an adequate analysis of reasonable and implementable alternatives.
2. We can see that modification of these specific parameters [outlined in MIP] is needed.
3. Adding PRG comparison and risk assessment standards of suburban residential remediation goals used throughout the regulatory world, will adequately protect human and ecological health, and will provide a solution that is consistent with an existing programmatic agreement in place (for the Record of Decision to follow), which is proven.
    a. Using AOC without modification insists on a process that is not consistent with any programmatic agreement ever used to address a site of this magnitude and is inconsistent with the way these assessments are done by the experts regulating the process.
    b. Adding a comparison matrix to soil environmental condition (undisturbed pristine natural environment would score higher

[1] Dr. Ronald Ziman, DEIS Comment letter from Bell Canyon Association, p. 2

than a debris pile within a former building footprint) so that undisturbed stays as such, wherever feasible based on risk assessment analysis by State Toxicologists to consider those inputs.

4. The AOC provides for limited modification based on change in referenced law[2] ***The Modification In Principle [MIP***][3] articulating the limited proposed changes is provided as "Attachment-A" of this document.
5. **The AOC explicitly defines severability** so that portions can be modified by mutual agreement of the parties without causing the agreement in its entirety to be null and void. In fact, the agreement is severable and can therefore be modified to provide for these additional analysis comparisons to inform the LUT [look up table] decision-tree process for better-informed decisions that consider health-protection as well as ecological protection of existing habitats.
6. **AIP specifically directs** the use of alternative in situ treatments to reduce soil movement impacts, yet the DEIS fails to address any alternatives that utilize this directed, proven, and more sustainable method of action.
7. **DEIS should provide multiple alternatives** that describe specific efforts to minimize those impacts instead of this devastate-all approach.

<u>Important Context not adequately presented in the DEIS or to the public in general:</u>

The <u>*Federal Declaration of Excess*</u> that took place in 2009 did not require a Section 106 process because they "didn't know" at that time, what future use would entail and set that as a future decision to be made. They just put it up for bid to other federal agencies and pushed that question aside.

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[2] SB990 was declared unconstitutional by a Federal District Court, and is the law referenced as the basis for the agreed deal in the Agreement in Principle, which the AOC is based.

[3] MIP Modification in Principle provides for examples of the basis of which changes can occur, and examples of limited modifications on a severable basis that provide for a workable solution that is health protective, as well as protective of the natural environment including all the ancient sacred native American sites, as well as the test stands that mark man's early travels to another world.

- Now: **they are not looking at future use**, but deciding on up to 100% demolition of all structures for the purpose of a clean site for future disposition, even though they don't know the purpose OR if it will stay within, or leave federal jurisdiction. Yet, these decisions propose to remove all valuable assets ***before*** future-use is determined.
- They claim that GSA wasn't required to consider future use when declaring the site excess and now they state that those considerations needed to be commented on in the prior process [Excess Declaration] essentially leaving all public consideration without mechanism to be heard or considered.
- **This NEPA and Section 106 process must slow down for CEQA** considerations, otherwise the process fails it's purpose entirely.
- This process as proposed, ***removes the assets before evaluating the potential*** value of those assets, and then later, when DTSC does their "Soils" EIR, there won't be anything to consider because the test stands will already be gone. NASA and DTSC have stated publicly that their CEQA process will not consider demolition. This is possibly why they are choosing to have the CEQA process follow this process instead of working in tandem as recommended by CEQ [White House Council for Environmental Quality].
- This inappropriate failure to consider future use potential, which is part of the "*purpose and need*" as defined by the DEIS results in an all or nothing approach that threatens the future use that has been defined by the surrounding public as being most appropriate and beneficial to past, present and future generations.

With this kind of backwards thinking, how on earth did NASA ever get to the moon or inter-stellar space?

GSA and NASA defend this decision because it allows for NO ONE to take responsibility. It just happens, and everyone throws up their arms in dismay and points to someone else. This is the ultimate failure in analysis of the actions and solutions proposed. **This is unacceptable**.

The future disposition is in the "*Purpose and Need*" of the DEIS yet NASA chooses to consider that process separately. WHY? Because then, they never really consider it; It just happens.

- 100% demolition of the Test Stands Structures is **NOT** required by the AOC as they are located in un-weathered bedrock and therefore do not require cleanup below the test stands structures. **Any decision to remove the Test Stands, is strictly a NASA decision, not an AOC decision.**

The fact that they separated the process between the NEPA [federal] and CEQA [state] process makes it possible to lose the assets in Demolition phase and then later, **having nothing to evaluate because nothing is left** by the time the "soils" evaluation comes up for review.

> We cannot allow this "cart before the horse" process to destroy human space history which are considered valuable on many levels in the way of future education as well as honoring our past.[4]

As stated by many experts about the proposed actions outlined in the DEIS:

> ***"I believe important and irreplaceable monuments of America's heritage in technology and space exploration are going to be lost .. and we need to know about this imminent threat to these relics of the watershed event in the planet's history, the travel of men from earth to another world."***
>
> ***~Dr. E.C. Krupp***
> ***Director***
> ***Griffith Observatory***
> ***Author, "Echoes of Ancient Civilizations"***

DEIS Comments from Senator Fran Pavley

It is greatly appreciated that Senator Pavley, who has been a long involved voice for cleanup and protection of human health and the environment has emphasized the importance of protecting the communities surrounding SSFL. The impacts described in the DEIS include the concerns described in the DEIS about ***"soil disturbance, changes in surface and groundwater hydrology, displacement of migratory birds and wildlife, and air emissions and fugitive dust, as well as traffic impacts to surrounding communities as contaminated materials are moved off the site to approved landfills." She further emphasizes as we are requesting that protection of human health and safety of the residents who have lived in close proximity to the site, many for decades, while activities were taking place with little or no information about contaminants being disbursed into the air, soil and water from the activities being conducted. I am also concerned about minimizing impacts to other residents during the cleanup of the site."***

[4] Dr. Ronald Ziman [co-signer of this letter] statement on Section 106 Consulting Party meeting held September 18, 2013

Senator Fran Pavley, September 11, 2013
eNews Bulletin

We need to consider the impact on the existing environment/habitat as well as the current residents who will be exposed to potential impacts of the proposed action. It is crucial that the State's EIR consider these issues and do so in concurrence with NASA's investigation so that important considerations are not missed along the way.

<u>Following is the SSFL CAG's press release related to their concerns about the proposed actions outlined in the DEIS:</u>

SANTA SUSANA FIELD LABORATORY COMMUNITY ADVISORY GROUP REJECTS NASA'S DRAFT ENVIRONMENTAL IMPACT STATEMENT [DEIS].

RECOMMENDS NASA AND CAL EPA'S DEPARTMENT OF TOXIC SUBSTANCES CONTROL [DTSC] MODIFY CLEANUP AGREEMENT TO A LESS DESTRUCTIVE, MORE HEALTH-PROTECTIVE SOLUTION.

BELL CANYON, CALIFORNIA - SSFL Community Advisory Group [CAG] voted Wednesday night to reject Draft EIS (Environmental Impact Statement) by NASA, which proposes to limit actions to either an "all or nothing" action that either destroys the environment, or fails to clean up the site. The SSFL CAG further agreed to send a cover letter that includes substantive comments from its members who represent many perspectives from the surrounding communities, but agreed here, that the DEIS proposal went far beyond what is needed to protect human health, and proposes to destroy the existing environment and even potentially impacting the sacred Burro Flats Cave area and historic districts. The CAG had consensus that a modification is needed to the agreement outlining the cleanup requirements, and are proposing a "Modification in Principle" [MIP] as one example of how limited modifications can allow for a protective cleanup that considers health-risk, so that soil is not needlessly disturbed that does not present a risk to humans OR the environment, and further prevents potential impacts to the sacred cultural sites as well as honoring our nations history of Space Exploration.

Deadline for comments is October 1st to NASA at:

Mr. Allen Elliott
Program Director, NASA
Marshall Space Flight Center
MSFC AS01, Building 4494,
Huntsville, AL 35812
or via email to: msfc-ssfl-eis@mail.nasa.gov

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SSFL CAG and many surrounding community members ask that the responsible parties [NASA] and DTSC consider meeting and consult on these topics and potentially include toxicological expertise from within the agency to determine of the proposed changes to the AOC might provide for more reasonable solutions that are implementable to protect the surrounding public health and existing environment?

ES-5.2.2 Air Quality and Greenhouse Gas Emissions

Question not addressed in document:

How many trucks of the estimated number described as 142 truck trips per day will carry steel from test stands for recycling? [please provide these details as the numbers provided in Section 106 process are acknowledged to include all demolition and do not specify the costs/revenues associated with the test stands and control houses (of highest historic value)]

These truck trips are not based on an AOC requirement, but rather on NASA financial decisions that also unnecessarily burden surrounding communities with the dust, traffic, noise, and hazard impacts that are not for the

purpose of health protection or the natural environment. ...Just a Business Decision.

The estimate of truck-trips per day will likely triple and will occur simultaneously as all three Responsible Parties are conducting their soil removal at the same time to accommodate the same deadline. The number when tripled and calculated over the course of daylight hours equates to more than one truck per minute for all daylight hours over the course of several years. This is not only unacceptable, but also impossible when considering the loading and staging requirements that will be needed.

If the steel is not necessary to remove, why add that burden to these already impossible traffic and operational challenges as currently proposed in the Action? This agreement must be revisited to consider these short-comings that make implementation so difficult.

This reminds us of the decision made by DOE to fail the originally proposed Area IV cleanup action by declaring a potential of 1.4 fatality traffic accidents which is the reason for the community rising up and proposing a law that would require cleanup to an "EPA level cleanup" [SB990].

- **Please consider modifying the AOC agreement to allow that in situ remedies be considered, and allow the deadline to be described as "completion of construction**" as was the case, in all prior versions of the agreement so that the time required to achieve cleanup goals allows for treatment time.
- By using health-risk to guide in determining remediation requirement, the alternative in situ treatment methods become achievable and protective of human health. This will reduce truck trips, traffic, and dust impacts significantly as "removal" won't be necessary. It further eases the pressure on landfills that need to focus on soil that DOES present a health risk and therefore requires removal because alternative treatment methods are not possible or achievable.
- A "treat first" approach will significantly minimize the impacts that require mitigation, and that cause damage to the current environment.

We wanted the responsible parties to be accountable to cleanup the site as required to protect human health and the environment. Not different from what we are asking for now. That was reasonable then. Instead we got nothing.

It was the State and Responsible parties who decided to take health risk out of the equation, and by this long and endless block of each action, the equation of time is part of that process and these communities have waited long enough.

time v concentration of COC v pathway to receptor

Without considering these scientific facts, the State and Responsible Parties fail to protect human health and the environment as promised by these agreements.

We must not make the solution worse than the problem it proposes to address. Let's allow risk assessment parameters being prepared under the same deadline, to inform this process so that we don't remove soil that does not present a risk to human health or the environment. Let's be the stewards of the site we always wanted and make these decisions now, before it's too late.

__We can make more informed and responsible decisions by evaluating risk__ so that soil that does not present a risk, is not unnecessarily removed, excavated, and burdening another community.

The State has Toxicologists on staff studying this site, who can assist in making informed risk-based recommendations on how to best protect human health and the environment within this cleanup objective if it can be modified to consider traditional risk-based decision-making.

Recommended steps to mitigate impacts, avoid unnecessary impacts and provide a sustainable solution moving forward:

Limited Modification in Principle [MiP] of the signed AOC (2010) by mutual agreement of existing parties for the purpose of making the AOC signed, workable, achievable, protective of human health and the environment, and implementable as long promised to the surrounding communities. Time is part of the equation to risk for the surrounding residents and ecological environment. We have waited long enough.[5]

How will we be protected if <u>nothing</u> ever happens?

How will we be protected from unnecessary impacts of trucks, traffic, fugitive dust pulmonary impacts to surrounding residents where the body burden is already very high.

How will we be protected from unnecessary impacts to this unique ecological habitat when such drastic soil excavation (the top two feet of everything is essentially all living things) **<u>when these actions are not required to protect human health based on risk assessments currently understood?</u>**

How will irreversible impacts and possible destruction of our nation's Space History as well as irreplaceable ancient sacred Native archeological sites that can never be replaced be addressed? **How will NASA explain this decision** after fifty years of keeping these treasures behind locked fences?

We cannot believe that this is the current attitude after so many years of a long involved community clearly communicating otherwise.

We ask NASA and DTSC to please reconsider these decisions and contemplate this minor modification to provide toxicological parameters for the purpose of informed decision-making and best protecting human health and the environment.

How is it possible that NASA is not more proud of these beginnings as we are? This is truly a travesty failing to seriously consider implementable solutions that are *<u>health protective and protective of the environment</u>* we are trying to save and protect.

Santa Ynez Band of Chumash Indians has requested a "treat first" to avoid impacts where possible, approach. We support this methodology and echo the need for this approach and effort.[6] There needs to be a real effort here as the AOC mandates this

[5] MiP Modification in Principle as described in [Attachment-A]
[6] Santa Ynez Band of Chumash Indians letter September 30, 2013, page 12, para. 12 "Exhaustion of non-excavation methods of remediation…"

approach according to page 11, paragraph 5. If the AOC is an enforceable document, then **all portions of the AOC must be adhered to.**

ES-5.2 Water Resources

This section describes a moderate negative, local and long-term impact based on water resources where demolition would remove impervious surfaces (which would also allow for percolation and recharge of groundwater). Additionally, current impacts to groundwater pump and diversion actions as required to prevent discharge is having a negative long-term impact on the receiving mesic riparian habitat (1.4 miles of riparian habitat is now bone dry and being ignored by these same reviews)

> *Background:* Current measures to pump down groundwater levels to prevent seeps from emerging are ***not analyzed or recognized*** for these impacts despite continued requirement to manage these emergences due to existing VOC contamination. This is an action that is being required by DTSC, and is resulting in a long-term loss of ecological water resources, and has already been described to have dried a perennial stream that feeds Bell Creek[7] according to many residents, a mesic-riparian habitat, and is a primary water resource for the wildlife corridor, migratory species and has been severely impacted as a result for two years now. Why are these current impacts not being analyzed when they have been observed to already be happening by hundreds of residents?
>
> Why does this environmental analysis only occur to benefit the polluter?
>
> *Why is the responsible party not accountable for these current impacts that have been communicated for more than a year by residents?*

[7] Bell Creek impacts include 1.4 miles of riparian perennial habitat described as "rare, high-quality, pristine habitat" which is now dry.

<u>Key comments provided and concerns highlighted during Section 106 process</u> (including recent consulting members call on 9/11/13:

- SHPO asked for clarification that Demolition of the test stands is to prepare the site for cleanup, and then a separate action is to prepare the site for excess to another agency. Is it true that transferring of the site is not being considered in this DEIS. We aren't considering what we are going to do with the site.
- Allen Elliott, NASA confirmed that the costs presented are for everything, not just for the test stands. "it is my opinion that you can clean up around them to meet the AOC. That may not be true of the control houses (alfa specifically).
- Transfer out of federal government, IF that happens and we don't know of that is happening. If they do transfer it out of the federal government, GSA would have to do another 106 at that point. This means that efforts to save anything will not be heard when considering demolition separately.
- "So, where is consideration of saving the test stands part of the evaluation?"

[GSA] Biederman: The issue of excess is long past and they did a NEPA analysis for that action and now they are doing this action.

- So NO ONE considers what to do with the property for this decision to be an informed decision, and this means that
- NASA says that it's in the purpose and need, so how can it be a separate action?
- This is truly piece-mealing and artificially segmenting the process to essentially avoid any proper analysis or "decision" being made by anybody.

Native cultural considerations of the Coca area as being appropriate for demolition and any historic preservation of test stands or portions thereof for museum preservation, should be focused on assets from Alfa and Bravo districts.

- As stated by Santa Ynez Band of Chumash Indians, "official recognition in the DEIS need to be made of the areas surrounding Burro Flats" according to according to EO 13007[8]

Key points understood from the call based on the comments by many:

NASA stated that they *could* go around the test stands, and this certainly emphasizes the need to modify the look-up table section of the AOC to accommodate for risk considerations which seem to be what everyone wants: protective of human health and the environment.

NASA also stated the AOC as reasoning when we have shown that the AOCs are not the reasoning (blame assigned to deflect from NASA as a decision).

Now they are stating cost, but in the costs they present, are the costs of remediating the drainages as well – which is NOT what we are trying to prevent or save. Encapsulation should be necessary in either action of they are claiming it to be a mandate for the purpose of liability issues. Those issues exist whether you choose either alternative since the Test Stands are not required to be demolished in order to comply wih the agreement. Those issues need to be clearly understood and presented by the responsible parties and regulatory reports presented to the public.

ES-2.1 Public Involvement:

- While comments included an effort to politically limit the range of alternatives, the letter from US Senator Barbara Boxer that NASA uses to justify this decision, provides only one alternative (… or nothing) and does not provide for a reasonable cleanup, or a rational basis to destroy such a large eco-system that includes removing soils that do not present a risk to human health or to the environment according to US EPA Public Remediation Goals.
- During the course of the two years of meetings, multiple options were presented as a mechanism for defining "how to achieve project

[8] Letter from Santa Ynez Band of Chumash Indians dated September 30, 2013 page 10, para. 9. Entire southern half of Area II District needs to be protected. Sec. 3.3.3.4, p. 3-17.

objectives" meaning to provide for meaningful alternative in situ methods to reduce soil volumes and in fact, goes so far as to direct the process to use alternative in situ methods "**to the maximum extent possible**"[9] within the AOC agreement, yet the DEIS flatly dismisses this entirely and provides ZERO effort to comply with this directive while simultaneously claiming to comply "to the letter of the AOC."

- The surrounding affected public attended dozens of meetings to discuss alternative options, to educate themselves on these technologies and weigh in, because of the importance to protect the environment, and NASA has dismissed all of these methods leading the public to wonder if the entire process is really sincere.
- The 756 comments referenced in this section ask to preserve the valuable natural, historical, and cultural resources at the SSFL yet the DEIS says plainly that all of these valuable resources will be impacted and potentially destroyed.
- CEQ comments as presented " CEQ encourages agencies to carry out robust alternatives analysis that consider all reasonable alternatives including those that are not within the agencies authorities. The real focus, however, must always be on a meaningful consideration of alternatives. In this particular situation, where NASA has signed the Agreement and committed to a cleanup standard to "background," nothing under NEPA or CEQ regulations constrains NASA from looking beyond cleanup to background, even though some may consider the analysis unnecessary and inconsistent with the agreement NASA signed with the State…"
  - Yet the DEIS presented for comment directly ignores CEQs directive and the comments by the public, and only considers two scenarios: all or nothing (no action alternative) providing no potential for a responsible cleanup.
  - All effort to minimize soil movement through alternative in situ treatment are ignored despite this directive being contained within the AOC signed by NASA and the State.
- Based on CEQ analysis of these letters submitted, it states that NASA is not compelled to consider less comprehensive cleanup measures…
- But nothing ***prevents*** NASA from doing so. NASA is ***choosing*** not to.
- **Follow the AOC to the letter, but ignore page 11?** How is this reconciled or justified?

[9] using alternative in situ treatment methods "to the maximum extent possible" (page 11, section 5 of AOC final agreement)

ES-2 The statement that NASA will analyze only the alternatives of (a) cleanup to background and (b) the no-action alternative fails to protect the areas specifically directed by CEQ and the AOC itself.

Multiple comment letters were also received that question this decision and ask that NASA reconsider its decision to limit the alternatives including a legal memorandum prepared for the Santa Ynez Band of Chumash Indians that questions the legality of limiting the scope of an EIS to only a Proposed Action and a No Action Alternative. Further, the Chumash legal memorandum and other comments specifically state that every effort should be made to reduce soil impacts, and ground disturbance where possible (consistent with the AOC) by employing alternative in situ methods yet NASA dismisses these directives entirely. Making claims of strict compliance is disingenuous at best.

Statements made by NASA that "DTSC will only review soils impacts" during their review which will occur a year after the decisions of demolition may remove any/all structures prior to an evaluation to save them. This makes the entire process **invalid and indeed illegal** as it fails the purpose and intent of the California Environmental Quality Act as well as the National Environmental Policy Act.

CONCLUSION of Alternatives Evaluated:

- Following the AOC so stringently, while dismissing specific segments of the signed agreement that provide for this protection fails to follow a Programmatic Agreement [PA] without justification and instead chooses to follow a process that is NOT consistent with existing programs such as RCRA and Superfund and this bright-line AOC approach is unproven and not consistent with any existing programmatic agreement for a site of this size and complexity according to US EPA staff involved in this process throughout Radiological Survey that was recently completed.
- The National Historic Preservation Act requires that Section 106 consultation process [under NHPA regulations 36 CFR 800] be followed, but in this process, the same limitations by presenting too narrow a range of alternatives, prevents the process from being followed effectively for the purpose of historic preservation.
- Separating the NEPA and CEQA processes instead of proceeding in tandem, provides for deadlines to be missed and unnecessarily dismisses primary directive of "how" to achieve the objective from the process.
- It is inappropriate to assign a single ROD Record of Decision to apply to the entire site without additional considerations such as the range of exceptions designed to protect sacred and historical sites, and without providing a graded range of "soil environmental condition" so that undisturbed areas that have had no operational impacts are preserved instead of destroyed.

- All mechanisms and tools available to reduce soil excavation and disposal quantities should be employed so that all impacts to the aforementioned categories (traffic, noise, fugitive dust impacts on pulmonary receptors, greenhouse gas emissions, and most importantly, the complete destruction of 105 acre habitat), as well as, burden on existing landfills.
- Instead, we are seeing complete dismissal of all mechanisms to reduce impacts as promised over the course of years of meetings and presentations to the public.
- These alternative mechanisms (including soil sorting for impacted excavation areas to reduce removal and disposal volumes on a significant basis) are dismissed by blaming the very document that directs these actions to be considered "to the maximum extent possible".

ES-3.0 Alternatives Evaluated

Demolition and soil cleanup to background levels are separated in evaluation process, yet cost estimates provided to the public and consulting parties includes cost of both demolition and soil cleanup (unfairly presenting an inflated apparent cost for saving "test stands"

- The public has asked for specific costs associated with saving only test stands and control buildings and should therefore exclude the cost requirements associated with soil cleanup, and demolition of structures, piping, utility poles, water tanks and drainage ways (the most impacted should not be included in test stand cost)
- With NASA's long history of being the protective stewards of the Native Chumash sacred sites, it is truly unconscionable to fail to protect them now.
- We request specific cost recovery mechanisms to be detailed publicly including the cost/benefit of the potential steel recycling revenues that may counter the other costs. These are important for the public to understand clearly.
- Given the legal memorandum submitted by Santa Ynez Band of Chumash Indians, a stewardship solution that provides sustainability mechanisms through museum preservation, open air tours and education of cultural resources and national space history monuments could easily provide the required revenues to fund maintenance and should be considered here, prior to a short sighted decision to gut our history.

We want the forward thinking that did get NASA to the moon beyond, and now into inter-stellar space which all began at this site.

Alternatives evaluated as presented in DEIS states that "up to all structures will be demolished including test stands" even though the test stands are located in weathered and un-weathered bedrock and therefore are not part of the AOC requirement. **It must be made perfectly clear that the decision to demolish history is a NASA decision that may be based on financial and liability decisions, but should not be stated as having an AOC basis.**

> This idea that we are supposed to interpret All or Nothing to equate to mean a range from ***<u>nothing => anything</u>*** fails the purpose of this analysis, which is to consider logical and rational responsible solutions and find the best one so that we don't make the solution worse than the problem.
>
> We have outlined here, a method to inject reason and health protection providing the basis for a green, sustainable, long lasting and health protective solution that honors the past and recognizes the existing wildlife habitat and provides for a sound future and minimize negative impacts of the actions proposed. Please consider.

<u>ES-3.1.2 Proposed Soil Cleanup Activities</u>

All non-treatable soils should use "soil sorting" for the purpose of identifying the particle sizes associated with the COCs driving the soil excavation so that a portion sent for disposal and burden on other communities can be reduced. Native Cultural Monitor for all such process should be required.

Limited modification to AOC to utilize risk-based limits so that alternative methods are achievable (Suburban residential health risk standard as prescribed by USEPA) making the action protective of human and ecological health, and also provides for many alternative in situ programs to be employed to drastically reduce the impact to the current environment.

The designation of "treatable" also fails to be employed on the basis of a change to the deadline from all prior agreements upon which the 2017 deadline is based. All versions of this agreement including the 07 Consent Order for Corrective Action, and all versions of the AOC through 1.9 include the requirement of all in situ treatment to be "constructed by 2017" not completed, as it is understood that these methods that require time for degradation processes to occur, cannot be completed by 2017. This modification of the AOC is necessary to make for a workable sustainable solution that the AOC itself directs.

The AIP which the AOC is written from specifically states that the "2017 deadline shall remain the same" which demonstrates the fact that this deadline is driven from the prior agreements and therefore cannot be made shorter, while also making the requirement (background) larger.

This AOC path forward [unchanged] is designed to fail and therefore must be modified.

The alternative soil treatment technologies as outlined in ES-3.1.2.2 are all dismissed based on an internally defined conjured deadline and therefore fails to follow the AOC it of which it claims to be based.

In the definition of "treatable" it states that excavation is the only "proven" method despite a decade of proven technology data available. These are not new and emerging technologies, but rather existing and already proven effective at residential standards and therefore should not be flatly dismissed here.

ES-3.2 No Action Alternative -- Unacceptable

This analysis fails to protect human health or the natural environment. This analysis proposes that no demolition of test-stands would occur and does not require an encapsulation as described by NASA when pushed to answer the questions about the test stands.

> Why are liability requirements used to justify demolition not required under the no action alternative?
>
> This appears to show that this is a false claim with no real basis according to the AOC, but rather a decision by NASA.

Evaluation Criteria for Analyzing Environmental Impacts and Region of Influence are incorrectly characterized and described. These categories fail to address the underlying issues we request to be addressed further.

Why doesn't 'leave in place' solution under the "no action alternative" also impose maintenance costs for encapsulation and annual maintenance an paint fees when these requirements are being imposed to respond to an effort to save the test stands. Further, why are the costs provided and presented to the community also including the encapsulation of the "entire district" which includes contaminant impacted drainages. **We aren't trying to save the contamination, but the history.**

This can be done as it is acknowledged that the problem is in the drainage, not in the rock below the test stands. Please provide these numbers separately by district structure for Alfa, Bravo and Coca and provide costs by structure, so that test stands can be differentiated from the cost of remediating the soils, concrete, and support structures that do not represent historic value.

ES-5.1 Significant Impacts

This describes erosion impacts to be short term despite the proposed action only includes a 30% replacement of excavated soils. Considering the existing steep topography, it is unclear how this impact will be temporary since these topographic changes will be long term by definition. The soil won't grow back. Most importantly, the living biota, flora and fauna will all be destroyed to which there is no legitimate or adequate mitigation presented.

The proposed action calls unnecessarily for the demolition of historic structures on NASA administered land at SSFL having significant negative local and long-term impacts, yet the AOC does not require this. **Why is NASA not making any effort whatsoever to save the national history that it is capable of saving through the more accurate and protective interpretation of the AOC.** These historic structures are not located in soils but in rock and therefore do not require removal. NASA staff has acknowledged that these can be worked around, so why is there no acknowledgement provided with in the ROD process that is intended to protect the site by evaluating the solution to be sure it isn't worse than the problem. **The AOC MUST be modified on a limited basis to account for these very real details that can provide for a responsible cleanup that honors both the past and the future.**

1. Soil prior disturbance is NOT dispositive:
2. Disturbed sites are not valuable is not necessarily correct.
3. Disturbed sites may still contain valuable information.
4. Disturbed sites may still have spiritual significance.
5. Disturbance may only be on the surface. Some excavation will be much deeper.
6. Need to analyze for cumulative impacts to cultural resources.

As described by the Chumash letter, deferral of mitigation until Record of Decision [ROD] is problematic as it prevents meaningful comment, and fails to consider impacts of demolition that are within the "purpose and need" as described in the DEIS. How can this be artificially segmented?

ES-5.1.2 Cultural Resources

This section fails to acknowledge the specific exceptions written in the AOC. These exceptions are designed and written for the purpose of protecting the Burro Flats Cave Sacred Site as well as other smaller sites. NASA fails to acknowledge that the word "artifact" includes sacred cave paintings, which are considered among the most well-preserved in North America and estimated to be 1,000 years old. This failure demonstrates an unwillingness to use the portions of the AOC intended to protect the past, to do so. This is of great disappointment and is indeed inexcusable. NASA must acknowledge the purpose and intent behind each and every point within the *Agreement In Principle* [AiP] which the AOC was based upon, to include the specific sections written by and agreed to for the specific purpose of protecting these important sites.

This kind of finger-pointing and refusal to take responsibility is a violation of the AOC principals signed and agreed to. The idea was "to stop trading paper and get to work." Not trade paper forever. Proper mitigation for the cultural impacts proposed by the action:

1. NEW MITIGATION: Cultural Interpretive Center.[10]
2. NEW MITIGATION: Native American monitoring during any ground disturbing activities.
3. NEW MITIGATION: First Native Chumash National Park[11]

It is inappropriate for NASA to choose to define "artifact" now as something limited to exclude this ancient sacred site that indeed inspired the need for this clause in the *agreement in principle*[12] which the AOC is based.

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[10] as proposed by Native Chumash comments from Santa Ynez Band of Chumash Indians [September 30 letter] as well as other local tribe representatives and native cultural organizations.
[11] As proposed by many Native Chumash as consideration as best stewards of this land.

For example, the National Register defines a "site" as "the location of a significant event, a prehistoric or historic occupation or activity, or a building or structure, whether standing, ruined, or vanished, where the location itself possesses historic, cultural, or archeological value regardless of the value of any existing structure." Further, a culturally significant landscape may be classified as a site, as may be the specific location where significant traditional events, activities, or cultural observances have taken place. There are many books written that reference this culturally significant site for this reason and must be acknowledged here that clearly define this site as significant within our human history. [13]

- Significance should also include that of religious history, scholarly secular recognition as defined by the National Registry.
- The fact that a property may have gone unused for a lengthy period of time, with use only beginning again only recently, does not make the property ineligible for the Register, especially since non-use is associated here with lack of access provided.

This section describes the burro flats site as being 0.65 acres and certainly any proposed soil removals would be under the "5% exception clause" since 5% of the proposed soil removal of 500,000 cubic yards is 25000 yards and it is clearly known that the soil in this area (even if you were to remove all of the top two feet of soil in the 0.65 acres would not exceed this limit, so it is confusing to see NASA threaten this impact when it can clearly be handled within the agreement as currently written. This points to an underlying political pressure being exerted and really driving these decisions making promised transparency somewhat of a charade.[14]

In addition to the sites listed in the report, there are other native sites both in Area IV and to the north and south of the NASA owned area, which indicate a strong likelihood of additional sites to be located within the boundaries of the proposed action. This demonstrates a need to take the utmost care in making these decisions and political strategy that puts these sacred areas in potential harms way should not be allowed.

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[12] Agreement in Principle is a supplemental attachment to the final signed AOC and lists the principles, which were agreed to that allowed for, and provided the decisions made by the AOC.
[13] Dr. E.C. Krupp, Echoes of Ancient Civilizations, Dr. Al Knight Archeological study incl. other studies: Clive Ruggles; Dan Larsson, ….
[14] Letter from US Senator Barbara Boxer mandating that this "all or nothing" approach be pursued without a range of more reasonable health protective alternatives that also protect the environment be made available for discussion and debate.

SSFL has been formally identified by the Santa Ynez Band of Chumash Indians as an Indian Sacred Site under Executive Order 13007 and the proposed action seems to dismiss this Executive Order and the importance of this consideration by the limited range of alternatives that are artificially imposed on the surrounding affected public.

ES-5.3.3 Hazardous and Nonhazardous Materials and Waste

Demolishing the test stands is acknowledged to be a long-term negative impact, and is not required by the AOC and therefore should be mitigated by acknowledging their historic preservation value and eliminating this impact. A large majority of the 3000+ truck trips for demolition, can be eliminated by saving these historic sites as is being requested by nearly the entire surrounding affected communities.

ES-5.4 Summary of Impacts, Best Management Practices, and Mitigation Measures

It is strongly recommended that the summary of cumulative impacts be addressed to consider the obvious mitigations so that a reasonable solution can be attained. This emphasizes the need to revisit the negotiating process to modify the AOC in a limited manner so a workable and reasonable, and health protective solution can be achieved.[15]

- DEIS fails to consider cumulative impacts of other remedial activities ongoing at the site by the other responsible parties all working based on the same deadline and will be engaging in these activities concurrently.

Section 4.2 Soils, landslide potential, topography, and paleontological resources:

Significant, negative, long-term for action, and negligible, negative, local, and short term are how no action alternative is described. This incorrectly assumes that a total lack of cleanup of contaminated soils that represent health risks potentially for centuries moving forward will carry a negligible impact? This fails to analyze and evaluate the no action alternative as a viable possibility when it is indeed the only alternative provided, other than total destruction of the site.

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[15] Specific exclusions addressed within the AiP which the Administrative Order on Consent for Corrective Action was based. These include a 5% soil volume to allow for protection of the 0.65 acre Burro Flats Cave site. Ignoring these exceptions provides for an unrealistic message and in fact potentially unnecessarily puts these areas at risk.

Section 4.3 Cultural Resources

This table summary describes the impacts as significant despite the fact that no sampling data proposes that these soils require removal. Pending Consultation, significant mitigation will be required to address this unnecessary destruction of native history and culture.

What sort of mitigation could possibly come even close to comparison to the damage to irreplaceable sites this action proposes to destroy?

Section 4.4 Biological Resources

Moderate regional long-term impacts from failing to address the contamination impacts that present a health risk to either the environment or human health of the surrounding communities which will never be resolved if no actions to protect human health are taken. The purpose of CEQA is to protect the site from a solution that is worse than the problem itself. NEPA is also supposed to evaluate alternatives to avoid such impacts for the same reason. In this case, the processes are separated so that cumulative impacts are not evaluated and therefore missed. The damage to the environment will be devastating and for no measurable increase in protection of public health**. Then for what purpose are these extreme and unnecessary actions really being considered?**

Political??

Section 4.5 Traffic and Transportation

Significant impacts as described are also likely to be impossible considering the proposal that puts hundreds of trucks in the same place at the same time. During daylight hours this would likely equate to mean one truck leaving every single minute for years at a time. This proposal is with out merit in the real world.

Section 4.6 Water Resources

No action on the impacts to water resources will continue to present a health risk to the surrounding environment and public health as well as degradation to the California resource, which requires protection according to California's non degradation policy for groundwater resources.

<u>Section 4.7 Air quality and Greenhouse Gas Emissions</u>

Mitigation to these impacts can be partially achieved by using in situ alternative treatment methods to the maximum extent possible to avoid and reduce required truck trips and traffic emissions.

<u>Section 4.9 Health and Safety</u>

Impacts to a no action have significant long term impacts on the local environment and therefore emphasizes the requirement for health risk to human health and ecological health risk be considered.

<u>Section 4.10 Site Infrastructure and Utilities</u>

It is advised to maintain water storage resources to maximize opportunities for sustainable solutions to address soil treatment and needed groundwater treatment plans that protect local habitats during treatment cycles. Why build it if it already exists?

<u>Section 4.12 Hazardous and nonhazardous Materials and Waste</u>

In addition to this moderate negative long-term impact by failing to act and protect the surrounding public, the answers and uncertainties will never be addressed making any potential for a real future for the site to be negligible at best.

<u>Section 2.10 of the AOC as described in the MIP should be modified</u> to reflect current waste disposal classifications and directives to prevent problems with disposal needs required by the implementation of the proposed action. Enhance this section by specifying that alternative methods of in situ treatment to reduce and minimize burden on landfills, truck trips, etc. will be employed "to the maximum extent possible" as prescribed in the AOC[16]

[16] AOC Administrative Order on Consent for Corrective Action signed December, 2010, Page 11, paragraph 5.

Table ES-5 Summary of Cumulative Impacts without Mitigation or Best Management Practices

> ES-5 presents the cumulative impact on cultural resources as significant and negative and specifically references the "cave site" as being impacted long-term when there is no specific sampling data that supports this claim. Further given the size of the specific "cave site" referenced, the exceptions defined, would appropriately be able to protect this area to the maximum extent possible. The summary is in fact inaccurate, and unfairly presents a picture of certain destruction and "nothing" as the only possibilities.
>
> This is inappropriate and irresponsible to put these areas at risk in this way when it is not necessary to meet health-risk requirements by law, and there is no existing programmatic agreement used to guide such cleanups that DOES NOT consider risk as the primary means to measure needed remedial actions and mitigation.

ES-7.0 Summary of proposed mitigations:

No adequate mitigations are proposed in this action where ***complete-destruction*** or ***no-action*** are the only alternatives.

Most of the analysis of impacts presented in the aforementioned table [Table ES-5 Summary], do not consider more reasonable and health protective as well as legally compliant methods of considering risk inputs [as prescribed in examples shown in Attachment-A (MiP)] which would prevent these areas from being put at such risk. In this proposal of action, 62 acres of open-space is proposed to be devastated, "…requiring complete removal of all existing vegetation such as shrubs, plants, and trees. Additionally, removing large volume of soil would change soil profiles creating soil instability, decreased vegetative biodiversity and increased spead of invasive weeds"[17]

Reasonable alternatives that are protective of human health and the environment need to be presented, and for that to be measurable, risk comparisons need to be made. Please consider a modification to the AOC that allows for this risk information at Suburban Residential, using state toxicology expertise to weigh with current lookup tables and provide alternative methods to be used to achieve these similar objectives (based on health-risk).

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[17] Shown in ES-11.0 "Unavoidable Impacts" are unnecessary to comply with law, or to measure protection of public health and the environment.

Consideration of current environmental soil condition is necessary to employ best management practices in protecting that which is undisturbed open-space wherever possible.

Proposed mitigation should include ceremonial areas for use by local Tribes to encourage outreach and education about their traditions for the future. According to [40CFR 1508.20, replacing or providing substitute resources or environments" by "compensating for an impact" is where the first alternative proposed should be to prevent impact to these resources, and because these resources have not been available for scholarly secular research or religious or ceremonial purposes to allow for that education within the local community to exist, every effort should be made here to provide ceremonial areas in addition to and nearby cultural resources so that presentation of these cultural traditions can be made for the future.

<u>ES-8.0 Incomplete and Unavailable Information</u>

"Should substantial new information become available that conflicts with the EIS and indicates significant increases in potential environmental impacts from the proposed action, the environmental impact analysis would be updated as needed."

NASA has demonstrated that the actions proposed are unacceptable as are the alternatives presented and therefore, the environmental impact analysis should be updated upon modification of the Look up Table [LUT] requirements so that a feasible, implementable, and effective alternative can be presented for analysis with multiple technologies acknowledged to be feasible, presented as alternative methods to achieve the objective to a health protective and environmentally sound cleanup goal.

- New sites have been discovered throughout the SSFL site including in Area IV through the RAD survey, as well as in other areas in the undeveloped areas. This indicates that there is much that is not known and great care must be taken when considering disturbance of these soils. A proposal to devastate the top two feet of everything living on 105 acres cannot be justified and must be reconsidered.

<u>ES-9.0 Required Permits, License and Approvals</u>

Completion of CEQA evaluation prior to Record of Decision is necessary BEFORE any demolition decisions are made on historic or sacred areas. It is inappropriate to move forward without CEQA full evaluation, which should be happening in tandem so that NEPA and CEQA processes can best inform one another to ensure that protection of the existing environment is maintained.

Since the Section 106 process referenced here separates the review of demolition of assets from review of soils (during the later CEQA phase) the purpose of these requirements is NOT met, therefore failing CEQA, and NEPA and providing an inappropriate record of decision [ROD] that allows for only one solution that fails the purpose, or no action at all. These permit requirements must be coordinated so that CEQA and NEPA are done and considered during the same review time-period.

<u>ES-10.0 Agency Consultations</u>

We ask that NASA consult with DTSC decision-makers and to consult using mediator if useful, to attempt to see if these limited modifications (or similar ideas of limited modification) to utilize the existing work and provide a better, more traditionally measured, risk-based solution path forward, that allows for an environmentally sound cleanup plan that meets health-risk standards and is compliant of the law. Using health-risk standards as a measurable tool to determine level of safety provided to the surrounding communities, and is in keeping with the regulatory decision processes utilized by the regulatory agencies to be most effective at achieving water and soil quality standards.

Please also consult with US Senator Barbara Boxer's office to see if these efforts to protect the existing environment, the sacred sites and our nation's history can be attained by considering risk so that measurable, and better-informed remedy decisions can be made.

Please consult with the Santa Ynez Band of Chumash Indians to see if they would be willing to steward this process to see if a future use consideration can include an open space open air cultural and historical museum park. Many experts have spoken about these valuable assets being protected and we ask that those discussions be given real consideration.

Please consult with other local tribe cultural representatives [both federally recognized as well as non-recognized native cultural groups] as several tribes are expected to have history with the site.

Please consult with Department of Wildlife and consider their long-term concerns and we ask that their staff be given a full presentation and review of the impacts as proposed.

Please consult with Ventura County to consider the Oak Tree ordinance and how it will be navigated considering the proposed action seeks the removal of all trees and vegetation in a 105 acre area that includes steep drainages where erosion considerations and streambed modification must be considered.

Please consult with Los Angeles Regional Water Quality Control Board about their interim measures, long term effects of the actions proposed as well as the impact on the discharge permit [NPDES][18] held by the responsible parties.

ES-11.0 Unavoidable Adverse Impacts

- "Implementing the proposed action to meet 2010 AOC would result in the excavation of non-treatable soils to the depth of 2ft (and in some places 20ft) from approximately 105 acres" yet they are claiming this mandates impacts of the native burro flats site, (where no samples have been taken to support this claim) and the 5% exception clause could easily accommodate this and all other sites (0.65 acres) but NASA chooses to put them in harms way despite the **fact that the** **AOC DOES NOT REQUIRE IT**
- This is a NASA decision and it is dishonest to blame the AOC for this very irresponsible decision that in fact betrays the long involved communities.
- This is truly the worst idea ever. There is no legitimate reason to consider this level of destruction that does not protect human health any more, and destroys an entire eco system and creates serious adverse impacts to the surrounding communities. This must be re-thought to consider passive treatment systems, sustainable treatment systems that consider long range solutions and not just the short term compliance of a law that has already fallen.
- A proposal to devastate the top two feet of everything living on 105 acres cannot be justified and must be reconsidered.

ES-12.0 Relationship between Local Short-term Use of the Environment and Long-term Productivity.

- If NEPA requires this analysis, why has NASA failed to present this analysis within the DEIS material and why is NASA not providing for a range of alternatives to provide opportunity to save these historic structures and sense of place sacred areas in Burro Flats and other designated areas.

[18] NPDES: National Pollutant Discharge Elimination System Permit as held by The Boeing Company and NASA and DOE as the dischargers of storm and surface water.

- It is inappropriate for NASA to claim that cleanup of soils to LUT values reduces risk when risk is not considered. In order to make such a claim, RISK ***must*** be considered on a prominent basis.

ES-13.0 Maintenance and Enhancement of Irreversible and Irretrievable Commitments of Resources

Based on the statements made in the Section 106 consultation, it seems that no effort to protect these resources is being made because the process is being split where demolition is not examined and future use is not considered. This is a complete betrayal of the process we have all committed to follow.

We request that this information be made available and clearly define the costs that relate to disposal of materials, versus recycling revenues associated with steel from the test stands and concrete from the drainages, roads, and building footprints. The goal is to save what is most feasible, most presentable and is able to help tell the story of our Nations Race to Space.

Section 1 – Purpose and Need

Since future use is described as being part of the defined "purpose and need", why does the DEIS fail to analyze for these potential decisions within the process. By artificially segmenting this decision-making process, the DEIS fails to inform it's primary purpose: **to protect the site solution from being worse than the problem it proposes to address.**

1.4 Decision to be Made

Modification of AOC to provide for reasonable alternatives for an updated DEIS to present and analyze, is necessary.

Record of Decision should be examined for each of the regions of influence (ROI) and should evaluate multiple methods of reaching a health protective legally compliant cleanup that protects the current natural, cultural and historical features and assets currently present within the site boundaries as well as within the bordering areas of the Santa Susana Field Laboratory. These decisions need to be responsible for addressing the complexities that arise by the differences in land ownership and requirement for action.

ROD needs to be done in detail, by area using alternative non-excavations methods first (within the Decision-tree process).

Non treatable areas should employ soil sorting for the purpose of reducing soil movement and disposal (burden on landfills) and long term phyto sequestration solutions for the groundwater challenges that will span many generations.

All treatable soils should be considered for alternative in situ methods so that truck traffic, burden to landfills, greenhouse gas emissions and fugitive dust impacts can be minimized to the maximum extent possible. Limited modification of AOC to allow for completion of construction so that these technologies may be prominently considered based on human and ecological health-risk levels.

Test Stands are not in soils and therefore should not be part of the "requirement" but rather, to be discussed and debated so that reasonable and rational and sustainable decisions can be made to protect our national history.

Sacred Cultural Areas should not be part of this decision, as nothing based on science (sampling or otherwise) requires this potential harm to take place. It is clear that these areas should be declared protected from impact by this record of decision and all related decisions in this complex process moving forward.

<u>2.2.1 Groundwater</u>

GETS system must be modified to discharge treated water in a balanced manner so that the drainages that have historically been riparian, remain so. Current impacts as a result of this effort by NASA and Boeing has resulted in adverse impacts to 1.4 miles of Bell Creek from the water diversion to outfall 19. Please consider moving this discharge to outfall 2, and to balance with pumping that may occur to the north where similar mitigative measures will be necessary to protect those watersheds and habitat.

Deeply concerned that demolition seems to include these long term treatment systems that are acknowledged to be needed for decades and possibly centuries. How can we be pulling them offline now? Especially given that the biggest challenge to be addressed is the groundwater impacts and how that will affect surface water impacts in the future.

The groundwater responsibility by the parties, MUST be acknowledged by NASA and Boeing as we will not accept any more "wait and see." As previous promises have not been kept.

Comprehensive groundwater solutions are primary to achieving the objectives presented in the cleanup agreements and they must be modified to be workable and implementable. A site-wide seep and stream study to best understand all potential migration pathways of existing contaminants must be more clearly understood and presented to the surrounding affected public.

<u>2.2.1.2 Pre-demolition Activities</u>

Standard Operating Procedures must include a sample per bin (not multiple bins) policy to ensure that adequate health protection is achieved. This is especially important given the impacts in many of these areas are of multiple COCs that co-exist within the same soil profile requiring action.

<u>Table 2-2-1 NASA Administered Structures proposed for Demolition</u> and their NRHP and Biological Considerations:

1. 2727 Alfa 1 Test Stand is individually NRHP eligible and also has potential as bird nesting and bat roosting area. Contributes strongly to America's space history.
2. 2729 Alfa 3 Test Stand is individually NRHP eligible and also has potential as bird nesting and bat roosting area. Contributes strongly to America's space history.
3. 2729a Alfa 3 control station shack is individually NRHP eligible and also has potential as bird nesting and bat roosting area. Contributes strongly to America's space history.
4. 2739 Stand talker Shack contributes strongly to the story of America's space history.
5. Road to test facility should be maintained for access and infrastructure purposes. This otherwise adds unnecessarily to the negative impacts felt by neighboring communities that serves no real purpose.
6. 2730 Bravo 1 Test Stand is individually NRHP eligible and also has potential as bird nesting and bat roosting area. Contributes strongly to America's space history.

7. 2214 Bravo Terminal House is individually NRHP eligible. Contributes strongly to America's space history.
8. 2731 Bravo II Test Stand is individually NRHP eligible and also has potential as bird nesting and bat roosting area. Contributes strongly to America's space history.
9. 22 Bravo Observation Structure (pill box) is individually NRHP eligible. Contributes strongly to America's space history.
10. 2733 Coca 1 Test Stand is individually NRHP eligible and contributes strongly to America's space history.
    a. Perhaps the "dance floor" can be disassembled and moved to NASM or other facility designed to honor our national space history.
11. ELV should be re-used to provide mitigation for Chumash Interpretive Center to provide for additional ceremonial areas for Chumash assembly and presentation and continued education centering around the ethnography and presentation of historically rooted beliefs, customs and practices allowing for local native groups to present their history and culture to the interested surrounding public.
12. Skyline Area should be considered for re-use for water storage capacity for the purpose of supplying irrigation and groundwater recharge for alternative soil treatability programs employed at the site. Why build it if it's already built?

Proposed liability reduction actions and potential presentation, preservation and cultural opportunities that can ensure a sustainable future that regards the accomplishments achieved at Santa Susana. A Chumash National Park that honors the history of the site. Other examples of preservation and education of history referenced for research in this process:

- Griffith Observatory
- Smithsonian Institute, Washington, DC
- Reagan Museum, Simi Valley
- National Aeronautic Space History Museum, Smithsonian Institute
- The Boeing Company
- Volvo, Gothenburg Museum, Sweden "the history of safety" and the corporate thinking.
- NASA Space Flight Center, Huntsville
- JPL
- VASA Museum, Stockholm, Sweden – and erected ship and archaeological findings presented from many view points.
- Ale Stones, Sweden – a ship shaped "stone henge" like monument estimated to be from the bronze age and available for visitors to see up close and be a part of history.

- Stads Huset Torn, Stockholm Sweden. Daily tours of climbing the stairs of the tower provide for maintenance revenue.

Opportunities as listed above provide examples of successful revenue funding from tours, parking, and gift-shop marketing opportunities, which would enhance Human Space History as well as Human History regarding Indigenous Peoples.

Table 2-2.2 Proposed Demolition Hauling

Hundreds of truck trips can be avoided by considering creative re-use onsite programs to avoid unnecessary damage to the environment and unnecessary impacts to the surrounding communities due to the traffic, noise, dust associated with these activities. Treat first approach should be used to the maximum extent possible as prescribed by the Agreement in Principle and AOC (page 11)

Demolition truck schedule should include hiatus between 7 and 8am and 3-4pm to avoid school hours.

2.2.2.1 Cleanup of Soil to Background

Modification in Principle to modify this requirement to consider risk based objectives as outlined in MiP[19] to ensure that surrounding residential human and ecological health is protected, and unnecessarily removing soils that do not present a health risk can therefore be avoided.

2.2.2.2 Preliminary Remediation Areas

In addition to Table 2.2-3 screening values, Suburban Residential PRG and risk based recommendations from Staff Toxicologists as well as soil zone grading system to avoid disturbing undisturbed areas and protecting what needs protecting including natural habitat, sacred sites, sensitive species, migratory species pathways, and water resources for surrounding ecology.

2.2.2.3 Soil Cleanup Technologies

All technologies that were dismissed based on deadline issues related to achieving objectives by 2017 should be revisited. This can be accommodated

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[19] MIP Modification in Principle, Attachment A

by adding back in the requirement that alternative methods construction must be completed, and that the final objective of cleanup goal would have additional time to become effective as presented in all previous versions of this agreement including the signed '07 Order agreed to by all parties.

Ex situ Treatment Technologies using Land Farming have proven successful on the site in the past (including Happy Valley treatment of Perchlorate onsite) and should be considered here as a viable potential alternative that is very effective.

Sustainability presentations stewarded by local Universities including Grant projects should be considered as alternative opportunities that provide a consistent message that supports the sites place in technological history advances.

In Situ Anaerobic or Aerobic Biological Treatment methods should also be seriously considered as detailed above.

Pump and Treat is most effective for specific targeted areas, and needs to have more attention to long-term negative impacts so that effective treatment can be attained without the negative impacts as observed at Bell Creek. We therefore recommend that groundwater that is treated be redistributed to the location closest feasible to where it was extracted from the site.

In situ Chemical Oxidation is currently being tested and it is hopeful that it will prove very effective at the site and certainly should be considered here.

Pump and treat should also be considered from mid-plume so that unintended drawing toward communities does not occur further.

Enhanced Bioremediation and vapor extraction to prevent additional impacts to groundwater resources should be seriously considered and implemented wherever feasible throughout the site, especially at high-VOC impacted areas.

Monitored Natural Attenuation occurs today, but is not adequate as a solution and must only be considered in tandem with other working solutions to protect future generations and seep impacts that potentially bring those impacts to ecological receptors as well as surrounding communities.

2.4.1.1 Alternative 1-Demolition, Soil Cleanup to Suburban Residential Cleanup Goals and Groundwater Cleanup as described by limited modification is supported by an overwhelming portion of the surrounded affected communities and should be considered here as proposed throughout this and accompanying documents [MiP]

Table 2.4-2 Alternative Comparison of Offsite Waste Type

This comparison illustrates clearly the need for limited modification so that continued efforts of injunction by the very people insisting on the impossible cleanup will cease. We need a workable solution that uses current regulatory standards for waste classification in a protective and responsible way. Limited modification of AOC in Section 2.10 related to waste classification is necessary as proposed in MiP.

2.4.2 Remedial Technologies Eliminated

Phyto Remediation can achieve long-term health protective objectives in a less damaging matter and can also provide longevity to the solution (especially when considering the challenges related to the groundwater impacts at depth and those migration pathways) With limited modification these solutions can prove very effective in the drainages.

Table 3-2-1 Summary of Existing Utilities and Infrastructure at SSFL by area:

Concrete removal where infrastructure roads are concerned should be minimized to keep access feasible and prevent unnecessary hauling of concrete.

Water conveyance and storage infrastructure should be maintained and enhanced to suit the water needs related to alternative treatment methods.

3.3 Cultural Resources

Listed in the criteria articulated that is used under NHPA to evaluate properties for NRHP eligibility include to "embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, possess high artistic values, or represents a significant and distinguishable entity whose components might lack individual distinction (criterion C)" where the burro flats cave site is estimated to be ancient in its' origin and depicts religious and spiritual significance in portraying the Chumash Rainbow Bridge creation story that has been handed down for centuries as astronomical events, are depicted in layers of artwork exhibited in the burro flats cave site that may span decades or even centuries between the layers. By experts, who have studied this particular solstice site for decades, it is described as being among the most well preserved representation of Chumash Ancient Sacred Rock Art in North America.

Traditional Culture Landscapes must also be included in the 106 Consultations yet here, the process puts these sacred areas in harms way on the basis of a very limited view of how "artifact" is defined in this context. No single defining feature or set of features that comprise a traditional cultural landscape. Such places could be comprised of natural features such as mountains, caves, plateaus, and outcroppings; water courses and bodies such as rivers, streams, lakes and bays and inlets; views and view sheds from them, including the overlook or similar locations, vegetation that contributes to its significance [soap lily, native cucumber used for paint, etc], and manmade features including archaeological sites; buildings and structures; circulation features such as trails, land use patterns, evidence of cultural traditions, such as petroglyphs and evidence of burial practices, and markers or monuments such as calms, sleeping circles and geoglyphs"[20] **Record of Decision must consider all reasonable alternatives.** [21]

Deferral of mitigation DOES NOT comply with NEPA.[22]

At the very minimum, all effort to use the exceptions provided to absolutely protect the areas we know about, and every effort must also be made to proceed with extreme caution so that currently unknown sites that may be located within the region must be considered as likely and therefore cultural monitoring of this process should be mandatory every step of the way, with an immediate "stop work" for any potential finding and assessment of said finding by local cultural monitors and stewards of the site.

The tribe has already designated all of the NASA administered property as a sacred site under E.O. 13007.

Echoing the concerns detailed in the comments from the tribe, we believe that NASA must complete the eligibility process for protection in the National Register.

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[20] http://www.ahcp.gov/natl-ga.pdf
[21] Record of Decision [ROD] must mitigate any impacts and identify all alternatives considered and identify alternatives that are environmentally preferable.
[22] Santa Ynez Band of Chumash Indians letter September 30, 2013 points out that Deferral of mitigation does not comply with NEPA [http://www.npi.org/NEPA/impact]

UN Declaration on the Rights of Indigenous Peoples must now be followed after December 2010

In December of 2010, the United States announced support for the United Nations Declaration on the Rights of Indigenous Peoples [UNDRIP] in announcing this support, President Obama stated: "The aspirations it affirms – including the respect for the institutions and rich cultures of Native peoples—are one we must always seek to fulfill…[W]hat matters far more than any resolution or declaration – are actions to match those words." The UNDRIP addresses indigenous peoples' rights to maintain culture and traditions (Article 11); and religious traditions, customs, and ceremonies (Article 12); to participate in decision making in matters which would affect their rights (Article 18); and to maintain spiritual connections to traditionally owned lands (Article 25).

> The ACHP will now incorporate UNDRIP in the Section 106 review process:
>
> While the Advisory Council on Historic Preservations (ACHP) work already largely supports the United Nations Declaration on the Rights of Indigenous Peoples, additional deliberate actions will be taken to more overtly support the Declaration. The Section 106 review process provides Indian tribes and Native Hawaiian organizations (NHOs) with a very important opportunity to influence federal decision making when properties of religious and cultural significance may be threatened by proposed federal actions" [23]

<u>Executive Order 13007</u>

On December 10, 2012, the Santa Ynez Band of Chumash Indians, a federally recognized tribe ("Tribe"), hereby designates the NASA portion of the SSFL as an Indian sacred site pursuant to Executive Order 13007. This Indian sacred site also includes the former Rocketdyne and now Boeing portion of SSFL and the Tribe is open to discussing he exact boundaries at a later date.

EO 13007 requires Federal land managing agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and to avoid adversely affecting the physical integrity of such sacred sites. It also requires agencies to develop procedures for reasonable notification of proposed action or land management policies that may restrict access to, or ceremonial use of, or adversely affect sacred sites."

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[23] http://www.achp.gov/docs/UN%20Declaration%20Plan%203-21-13.pdf

Sacred sites are defined in the executive order as "any specific discrete narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site." There is no review of such determinations by a Federal agency.[24]

Deferral of boundary research as to VEN-1072 and VEN-1803 is inappropriate and not allowed. Additional boundary research is needed to conclude that any avoidance of excavation within the boundaries of burro flats (CA-VEN-1072) and CA-VEN-1803 to diminish or eliminate adverse effects to known archaeological sites

<u>3.3.3 Cultural Resources identified</u>

While several studies have occurred over recent years, the entire site has not been adequately studied due to limited access for such scholarly and field research opportunities. Additional sites have been identified in nearby locations and indicate the potential for additional sites being present and yet to be discovered is extremely high. [25][26]

<u>3.3.3.1 Sacred Sites</u>

Executive Order (EO) 13007 (1996) states that, for land designated as sacred sites, agencies managing federal lands shall: "Accommodate access to and ceremonial use of Indian Sacred Sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sacred sites." This certainly should be interpreted to mean that the proposed action of removal of the top two feet of soil and all living species should be strictly avoided.

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[24] http://www.achp.gov/eo13007-106.html

[25] Interview and photographic review recently submitted for expert analysis by draft author of this technical comment proposal document.

[26] 56-1072/CA-VEN-1072, Burro Flats Painted Cave; 56-1800/CA-VEN-1800 Rock Shelter; 56-1803/CA-VEN-1803 Lithic Scatter; Alfa Test Area, Historic District; Bravo Test Area, Historic District; Coca Test Area, Historic District, Undesignated to date sites in Area IV and Bufferzone area(s),

3.3.3.4 Architectural Resources

The DEIS fails to provide adequate proposal for mitigation of architectural resources. Assembly pieces from Alfa, Bravo and Coca should be considered for preservation under the stewardship of Smithsonian Institute NASM and/or other scholarly institutions for the preservation of American history.

3.4 Biological Resources

Table 3.4-2 Sensitive Plant Species potentially located within SSFL

According to the DEIS, page 3-24 it states that the California red-legged flog (Rana draytonii) is federally listed as threatened and known to occur in the vicinity of SSFL, and that no evidence of California red-legged flog occurrence was found during the 2010 or 2011 surveys (NASA, 2011b; 2011d). and that limited potential suitable frog habitat for this species primarily around R-2 Ponds and the Coca Skim Pond. It should be noted that this species was found in and around Bell Canyon Creek, but due to impacts from previous groundwater pumping, those area (as with the R-2 and Coca skim ponds) are completely dry now, and therefore no longer suitable habitat due to these actions being take to "control discharge." These actions were taken without CEQA or NEPA review and makes clear the need for such a review so that these sensitive species are protected before decisions make it too late (as we are seeing here, if limited modification to the decisions moving forward are not considered).

With such a severe proposal of soil replacement, it is likely that different vegetative species will grow from different soil, thereby further impacting the wildlife currently supported by the habitat.

Activities not considered in DEIS

Pumping occurring at WS9a in the recent two years has exacerbated the current drought conditions and has limited the potential habitat significantly as 1.4 miles of riparian habitat now has no water source.

All of the plant species listed on Table 3.4.2 should be considered further threatened with recharge water source conditions continue to be changed as a result of unmitigated water diversion that has occurred since 2010 for this purpose.

Additionally the Humboldt Lily (lillium humboldtii) has been found both within the sacred cultural resource district, as well as to the immediate south of the property boundary.[27]

<u>Figure 3.4-2 Wildlife Migration Corridor</u> depicted on page 3-25 is inaccurate in that it does not adequately acknowledge the use by wildlife to transverse the property following water resources. Cattle, horses, mule deer, and even mountain lions have been spotted in Area IV during our site visits guided by Responsible Parties so it is truly ridiculous to ignore those occurrences here, when we've viewed these species migrating and feeding across the entirety of the site, including the southern bufferzone, northern bufferzone, and areas 1, 2 and 3 (including the NASA owned LOX area where horses have been photographed drinking from the pond and feeding on the grasses there. The currently existing use of this corridor (which clearly includes Area 2 and other NASA owned portions) must be considered as an impact, especially given that the play presented states that the top two feet of all living vegetation will be removed.

The very idea that such extreme actions (to devastate all living things in an open space area of more 50 acres) is being considered while presenting a map on Figure 3.4-2 that doesn't even include the NASA owned portions as being part of that corridor is UNACCEPTABLE. This must be corrected as you will be advised of such by every expert writing in as well.

What will be the mitigation for all the oak trees removed? The report says "up to 100% of all vegetation" and includes trees in that category.

1. How many oak trees will be replanted to mitigate this?

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[27] Lilium Humboldtii *Lilium humboldtii* There are two subspecies:

Lilium humboldtii subsp. *humboldtii* (syn. Lilium puberulum)[2]

Lilium humboldtii subsp. *ocellatum*

Both are on the California Native Plant Society Inventory of Rare and Endangered Plants and described as "fairly endangered in California".[3]

http://en.wikipedia.org/wiki/Lilium_humboldtii

2. And how will the Ventura County Oak Tree Ordinance be considered in such a plan that needlessly devastates the environment, or fails it entirely?
3. What will be done to mitigate the damage done to the habitat that supports several hundred diverse species?

<u>Figure 3.4-4 Sensitive Wildlife Species</u>
Why is the mountain lion not included here since they are all tagged and have such a large roaming need? The corridor presented can only mean that the "safest crossing" allows only for a narrow corridor, making that even more important to protect.
Listed is the Two-striped garter snake which I have personally photographed in the endangered area of Bell Creek where the habitat is being damaged, and reduced as a result of actions related to the groundwater proposed action and should be considered here.
The ring-tailed cag (Bassariscus astutus) as also been cited by comment author in the riparian drainage immediately to the south of NASAs Area II (Figure 3.4-4).

<u>Table 3.4-4 Biological Species of Native American Concern</u>
Included in this list, are both milkweed species (Asclepias eriocarpa, and asclepias fascicularis), Wild Cucumber which have been further identified and photographed throughout the riparian drainage receiving the potential impacts of this action (Bell Canyon Creek).[28] As well as the salvia columbariae. This area is also contains several culturally recognized significant sites.

<u>Section 4 Environmental Consequences</u>
The most disturbing part of this proposed action is the limited alternatives of only providing for total biological destruction of the site, or no action at all. We ask that the DEIS be modified to include reasonable alternatives that are protective of human health and the environment and that the necessary changes to the AOC signed, as agreed mutually by the parties, so that traditional health risk assessment can properly inform this process to avoid the unnecessary removal of so much soil, habitat destruction and destruction of cultural and historic assets.

We have learned from this evaluation, what a non-risk-based cleanup looks like and many proponents of cleanup (myself included) did not believe that it would result in such extensive soil disturbance. Especially given the directive in the AOC that states that alternative methods should be used to the "maximum extent possible"

[28] Photographs of Humboldt lily, wild cucumber, two striped garter snake and ring-tailed cat will be provided separately as color attachments to submission.

We can now see the startling consequences of an action using the AOC proposed "background" as the objective when no such [PA] exists that does not consider health risk. We ask that NASA and DTSC revisit this decision and work with their toxicological resources within the department to establish sound health-risk based parameters to bring this back to a reasonable solution.

I do not agree with the idea that we "must abide by the AOC" while ignoring the primary directive stated on page 11 of the AOC that says alternative in situ methods should be used. I think that a strict adherence of the agreement needs to include all 46 pages, and not exclude such a primary tool to reduction efforts made and intended to minimize all the consequences outlined throughout this document.

The response from both NASA and DTSC is that the final signed version does not include the language that "construction shall be completed" for alternative in situ methods as it was always understood that such methods would require more time for completion. The removal of that line in the final document can only mean a purposeful intent to make strict adherence of this portions of the AOC impossible and therefore requires modification.

Was the AOC intended to not be possible? Because as proposed action that does not follow any existing programmatic agreement as requirement for the federal government to follow, it therefore creates it's own programmatic agreement that we can see here cannot be fulfilled by the very limitations it also provides. This is additional basis that makes clear the necessity of modification of the AOC agreement in order to make it feasible, possible, and something beyond the paper it is written. If protection of the surrounding communities is the intent, then TIME must be part of that consideration and creating fictional programs that do not have a reasonable basis to be implemented cannot be used as an excuse to fail those communities now.

<u>Section 5 Agencies, Organization and Individuals Consulted</u>
This section proposes that the meetings used to present alternative in situ methods to reduce soil volumes were legitimate. I would argue that there was never any intent (based on this DEIS where any such consideration fails at the first deadline), and instead, these meetings were used to fill in this portion of the report though no real or sincere consideration of any alternatives was ever made.

During Section 106 call that occurred last week, it was stated that exceedingly false data has been provided in the media on a substantial political level in an effort to sell the idea that nothing short of full destruction of the site would be protective. This was acknowledged to be untrue, yet no effort to counter those very real messages in the media, has been made. We ask that added media coverage that includes the realities of these issues be done.

<u>5.4.1 Consultation Process for National Historic Preservation Act</u> (Section 106 Consultation) indicated that the review of demolition activities would not be done by CEQA in that those processes will not occur until after demolition has already occurred. This fails the purpose of the "historic preservation" objective, and therefore ask that this proposed action/evaluation be halted until full CEQA review of all activities including those that potentially impact historic structures, districts, and sacred sites receive complete review and consideration.
<u>Artificial segmenting of the process (Piecemeal) should not be allowed.</u>

We recommend that limited modification occur to make a workable feasible and effective cleanup solution that is health protective and measurable and ask that DTSC and NASA re-visit these issues and attempt to find solutions that can make this possible.

Thank you for your consideration and appreciate the opportunity to provide substantive comment to the process of formulating these decisions moving forward.

Sincerely,

Christina Walsh
Cleanuprocketdyne.org
SSFL CAG Member, Communications Committee Co-chair
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Bell Canyon CA 91307
SSFL CAG Member

Date: September 18, 2013

Administrative Order on Consent for Remedial Action [AOC]
In the matter of Santa Susana Field Laboratory
Simi Hills, Ventura County, California
CA1800090010 (NASA)

And

United States National Aeronautics and Space Administration

Draft Environmental Impact Statement [DEIS]

Health and Safety Code Sections
25355.5(a)(1)(B), 58009 and 58010
Docket No. HAS-CO 10/11 -038

Modification in Principle [MIP]

Modifications needed to create an agreement that is implementable, and that addresses the concerns and needs of the surrounding affected public are as follows:

Basis:

1. Draft EIS submitted by NASA fails to provide legitimate solutions by framing alternatives be either: devastating to the natural ecosystem and sensitive habitats, the sacred Native American sites, as well as failing to conserve American History by suggesting demolishing historic rocket test stands and indicating that the mandating mechanism for these actions is aforementioned AOC.
2. The AOC driving the project goes beyond EPA recommended requirements for human health and safety.
3. SB990 (Kuehl2007) was later struck down by Federal District Court decision, of which the AOC was originally based. A health protective cleanup is what the communities have always wanted.
4. Section 5.26 Severability of AOC Order [2010] provides that "…should a court determine that any federal or State law or regulation incorporated into, referenced in, or authorizing this order is invalid or unenforceable in

whole or in part, NASA shall comply with each and every remaining part."[1]

5. 6.0 Modification This Order may be modified by the mutual agreement of the parties. Any agreed modifications shall be in writing, shall be signed by both parties, shall have as their effective date the date on which they are signed by DTSC, and shall be deemed incorporated into this Order.[2]
6. Agreement in Principle (attached) which AOC is based, indicates that "scheduled completion of soils cleanup *remains* as 2017" yet original specifies that alternative method in situ treatments shall only require completion of construction (not of remedial soil completion) by 2017 and by omitting "construction" language, the responsible parties do not have adequate time to comply with Order as written, despite directive to use said alternative methods "to the maximum extent possible"[3]
7. 2.8 Soils Remedial Action Implementation Plan does follow clear directive to use alternative in situ methods "to the maximum extent possible" as the DEIS proposes zero alternative solutions on the basis that adequate time to achieve objective is not provided.
    a. The purpose of this directive is to minimize the potential impact on sensitive habitat, eco systems, flora and fauna, migratory species protection that use this sensitive corridor, protect historic structures and sacred Native American cultural sites, yet the DEIS describes a solution that in its declaration states all of the above will be potentially impacted by the large magnitudes soil removal being mandated.
8. 1.6 Agreement in Principle is defined the guiding document that shall govern the AOC process and lists specific exceptions that include the Native American cultural resources, yet the DEIS continues to ignore this primary promise as it is found in the secondary document. NASA has to follow the Agreement in Principle, which clearly stipulates a 5% volume exception, which could assist in prioritizing and the protection of sacred areas currently known. Due to the likelihood of additional sites being discovered, it is recommended that these boundaries be drawn wide and use of native monitors throughout excavation and alternative method efforts be present.

Modifications needed:

1 1.7.2.1 "cleanup to background levels" shall be modified to include a risk-based PRG table of suburban residential risk levels which shall be compared to background "LUT" table for purpose of establishing a risk

[1] 5.26. Severability (page 38 AOC)
[2] 6.0 Modification (page 38, 39 AOC)
[3] 2.8 Soils Remedial Action Implementation Plan Section 5 (page 11 AOC)

quotient for the purpose of avoiding removing near-background soils which do not present a risk to human health or the environment. Remediation decisions should be based on EPA protocols.

2 1.7.2.2 "Cleanup background levels does not include land-filling alternatives, but in situ treatments to achieve PRG standards shall not be defined as land-filling, but as *alternative treatment of soils*.

3 1.7.4 Soils shall include language to address and compare *Soil Environmental Condition* by regional cleanup zone. Screening evaluation shall also be applied in matrix decision-tree to be reviewed by State Toxicologists where undisturbed soils would be prioritized for alternative in situ methods, where clearly (building footprints) disturbed soils would use in situ methods such as soil sorting technologies for the purpose of reducing soil volumes for excavation and to minimize burden on existing landfills by filling them with near-background soils.

4 2.0 Remediation Goal shall be modified to include suburban residential PRGs to enhance [LUT] Lookup Table process by comparing to soil condition and risk standards established by USEPA as public remediation goals.

5 2.5 Treatability Studies shall be enhanced to consider all potential mechanisms to reduce soil volume impacts to landfills, traffic, noise, dust, roads, sensitive habitat destruction, cultural resources destruction, migratory species pathways impaired, etc. by using the established EPA objective of Suburban Residential PRGs as a weighted balancing mechanism to create achievable programs of remediation.

6 2.8 Soils Remedial Action Implementation Plan shall be enhanced to follow the directive from AIP and subsection 5 of 2.8 to use in situ treatment to the "maximum extent possible" by modifying objectives to construction in place language.

7 2.10 Contaminated Soils shall be modified to use existing standards for waste classification instead of referencing a local background number that is of little value or relevance to the landfill in question.

8 2.12 Modifications to Soils Remedial Action Implementation Plan acknowledges the need for the above prescribed changes which are now quite clear considering the potential impacts identified by the DEIS if no modifications to occur.

9 5.1 Project Director has been changed several times since the signing of this order, further demonstrating the need for revisiting these changes before the process of damage and irreversible impacts begins.

Administrative Order on Consent for Remedial Action [AOC]
In the matter of Santa Susana Field Laboratory
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CA1800090010 (NASA)

And

United States National Aeronautics and Space Administration (Respondent)

Modification in Principle [MIP]

Talking points about an ALL or NOTHING losing scenario and how to change the document to address what is needed now:

1. DEIS is rejected by surrounding affected communities.
2. NASA's DEIS put's sacred cultural and archeological resources at risk. THE AOC as written is unworkable and unacceptable to unnecessarily put these resources at risk as proposed in this draft EIS.
3. We want a real cleanup that is doable, not a paper version that has no hope.
4. We don't want to destroy the natural environment and ecology we are trying to save.
5. The law does not require this, so we must revisit the AOC to make it workable, feasible, realistic, practical and health protective.
6. Adding PRGs to compare risk to the LUT (look up tables) and grade soil environmental condition (sensitivity from disturbed to undisturbed/pristine)
7. The AOCs allow for modification in the event of legislative changes, which have occurred.
8. The AOCs prescribe and direct use of alternative in situ methods to reduce soil volume and other impacts. We must follow this clear point in the AOCs and AIP (original Agreement in Principle)
9. This gives the affected communities and the important resources protection from a cleanup that isn't sensible or practical.
10. Let's do everything we can to protect the important human history that is part of the Santa Susana Field Lab Story. The AOCs provide for the answer, please consider the following limited modifications to make the right solution possible….for all the affected communities and for native and national history which should be preserved and honored, not used as a bargaining tool.

Mariah Mills

From: Christine Rowe [crwhnc@gmail.com]
Sent: Sunday, February 09, 2014 4:37 PM
To: DTSC_SSFL_CEQA
Cc: Malinowski, Mark@DTSC; Leclerc, Ray@DTSC; Hume, Richard@DTSC; Rainey, Laura@DTSC; Perez, Marina@DTSC; John Jones; Stephanie Jennings; Bell, Jazmin; Dassler, David W; Kamara Sams; James A. Elliott, (MSFC-AS10); Merrilee Fellows, (HQ-NB000)
Subject: Christine L. Rowe DTSC SSFL PEIR - Final 2
Attachments: INES_Users_Manual_1545.pdf

Dear Mr. Malinowski,

Please do not use the term "meltdown" or "partial meltdown" in your DRAFT Environmental Impact Report (DEIS). The term "partial meltdown" was used by elected officials for SB 990. I believe that has been the basis of this term. However, SB 990 has been overturned at this time, and thus this term should go away with that law.

"Meltdown" and "Partial Meltdown" are non technical terms. They do not explain what occurred during a specific incident in 1959.

There is no evidence of this incident (an incident in July 1959) today to the best of my knowledge. Any remaining contamination at the SRE complex is probably due to the leakage of radioactive waste tanks, not this incident in 1959.

In the statement of Dr. Thomas Cochran of the NRDC, he stated that you could not compare the SRE to Three Mile Island due to the difference in scale.

Most people that see an article in the newspaper reference a partial meltdown at the SSFL site, and they are not aware of the size of the reactor or how that incident would be ranked - a two on the INES scale.

To the best of my knowledge, there was no evidence of any release other than the gases Xenon and Krypton. I believe that is what the EPA HSA said as well.

Due to the controversial nature of this issue, and litigation that occurs when documents reference this incident, I respectfully request that the focus of the DEIS be on what is there today in AREA IV that is a contaminant of concern.

The focus on the DRAFT Environmental Impact Statement should mention the SRE, and it should mention an incident. But it should also point out that there is no evidence of widespread radiation from this incident.

Please see this EPA Power Point regarding the history of AREA IV:
http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/3dc283e6c5d6056f88257426007417a2/db19cbb72e867e3c88257acd00621c69/$FILE/EPA%20Public%20Meeting%20Presentation%2012%20Dec%202012.pdf

Maps should be created that remove Cesium or Strontium that is considered at or below Background so that people do not believe that this contamination came from a discrete event. The maps should show the areas that require remediation.

DTSC needs to put the radionuclides above "Background" in context with the FAL used by the EPA, "Background" Look Up Table" values created by DTSC. and what these values would be at a suburban residential standard, a commercial / industrial standard, and a parkland standard.

Respectfully submitted,

Christine L. Rowe

Newton's Third Law of Motion:

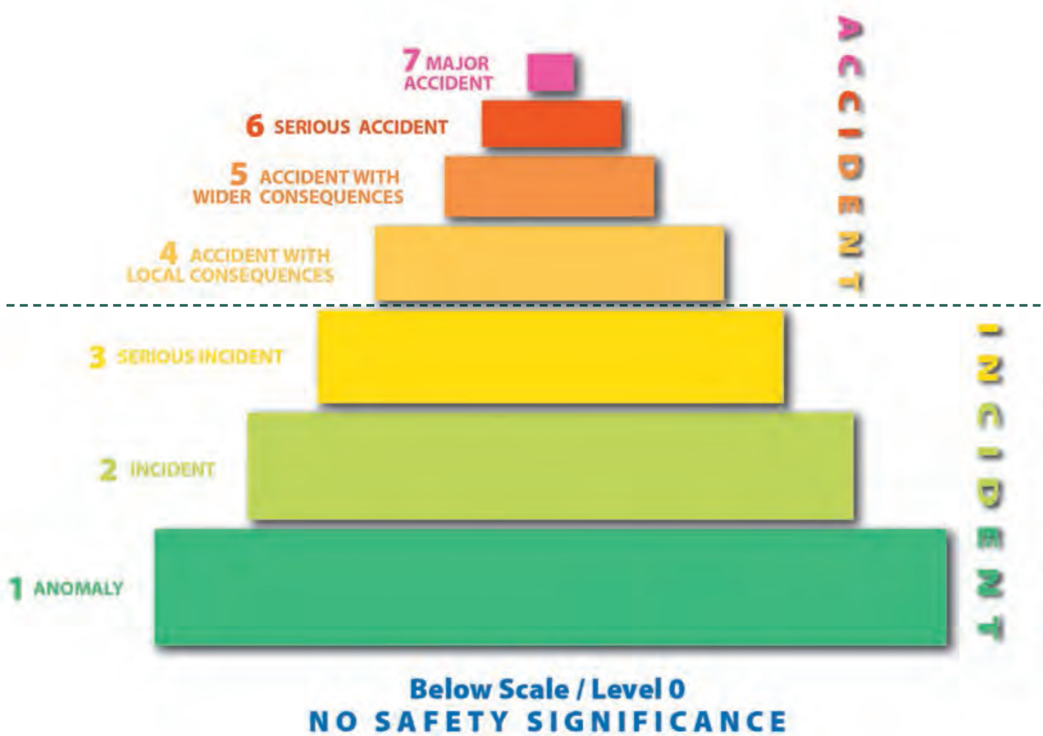
"For every action there is an equal and opposite re-action."

INES

The International Nuclear and Radiological Event Scale

User's Manual

2008 Edition



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IAEA
International Atomic Energy Agency

INES
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AND OECD/NUCLEAR ENERGY AGENCY

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FOREWORD

The need for easily communicating the significance of any event related to the operation of nuclear facilities or the conduct of activities that give rise to radiation risks arose in the 1980s following some accidents in nuclear facilities that attracted international media attention. In response, and based on previous national experience in some countries, proposals were made for the development of an international event rating scale similar to scales already in use in other areas (such as those comparing the severity of earthquakes), so that communication on the radiation risks associated with a particular event could be made consistent from one country to another.

The International Nuclear and Radiological Event Scale (INES) was developed in 1990 by international experts convened by the IAEA and the OECD Nuclear Energy Agency (OECD/NEA) with the aim of communicating the safety significance of events at nuclear installations. Since then, INES has been expanded to meet the growing need for communication on the significance of any event giving rise to radiation risks. In order to better meet public expectations, INES was refined in 1992 and extended to be applicable to any event associated with radioactive material and/or radiation, including the transport of radioactive material. In 2001, an updated edition of the INES User's Manual was issued to clarify the use of INES and to provide refinement for rating transport -and fuel cycle-related events. However, it was recognized that further guidance was required and work was already under way, particularly in relation to transport-related events. Further work was carried out in France and in Spain on the potential and actual consequences of radiation source and transport-related events. At the request of INES members, the IAEA and the OECD/NEA Secretariat coordinated the preparation of an integrated manual providing additional guidance for rating any event associated with radiation sources and the transport of radioactive material.

This new edition of the INES User's Manual consolidates the additional guidance and clarifications, and provides examples and comments on the continued use of INES. This publication supersedes earlier editions. It presents criteria for rating any event associated with radiation and radioactive material, including transport-related events. This manual is arranged in such a way as to facilitate the task of those who are required to rate the safety significance of events using INES for communicating with the public.

The INES communication network currently receives and disseminates information on events and their appropriate INES rating to INES National Officers in over 60 Member States. Each country participating in INES has set up a network that ensures that events are promptly rated and communicated inside or outside the country. The IAEA provides training services on the use of INES on request and encourages Member States to join the system.

This manual was the result of efforts by the INES Advisory Committee as well as INES National Officers representing INES member countries. The contributions of those involved in drafting and reviewing the manual are greatly appreciated. The IAEA and OECD/NEA wish to express their gratitude to the INES Advisory Committee members for their special efforts in reviewing this publication. The IAEA expresses its gratitude for the assistance of S. Mortin in the preparation of this publication and for the cooperation of J. Gauvain, the counterpart at the OECD/NEA. The IAEA also wishes to express its gratitude to the Governments of Spain and the United States of America for the provision of extrabudgetary funds.

The IAEA officer responsible for this publication was R. Spiegelberg Planer of the Department of Nuclear Safety and Security.

CONTENTS

1. SUMMARY OF INES

1.1. BACKGROUND

The International Nuclear and Radiological Event Scale is used for promptly and consistently communicating to the public the safety significance of events associated with sources of radiation. It covers a wide spectrum of practices, including industrial use such as radiography, use of radiation sources in hospitals, activities at nuclear facilities, and the transport of radioactive material. By putting events from all these practices into a proper perspective, use of INES can facilitate a common understanding between the technical community, the media and the public.

The scale was developed in 1990 by international experts convened by the IAEA and the OECD Nuclear Energy Agency (OECD/NEA). It originally reflected the experience gained from the use of similar scales in France and Japan as well as consideration of possible scales in several countries. Since then, the IAEA has managed its development in cooperation with the OECD/NEA and with the support of more than 60 designated National Officers who officially represent the INES member States in the biennial technical meeting of INES.

Initially the scale was applied to classify events at nuclear power plants, and then was extended and adapted to enable it to be applied to all installations associated with the civil nuclear industry. More recently, it has been extended and adapted further to meet the growing need for communication of the significance of all events associated with the transport, storage and use of radioactive material and radiation sources. This revised manual brings together the guidance for all uses into a single document.

1.2. GENERAL DESCRIPTION OF THE SCALE

Events are classified on the scale at seven levels: Levels 4–7 are termed "accidents" and Levels 1–3 "incidents". Events without safety significance are classified as "Below Scale/Level 0". Events that have no safety relevance with respect to radiation or nuclear safety are not classified on the scale (see Section 1.3).

For communication of events to the public, a distinct phrase has been attributed to each level of INES. In order of increasing severity, these are: ‘anomaly’, ‘incident’, ‘serious incident’, ‘accident with local consequences’, ‘accident with wider consequences’[1], ‘serious accident’ and ‘major accident’.

The aim in designing the scale was that the severity of an event would increase by about an order of magnitude for each increase in level on the scale (i.e. the scale is logarithmic). The 1986 accident at the Chernobyl nuclear power plant is rated at Level 7 on INES. It had widespread impact on people and the environment. One of the key considerations in developing INES rating criteria was to ensure that the significance level of less severe and more localized events were clearly separated from this very severe accident. Thus the 1979 accident at the Three Mile Island nuclear power plant is rated at Level 5 on INES, and an event resulting in a single death from radiation is rated at Level 4.

The structure of the scale is shown in Table 1. Events are considered in terms of their impact on three different areas: impact on people and the environment; impact on radiological barriers and controls at facilities; and impact on defence in depth. Detailed definitions of the levels are provided in the later sections of this manual.

The impact on people and the environment can be localized (i.e. radiation doses to one or a few people close to the location of the event, or widespread as in the release of radioactive material from an installation). The impact on radiological barriers and controls at facilities is only relevant to facilities handling major quantities of radioactive material such as power reactors, reprocessing facilities, large research reactors or large source production facilities. It covers events such as reactor core melt and the spillage of significant quantities of radioactive material resulting from failures of radiological barriers, thereby threatening the safety of people and the environment. Those events rated using these two areas (people and environment, and radiological barriers and controls) are described in this manual as events with “actual consequences.” Reduction in defence in depth principally covers those events with no actual consequences, but where the measures put in place to prevent or cope with accidents did not operate as intended.

Level 1 covers only degradation of defence in depth. Levels 2 and 3 cover more serious degradations of defence in depth or lower levels of actual consequence to people or facilities. Levels 4 to 7 cover increasing levels of actual consequence to people, the environment or facilities.

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[1] For example, a release from a facility likely to result in some protective action, or several deaths resulting from an abandoned large radioactive source.

TABLE 1. GENERAL CRITERIA FOR RATING EVENTS IN INES

Description and INES Level	People and the environment	Radiological barriers and controls at facilities	Defence in depth
Major accident Level 7	- Major release of radioactive material with widespread health and environmental effects requiring implementation of planned and extended countermeasures.		
Serious accident Level 6	- Significant release of radioactive material likely to require implementation of planned countermeasures.		
Accident with wider consequences Level 5	- Limited release of radioactive material likely to require implementation of some planned countermeasures. - Several deaths from radiation.	- Severe damage to reactor core. - Release of large quantities of radioactive material within an installation with a high probability of significant public exposure. This could arise from a major criticality accident or fire.	
Accident with local consequences Level 4	- Minor release of radioactive material unlikely to result in implementation of planned countermeasures other than local food controls. - At least one death from radiation.	- Fuel melt or damage to fuel resulting in more than 0.1% release of core inventory. - Release of significant quantities of radioactive material within an installation with a high probability of significant public exposure.	
Serious incident Level 3	- Exposure in excess of ten times the statutory annual limit for workers. - Non-lethal deterministic health effect (e.g. burns) from radiation.	- Exposure rates of more than 1 Sv/hr in an operating area. - Severe contamination in an area not expected by design, with a low probability of significant public exposure.	- Near accident at a nuclear power plant with no safety provisions remaining. - Lost or stolen highly radioactive sealed source. - Misdelivered highly radioactive sealed source without adequate radiation procedures in place to handle it.
Incident Level 2	- Exposure of a member of the public in excess of 10mSv. - Exposure of a worker in excess of the statutory annual limits.	- Radiation levels in an operating area of more than 50 mSv/h. - Significant contamination within the facility into an area not expected by design.	- Significant failures in safety provisions but with no actual consequences. - Found highly radioactive sealed orphan source, device or transport package with safety provisions intact. - Inadequate packaging of a highly radioactive sealed source.
Anomaly Level 1			- Overexposure of a member of the public in excess of statutory limits. - Minor problems with safety components with significant defence in depth remaining. - Low activity lost or stolen radioactive source, device or transport package.
	No safety significance (Below scale/Level 0)		

Although INES covers a wide range of practices, it is not credible for events associated with some practices to reach the upper levels of the scale. For example, events associated with the transport of sources used in industrial radiography could never exceed Level 4, even if the source was taken and handled incorrectly.

1.3. SCOPE OF THE SCALE

The scale can be applied to any event associated with the transport, storage and use of radioactive material and radiation sources. It applies whether or not the event occurs at a facility. It includes the loss or theft of radioactive sources or packages and the discovery of orphan sources, such as sources inadvertently transferred into the scrap metal trade. The scale can also be used for events involving the unplanned exposure of individuals in other regulated practices (e.g. processing of minerals).

The scale is only intended for use in civil (non-military) applications and only relates to the safety aspects of an event. The scale is not intended for use in rating security-related events or malicious acts to deliberately expose people to radiation.

When a device is used for medical purposes (e.g. radiodiagnosis and radiotherapy), the guidance in this manual can be used for the rating of events resulting in actual exposure of workers and the public, or involving degradation of the device or deficiencies in the safety provisions. Currently, the scale does not cover the actual or potential consequences on patients exposed as part of a medical procedure. The need for guidance on such exposures during medical procedures is recognized and will be addressed at a later date.

The scale does not apply to every event at a nuclear or radiation facility. The scale is not relevant for events solely associated with industrial safety or other events which have no safety relevance with respect to radiation or nuclear safety. For example, events resulting in only a chemical hazard, such as a gaseous release of non-radioactive material, or an event such as a fall or an electrical shock resulting in the injury or death of a worker at a nuclear facility would not be classified using this scale. Similarly, events affecting the availability of a turbine or generator, if they did not affect the reactor at power, would not be classified on the scale nor would fires if they did not involve any possible radiological hazard and did not affect any equipment associated with radiological or nuclear safety.

1.4. PRINCIPLES OF INES CRITERIA

Each event needs to be considered against each of the relevant areas described in Section 1.2, namely: people and the environment; radiological barriers and controls; and defence in depth. The event rating is then the highest level from consideration of each of the three areas. The following sections briefly describe the principles associated with assessing the impact on each area.

1.4.1. People and the environment

The simplest approach to rating actual consequences to people would be to base the rating on the doses received. However, for accidents, this may not be an appropriate measure to address the full range of consequences. For example, the efficient application of emergency arrangements for evacuation of members of the public may result in relatively small doses, despite a significant accident at an installation. To rate such an event purely on the doses received does not communicate the true significance of what happened at the installation, nor does it take account of the potential widespread contamination. Thus, for the accident levels of INES (4–7), criteria have been developed based on the quantity of radioactive material released, rather than the dose received. Clearly these criteria only apply to practices where there is the potential to disperse a significant quantity of radioactive material.

In order to allow for the wide range of radioactive material that could potentially be released, the scale uses the concept of "radiological equivalence." Thus, the quantity is defined in terms of terabecquerels of ^{131}I, and conversion factors are defined to identify the equivalent level for other isotopes that would result in the same level of effective dose.

For events with a lower level of impact on people and the environment, the rating is based on the doses received and the number of people exposed.

(The criteria for releases were previously referred to as "off-site" criteria)

1.4.2. Radiological barriers and controls

In major facilities with the potential (however unlikely) for a large release of activity, where a site boundary is clearly defined as part of their licensing, it is possible to have an event where there are significant failures in radiological barriers but no significant consequences for people and the environment (e.g. reactor core melt with radioactive material kept within the containment). It is also possible to have an event at such facilities where there is significant contamination spread or increased radiation, but where there is still considerable defence in depth remaining that would prevent significant consequences to people and the environment. In both cases, there are no significant consequences to individuals outside the site boundary, but in the first case, there is an increased likelihood of such consequences to individuals, and in the second case, such failures represent a major failure in the management of radiological controls. It is important that the rating of such events on INES takes appropriate account of these issues.

The criteria addressing these issues only apply at authorized facilities handling major quantities of radioactive materials. (These criteria, together with the criteria for worker doses, were previously referred to as "on-site" criteria). For events involving radiation sources and the transport of radioactive material, only the criteria for people and the environment, and for defence in depth need to be considered.

1.4.3. Defence in depth

INES is intended to be applicable to all radiological events and all nuclear or radiation safety events, the vast majority of which relate to failures in equipment or procedures. While many such events do not result in any actual consequences, it is recognized that some are of greater safety significance than others. If these types of events were only rated based on actual consequences, all such events would be rated at "Below scale/Level 0", and the scale would be of no real value in putting them into perspective. Thus, it was agreed at its original inception, that INES needed to cover not only actual consequences but also the potential consequences of events.

A set of criteria was developed to cover what has become known as "degradation of defence in depth." These criteria recognize that all applications involving the transport, storage and use of radioactive material and radiation sources incorporate a number of safety provisions. The number and reliability of these provisions depends on their design and the magnitude of the hazard. Events may occur where some of these safety provisions fail but others prevent any actual consequences. In order to communicate the significance of such events, criteria are defined which depend on the amount of radioactive material and the severity of the failure of the safety provisions.

Since these events only involve an increased likelihood of an accident, with no actual consequences, the maximum rating for such events is set at Level 3 (i.e. a serious incident). Furthermore, this maximum level is only applied to practices where there is the potential, if all safety provisions failed, for a significant accident (i.e. one rated at Levels 5, 6 or 7 in INES). For events associated with practices that have a much smaller hazard potential (e.g. transport of small medical or industrial radioactive sources), the maximum rating under defence in depth is correspondingly lower.

One final issue that is addressed under defence in depth is what is described in this document as additional factors, covering as appropriate, common cause failure, issues with procedures and safety culture. To address these additional factors, the criteria allow the rating to be increased by one level from the rating derived solely by considering the significance of the actual equipment or administrative failures. (It should be noted that for events related to radiation sources and transport of radioactive material, the possibility of increasing the level due to additional factors is included as part of the rating tables rather than as a separate consideration.)

The detailed criteria developed to implement these principles are defined in this document. Three specific but consistent approaches are used; one for transport and radiation source events, one specific to events at power reactors in operation and one for events at other authorized facilities (including events at reactors during cold shutdown, research reactors and decommissioning of nuclear facilities). It is for this reason that there are three separate sections for defence in depth, one for each of these approaches. Each section is self-contained, allowing users to focus on the guidance relevant to events of interest.

The criteria for transport and radiation source events are contained in a set of tables that combine all three elements of defence in depth mentioned earlier (i.e. the amount of radioactive material, the extent of any failure of safety provisions and additional factors).

The criteria for power reactors in operation give a basic rating from two tables and allow additional factors to increase the rating by one level. The basic rating from the tables depends on whether the safety provisions were actually challenged, the extent of any degradation of the safety provisions and the likelihood of an event that would challenge such provisions.

The criteria for events at reactors in cold shutdown, research reactors and other authorized facilities give a basic rating from a table, depending on the maximum consequences, were all the safety provisions to fail, and the extent of the remaining safety provisions. This latter factor is accounted for by grouping safety provisions into what are called independent safety layers and counting the number of such safety layers. Additional factors are then considered by allowing a potential increase in the basic rating by one level.

1.4.4. The final rating

The final rating of an event needs to take account of all the relevant criteria described above. Each event should be considered against each of the appropriate criteria and the highest derived rating is the one to be applied to the event. A final check for consistency with the general description of the levels of INES ensures the appropriateness of the rating. The overall approach to rating is summarized in the flow charts of Section 7.

1.5. USING THE SCALE

INES is a communication tool. Its primary purpose is to facilitate communication and understanding between the technical community, the media and the public on the safety significance of events. Some more specific guidance on the use of INES as part of communicating event information is given in Section 1.6.

It is not the purpose of INES or the international communication system associated with it to define the practices or installations that have to be included within the scope of the regulatory control system, nor to establish requirements for events to be reported by the users to the regulatory authority or to the public. The communication of events and their INES ratings is not a formal reporting system. Equally, the criteria of the scale are not intended to replace existing well-established criteria used for formal emergency arrangements in any country. It is for each country to define its own regulations and arrangements for such matters. The purpose of INES is simply to help to put into perspective the safety significance of those events that are to be communicated.

It is important that communications happen promptly; otherwise a confused understanding of the event will occur from media and public speculation. In some situations, where not all the details of the event are known early on, it is recommended that a provisional rating is issued based on the information that is available and the judgement of those understanding the nature of the event. Later on, a final rating should be communicated and any differences explained.

For the vast majority of events, such communications will only be of interest in the region or country where the event occurs, and participating countries will have to set up mechanisms for such communications. However, in order to facilitate international communications for events attracting, or possibly attracting, wider interest, the IAEA and OECD/NEA have developed a communications network that allows details of the event to be input on an event rating form (ERF), which is then immediately disseminated to all INES member States. Since 2001, this web-based INES information service has been used by the INES members to communicate events to the technical community as well as to the media and public.

It is not appropriate to use INES to compare safety performance between facilities, organizations or countries. Arrangements for reporting minor events to the public may be different, and it is difficult to ensure precise consistency in rating events at the boundary between Below scale/Level 0 and Level 1. Although information will be available on events at Level 2 and above, the statistically small number of such events, which also varies from year to year, makes it difficult to put forth meaningful international comparisons.

1.6. COMMUNICATING EVENT INFORMATION

1.6.1. General principles

INES should be used as part of a communications strategy, locally, nationally and internationally. While it is not appropriate for an international document to define exactly how national communications should be carried out, there are some general principles that can be applied. These are provided in this section. Guidance on international communications is provided in Section 1.6.2.

When communicating events using the INES rating, it needs to be remembered that the target audience is primarily the media and the public. Therefore:

— Use plain language and avoid technical jargon in the summary description of the event;
— Avoid abbreviations, especially if equipment or systems are mentioned (e.g. main coolant pump instead of MCP);
— Mention the actual confirmed consequences such as deterministic health effects to workers and/or members of the public;
— Provide an estimate of the number of workers and/or members of the public exposed as well as their actual exposure;
— Affirm clearly when there are no consequences to people and the environment;
— Mention any protective action taken.

The following elements are relevant when communicating events at nuclear facilities:

— Date and time of the event;
— Facility name and location;
— Type of facility;

— Main systems involved, if relevant;
— A general statement saying that there is/is not release of radioactivity to the environment or there are/are not any consequences for people and the environment.

In addition, the following elements are relevant parts of the event description for an event related to radiation sources or the transport of radioactive material:

— The radionuclides involved in the events;
— The practice for which the source was used and its IAEA Category [1];
— The condition of the source and associated device; and if it is lost, any information that will be helpful in identifying the source or device, such as the registration serial number(s).

1.6.2. International communications

As explained in Section 1.5, the IAEA maintains a system to facilitate international communication of events. It is important to recognize that this service is not a formal reporting system, and the system operates on a voluntary basis. Its purpose is to facilitate communication and understanding between the technical community (industry and regulators), the media and the public on the safety significance of events that have attracted or are likely to attract international media interest. There are also benefits in using the system to communicate transboundary transport events.

Many countries have agreed to participate in the INES system because they clearly recognize the importance of open communication of events in a way that clearly explains their significance.

All countries are strongly encouraged to communicate events internationally (within 24 hours if possible) according to the agreed criteria which are:

— Events rated at Level 2 and above; or
— Events attracting international public interest.

It is recognized that there will be occasions when a longer time scale is required to know or estimate the actual consequences of the event. In these circumstances, a provisional rating should be given with a final rating provided at a later date.

Events are posted in the system by the INES national officers, who are officially designated by the Member States. The system includes event descriptions, ratings in INES, press releases (in the national language and in English), and technical documentation for experts. Event descriptions, ratings and press releases are available to the general public without registration. Access to the technical documentation is limited to nominated and registered experts.

The main items to be provided for a specific event are summarized in the ERF. The information being made available to the public should follow the principles listed in Section 1.6.1. When the scale is applied to transport of radioactive material, the multinational nature of some transport events complicates the issue; however, the ERF for each event should only be provided by one country. The ERF, which itself is not available to the public, is posted by the country where the event occurs. The principles to be applied are as follows:

— It is expected that the country in which the event is discovered would initiate the discussion about which country will provide the event rating form.
— As general guidance, if the event involves actual consequences, the country in which the consequences occur is likely to be best placed to provide the event rating form. If the event only involves failures in administrative controls or packaging, the country consigning the package is likely to be best placed to provide the event rating form. In the case of a lost package, the country where the consignment originated is likely to be the most appropriate one to deal with rating and communicating the event.
— Where information is required from other countries, the information may be obtained via the appropriate competent authority and should be taken into account when preparing the event rating form.
— For events related to nuclear facilities, it is essential to identify the facility, its location and type.
— For events related to radiation sources, it may be helpful to include some technical details about the source/device or to include device registration numbers, as the INES system provides a rapid means for disseminating such information internationally.
— For events involving transport of radioactive material, it may be helpful to include the identification of the type of package (e.g. excepted, industrial, Type A, B).
— For nuclear facilities, the basic information to be provided includes the facility name, type and location, and the impact on people and the environment. Although other mechanisms already exist for international exchange of operational feedback, the INES system provides for the initial communication of the event to the media, the public and the technical community.

— The event rating form also includes the basis of the rating. Although this is not part of the material communicated to the public, it is helpful for other national officers to understand the basis of the rating and to respond to any questions. The rating explanation should clearly show how the event rating has been determined referring to the appropriate parts of the rating procedure.

1.7. STRUCTURE OF THE MANUAL

The manual is divided into seven main sections.

Section 1 provides an overview of INES.

Section 2 gives the detailed guidance required to rate events in terms of their impact on people and the environment. A number of worked examples are provided.

Section 3 provides the detailed guidance required to rate events in terms of their impact on radiological barriers and controls at facilities. Several worked examples are also provided.

Sections 4, 5 and 6 provide the detailed guidance required to rate events in terms of their impact on defence in depth.

Section 4 provides the defence in depth guidance for all events associated with transport and radiation sources, except those occurring at:

— Accelerators;
— Facilities involving the manufacture and distribution of radionuclides;
— Facilities involving the use of a Category 1 source [1];

These are all covered in Section 6.

Section 5 provides the defence in depth guidance for events at power reactors. It only relates to events while the reactor is at power. Events on power reactors while in shutdown mode, permanently shutdown or being decommissioned are covered in Section 6. Events at research reactors are also covered in Section 6.

Section 6 provides the defence in depth guidance for events at fuel cycle facilities, research reactors, accelerators (e.g. linear accelerators and cyclotrons) and events associated with failures of safety provisions at facilities involving the manufacture and distribution of radionuclides or the use of a Category 1 source. It also provides the guidance for rating events on nuclear power reactors while in cold shutdown mode (during outage, permanently shutdown or under decommissioning).

The purpose of providing three separate sections for defence in depth is to simplify the task of those determining the rating of events. While there is some duplication between chapters, each chapter contains all that is required for the rating of events of the appropriate type. Relevant worked examples are included in each of the three defence in depth sections.

Section 7 is a summary of the procedure to be used to rate events, including illustrative flowcharts and tables of examples.

Four appendices, two annexes and references provide some further scientific background information.

Definitions and terminology adopted in this manual are presented in the Glossary.

This manual supersedes the 2001 edition [2], the 2006 working material published as additional guidance to National Officers [3] and the clarification for fuel damage events approved in 2004 [4].

2. IMPACT ON PEOPLE AND THE ENVIRONMENT

2.1. GENERAL DESCRIPTION

The rating of events in terms of their impact on people and the environment takes account of the actual radiological impact on workers, members of the public and the environment. The evaluation is based on either the doses to people or the amount of radioactive material released. Where it is based on dose, it also takes account of the number of people who receive a dose. Events must also be rated using the criteria related to defence in depth (Sections 4, 5 or 6) and, where appropriate, using the criteria related to radiological barriers and controls at facilities (Section 3), in case those criteria give rise to a higher rating in INES.

It is accepted that for a serious incident or an accident, it may not be possible during the early stages of the event to determine accurately the doses received or the size of a release. However, it should be possible to make an initial estimate and thus to assign a provisional rating. It needs to be remembered that the purpose of INES is to allow prompt communication of the significance of an event.

In events where a significant release has not occurred, but is possible if the event is not controlled, the provisional level is likely to be based on what has actually occurred so far (using all the relevant INES criteria). It is possible that subsequent re-evaluation of the consequences would necessitate revision of the provisional rating.

The scale should not be confused with emergency classification systems, and should not be used as a basis for determining emergency response actions. Equally, the extent of emergency response to events is not used as a basis for rating. Details of the planning against radiological events vary from one country to another, and it is also possible that precautionary measures may be taken in some cases even where they are not fully justified by the actual size of the release. For these reasons, it is the size of release and the assessed dose that should be used to rate the event on the scale and not the protective actions taken in the implementation of emergency response plans.

Two types of criteria are described in this section:

— Amount of activity released: applicable to large releases of radioactive material into the environment;
— Doses to individuals: applicable to all other situations.

The procedure for applying these criteria is summarized in the flowcharts in Section 7. However, it should be noted that for events associated with transport and radiation sources, it is only necessary to consider the criteria for doses to individuals when there is a significant release of radioactive material.

2.2. ACTIVITY RELEASED

The highest four levels on the scale (Levels 4–7) include a definition in terms of the quantity of activity released, defining its size by its radiological equivalence to a given number of terabecquerels of ^{131}I. (The method for assessing radiological equivalence is given in Section 2.2.1). The choice of this isotope is somewhat arbitrary. It was used because the scale was originally developed for nuclear power plants and ^{131}I would generally be one of the more significant isotopes released.

The reason for using quantity released rather than assessed dose is that for these larger releases, the actual dose received will very much depend on the protective action implemented and other environmental conditions. If the protective actions are successful, the doses received will not increase in proportion to the amount released.

2.2.1. Methods for assessing releases

Two methods are given for assessing the radiological significance of a release, depending on the origin of the release and hence the most appropriate assumptions for assessing the equivalence of releases. If there is an atmospheric release from a nuclear facility, such as a reactor or fuel cycle facility, Table 2 gives conversion factors for radiological equivalence to ^{131}I that should be used. The actual activity of the isotope released should be multiplied by the factor given in Table 2 and then compared with the values given in the definition of each level. If several isotopes are released, the equivalent value for each should be calculated and then summed (see examples 5–7). The derivation of these factors is explained in Appendix I.

If the release occurs during the transport of radioactive material or from the use of radiation sources, D_2 values should be used. The D values are a level of activity above which a source is considered to be ‘dangerous’ and has a significant potential to cause severe deterministic effects if not managed safely and securely. The D_2 value is “the activity of a radionuclide in a source that, if uncontrolled and dispersed, might result in an emergency that could reasonably be expected to cause severe deterministic health effects” [5]. Appendix III lists D_2 values for a range of isotopes.

TABLE 2. RADIOLOGICAL EQUIVALENCE TO ^{131}I FOR RELEASES TO THE ATMOSPHERE

Isotope	Multiplication factor
Am-241	8 000
Co-60	50
Cs-134	3
Cs-137	40
H-3	0.02
I-131	1
Ir-192	2
Mn-54	4
Mo-99	0.08
P-32	0.2
Pu-239	10 000
Ru-106	6
Sr-90	20
Te-132	0.3
U-235(S)[a]	1 000
U-235(M)[a]	600
U-235(F)[a]	500
U-238(S)[a]	900
U-238(M)[a]	600
U-238(F)[a]	400
U nat	1 000
Noble gases	Negligible (effectively 0)

[a] Lung absorption types: S — slow; M — medium; F — fast. If unsure, use the most conservative value.

For events involving releases that do not become airborne (e.g. aquatic releases or ground contamination due to spillage of radioactive material), the rating based on dose should be established, using Section 2.3. Liquid discharges resulting in doses significantly higher than that appropriate for Level 3 would need to be rated at Level 4 or above, but the assessment of radiological equivalence would be site specific, and therefore detailed guidance cannot be provided here.

2.2.2. Definition of levels based on activity released[2]

Level 7

"*An event resulting in an environmental release corresponding to a quantity of radioactivity radiologically equivalent to a release to the atmosphere of more than several tens of thousands of terabecquerels of ^{131}I.*"

This corresponds to a large fraction of the core inventory of a power reactor, typically involving a mixture of short and long lived radionuclides. With such a release, stochastic health effects over a wide area, perhaps involving more than one country, are expected, and there is a possibility of deterministic health effects. Long-term environmental consequences are also likely, and it is very likely that protective action such as sheltering and evacuation will be judged necessary to prevent or limit health effects on members of the public.

Level 6

"*An event resulting in an environmental release corresponding to a quantity of radioactivity radiologically equivalent to a release to the atmosphere of the order of thousands to tens of thousands of terabecquerels of ^{131}I.*"

With such a release, it is very likely that protective action such as sheltering and evacuation will be judged necessary to prevent or limit health effects on members of the public.

Level 5

"*An event resulting in an environmental release corresponding to a quantity of radioactivity radiologically equivalent to a release to the atmosphere of the order of hundreds to thousands of terabecquerels of ^{131}I.*"

or

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[2] These criteria relate to accidents where early estimates of the size of release can only be approximate. For this reason, it is inappropriate to use precise numerical values in the definitions of the levels. However, in order to help ensure consistent interpretation of these criteria internationally, it is suggested that the boundaries between the levels are about 500, 5000 and 50 000 TBq ^{131}I.

"An event resulting in a dispersed release of activity from a radioactive source with an activity greater than 2500 times the D_2 value for the isotopes released."

As a result of the actual release, some protective action will probably be required (e.g. localized sheltering and/or evacuation to prevent or minimize the likelihood of health effects).

Level 4

"An event resulting in an environmental release corresponding to a quantity of radioactivity radiologically equivalent to a release to the atmosphere of the order of tens to hundreds of terabecquerels of ^{131}I."

or

"An event resulting in a dispersed release of activity from a radioactive source with an activity greater than 250 times the D_2 value for the isotopes released."

For such a release, protective action will probably not be required, other than local food controls.

2.3. DOSES TO INDIVIDUALS

The most straightforward criterion is that of dose received as a result of the event, and Levels 1 to 6 include a definition based on that criterion[3]. Unless specifically stated (see Level 1 criteria[3]), they apply to doses that were received, or could have easily been received[4], from the single event being rated (i.e. excluding cumulative exposure). They define a minimum rating if one individual is exposed above the given criteria (section 2.3.1) and a higher rating if more individuals are exposed above those criteria (section 2.3.2).

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[3] The Level 1 definitions are based on the defence in depth criteria explained in Sections 4–6 but they are included here for completeness.

[4] The intention here is not to invent scenarios different than the one that occurred but to consider what doses might reasonably have occurred unknowingly. For example if a radioactive source has become separated from its shielding and transported, doses to drivers and package handlers should be estimated.

2.3.1. Criteria for the assessment of the minimum rating when one individual is exposed

Level 4 is the minimum level for events that result in:

(1) *"The occurrence of a lethal deterministic effect;*

or

(2) *The likely occurrence of a lethal deterministic effect as a result of whole body exposure, leading to an absorbed dose*[5] *of the order of a few Gy".*

Appendix II presents further details on the likelihood of fatal deterministic effects and the thresholds for non-lethal deterministic effects.

Level 3 is the minimum level for events that result in:

(1) *"The occurrence or likely occurrence of a non-lethal deterministic effect (see Appendix II for further details);*

or

(2) *Exposure leading to an effective dose greater than ten times the statutory annual whole body dose limit for workers".*

Level 2 is the minimum level for events that result in:

(1) *"Exposure of a member of the public leading to an effective dose in excess of 10 mSv;*

or

(2) *Exposure of a worker in excess of statutory annual dose limits*[6]."

Level 1[3] is the minimum level for events that result in:

(1) "*Exposure of a member of the public in excess of statutory annual dose limits*[6]*;*

or

(2) *Exposure of a worker in excess of dose constraints*[7];

or

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[5] Where high LET radiation is significant, the absorbed dose should take into account the appropriate RBE. The RBE weighted absorbed dose should be used to determine the appropriate INES rating.

[6] The dose limits to be considered are all statutory dose limits including whole body effective dose, doses to skin, doses to extremities and doses to lens of the eye.

[7] Dose constraint is a value below the statutory dose limit that may be established by the country.

(3) *Cumulative exposure of a worker or a member of the public in excess of statutory annual dose limits*[6]*".*

2.3.2. Criteria for consideration of the number of individuals exposed

If more than one individual is exposed, the number of people falling into each of the defined levels in Section 2.3.1 should be assessed and in each case, the guidance given in the following paragraphs should be used to increase the rating as necessary.

For exposures that do not cause or are unlikely to cause a deterministic effect, the minimum rating assessed in Section 2.3.1 should be increased by one level if doses above the value defined for the level are received by 10 or more individuals, and by two levels if the doses are received by 100 or more individuals.

For exposures that have caused or are likely to cause deterministic effects, a more conservative approach is taken, and the rating should be increased by one level if doses above the value defined for the level are received by several individuals and by two levels if the doses are received by a few tens of individuals[8].

A summary table of the criteria in this section and the preceding section is presented in Section 2.3.4.

Where a number of individuals are exposed at differing levels, the event rating is the highest of the values derived from the process described. For example, for an event resulting in 15 members of the public receiving an effective dose of 20 mSv, the minimum rating applicable to that dose is Level 2. Taking into consideration the number of individuals exposed (15) leads to an increase of one level, giving a rating at Level 3. However if only one member of the public received an effective dose of 20 mSv, and 14 received effective doses between one and 10 mSv, the rating based on those receiving an effective dose of 20 mSv would be Level 2 (minimum rating, not increased, as only one person affected) and the rating based on those receiving an effective dose of more than one but less than 10 mSv would be Level 2 (minimum rating of Level 1, increased by one, as more than 10 people were exposed). Thus the overall rating would be Level 2.

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[8] As guidance to help with a consistent approach to the application of these criteria, it may be considered that "several" is more than three and "a few tens" is more than 30. (These values correspond to approximately half an order of magnitude on a logarithmic basis.)

2.3.3. Dose estimation methodology

The methodology for estimation of doses to workers and the public should be realistic and follow the standard national assumptions for dose assessment. The assessment should be based on the real scenario, including any protective action taken.

If it cannot be known for certain whether particular individuals received a dose (e.g. a transport package subsequently found to have inadequate shielding), the probable doses should be estimated and the level on INES assigned based on a reconstruction of the likely scenario.

2.3.4. Summary

The guidance in Section 2.3 is summarized in Table 3, showing how the level of dose and the number of people exposed are taken into account.

TABLE 3. SUMMARY OF RATING BASED ON DOSES TO INDIVIDUALS

Level of exposure	Minimum rating	Number of individuals	Actual rating
The occurrence of a lethal deterministic effect or the likely occurrence of a lethal deterministic effect as a result of a whole body absorbed dose of the order of a few Gy	4	Few tens or more	6[a]
		Between several and a few tens	5
		Less than several	4
The occurrence or likely occurrence of a non-lethal deterministic effect	3	Few tens or more	5
		Between several and a few tens	4
		Less than several	3
Exposure leading to an effective dose greater than ten times the statutory annual whole body dose limit for workers	3	100 or more	5
		10 or more	4
		Less than ten	3
Exposure of a member of the public leading to an effective dose in excess of 10 mSv or Exposure of a worker in excess of statutory annual dose limits	2	100 or more	4
		10 or more	3
		Less than ten	2

TABLE 3. SUMMARY OF RATING BASED ON DOSES TO INDIVIDUALS (cont.)

Level of exposure	Minimum rating	Number of individuals	Actual rating
Exposure of a member of the public in excess of statutory annual dose limits or Exposure of a worker in excess of dose constraints	1	100 or more	3
		10 or more	2
		Less than ten	1[b]
Cumulative exposure of workers or members of the public in excess of statutory annual dose limits	1	1 or more	1[b]

[a] Level 6 is not considered credible for any event involving radiation sources.
[b] As explained in Section 2.3, the Level 1 definitions are based on defence in depth criteria explained in Sections 4–6, but they are included here for completeness.

2.4. WORKED EXAMPLES

The purpose of these examples is to illustrate the rating guidance contained in this section of the manual. The examples are based on real events but have been modified slightly to illustrate the use of different parts of the guidance. The rating derived in this section is not necessarily the final rating as it would be necessary to consider the criteria in Sections 3 to 6 before defining the final rating.

Example 1. Overexposure of an electrician at a hospital — Level 2

Event description

While a service person was installing and adjusting a new radiotherapy machine in a hospital, he was not aware of an electrician working above the ceiling. He tested the machine, pointing the radiation beam towards the ceiling, and the electrician was probably exposed. The estimated whole body exposure range was between 80 mSv and 100 mSv effective dose. The electrician had no symptoms but as a precaution, a blood test was undertaken. As would be expected for this level of dose, the blood test was negative.

Rating explanation

Criteria	Explanation
2.2.1. Activity released	Not applicable. No release.
2.3. Doses to individuals	One person (not an occupational radiation worker) received an effective dose greater than 10 mSv but less than "ten times the statutory annual whole body dose limit for workers". There were no deterministic health effects. Rating Level 2.
Rating for impact on people and the environment	Level 2.

Example 2. Overexposure of a radiographer — Level 2

Event description

A radiographer was disconnecting the source guide tube from a radiographic camera and noticed that the source was not in the fully shielded position. The exposure device contained an 807 GBq ^{192}Ir sealed source. The radiographer noticed that his pocket ion chamber was off-scale and notified the radiation safety officer (RSO) of the company. Because extremity dosimeters are not commonly used during radiographic operations, the RSO conducted a dose reconstruction. Based on the dose reconstruction, one individual may have received an extremity dose in the range of 3.3–3.6 Gy, which is in excess of the statutory annual dose limit of 500 mSv to the skin or the extremity. Whole body dosimeter results revealed that the radiographer received a whole body dose of approximately 2 mSv. The radiographer was admitted to the hospital for observation and was later released. No deterministic effects were observed.

Subsequent information obtained indicated that the individual had worn his dosimeter on his hip and his body may have shielded the dosimeter.

Rating explanation

Criteria	Explanation
2.2. Activity released	Not applicable. No release.
2.3. Doses to individuals	One worker received a dose in excess of the annual limit. No deterministic effects were observed, nor would they be expected. Level 2. (Even taking account of the possible shielding of the dosimeter, the effective dose was well below the criteria for Level 3).
Rating for impact on people and the environment	Level 2.

Example 3. Overexposure of an industrial radiographer – Level 3

Event description

Three workers were carrying out industrial radiography using a source of 3.3 TBq of ^{192}Ir on a 22.5 m high tower platform.. For some reason, the ^{192}Ir source (pigtail) was disengaged (or never engaged) from the driver. At the end of the job, one of the workers unscrewed the guide tube, and the source fell on the platform without anyone noticing (no radiation pagers or pocket dosimeters were used). The workers left the work site and the next evening (23:00), an employee found the source and tried to identify it. He showed the source to another employee, and this latter employee noticed that the first employee had a swollen cheek. The first employee handed the source to his colleague and went down to wash his face. The second employee went down the tower with the source in his hand. When both employees decided to hand the source to their supervisor in his office, the alarming dosimeter of a worker from another company started to alarm indicating a high radiation field. The source was identified, and the employees were advised that the piece of metal was a dangerous radioactive source and to put it away immediately. The source was put in a pipe, and the owner of the company was contacted, after which the source was recovered. The time elapsed between identifying that the source was radioactive and the source recovery was about half an hour. The three construction staff members were sent for medical examination (including cytogenetics examination) and were admitted to hospital. One of them showed some deterministic effects (severe radiation burns to one hand). Five employees from the industrial radiography company had blood samples taken for analysis at a cytogenetics laboratory, however no abnormalities were observed.

Rating explanation

Criteria	Explanation
2.2. Activity released	Not applicable.
2.3. Doses to individuals	One person showed deterministic effects from the radiation. This gives a rating of Level 3.
Rating for impact on people and the environment	Level 3.

Example 4. Breakup of an abandoned highly active source — Level 5

Event description

A private radiotherapy institute moved to new premises, taking with it a ^{60}Co teletherapy unit and leaving in place a 51 TBq ^{137}Cs teletherapy unit. They failed to notify the licensing authority as required under the terms of the institute's licence. The former premises were subsequently partly demolished. As a result, the ^{137}Cs teletherapy unit became totally insecure. Two people entered the premises and, not knowing what the unit was, but thinking it might have some scrap value, removed the source assembly from the machine. They took it home and tried to dismantle it. In the attempt, the source capsule was ruptured. The radioactive source was in the form of caesium chloride salt, which is highly soluble and readily dispersible. As a result, several people were contaminated and irradiated.

After the source capsule was ruptured, the remnants of the source assembly were sold for scrap to a junkyard owner. He noticed that the source material glowed blue in the dark. Several persons were fascinated by this and over a period of days, friends and relatives came and saw the phenomenon. Fragments of the source the size of rice grains were distributed to several families. This continued for five days, by which time a number of people were showing gastrointestinal symptoms arising from their exposure to radiation from the source. The symptoms were not initially recognized as being due to irradiation. However, one of the persons irradiated made the connection between the illnesses and the source capsule and took the remnants to the public health department in the city.

This action began a chain of events, which led to the discovery of the accident. A local physicist was the first to monitor and assess the scale of the accident and took actions on his own initiative to evacuate two areas. At the same time, the authorities were informed, upon which the speed and the scale of the response were impressive. Several other sites of significant contamination were quickly identified and residents evacuated. As a result of the event, eight people developed acute radiation syndrome, and four people died from radiation exposure.

Rating explanation

Criteria	Explanation
2.2. Activity released	The source was broken up, and therefore the bulk of the activity was released into the environment. The D_2 value for ^{137}Cs from Appendix III is 20 TBq, so the release was about 2.5 times the D-value, which is well below the value for Level 4 “greater than 250 times the D_2 value”.
2.3. Doses to individuals	A single death from radiation would be rated at Level 4. Because four people died, the rating should be increased by one.
Rating for impact on people and the environment	Level 5.

Example 5. Iodine-131 release from reactor — Level 5

Event description

The graphite moderator of an air-cooled plutonium production reactor had a fire, which resulted in a significant release of radioactive material. The fire started during the process of annealing the graphite structure. During normal operation, neutrons striking the graphite result in distortion of the crystal structure of the graphite. This distortion results in a buildup of stored energy in the graphite. A controlled heating annealing process was used to restore the graphite structure and release the stored energy. Unfortunately, in this case, excessive energy was released, resulting in fuel damage. The metallic uranium fuel and the graphite then reacted with air and started burning. The first indication of an abnormal condition was provided by air samplers about 800 m away. Radioactivity levels were 10 times that normally found in air.

Sampling closer to the reactor building confirmed radioactivity releases were occurring. Inspection of the core indicated the fuel elements in approximately 150 channels were overheated. After several hours of trying different methods, the fire was extinguished by a combination of water deluge and switching off the forced air cooling fans. The plant was cooled down. The amount of activity released was estimated to be between 500 and 700 TBq of ^{131}I and 20 to 40 TBq of ^{137}Cs. There were no deterministic effects and no one received a dose approaching ten times the statutory annual whole body dose limit for workers.

Rating explanation

Criteria	Explanation
2.2. Activity released	The factor for the radiological equivalence of ^{137}Cs from Table 2 is 40, so the total release was radiologically equivalent to between 1300 and 2300 TBq ^{131}I. As the upper limit is well below 5000 TBq, this is rated at Level 5, "equivalent to hundreds to thousands of TBq ^{131}I"
2.3. Doses to individuals	Not applicable. Actual individual doses are not given but as no one received doses approaching the Level 3 criteria, the individual dose criteria cannot give rise to a higher rating than that already derived from the large release criteria.
Rating for impact on people and the environment	Level 5.

Example 6. Overheating of high level waste storage tank in a reprocessing facility — Level 6

Event description

The cooling system of a highly radioactive waste storage tank failed, resulting in a temperature increase of the contents of the tank. The subsequent explosion of dry nitrate and acetate salts had a force of 75 tons of TNT. The 2.5 m thick concrete lid was thrown 30 m away. Emergency measures, including evacuation were taken to limit serious health effects.

The most significant component of the release was 1000 TBq of ^{90}Sr and 13 TBq of ^{137}Cs. A large area, measuring 300 × 50 km was contaminated by more than 4 kBq/m² of ^{90}Sr.

Rating explanation

Criteria	Explanation
2.2. Activity released	The factors for the radiological equivalence of ^{90}Sr and ^{137}Cs from Table 2 are 20 and 40 respectively, so the total release was radiologically equivalent to 20 500 TBq ^{131}I. This is rated at Level 6 "equivalent to thousands to tens of thousands of TBq ^{131}I".
2.3. Doses to individuals	Not necessary to consider, as event is already rated at Level 6.
Rating for actual consequences	Level 6.

Example 7. Major release of activity following criticality accident and fire — Level 7

Event description

Design weaknesses and a poorly planned and conducted test led to a reactor going supercritical. Attempts were made to shut the reactor down but an energy spike occurred, and some of the fuel rods began to fracture, placing fragments of the fuel rods in line with the control rod columns. The rods became stuck after being inserted only one-third of the way, and were therefore unable to stop the reaction. The reactor power increased to around 30 GW, which was ten times the normal operational output. The fuel rods began to melt, and the steam pressure rapidly increased, causing a large steam explosion. Generated steam traveled vertically along the rod channels in the reactor, displacing and destroying the reactor lid, rupturing the coolant tubes and then blowing a hole in the roof. After part of the roof blew off, the inrush of oxygen, combined with the extremely high temperature of the reactor fuel and graphite moderator, sparked a graphite fire. This fire was a significant contributor to the spread of radioactive material and the contamination of outlying areas.

The total release of radioactive material was about 14 million TBq, which included 1.8 million TBq of ^{131}I, 85 000 TBq of ^{137}Cs and other caesium radioisotopes, 10 000 TBq of ^{90}Sr and a number of other significant isotopes.

Rating explanation

Criteria	Explanation
2.2. Activity released	The factors for the radiological equivalence of ^{90}Sr and ^{137}Cs from Table 2 are 20 and 40 respectively, so the total release was radiologically equivalent to 5.4 million TBq ^{131}I. This is rated at the highest level on the scale, Level 7 "equivalent to more than several tens of thousands of TBq ^{131}I". Although other isotopes would have been present, there is no need to include them in the calculation, as the isotopes listed are already equivalent to a Level 7 release.
2.3. Doses to individuals	Not necessary to consider, as event is already rated at Level 7.
Rating for impact on people and the environment	Level 7.

3. IMPACT ON RADIOLOGICAL BARRIERS AND CONTROLS AT FACILITIES

3.1. GENERAL DESCRIPTION

The guidance in this section is only applicable to events within authorized facilities, where a site boundary is clearly defined as part of their licensing. It is only applicable at major facilities where there is the potential (however unlikely) for a release of radioactive material that could be rated at Level 5 or above.

Every event needs to be considered against the criteria for impact on people and the environment and the criteria for impact on defence in depth, and it could be argued that those two sets of criteria cover all the issues that need to be addressed in rating an event. However, if this were done, then two key types of events would not be rated at a level appropriate to their significance.

The first type of event is where significant damage occurs to the primary barriers preventing a large release (e.g. a reactor core melt or loss of confinement of very large quantities of radioactive material at a nuclear fuel reprocessing facility). In this type of event, the principle design protection has failed, and the only barriers preventing a very large release are the remaining containment systems. Without specific criteria to address such events, they would only be rated at Level 3 under defence in depth, the same level as a “near accident with no redundancy remaining”. The criteria for Level 4 and Level 5 specifically address this situation.

The second type of event is where the primary barriers preventing a large release remain intact, but a major spillage of radioactive materials or a significant increase in dose rate occurs at facilities handling large quantities of radioactive material. Such events could well be rated at Level 1 under defence in depth due to the large numbers of barriers that would still be in place. However, these events represent a major failure in the management controls for handling radioactive material and hence in themselves suggest an underlying risk of events with significant impact on people and the environment. The criteria for Levels 2 and 3 specifically address this second type of event.

The significance of contamination is measured either by the quantity of activity spread or the resultant dose rate. These criteria relate to dose rates in an operating area but do not require a worker to be actually present. They should not be confused with the criteria for doses to workers in Section 2.3, which relate to doses actually received.

Contamination levels below the value for Level 2 are considered insignificant for the purpose of rating an event under this criterion; it is only the impact on defence in depth which has to be considered at these lower levels.

It is accepted that the exact nature of damage and/or contamination may not be known for some time following an event with consequences of this nature. However, it should be possible to make a broad estimate in order to decide an appropriate provisional rating on the event rating form. It is possible that subsequent re-evaluation of the situation would necessitate re-rating the event.

For all events, the criteria related to people and the environment (Section 2) and defence in depth (Sections 4, 5 and 6) must also be considered, as they may give rise to a higher rating.

3.2. DEFINITION OF LEVELS

Level 5

For events involving reactor fuel (including research reactors):

"*An event resulting in the melting of more than the equivalent of a few per cent of the fuel of a power reactor or the release*[9] *of more than a few per cent of the core inventory of a power reactor from the fuel assemblies*[10]*.*"

The definition is based on the total inventory of the core of a power reactor, not just the free fission product gases (the "gap inventory"). Such an amount requires significant release from the fuel matrix as well as the gap inventory. It should be noted that the rating based on fuel damage does not depend on the state of the primary circuit.

For research reactors, the fraction of fuel affected should be based on quantities of a 3000 MW(th) power reactor.

[9] Release here is used to describe the movement of radioactive material from its intended location but still contained within the facility boundary

[10] Since the extent of fuel damage is not easily measurable, utilities and regulators should establish plant specific criteria expressed in terms of symptoms (e.g. activity concentration in the primary coolant, radiation monitoring in the containment building) to facilitate the timely rating of events involving fuel damage.

For other facilities:

"*An event resulting in a major release*[9] *of radioactive material at the facility (comparable with the release from a core melt) with a high probability of significant overexposure*[11]*.*"

Examples of non-reactor accidents would be a major criticality accident, or a major fire or explosion releasing large quantities of radioactive material within the installation.

Level 4

For events involving reactor fuel (including research reactors):

"*An event resulting in the release*[9] *of more than about 0.1% of the core inventory of a power reactor from the fuel assemblies,*[10] *as a result of either fuel melting and/or clad failure.*"

Again this definition is based on the total inventory of the core not just the "gap inventory" and does not depend on the state of the primary circuit. A release of more than 0.1% of the total core inventory could occur if either there is some fuel melting with clad failure, or if there is damage to a significant fraction (~10%) of the clad, thereby releasing the "gap inventory".

For research reactors, the fraction of fuel affected should be based on quantities of a 3000 MW(th) power reactor.

Fuel damage or degradation that does not result in a release of more than 0.1% of the core inventory of a power reactor (e.g. very localized melting or a small amount of clad damage) should be rated at Below scale/Level 0 under this criterion and then considered under the defence in depth criteria.

[11] 'High probability' implies a similar probability to that of a release from the containment following a reactor accident.

For other facilities:

"An event involving the release[9] *of a few thousand terabecquerels of activity from their primary containment*[12] *with a high probability of significant public overexposure*[11]*."*

Level 3

An event resulting in a release[9] *of a few thousand terabecquerels of activity into an area not expected by design*[13] *which require corrective action, even with a very low probability of significant public exposure."*

or

"An event resulting in the sum of gamma plus neutron dose rates of greater than 1 Sv per hour in an operating area[14] *(dose rate measured 1 metre from the source).*

Events resulting in high dose rates in areas not considered as operating areas should be rated using the defence in depth approach for facilities (see Example 49).

Level 2

"An event resulting in the sum of gamma plus neutron dose rates of greater than 50 mSv per hour in an operating area[14] *(dose rate measured 1 metre from the source)".*

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[12] In this context, the terms primary and secondary containment refer to containment of radioactive materials at non-reactor installations and should not be confused with the similar terms used for reactor containments.

[13] Areas not expected by design are those whose design basis, for either permanent or temporary structures, does not assume that during operation or following an incident the area could receive and retain the level of contamination that has occurred and prevent the spread of contamination beyond the area. Examples of events involving contamination of areas not expected by design, are:

- Contamination by radioactive material outside controlled or supervized areas, where normally no such material is present, for example floors, staircases, auxiliary buildings, and storage areas.
- Contamination by plutonium or highly radioactive fission products of an area designed and equipped only for the handling of uranium.

[14] Operating areas are areas where worker access is allowed without specific permits. It excludes areas where specific controls are required (beyond the general need for a personal dosimeter and/or coveralls) due to the level of contamination or radiation.

or

"An event resulting in the presence of significant quantities of radioactive material in the installation, in areas not expected by design[13] and requiring corrective action."

In this context, 'significant quantity' should be interpreted as:

(a) A spillage of liquid radioactive material radiologically equivalent to a spillage of the order of ten terabecquerels of ^{99}Mo.
(b) A spillage of solid radioactive material radiologically equivalent to a spillage of the order of a terabecquerel of ^{137}Cs, if in addition the surface and airborne contamination levels exceed ten times those permitted for operating areas.
(c) A release of airborne radioactive material contained within a building and radiologically equivalent to a release of the order of a few tens of gigabecquerels of ^{131}I.

3.3. CALCULATION OF RADIOLOGICAL EQUIVALENCE

Table 4 gives the isotope multiplication factors for the radiological equivalence of facility contamination. The actual activity released should be multiplied by the factor given and then compared with the values given in the definition of each level for the isotope being used for comparison. If several isotopes are released, the equivalent value for each should be calculated and then summed. The derivation of these factors is given in Appendix I.

3.4. WORKED EXAMPLES

The purpose of these examples is to illustrate the rating guidance contained in this section of the manual. The examples are based on real events but have been modified slightly to illustrate the use of different parts of the guidance. The final row of the table gives the rating based on actual consequences (i.e. taking account of the criteria in Sections 2 and 3). It is not necessarily the final rating as it would be necessary to consider the defence in depth criteria before defining the final rating.

TABLE 4. RADIOLOGICAL EQUIVALENCE FOR FACILITY CONTAMINATION

Isotope	Multiplication factor for airborne contamination based on ^{131}I equivalence	Multiplication factor for solid contamination based on ^{137}Cs equivalence	Multiplication factor for liquid contamination based on ^{99}Mo equivalence
Am-241	2000	4000	50 000
Co-60	2.0	3	30
Cs-134	0.9	1	20
Cs-137	0.6	1	12
H-3	0.002	0.003	0.03
I-131	1	2	20
Ir-192	0.4	0.7	9
Mn-54	0.1	0.2	2
Mo-99	0.05	0.08	1
P-32	0.3	0.4	5
Pu-239	3000	5000	57 000
Ru-106	3	5	60
Sr-90	7	11	140
Te-132	0.3	0.4	5
U-235(S)[a]	600	900	11 000
U-235(M)[a]	200	300	3000
U-235(F)[a]	50	90	1000
U-238(S)[a]	500	900	10 000
U-238(M)[a]	100	200	3000
U-238(F)[a]	50	100	1000
Unat	600	900	11 000
Noble gases	Negligible (effectively 0)	Negligible (effectively 0)	Negligible (effectively 0)

[a] Lung absorption types: S — slow, M — medium, F — fast. If unsure, use most conservative value.

Example 8. Event at a laboratory producing radioactive sources — Below scale/Level 0

Event description

An event occurred at a laboratory in which ^{137}Cs sources are produced. As a result of rebuilding work in another part of the laboratory building, there were problems with keeping a negative pressure differential in the laboratory. This led to airborne contamination with ^{137}Cs of the laboratory and a conduit connected to the laboratory.

The event resulted in low doses (<1 mSv) to both workers and members of the public. Measurements showed that the quantity of activity spread within the facility was approximately 3–4 GBq of ^{137}Cs, and that the quantity of activity released to the environment through the ventilation system was approximately 1–10 GBq.

Rating explanation

Criteria	Explanation
2.2. Activity released	Based on Table 2, 1–10GBq of ^{137}Cs is radiologically equivalent to 40–400GBq ^{131}I, which is much less than the value for rating under the release criteria of "tens to hundreds of terabecquerels of ^{131}I".
2.3. Doses to individuals	All doses are less than 1 mSv so rating based on individual doses is Level 0.
3.2. Radiological barriers and controls at facilities	Based on Table 4, airborne release of 4 GBq of ^{137}Cs is radiologically equivalent to 2.4 GBq ^{131}I, which is much less than the value for rating under the contamination spread criterion of "a few tens of gigabecquerels of ^{131}I".
Rating for actual consequences	Below Scale/Level 0

Example 9. Fuel damage at a reactor — Below Scale/Level 0

Event description

During reactor operation, a slight increase in coolant activity was detected, indicating that some minor damage to the fuel was occurring. However, the level was such that continued operation was determined to be acceptable. Based upon the reactor coolant activity, the operator entered the refueling outage expecting to find a small number of the 3400 fuel rods failed. The actual inspection, however, revealed that about 200 (6% of the total) rods had failed, though there was no fuel melting or significant release of radionuclides from the fuel matrix. The cause was found to be foreign material present in the reactor coolant causing local overheating of the fuel.

Rating explanation

Criteria	Explanation
2.2. Activity released	Not applicable. No release.
2.3. Doses to individuals	Not applicable. No doses.
3.2. Radiological barriers and controls at facilities	6% of the fuel rods failed leads to about 0.06% of the core inventory released into the coolant. This is less than the criterion for Level 4, giving a rating of Level 0 based on this criterion.
Rating for actual consequences	Below Scale/Level 0 (defence in depth criteria would give a higher rating)

Example 10. Spillage of plutonium contaminated liquid onto a laboratory floor — Level 2

Event description

A flexible hose feeding cooling water to a glass condenser in a glove box became detached. Water flooded the glove box and filled the glove until it burst. The spilled water contained about 2.3 GBq of ^{239}Pu.

Rating explanation

Criteria	Explanation
2.2. Activity released	Not applicable.
2.3. Doses to individuals	Because the spillage occurred as a liquid, there was no significant exposure of personnel.
3.2. Radiological barriers and controls at facilities	The laboratory was not designed to contain spillages. The value for Level 2 from liquid spillages is defined as radiologically equgivalent to ten terabecquerels of ^{99}Mo. From section 3.3, 2.3 GBq ^{239}Pu ≡ 130 TBq ^{99}Mo. The Level 3 definition involves a few thousand terabecquerels of activity, so 2.3 GBq is well below this level.
Rating for actual consequences	Level 2.

Example 11. Plutonium uptake at a reprocessing facility – Level 2

Event description

Four employees entered a controlled radiation zone to perform work on a ventilation system. The work involved the removal of a component (baffle box) in a room located in a building that contained a plutonium processing facility. The facility had been non-functional since 1957 and had remained in a dormant state in preparation for decommissioning.

The workers were wearing protective and monitoring equipment. Cutting of the baffle box proceeded for an hour and 40 minutes and dust was observed falling from the box. When they stopped work and left the area, personal contamination monitors detected contamination on the clothing of all the workers. Immediate actions included placing work restrictions on affected personnel and initiating dose assessment through bioassay techniques. Initial exposure estimates were less than 11 mSv effective dose. Subsequently, maximum committed doses of between 24 and 55 mSv effective dose were assessed for the individuals involved. The annual limit at the time was 50 mSv.

Rating explanation

Criteria	Explanation
2.2. Activity released	Not applicable. No release to the environment.
2.3. Doses to individuals	One worker received a dose greater than the annual limit. The number receiving such a dose was less than 10, so the rating is not increased due to the number of people involved. Rating Level 2.
3.2. Radiological barriers and controls at facilities	The contamination occurred during the decommissioning of a specific item in an area which had been prepared for the potential contamination (i.e. an area 'expected by design'). The criteria are therefore not applicable.
Rating for actual consequences	Level 2.

Example 12. Evacuation near a nuclear facility — Level 4

Event description

An accident at a nuclear power station, involving overheating of the fuel, led to failure of about half of the fuel pins and a subsequent release of radioactive material. (Failure of about half the fuel pins, without significant fuel melting would release about 0.5% of the total core inventory.) Local police, in consultation with the licensee and the regulatory authority, took the immediate decision to evacuate people within a 2 km radius of the facility and as a result, no one received doses above 1 mSv. Assessment of the release by experts at the facility suggested that the total activity was about 20 TBq, comprised about 10% ^{131}I, 5% ^{137}Cs and the rest noble gases.

Rating explanation

Criteria	Explanation
2.2. Activity released	The fact that evacuation was undertaken is not relevant to rating. Based on Table 2, 1 TBq of ^{137}Cs is radiologically equivalent to 40 TBq ^{131}I, so that the total release is radiologically equivalent to 42 TBq ^{131}I, which is close to the value for rating under the release criteria at Level 4 of 'tens to hundreds of terabecquerels of ^{131}I'.
2.3. Doses to individuals	All doses were less than 1 mSv, so rating based on individual dose is Level 0.
3.2. Radiological barriers and controls at facilities	The release from the fuel reaches the value for Level 4, "more than about 0.1% of the core inventory of a power reactor has been released from the fuel assemblies", but is less than the definition for Level 5, "more than a few per cent of the core inventory of a power reactor has been released from the fuel assemblies".
Rating for actual consequences	Level 4.

Example 13. Reactor core melt – Level 5

Event description

A valve in the condensate system failed closed, which reduced the amount of water being supplied to the steam generator. The main feedwater pumps and the turbine tripped within seconds.

The emergency feedwater pumps, which started as expected, were unable to inject water into the steam generators because several valves in the system were closed. The reactor coolant pumps continued circulating the water to the steam generators, but no heat could be removed by the secondary side since there was no water in the steam generators.

Pressure rose in the reactor cooling system until the reactor shutdown. A power operated relief valve opened in the line between the pressurizer and the quench tank, but unknown to the operator, this valve failed to reclose, allowing steam to continue discharging to the quench tank. Pressure dropped in the reactor cooling system. The quench tank rupture disc opened, and steam was released to the containment. As coolant pressure dropped, eventually water in the upper-most area of the reactor (about 3–5 m above the fuel) flashed to steam.

The operators turned off the emergency water injection pumps because they thought there was still water in the pressurizer. The operators also turned off the reactor cooling pumps because they were concerned about damage due to potential excessive vibration. This resulted in a steam void forming in the reactor coolant loop. In addition, a steam bubble formed in the upper part of the reactor, above the fuel. Eventually as the fuel heated, this void expanded, the fuel cladding material overheated and more than 10% of the fuel melted. The containment system remained intact.

Water was eventually added to the reactor cooling system, and cooling of the reactor was assured.

Studies indicated that the release from the site was small, and the maximum potential offsite exposure was 0.8 mSv effective dose. Worker doses were well below the annual statutory limits.

Rating explanation

Criteria	Explanation
2.2. Activity released	Although detailed quantities are not provided, it can be inferred from the small doses that the level of release to the environment was orders of magnitude below the value for Level 4.
2.3. Doses to individuals	Doses to members of the public were less than 1 mSv, and the doses to workers did not reach the statutory annual dose limit.
3.2. Radiological barriers and controls at facilities	More than a few per cent of the core was molten, giving a rating of Level 5.
Rating for actual consequences	Level 5.

4. ASSESSMENT OF THE IMPACT ON DEFENCE IN DEPTH FOR TRANSPORT AND RADIATION SOURCE EVENTS

This section deals with those events where there are no ‘actual consequences’, but some of the safety provisions failed. The deliberate inclusion of multiple provisions or barriers is termed ‘defence in depth’. Annex I gives more background on the concept of defence in depth, particularly for major facilities.

The guidance in this section is for practices associated with radiation sources and the transport of radioactive material. Guidance for accelerators and for facilities involving the manufacture and distribution of radionuclides or the use of a Category 1 source is given in Section 6.

The safety of the public and workers during the transport and use of radiation sources is assured by good design, well controlled operation, administrative controls and a range of protection systems (e.g. interlocks, alarms and physical barriers). A defence in depth approach is applied to these safety provisions so that allowance is made for the possibility of equipment failure, human error and the occurrence of unplanned developments.

Defence in depth is thus a combination of conservative design, quality assurance, surveillance, mitigation measures and a general safety culture that strengthens each of the other aspects.

The INES rating methodology considers the number of safety provisions that still remained functional in an event and the potential consequences if all the safety provisions failed.

As well as considering these factors, INES methodology also considers “additional factors” (i.e. those aspects of the event that may indicate a deeper degradation within the management or the arrangements controlling the operations associated with the event).

This section is divided into three main sections. The first (Section 4.1) gives the general principles that are to be used to rate events under defence in depth. Because they need to cover a wide range of types of events, they are general in nature. In order to ensure that they are applied in a consistent manner, Section 4.2 gives more detailed guidance. The third section (Section 4.3) gives a number of worked examples.

4.1. GENERAL PRINCIPLES FOR RATING OF EVENTS

Although INES allocates three levels for the impact on defence in depth, the maximum potential consequences for some practices, even if all the safety provisions fail, are limited by the inventory of the radioactive material and the release mechanism. It is not appropriate to rate events associated with the defence in depth provisions for such practices at the highest of the defence in depth levels. If the maximum potential consequences for a particular practice cannot be rated higher than Level 4 on the scale, a maximum rating of Level 2 is appropriate under defence in depth. Similarly, if the maximum potential consequences cannot be rated higher than Level 2, then the maximum rating under defence in depth is Level 1.

Having identified the upper limit to the rating under defence in depth, it is then necessary to consider what safety provisions still remain in place (i.e. what additional failures of safety provisions would be required to result in the maximum potential consequences for the practice). This includes consideration of hardware and administrative systems for prevention, control and mitigation, including passive and active barriers. Consideration is also given as to whether any underlying safety culture issues are evident in the event that might have increased the likelihood of the event maximum potential consequences occurring.

The following steps should therefore be followed to rate an event:

(1) The upper limit to the rating under defence in depth should be established by determining the rating for the maximum potential consequences of the relevant practices, based on the criteria in Sections 2 and 3 of this manual. Detailed guidance on establishing the maximum potential consequences is given in Section 4.2.1.

(2) The actual rating should then be determined:
   - (a) firstly, by taking account of the number and effectiveness of safety provisions available (hardware and administrative) for prevention, surveillance and mitigation, including passive and active barriers;
   - (b) secondly, by considering those safety culture aspects of the event that may indicate a deeper degradation of the safety provisions or the organizational arrangements.

Detailed guidance on these two aspects of the rating process is given in Section 4.2.

In addition to considering the event under defence in depth, each event must also be considered against the criteria in Sections 2 and 3 (if applicable).

4.2. DETAILED GUIDANCE FOR RATING EVENTS

4.2.1. Identification of maximum potential consequences

The maximum potential consequences are derived from the source category based on the activity of the source (A) and the D value for the source from the IAEA's Categorization of Radioactive Sources [1] and its supporting reference [5]. The maximum potential consequences do not depend on the detailed circumstances of the actual event. The D values are given in terms of an activity above which a source is considered to be 'a dangerous source' and has a significant potential to cause severe deterministic effects if not managed safely and securely. The D values from the Safety Guide [1], which contains the more common isotopes, are reproduced in Appendix III. If D values for other isotopes are required, they can be found in the supporting Ref. [5].

Table 5 shows the relationship between A/D value, source category and the rating of the maximum potential consequences (should all the safety provisions fail). It also shows the maximum rating under defence in depth for each source category in accordance with the general principles for rating events described earlier. The actual ratings will be equal to or less than those shown in the bottom row of this table when the rating guidance given in Section 4.2.2 is applied.

Since the maximum rating under defence in depth is the same for Category 2 and 3 sources, they are considered together in the rest of this section.

TABLE 5. RELATIONSHIP BETWEEN A/D RATIO, SOURCE CATEGORY, MAXIMUM POTENTIAL CONSEQUENCES AND DEFENCE IN DEPTH RATING.

A/D Ratio	$0.01 \leq A/D < 1$	$1 \leq A/D < 10$	$10 \leq A/D < 1000$	$1000 \leq A/D$
Source category	Category 4	Category 3	Category 2	Category 1
Rating for the maximum potential consequences for a practice should all safety provisions fail	2	3	4	5[a]
Maximum rating using defence in depth criteria	1	2	2	3

[a] Higher levels are not considered credible for events involving radioactive sources.

D values do not apply specifically to irradiated nuclear fuel. However, events involving the transport of irradiated nuclear fuel should be assessed using the guidance in Section 4.2.2 for Category 1 sources.

As stated earlier, rating of events at accelerators uses the guidance in Section 6. For other machine sources, the guidance in this section is relevant. However, there is no simple method for categorizing machine sources based on their size etc. Therefore, it is necessary to use the general principles of INES. For machines where no event can result in any deterministic effects even when all the safety provisions fail, the events should be rated using the guidance in Section 4.2.2 for Category 4 sources. For machines where deterministic effects could occur if all the safety provisions fail, events should be rated using the guidance in Section 4.2.2 for Category 2 and 3 sources.

Category 5 sources are not included in Table 5, nor are they considered in the rating tables of section 4.2.2. The IAEA's Categorization of Radioactive Sources [1] explains that Category 5 sources cannot cause permanent injury to people. Thus events involving the failure of safety provisions for such sources need only be rated at Below scale/Level 0 or Level 1 under defence in depth. Some simple guidance on whether Below scale/Level 0 or 1 is appropriate is given in the introduction to Section 4.2.2.

Where an event involves a number of sources or a number of transport packages, it is necessary to consider whether to use the inventory of a single item or the total inventory of the packages/sources. If the reduction in safety requirements has the potential to affect all the items (e.g. a fire), then the total inventory should be used. If the reduction in safety requirements can only affect a single item (e.g. inadequate labeling of one transport package), the inventory used should be that of the package affected. Appendix III gives the methodology for calculating an aggregate D value.

In order to allow for the wide range of possible events covered by this guidance, the steps below should be followed to take into account the maximum potential consequences when assessing an event:

— If the activity is known, the A/D value should be determined by dividing the activity (A) of the radionuclide by the defined D value. The A/D ratio should be compared to the A/D ratios in Table 5 and a category assigned.
— If the actual activity is not known (e.g. an unidentified source found in scrap metal), the activity should be estimated from known or measured dose rates and by identification of the radionuclide. The category should then be assigned based on the A/D ratio.

— If the actual activity is not known and no measurements of dose rate are available, a source category should be estimated based on any available knowledge about the use of the source. Appendix IV gives examples of the different uses of sources and their likely category.
— For events involving packages containing fissile material (which is not "fissile-excepted" as defined in the Transport Regulations [6]):
  • Where safety provisions necessary to prevent criticality are affected, the event should be rated as if the package was a Category 1 source.
  • Where there is a failure of a provision that does not relate to criticality safety, for unirradiated fuel, the rating should be based on the actual activity involved using the A/D ratio. For irradiated fuel, the column for Category 1 sources should generally be used, though the actual A/D value could be calculated and used, if the quantities of irradiated material are extremely small.

4.2.2. Rating based on effectiveness of safety provisions

The following sections give guidance on the rating of a number of types of events associated with degradation of safety provisions. Section 4.2.2.2 covers events involving lost or found radioactive sources, devices or transport packages, Section 4.2.2.3 covers events where intended safety provisions have been degraded, and Section 4.2.2.4 covers a number of other safety related events.

In all cases where there is a choice of rating, an issue for consideration will be the underlying safety culture implications. Therefore, further guidance on this aspect is given in Section 4.2.2.1. In some of the cases where there is a choice of rating, other factors also need to be considered, and footnotes are provided to give guidance on the specific factors to be taken into account.

Events associated with Category 5 sources are not included in the sections below because they are generally rated at Below Scale/Level 0. However, a rating of Level 1 would be appropriate if all intended safety provisions had clearly been lost or there is evidence of a significant safety culture deficiency. Where there was no intent to provide specific controls over the location of Category 5 sources, their loss should only be rated at Below Scale/Level 0.

4.2.2.1. Consideration of safety culture implications

Safety culture has been defined as "that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance" [7]. A good safety culture helps to prevent incidents but, on the other hand, a lack of safety culture could result in employees performing in ways not in accordance with the assumptions of the design. Safety culture has therefore to be considered as part of the defence in depth.

To merit the choice of the higher rating due to safety culture issues, the event has to be considered as a real indicator of an issue with the safety culture. Examples of such indications could be:

— A violation of authorized limits or requirements, or a violation of a procedure, without prior approval;
— A deficiency in the quality assurance process;
— An accumulation of human errors;
— A failure to maintain proper control over radioactive materials, including releases into the environment, spread of contamination or a failure in the systems of dose control; or
— The repetition of an event, where there is evidence that the operator has not taken adequate care to ensure that lessons have been learned or that corrective actions have been taken after the first event.

It is important to note that the intention of this guidance is not to initiate a long and detailed assessment but to consider if there is an immediate judgement that can be made by those rating the event. It is often difficult, immediately after the event, to determine if the rating of the event should be increased due to safety culture. A provisional rating should be provided in this case based on what is known at the time and a final rating can then take account of the additional information related to safety culture that will have arisen from a detailed investigation.

4.2.2.2. Events involving a lost or found radioactive source/device

Table 6 should be used for those events involving radioactive sources, devices and transport packages that have been misplaced, lost, stolen or found. If a source, device or transport package cannot be located, it may, in the first instance, be regarded as "missing". If, however, a search of the likely alternative locations is unsuccessful, it should be considered lost or stolen, in accordance with national requirements.

The loss of a radioactive source, device or transport package should be rated in terms of degradation of defence in depth. If the radioactive source, device or transport package is subsequently found, the earlier loss and subsequent discovery of the source should be considered as a single event. The original rating should be reviewed and the event could be re-rated (up or down) on the basis of any extra information available. Relevant information to be considered should include:

— The location in which the source, device or transport package was found and how it got there;
— The condition of the source, device or transport package;
— The length of time the source, device or transport package was lost;
— The number of persons exposed and possible doses.

The revised rating should cover both the original defence in depth rating and the actual consequences. In most cases, it will be necessary to estimate or calculate the doses that have been received using realistic assumptions, rather than worst case scenarios.

A found radioactive source and a found device are considered together in Table 6. The former is intended to describe an unshielded source. A found device, on the other hand, is intended to describe the discovery of an orphan source still within an intact, shielded container.

There have been many examples of lost or found orphan sources being transferred into the metal recycling trade. As a consequence, it is increasingly common for metal dealers and steel smelters to check for such sources in incoming consignments of scrap metals. The most appropriate rating for such events is determined by using the "found orphan source" row of Table 6. If the source has been melted, the higher rating should be used. If the source is discovered prior to melting, the rating should depend on whether any safety provisions remain, as explained in footnote 1.

For events associated with contaminated metal, it may not be practical to identify the category of the source based on the guidance in Section 4.2.1. In these cases, the dose rate should be measured and the doses to people in the area estimated. The rating should then be based on these potential doses.

4.2.2.3. Events involving degradation of safety provisions

Table 7 should be used for those events where the radiation source, device or transport package is where it is expected to be, but there has been a degradation of safety provisions. These include a range of hardware provisions such as the transport packaging or source housing, other shielding or containment systems, interlocks or other safety/warning devices. They also include administrative controls such as labelling of transport packages, transport documentation, working and emergency procedures, radiological monitoring and use of personal alarm dosimeters. Facilities such as irradiators using a Category 1 source, teletherapy units or linear accelerators are likely to

TABLE 6. EVENT RATING FOR LOST OR FOUND RADIOACTIVE SOURCES, DEVICES OR TRANSPORT PACKAGES

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
Missing radioactive source, device or transport package subsequently recovered intact within an area under control.	1	1	1
Found source, device (including orphan sources and devices) or transport package.	1	1 or 2 (Footnote a)	2 or 3 (Footnote a)
Lost or stolen radioactive source, device or transport package not yet recovered.	1	2	3
Lost or stolen radioactive source, device or transport package subsequently located with confirmation that no unplanned exposures occurred but where a decision has been made and approved not to recover the source as it is in a safe or inaccessible location (e.g. underwater)	1	1	1
Misdelivered transport package, but receiving facility has all the radiation safety procedures required to handle the package.	0 or 1	1	1
Misdelivered transport package, but receiving facility does not have all the radiation safety procedures required to handle the package	1	1 or 2 (Footnote b)	2 or 3 (Footnote b)

[a] The lowest proposed rating is more appropriate where it is clear that some safety provisions have remained effective (e.g. a combination of shielding, locking devices and warning signs).

[b] The lower rating may be more appropriate if the facility has some appropriate radiation safety procedures.

contain high integrity defence in depth provisions. As noted in the introduction to this section, events related to degradation of safety provisions at such facilities should be rated using Section 6.

TABLE 7. EVENT RATING FOR EVENTS INVOLVING DEGRADATION OF SAFETY PROVISIONS[15]

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
A. No degradation of safety provisions.			
Although an abnormal event may have occurred, it has no significance in terms of the effectiveness of the existing safety provisions. Typical events include:			
— Superficial damage to shielding and/or source containers or leaking sources, resulting in minor surface contamination and spillage where low level contamination of persons has occurred.	1	1	1
— Superficial damage to shielding and/or source containers or leaking sources, resulting in minor surface contamination and spillage where the resulting contamination is unusual but of little or no radiological significance.	0 or 1	0 or 1	0 or 1
— Contamination in areas designed to cope with such events.	0 or 1	0 or 1	0 or 1

[15] Wherever there is a choice of rating, a significant factor is whether there are safety culture implications as discussed in Section 4.2.2.1.

TABLE 7. EVENT RATING FOR EVENTS INVOLVING DEGRADATION OF SAFETY PROVISIONS[15] (cont.)

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
— Foreseeable events where safety procedures were effective in preventing unplanned exposures and returning conditions to normal. This could include events such as the non-return of exposed sources (e.g. industrial radiography gamma source or brachytherapy source) provided they are safely recovered in accordance with existing emergency procedures.	0 or 1	0 or 1	0 or 1
— No damage or minor damage to transport package, with no increase in dose rate.	0 or 1	0 or 1	0 or 1
B. Safety provision partially remaining			
One or more safety provisions have failed (for whatever reason), but there is at least one safety provision remaining.			
Typical events include:			
— Failure of part of an installed warning or safety system designed to prevent exposures to high dose rates.	0 or 1 (Footnote a)	1 or 2 (Footnote a)	(Footnote b)
— Failure to follow safety procedures (including radiological monitoring and safety checks), but where other existing safety provisions (hardware) remain effective.	0 or 1 (Footnote a)	1 or 2 (Footnote a)	(Footnote b)

TABLE 7. EVENT RATING FOR EVENTS INVOLVING DEGRADATION OF SAFETY PROVISIONS[15] (cont.)

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
— Significant degradation of containment systems or defective closures.	0 or 1 (Footnote a)	1 or 2 (Footnote a)	(Footnote b)
— Faulty packaging or tie-downs. Tamper indicating devices ineffective.	0 or 1 (Footnote c)	0 or 1 (Footnote c)	0 or 1 (Footnote c)
C. No safety provision remaining			
Event producing a significant potential for unplanned exposures, or which produce a significant risk of spreading contamination into areas where controls are absent.			
Typical events include:			
— Loss of shielding (e.g. due to fire or severe impact, making direct exposure to the source possible).	1	1 or 2 (Footnote d)	2 or 3 (Footnote e)
— Failure of warning and safety devices such that entry into areas of high dose rate is possible.	1	1 or 2 (Footnote d)	2 or 3 (Footnote e)
— Failure to monitor radiation levels where no other safety provisions remain or all other safety provisions have failed (e.g. to check that gamma sources are fully retracted after site radiography exposures).	1	1 or 2 (Footnote d)	2 or 3 (Footnote e)
— Events where a source remains accidentally exposed, and there are no effective procedures in place to cope with the situation, or where such procedures are ignored.	1	1 or 2 (Footnote d)	2 or 3 (Footnote e)

TABLE 7. EVENT RATING FOR EVENTS INVOLVING DEGRADATION OF SAFETY PROVISIONS[15] (cont.)

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
— Packaging found with inadequate or no shielding where there is significant potential for exposures.	1	1 or 2 (Footnote d)	2 or 3 (Footnote e)

[a] The lower rating may be appropriate if there are a number of safety provisions remaining with no significant safety culture implications. Where there is essentially only a single safety layer remaining, the higher rating should be used.

[b] Rating of events involving partial degradation of the safety provisions for Category 1 sources installed in facilities should be based on the safety layer approach to ratings described in Section 6. Rating of other events involving Category 1 sources should be rated Level 1 or 2, the lower rating being more appropriate if there are a number of safety provisions still remaining with no significant safety culture implications.

[c] The upper level would be appropriate unless the level of degradation is very low.

[d] The maximum potential consequences for a Category 3 source installed in a fixed location within a facility cannot be higher than Level 2. Therefore, for events at such facilities, the maximum under defence in depth should be Level 1.

[e] Level 3 is only appropriate when the maximum potential consequences can be greater than Level 4. Facilities using category 1 sources should be rated using the guidance in Section 6. Application of that guidance would give a rating of Level 3 only if there is the potential for dispersion of the radioactive material. If the event relates only to degradation of safety provisions for preventing overexposure of workers, the guidance would give a rating of Level 2.

4.2.2.4. Other safety relevant events

Table 8 should be used for other safety-relevant events that are not covered by the previous tables.

TABLE 8. RATING FOR OTHER SAFETY RELEVANT EVENTS[16]

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
Member of the public receiving a dose from a single event in excess of annual statutory dose limits.	1	1	1
Workers or members of the public receiving cumulative doses in excess of annual statutory dose limits.	1	1	1
Absence of or serious deficiency in records such as source inventories, breakdowns in dosimetry arrangements.	1	1	1
Discharges to the environment in excess of authorized limits.	1	1	1
Non-compliance with licence conditions for transport.	1	1	1
Inadequate radiological survey of transport.	0 or 1 (Footnote a)	0 or 1 (Footnote a)	0 or 1 (Footnote a)
Contamination on packages/ conveyance where the resulting contamination is of little or no radiological significance.	0 or 1	0 or 1	0 or 1
Contamination on packages/ conveyance where a number of measurements reveal excessive contamination above the applicable limits, and there is potential for the public to be contaminated.	1	1	1

[16] Wherever there is a choice of rating, a significant factor is whether there are safety culture implications as discussed in Section 4.2.2.1.

TABLE 8. RATING FOR OTHER SAFETY RELEVANT EVENTS[16] (cont.)

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
Shipping documents, package labels or vehicle placards incorrect or absent. Marking of packages incorrect or absent.	0 or 1	0 or 1	0 or 1
Radioactive material in a supposedly empty package.	1	1 or 2 (Footnote b)	1, 2 or 3 (Footnote b)
Radioactive material in the wrong type or an inappropriate packaging.	0 or 1 (Footnote c)	1 or 2 (Footnote c)	2 or 3 (Footnote c)

[a] The rating should take into account the degree of inadequacy of the surveys as well as any safety culture implications.
[b] The choice of rating should take into account the safety provisions that might still be in place even though the package was supposed to be empty.
[c] The higher rating in each category reflects situations where the wrong or inappropriate packaging could reasonably result in inadvertent exposures.

4.3. WORKED EXAMPLES

Example 14. Detachment and recovery of an industrial radiography source — Below Scale/Level 0

Event description

Industrial radiography was being undertaken at a petrochemical plant using a 1 TBq ^{192}Ir source. During an exposure, the source became detached in the exposed position. This was recognized when the radiographer re-entered the area with a survey meter. The controlled area barriers were checked and left in place, and assistance was sought from the national authorities. The authorities and the radiographers jointly planned the source recovery operation. Twelve hours after the event was first identified, the source was successfully recovered. Doses received (by three persons) as a result of the event, including the recovery of the source, were all below 1 mSv.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Doses received were below the value for Level 1.
4.2.1. Maximum potential consequences:	The D value for ^{192}Ir is 0.08 TBq, so the A/D ratio was 12 (i.e. a Category 2 source).
4.2.2. Effectiveness of safety provisions:	This is a foreseeable event in industrial radiography and contingency plans, and equipment to deal with such events are expected to be available. The monitoring by the radiographer was also effective. Based on the fourth bullet of section A of Table 7, "Foreseeable events where safety procedures were effective in preventing unplanned exposures and returning conditions to normal," the rating could be either Below scale/Level 0 or Level 1. Below scale/Level 0 is chosen, as there were no indications of safety culture issues.
Overall rating:	Below Scale/Level 0.

Example 15. Derailment of a train carrying spent fuel — Below Scale/Level 0

Event description

A train with three wagons, each containing a package of spent fuel, derailed at a speed of 28 km/h. The rail broke when the train went over it. Two of the rail wagons were derailed but remained upright, the other was leaning over and had to be made stable. Thirty six hours later, the wagons were on their way again. There were no radiological consequences.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	There were no doses reported.
4.2.1. Maximum potential consequences:	Spent fuel packages should be rated using the guidance for Category 1 sources.
4.2.2. Effectiveness of safety provisions:	Based on the fifth bullet of section A in Table 7, ‘no damage or minor damage to transport package, with no increase in dose rate’, the rating could be either Below scale/Level 0 or Level 1. Below scale/Level 0 is chosen, as there were no indications of safety culture issues.
Overall rating:	Below Scale/Level 0.

Example 16. Package damaged by forklift — Below Scale/Level 0

Event description

A Type A package was reported as damaged at an airport. Early reports suggested that the package had only been scuffed by the wheel of a fork lift truck. The consignor was requested to assess the damage to the package and determine what should be done with it. The consignor was able to repackage the contents (two ^{252}Cf sources — 1.98 MBq each) and enable the package to continue. They were also equipped to overpack the Type A package and return it to its origin. It was confirmed that there was minimal damage to the original outer packaging.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Doses received were below the value for Level 1.
4.2.1. Maximum potential consequences:	The D-value for ^{252}Cf is 0.02 TBq, giving an A/D ratio of <0.01. Thus, the package contained Category 5 sources.
4.2.2. Effectiveness of safety provisions:	There was no degradation of safety provisions. According to the introduction to Section 4.2.2, the rating is Below scale/Level 0.
Overall rating:	Below Scale/Level 0.

Example 17. Stolen industrial radiography source — Level 1

Event description

An industrial radiography device containing a 4 TBq ^{192}Ir source was reported as stolen to the national authorities. A press release was issued, and investigation of the surrounding areas was carried out. Twenty four hours later, the device was found in a ditch adjacent to a highway with no damage to the shielding and completely intact. No individuals were believed to have been exposed.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	There were no doses from the event or activity released.
4.2.1. Maximum potential consequences:	The D value for ^{192}Ir is 0.08 TBq, so the A/D ratio was 50 (i.e. a Category 2 source).
4.2.2. Effectiveness of safety provisions:	The initial event is a lost or stolen Category 2 source, which according to row three of Table 6 gives a rating of Level 2. When the device was found, a review of the rating was possible. Since the device was found with all the safety provisions remaining and no indication that they had been breached, a final rating of Level 1 was appropriate based on row 2 of Table 6.
Overall rating:	Level 1.

Example 18. Various radioactive sources found in scrap metal — Level 1

Event description

The regulator was notified by a scrap metal company that it had a radiation alarm from its portal detector. Using handheld survey equipment, the regulator measured an elevated radiation level at the surface of a 12 m container of 30 μSv/h. The container was unloaded by a firm specializing in tracing and recovering radioactive sources in scrap. Three identical stainless steel source holders were found, each containing a ^{137}Cs source but with no shutter mechanisms. Two of the source holders had identification marks which enabled the sources to be characterized as 2 GBq of ^{137}Cs and 8 GBq of ^{137}Cs. The dose rate at the surface of the three separate source holders was about 4.5, 4.2 and 17 mSv/h, and the activity of the separate sources was approximately 1.85 GBq, 1.85 GBq and 7.4 GBq. The container had been in transit for nearly one month, but the origin of the three sources could not be determined. The sources were secured and transported to an appropriate radioactive waste facility.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Considering the potential doses during transportation and handling of these sources, it is not considered credible that doses above 10 mSv could have been received, or that ten or more people could have been exposed (i.e. Level 1).
4.2.1. Maximum potential consequences:	Two of the sources were known to be ^{137}Cs and based on the dose rates and activity measurements, the third source appeared to be the same as the smaller of the two identified sources. The D value for ^{137}Cs is 1×10^{-1} TBq and the total source activity was 11.1 GBq, resulting in an A/D ratio of $0.01 \leq A/D < 1$. Therefore it was a Category 4 source.
4.2.2. Effectiveness of safety provisions:	The event was the discovery of three orphan sources. From the second row of Table 6, Level 1 is appropriate.
Overall rating:	Level 1.

Example 19. Loss of a density gauge — Level 1

Event description

A moisture-density gauge was lost and presumed stolen from a truck at a construction site. The gauge contained a ^{137}Cs source (0.47 GBq) and an Am-241/Be neutron source (1.6 GBq). It was reported to the national authorities, a press release was issued and an investigation of the surrounding areas was undertaken. The gauge was recovered a few days later with no signs of damage.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	There were no doses from the event.
4.2.1. Maximum potential consequences:	It is necessary to calculate the aggregate A/D value as explained in Appendix III. The D value for ^{137}Cs is 0.1 TBq compared to a source activity of 0.47 GBq and the D value for $^{241}Am/Be$ is 0.06 TBq compared to a source activity of 1.6 GBq, giving an aggregate A/D of 0.47/100 + 1.6/60 = 0.031. Thus the aggregate A/D ratio is between 0.01 and 1 and the source can be categorized as Category 4.
4.2.2. Effectiveness of safety provisions:	From the second row of Table 6 Level 1 is appropriate. Its recovery allowed the event to be reassessed as a ‘Lost or stolen radioactive source subsequently located’ (fourth row), which for a Category 4 source remains at Level 1.
Overall rating:	Level 1.

Example 20. Radioactive source stolen during transport — Level 1

Event description

When a package of a sealed 1.85 GBq ^{60}Co source was delivered by the shipper, it was found to be empty. The source was found seven hours later in a delivery truck. The package had been intentionally opened. 1.85 GBq of ^{60}Co delivers a dose rate of 0.5 mSv/h at a distance of 1 m.

It appeared that the event was a direct result of failure to comply with the regulations for the transport of radioactive materials:

— The security seal required by the regulations was not affixed to the package;
— The shipping declaration had not been completed; and
— The ‘radioactive’ label did not appear to have been fixed to the container (although this was never clearly established).

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Based on interviews of personnel involved and postulation of likely scenarios of what might have happened to the source, dose assessments were carried out. It was concluded that neither the driver nor the delivery personnel received measurable doses.
4.2.1. Maximum potential consequences:	The D value of ^{60}Co is 0.03 TBq, giving an A/D ratio between 0.01 and 1 and hence a Category 4 source.
4.2.2. Effectiveness of safety provisions:	Based on the 5th bullet of section C of Table 7, “packaging found with inadequate or no shielding where there is significant potential for exposures,” the rating is Level 1.
Overall rating:	Level 1.

Example 21. Spillage of radioactive material in a nuclear medicine department — Level 1

Event description

A trolley used to transfer radionuclides from the radiopharmacy to the injection/treatment room in a hospital was involved in a collision. The event occurred in a hospital corridor and a single dosage of ^{131}I (4 GBq in liquid form) was spilled on the floor. Two persons (a nurse and a patient) were contaminated (hands, outer clothing and shoes), each by an estimated activity of 10 MBq of ^{131}I. Staff from the nuclear medicine department were called, and the two people were decontaminated within an hour of the event.

Estimated doses to the two persons involved were minimal (less than 0.5 mSv committed effective dose). The area of the spill was temporarily closed for two weeks (equivalent to two half lives) and was then successfully decontaminated by nuclear medicine staff.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Doses received were below the value for Level 1.
3.2. Radiological barriers and controls at facilities	Not applicable as the facility did not handle large quantities of radioactive material (see 1st paragraph of Section 3.1).
4.2.1. Maximum potential consequences:	The D value of ^{131}I is 0.2 TBq, giving an A/D ratio of between 0.01 and 1, hence it was a Category 4 source.
4.2.2. Effectiveness of safety provisions:	As the source container was broken, there were no safety provisions remaining, and section C of Table 7 is appropriate, giving a rating of Level 1.
Final rating:	Level 1.

Example 22. Train collision with radioactive material packages — Level 1

Event description

A collision occurred between a train and a baggage truck that was crossing the railway line in a station.

Type A packages were amongst the luggage. There were seven cartons containing a range of radionuclides and two drums, each containing a technetium generator (using molybdenum), with an activity of 15 GBq (30 GBq at the start of the journey).

Being light, the cartons were only slightly damaged, and no radioactive material was lost from them. On the other hand, the two drums were thrown from the packages, and one source container broke, contaminating the cab of the locomotive and the gravel under the track. There were 291 persons screened for contamination, and 19 had positive results, which were not found to be significant. All doses received were less than 0.1 mSv. The resulting contamination was no reason for concern in view of the small quantities involved and the short half-lives of the radioisotopes.

A substantial amount of decontamination equipment was deployed. Two tracks were closed for a day and the locomotive was decontaminated.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Doses received were below the value for Level 1.
4.2.1. Maximum potential consequences:	The D value of ^{99}Mo is 300 GBq (and this includes the effects of the daughter product Tc), giving an A/D ratio between 0.01 and 1 and hence the sources were Category 4.
4.2.2. Effectiveness of safety provisions:	As a source container was broken, there were no safety provisions remaining and section C of Table 7 is appropriate, giving a rating of Level 1.
Final rating:	Level 1.

Example 23. Supposedly empty shipping containers found to contain nuclear material — Level 1

Event description

A fuel manufacturing plant routinely receives uranium oxide slightly enriched in ^{235}U from overseas. The material travels in special cans mechanically sealed within a sea container. After taking out the material, the fuel manufacturer sends the empty cans back to their provider.

Upon receiving a container of 150 cans that were supposed to be empty, the uranium oxide provider discovered that two cans were in fact full, containing a total of 100 kg of uranium oxide. The estimated activity of the material was 8 GBq. The outer surface of the cans and the sea container were found to be clean. No worker or member of the public received any unanticipated dose from this event.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	There were no doses reported from this event.
4.2.1. Maximum potential consequences:	Criticality was not an issue here because of the low enrichment, and therefore the event should be categorized based on A/D. (See final bullet of Section 4.2.1). The D value is not specified in Appendix III but is given in [5]. For enrichments of less than 10%, which is the case here, the D value is so high as to be unlimited. Therefore the A/D value is <0.01, which means the material can be treated as Category 5 sources.
4.2.2. Effectiveness of safety provisions:	Although the packaging for empty cans was the same as if they were full (mechanical seal as well as container conditions), labelling for the transport was less demanding and precautions for handling were slightly relaxed. The key point is that authorized limits were breached. There were significant safety culture issues associated with the event, and some of the provided safety provisions failed. Therefore, based on the third paragraph of Section 4.2.2, the event is rated at Level 1.
Final rating:	Level 1.

Example 24. Suspicious dose on film badge — Level 1

Event description

A radiation technician's annual cumulative exposure level was indicated to be 95 mSv by her film badge record. This was found in the course of an inspection of the hospital at which she worked. The regulatory authority inspected the hospital thoroughly and found one of the individual's monthly records indicating 54 mSv. However, the hospital had not taken any special actions until the inspection. The hospital has no radiation generator such as a linear accelerator (LINAC), and no obvious reason for the single over-exposure was found. There was some possibility of mischief by a colleague, but no direct evidence was found. According to a medical examination, which included blood tests, no abnormalities were found. The person also had no symptom suggesting a deterministic effect. The person was transferred to another section and was provided with additional training. Making the worst case assumption that the dose was real, she was also barred from entering controlled areas.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	There were no deterministic effects observed on the technician. While the blood tests showed that no serious doses had been received, it could not be proved that no radiation exposure had taken place. A detailed investigation was carried out to determine whether the radiation exposure took place or not. The investigation took into account: (1) The lack of any sources of high radiation in her normal workplace or anywhere she went during the period since the dosimeter was issued; (2) Colleagues who were always near her during potential exposure periods and whose dosimeters showed normal readings; (3) Additional dosimeters worn during some of the period of interest. It was ultimately concluded that she did not receive the radiation exposure and that the dose should be removed from her record.
4.2.1. Maximum potential consequences:	Not applicable.
4.2.2. Effectiveness of safety provisions:	Although the event involves no real dose, there are other factors involved in the event, such as the failure to monitor personnel radiation exposure records and to follow up on unusual readings. Based on row 3 of Table 8, the event is rated at Level 1.
Final rating:	Level 1.

Example 25. Melting of an orphan source — Level 2

Event description

An orphan source of 1 TBq of ^{137}Cs inadvertently included in scrap metal was melted in a steel factory. Fifty employees at the factory received an estimated dose of 0.3 mSv each.

Rating explanation

Criteria	Explanation
2.2. Activity release	It was estimated that 10% of the activity was released due to the melting, which resulted in an airborne activity release of 0.1 TBq of ^{137}Cs. The D_2 value for ^{137}Cs is 0.1 TBq, so the release is far less than the criterion for Level 5 of 2500 times the D_2 value (section 2.2.2).
2.3. Doses to individuals:	Doses received were below the value for Level 1.
4.2.1. Maximum potential consequences:	The D value for ^{137}Cs is 1×10^{-1} TBq, and the source activity (A) is 1 TBq, resulting in an A/D ratio of $1000 > A/D \geq 10$. Therefore, it is classified as a Category 2 source.
4.2.2. Effectiveness of safety provisions:	Based on the second row of Table 6, the rating should be Level 1 or 2. Considering that the source was melted, the final rating should be Level 2 based on footnote a in Table 6.
Final rating:	Level 2.

Example 26. Loss of a high activity radiotherapy source — Level 3

Event description

A source inventory check at a hospital that had been closed for some time revealed that a teletherapy head containing a 100 TBq ^{60}Co source was missing. The unit had been stored in a dedicated facility, but an inventory check had not been carried out for several weeks. It was suspected that the unit had been taken out of the hospital by unauthorized persons. A search was carried out, and one day later, the source was located on open land two kilometers away.

The unit had been dismantled, and the source was unshielded but not breached. It was recovered by the national authorities.

The subsequent investigation indicated that several people had been exposed as a result of the event, as follows:

- One person: 20 Gy to the hands, 500 mSv effective dose. Radiation injuries observed on one hand, requiring skin grafts and the amputation of one finger;
- Two persons: 2 Gy to hands, 400 mSv effective dose;
- Twelve persons: 100 mSv effective dose. (The statutory annual whole body dose limit for workers was 20 mSv.)

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Three people received doses greater than ten times the statutory annual whole body dose limit for workers. One of these people suffered a health effect. Both these aspects give a rating of Level 3. Twelve persons received doses higher than 10 mSv. According to the dose received, the rating is Level 2, and it should be uprated to Level 3 due to the number of persons affected.
4.2.1. Maximum potential consequences:	The D value for ^{60}Co is 0.03 TBq, and the A/D ratio is greater than 1000 (i.e. it was a Category 1 source/device).
4.2.2. Effectiveness of safety provisions:	The initial rating was made before the source was found. Thus the event is a lost or stolen source/device. Using Table 6, the event would be rated at Level 3.
Final rating:	Level 3.

5. ASSESSMENT OF IMPACT ON DEFENCE IN DEPTH SPECIFICALLY FOR EVENTS AT POWER REACTORS WHILE AT POWER

This section deals with those events where there are no “actual consequences,” but some of the safety provisions failed. The deliberate inclusion of multiple provisions or barriers is termed “defence in depth.”

The concept of defence in depth is not explained in detail here, as it will be familiar to the majority of those applying this manual to events at power reactors. However, Annex I does give some additional background material.

This section applies specifically to rating events at power reactors while at power, but it should also be used to rate events in hot shutdown or startup conditions as the safety case is quite similar to that for power operation. However, once the reactor is in cold shutdown , while some of the safety systems are still required to assure the safety functions, usually more time is available. Also in shutdown conditions, the configurations of the barriers are sometimes quite different (for example, open primary coolant system, open containment). For these reasons a different approach to rating events is proposed, and events during reactor shutdown should generally be rated using the guidance in Section 6. However, if a facility has an approved safety case based on the initiator and safety system approach, it may be possible to use the initiator approach described in this section for rating events.

Events on reactors that are being decommissioned where the fuel has been removed from the reactor should also be rated using Section 6 as should events at research reactors in order to take proper account of the range of maximum potential consequences and design philosophy.

One facility can, of course, cover a number of practices, and each practice must be considered separately in this context. For example, reactor operations, work in hot cells and waste storage, should be considered as separate practices, even though they can all occur at one facility. Rating events associated with hot cells or waste storage should be rated using the guidance in Section 6. This section of the manual is specific to events associated with the operation of power reactors.

The approach to rating is based on assessing the likelihood that the event could have led to an accident, not by using probabilistic techniques directly, but by considering whether safety provisions were challenged and what additional failures of safety provisions would be required to result in an accident. Thus a ‘basic rating’ is determined by taking account of the number and effectiveness of safety provisions available (hardware and administrative) for prevention, control and mitigation, including passive and active barriers.

To allow for any underlying “additional factors,” consideration is also given to increasing the “basic rating”. This increase allows for those aspects of the event that may indicate a deeper degradation of the plant or the organizational arrangements of the facility. Factors considered are common cause failures, procedural inadequacies and safety culture issues. Such factors may not have been included in the basic rating and may indicate that the significance of the event with respect to defence in depth is higher than the one considered in the basic rating process. Accordingly, in order to communicate the true significance of the event to the public, increasing the rating by one level is considered.

The other two sections on defence in depth include guidance related to the “maximum potential consequences” of events. However, this aspect does not need to be considered here as the inventory of a power reactor is such that, should all the safety provisions fail, an accident with a rating of Level 5 or above is possible. The maximum level under defence in depth is therefore Level 3.

This section of the manual is divided into three main sections. The first gives the guidance for assessing the basic rating for events occurring while the reactor is at power (known as the “initiator approach”). The second section (Section 5.2) gives the guidance associated with uprating events. Section 5.3 provides a number of worked examples.

5.1. IDENTIFICATION OF BASIC RATING TAKING ACCOUNT OF THE EFFECTIVENESS OF SAFETY PROVISIONS

Because the safety analysis for reactor installations during power operation follows a common international practice, it is possible to give fairly specific guidance about how to assess the safety provisions for events involving reactors at power. The approach is based on consideration of initiators, safety functions and safety systems. These terms will be familiar to those involved in safety analysis, but further explanation of the terms is provided below.

An initiator or initiating event is an identified event that leads to a deviation from the normal operating state and challenges one or more safety functions. Initiators are used in safety analysis to evaluate the adequacy of installed safety systems; the initiator is an occurrence that challenges the safety systems and requires them to function.

Events involving an impact on defence in depth will generally be of two possible forms:

(1) Either they include an initiator (initiating event), which requires the operation of some particular safety systems designed to cope with the consequences of this initiator, or
(2) They include the degraded operability of one or more safety systems without the occurrence of the initiator for which the safety systems have been provided.

In both cases the level of operability of safety systems leads to a level of operability for the overall safety function, noting that several safety systems may contribute to one safety function. It is this level of safety function operability that is important in determining the rating.

In the first case, the event rating depends principally on the extent to which the operability of the safety function is degraded. However, the rating also depends on the anticipated frequency of the particular initiator that has occurred.

In the second case, no deviation from normal operation of the plant actually occurs, but the observed degradation of the operability of the safety function could have lead to significant consequences if one of the initiators for which the degraded safety systems are provided had actually occurred. In such a case, the event rating depends on both:

— The anticipated frequency of the potential initiator;
— The operability of the associated safety function assured by the operability of particular safety systems.

It should be noted that one particular event could be categorized under both cases. (See Sections 5.1.3 and 5.1.4 as well as Example 35.)

To illustrate the above principles, consider a reactor where the protection against loss of off-site power is provided by four essential diesels. In order for an accident to occur, the event must challenge the safety of the reactor (in this example, loss of off-site power (LOOP)) and the protection must fail (in this example, all diesels fail to start). The initial challenge to plant safety (LOOP in the example) is termed the 'initiator' and the response of the diesels is defined by the 'Operability of the safety function' (post-trip cooling in this example). Thus for an accident to occur, there needs to be an initiator and inadequate operability of a safety function.

The rating under defence in depth assesses how near the accident is to happening (i.e. whether the initiator has occurred, how likely it was and what the operability of the safety functions were). In the previous example, if off-site power had been lost but all diesels started as intended, an accident was unlikely (such an event would be rated at Below Scale/Level 0). Similarly, if one diesel had failed under a test, but the others were available, and off-site supplies were available, then an accident was unlikely (again such an event would be rated at Below Scale/Level 0).

However, if during operation at power it was discovered that all diesels had been unavailable for a month, then even though off-site power had been available and the diesels were not required to operate, an accident was relatively likely, as the chance of losing off-site power was relatively high (such an event would probably be rated at Level 3, provided there were no other safety provisions).

The rating procedure therefore considers whether the safety functions were required to work (i.e. had an initiator occurred), what was the assumed likelihood of the initiator and what was the operability of the relevant safety functions.

The basic approach to rating events is to identify the frequency of the relevant initiators and the operability of the affected safety functions. Two tables are then used to identify the appropriate basic rating (see Sections 5.1.3 and 5.1.4). Detailed guidance on each aspect of rating is given below.

5.1.1. Identification of initiator frequency

Four different frequency categories have been defined:

(1) *Expected*
This covers initiators expected to occur once or several times during the operating life of the plant (i.e. $> 10^{-2}$ per year).

(2) *Possible*
These are initiators that are not expected but have an anticipated frequency (f) during the plant lifetime of greater than about 1% (i.e. $10^{-4} < f < 10^{-2}$ per year).

(3) *Unlikely*
These are initiators considered in the design of the plant, which are less likely than the above ($\leq 10^{-4}$ per year).

(4) *Beyond design*
These are initiators of very low frequency, not normally included in the conventional safety analysis of the plant. When protection systems are introduced against these initiators, they do not necessarily include the same level of redundancy or diversity as measures against design basis initiators.

Each reactor has its own list and classification of initiators as part of its safety analysis, and these should be used in rating events. Typical examples of design basis initiators that have been used in the past for different reactor systems are given in Annex II categorized into the previous frequency categories. These may provide a guide in applying the rating process, but it is important wherever possible to use the initiators and frequencies specific to the plant where the event occurred.

Small plant perturbations that are corrected by control (as opposed to safety) systems are not included in the initiators. However, if the control systems fail to stabilize the reactor, that will eventually lead to an initiator. For these reasons, the initiator may be different from the occurrence that starts the event (see Example 36); on the other hand, a number of different event sequences can often be grouped under a single initiator.

For many events, it will be necessary to consider more than one initiator, each of which will lead to a rating. The event rating will be the highest of the ratings associated with each initiator. For example, a power excursion in a reactor could be an initiator challenging the protection function. Successful operation of the protection system would then lead to a shutdown. It would then be necessary to consider the reactor trip as an initiator challenging the fuel cooling function.

5.1.2. Safety function operability

The three basic safety functions for reactor operation are:

(1) controlling the reactivity;
(2) cooling the fuel; and
(3) confining the radioactive material.

These functions are provided by passive systems (such as physical barriers) and by active systems (such as the reactor protection system). Several safety systems may contribute to a particular safety function, and the function may still be achieved even with one system unavailable. Following an initiator, non-safety systems may also contribute to a particular safety function (see explanation under definition of Adequate (C). Equally, support systems such as electrical supplies, cooling and instrument supplies will be required to ensure that a safety function is achieved. It is important to evaluate the operability of the safety function when events are rated, not the operability of an individual system. A system or component is considered operable when it is capable of performing its required function in the required manner.

The operational limits and conditions (OL&C) of a plant govern the operability of each safety system. In most countries, they are included within a plant's Technical Specifications.

The operability of a safety function for a particular initiator can range from a state where all the components of the safety systems provided to fulfil that function are fully operable to a state where the operability is insufficient for the safety function to be achieved. To provide a framework for rating events, four categories of operability are considered.

A. Full

This is when all the safety systems and components that are provided by the design to cope with the particular initiator in order to limit its consequences are fully operable (i.e. redundancy/diversity is available).

B. Minimum required by operational limits and conditions

This is when the operability of each of the safety systems required to provide the safety function meets the minimum level for which operation at power can be continued (possibly for a limited time), as specified in the Operational Limits and Conditions.

This level of operability will generally correspond to the minimum operability of the different safety systems for which the safety function can be achieved for all the initiators considered in the design of the plant. However, for certain particular initiators, redundancy and diversity may still exist.

C. Adequate

This is when the operability of at least one of the safety systems required to provide the safety function is sufficient to achieve the safety function challenged by the initiator being considered.

In some cases, categories B and C may be the same (i.e. the operability is inadequate unless all the safety systems meet the OL&C requirements). In other cases, Category C will correspond to a level of operability lower than that required by OL&C. One example would be where diverse safety systems are each required to be operable by OL&C, but only one is operable. Another would be where all safety systems that are designed to assure a safety function are inoperable for such a short time that the safety function can still be assured, even though the safety systems do not meet the OL&C requirements. (For example, the safety function ‘cooling of the fuel’ may be assured if a total station blackout occurs for only a short time). In identifying the effectiveness of such provisions, it is important to take account of the time available and the time required for identifying and implementing appropriate corrective action.

It is also possible that the safety function may be *adequate* due to the operability of non-safety systems (see Example 40). Non-safety systems can be taken into account if they have been demonstrated (or are known) to be operable during the event. However, care must be taken in including non-safety systems, as their operability is not generally controlled and tested in the same way as it is for safety systems.

D. Inadequate

This is when the operability of the safety systems is such that none of them is capable of achieving the safety function challenged by the initiator being considered.

It should be noted that although operability categories C and D represent a range of plant states, categories A and B represent specific operabilities. Thus, the actual operability may be between that defined by operability categories A and B (i.e. the operability may be less than *full* but more that the minimum allowed for continued operation at power). This is considered in Section 5.1.3.

5.1.3. Assessment of the basic rating for events with a real initiator

In order to obtain a basic rating, firstly decide whether there was an actual challenge to the safety systems (a real initiator). If so, then this Section is appropriate; otherwise Section 5.1.4 is appropriate. It may be necessary to consider an event using both sections if an initiator occurs and reveals a reduced operability in a system not challenged by the real initiator (e.g. if a reactor trip without loss of off-site power reveals a reduced operability of diesels).

For events involving potential failures that could have led to an initiator (e.g. discovery of structural defects or small leaks terminated by operator action), a similar approach is used, but it is also necessary to take into account the likelihood of the potential initiator occurring. This is explained in Section 5.1.5.

5.1.3.1. Basis of rating

The appropriate ratings for events with a real initiator are given in Table 9. The basis of the values given in the table is as follows.

Clearly, if the safety function is *inadequate*, an accident will have occurred, and it will need to be rated based on its actual consequences. Such a rating could well exceed Level 3. However, in terms of defence in depth, Level 3 represents the highest rating. This is expressed by 3+ in Table 9.

If the safety function is just *adequate*, then again Level 3 is appropriate, because a further failure would lead to an accident. However, in other cases even though the operability is less than that required by the OL&C, it may be considerably greater than just *adequate*, particularly for *expected* initiators because OL&C requirements often still incorporate significant redundancy or diversity. Therefore, in Table 9, Level 2 or 3 is shown for *expected* initiators and *adequate* safety function, the choice depending on the extent to which the operability is greater than just *adequate*. For *unlikely* initiators, the operability required by the OL&C is likely to be just *adequate* and, therefore, in general, Level 3 would be appropriate for *adequate* operability. However, there may be particular initiators for which there is redundancy, and therefore Table 9 shows Level 2 or 3 for all initiator frequencies.

If there is *full* safety function operability and an *expected* initiator occurs, this should clearly be Below Scale/Level 0, as shown in Table 9. However, the occurrence of a *possible* or *unlikely* initiator, even though there may be considerable redundancy in the safety systems, represents a failure of one of the important parts of defence in depth, namely the prevention of initiators. For this reason Table 9 shows Level 1 for *possible* initiators and Level 2 for *unlikely* initiators.

If the operability of safety functions is the *minimum required by OL&C*, then in some cases, as already noted, for *possible* and particularly for *unlikely* initiators, there will be no further redundancy. Therefore, Level 2 or 3 is appropriate, depending on the remaining redundancy. For *expected* initiators, there will be additional redundancy, and therefore a lower rating is proposed. Table 9 shows Level 1 or 2, where again the value chosen should depend on the additional redundancy within the safety function. Where the safety function availability is greater than the *minimum required by OL&C* but less than *full*, there may be considerable redundancy and diversity available for *expected* initiators. In such cases, Below Scale/Level 0 would be more appropriate.

TABLE 9. EVENTS WITH A REAL INITIATOR

Safety function operability		Initiator frequency		
		(1) Expected	(2) Possible	(3) Unlikely
A	Full	0	1	2
B	Minimum required by operational limits and conditions	1 or 2	2 or 3	2 or 3
C	Adequate	2 or 3	2 or 3	2 or 3
D	Inadequate	3+	3+	3+

5.1.3.2. Rating procedure

With the background described in the previous section, events should be rated using the following procedure:

(1) Identify the initiator that has occurred.

(2) Determine the category of frequency allocated to that initiator. In deciding the appropriate category, it is the frequency that was assumed in the safety case (the justification of the safety of the plant and its operating envelope) for the plant that is relevant.

(3) Determine the category of operability of the safety functions challenged by the initiator.
   - (a) It is important that only those safety functions challenged by the initiator are considered. If the degradation of other safety systems is discovered, it should be assessed using the section on *events without a real initiato*r in Section 5.1.4, using the initiator that would have challenged that safety system.
   - (b) In deciding whether the operability is within OL&C, it is the operability requirements prior to the event that must be considered, not those that apply during the event.
   - (c) If the operability is within OL&C but also just *adequate*, operability category C should be used as there is no additional redundancy (see earlier paragraphs in this section).

(4) The event rating should then be determined from Table 9. Where a choice of rating is given, the choice should be based on the extent of redundancy and diversity available for the initiator being considered.
   - (a) If the safety function operability is just *adequate* (i.e. one further failure would have lead to an accident), Level 3 is appropriate.
   - (b) In cell B1 of Table 9, the lower value would be appropriate if there is still considerable redundancy and/or diversity available.
   - (c) In some reactor designs, there is a large amount of redundancy/ diversity available for *expected* initiators. If the safety function operability is considerably greater than the *minimum required by OL&C*, but slightly less than *full*, Below Scale/Level 0 would be more appropriate.

Beyond design initiators are not included specifically in Table 9. If such an initiator occurs, then an accident may occur, requiring rating based on actual consequences. If not, Level 2 or 3 is appropriate under defence in depth, depending on the redundancy of the systems providing protection.

The occurrence of internal and external hazards such as fires, floods, tsunamis, explosions, hurricanes, tornados or earthquakes, may be rated using Table 9. The hazard itself should not be considered as the initiator (as the hazard may cause either initiators or degradation of safety systems or both), but the safety systems that remain operable should be assessed against an initiator that occurred and/or against potential initiators.

5.1.4. Assessment of the basic rating for events without a real initiator

As discussed in the previous section, in order to obtain a basic rating, firstly decide whether there was an actual challenge to the safety systems (a real initiator). If so, then Section 5.1.3 is appropriate, otherwise this section is appropriate. It may be necessary to consider an event using both sections if an initiator occurs and reveals a reduced operability in a system not challenged by the real initiator (e.g. if a reactor trip without loss of off-site power reveals a reduced operability of diesels).

For events involving potential failures that could have led to inoperability of safety systems (e.g. discovery of structural defects), a similar approach is used, but it is necessary to take into account the likelihood of inoperability of the safety system. This is explained in Section 5.1.5.

5.1.4.1. Basis of rating

The appropriate ratings for events without a real initiator are given in Table 10. The basis of the values given in the table is as follows.

The rating of an event will depend on the extent to which the safety functions are degraded and on the likelihood of the initiator for which they are provided. Strictly speaking, it is the likelihood of the initiator occurring during the period of safety function degradation, but in general, the methodology does not take account of the time period. However, if the period of degradation is very short, a level lower than that provided in Table 10 may be appropriate (see Section 5.1.4.2).

If the operability of a safety function is *inadequate*, then an accident was only prevented because an initiator did not occur. For such an event, if the safety function is required for *expected* initiators, Level 3 is appropriate. If the *inadequate* safety function is only required for *possible* or *unlikely* initiators, a lower level is clearly appropriate because the likelihood of an accident is much lower. For this reason, Table 10 shows Level 2 for *possible* initiators and Level 1 for *unlikely* initiators.

The level chosen should clearly be less when the safety function is *adequate* than when it is *inadequate*. Thus, if the function is required for *expected* initiators, and the operability is just *adequate*, Level 2 is appropriate. However, in a number of cases, the safety function operability may be considerably greater than just *adequate*, but not within the Operational Limits and Conditions. This is because the *minimum operability required by Operational Limits and Conditions* will often still incorporate redundancy and/or diversity against some *expected* initiators. In such situations, Level 1 would be more appropriate. Thus, Table 10 shows a choice of Level 1 or 2. The appropriate value should be chosen depending on the remaining redundancy and/or diversity.

If the safety function is required for *possible* or *unlikely* initiators, then reduction by one from the level derived above for an *inadequate* system gives Level 1 for *possible* initiators and Below scale/Level 0 for unlikely initiators. However, it is not considered appropriate to categorize at Below Scale/Level 0 a reduction in safety system operability below that required by the OL&C. Thus, Level 1 is shown in Table 10 for both *possible* and *unlikely* initiators.

If the safety function operability is full or within OL&C, the plant has remained within its safe operating envelope, and Below Scale/Level 0 is appropriate for all frequencies of initiators. Thus, Table 10 shows Below Scale/Level 0 for each cell of rows A and B.

TABLE 10. EVENTS WITHOUT A REAL INITIATOR

Safety function operability		Initiator frequency		
		(1) Expected	(2) Possible	(3) Unlikely
A	Full	0	0	0
B	Minimum required by OL&C	0	0	0
C	Adequate	1 or 2	1	1
D	Inadequate	3	2	1

5.1.4.2. Rating procedure

With the background described in the previous section, events should be rated using the following procedure:

(1) Determine the category of safety function operability.
   (a) If the operability is just *adequate* but still within OL&C, operability category B should be used as the plant has remained within its safe operating envelope.
   (b) In practice, safety systems or components may be in a state not fully described by any of the four categories. The operability of the safety function may be less than *full* but more than the *minimum required by OL&C*, or a complete system may be available but degraded by loss of indications. In such cases, the relevant categories should be used to give the possible range of the rating, and judgement used to determine the appropriate rating.

(2) Determine the category of frequency of the initiator for which the safety function is required.
   (a) If there is more than one relevant initiator, then each must be considered, and the one giving the highest rating should be used.
   (b) If the frequency lies on the boundary between two categories, both categories can be used to give the possible range of the rating, and then some judgement will need to be applied.
   (c) For systems specifically provided for protection against hazards, the hazard should be considered as the initiator.

(3) The event rating should be determined from Table 10.
   (a) If the period of inoperability was very short compared to the interval between tests of the components of the safety system (e.g. a couple of hours for a component with a monthly test period), consideration should be given to reducing the basic rating of the event.
   (b) In cell C1 of the table, where choice of rating is given, the choice should be based on whether the operability is just *adequate* or whether redundancy and/or diversity still exist for the initiator being considered.

Beyond design initiators are not included specifically in Table 10. If the operability of the affected safety function is less than the *minimum required by OL&C*, Level 1 is appropriate. If the operability is within the requirements of OL&C, or the OL&C do not provide any limitations on the system operability, Below Scale/Level 0 is appropriate.

5.1.5. Potential events (including structural defects)

Some events do not of themselves result in an initiator or a degraded safety system operability but do correspond to an increased likelihood of such an event. Examples are discovery of structural defects or a leak terminated by operating personnel. The general approach to rating these events is as follows. First, the significance of the potential event should be evaluated by assuming it had actually occurred and applying Section 5.1.3 or 5.1.4, based on the operability of safety provisions that existed at the time. The choice of section depends on whether the potential event was an initiator or a degradation of a safety system. Secondly, the rating should be reduced, depending on the likelihood that the potential event could have developed from the event that actually occurred. The level to which the rating should be reduced must be based on judgement.

One of the most common examples of potential events is the discovery of structural defects. The surveillance programme is intended to identify structural defects before their size becomes unacceptable. If the defect is within this size, then Below Scale/Level 0 would be appropriate.

If the event is the discovery of a defect larger than expected under the surveillance programme, rating of the event needs to take account of two factors.

Firstly, the rating of the potential event should be determined by assuming that the defect had led to failure of the component and applying Section 5.1.3 or 5.1.4. If the defect is in a safety system, applying Section 5.1.4 will give the basic rating of the potential event. The possibility of common mode failure may need to be considered. If failure of the component containing the defect could have led to an initiator, then applying Section 5.1.3 will give the basic rating of the potential event. Although the defect may have been found during shutdown, its significance must be considered over the time during which it is likely to have existed.

The rating of the potential event derived in this way should then be adjusted depending on the likelihood that the defect would have led to component failure, and by consideration of the additional factors discussed in Section 5.2.

5.1.6. Below Scale/Level 0 events

In general, events should be classified Below Scale/Level 0 only if application of the procedures described above does not lead to a higher rating. However, provided none of the additional factors discussed in Section 5.2 are applicable, the following types of events are typical of those that will be categorized as Below Scale/Level 0:

— Reactor trip proceeding normally;
— Spurious[17] operation of the safety systems, followed by normal return to operation, without affecting the safety of the installation;
— Coolant leakage at rate within OL&C;
— Single failures or component inoperability in a redundant system, discovered during scheduled periodic inspection or test.

5.2. CONSIDERATION OF ADDITIONAL FACTORS

Particular aspects may challenge simultaneously different layers of the defence in depth and are consequently to be considered as additional factors that may justify an event having to be rated one level above the one resulting from the previous guidance.

The main additional factors that act in such a way are:

— Common cause failures;
— Procedural inadequacies;
— Safety culture issues.

Because of such factors, it is possible that an event could be rated at Level 1, even though it is of no safety significance on its own without taking into account these additional factors.

When assessing the increase of the basic rating due to these factors, the following aspects require consideration:

(1) Allowing for all additional factors, the level of an event can only be increased by one level.
(2) Some of the above factors may have already been included in the basic rating (e.g. common mode failure). It is therefore important to take care that such failures are not double counted.
(3) The event cannot be increased beyond Level 3, and this upper limit for defence in depth should only be applied to those situations where, had one other event happened (either an *expected* initiator or a further component failure), an accident would have occurred.

[17] Spurious operation in this respect would include operation of a safety system as a result of a control system malfunction, instrument drift or individual human error. However, the actuation of the safety system initiated by variations in physical parameters which have been caused by unintended actions elsewhere in the plant would not be considered as spurious initiation of the safety system.

5.2.1. Common cause failures

A common cause failure is the failure of a number of devices or components to perform their function as a result of a single specific event or cause. In particular, it can cause the failure of redundant components or devices intended to perform the same safety function. This may imply that the reliability of the whole safety function could be much lower than expected. The severity of an event affecting a component that identifies a potential common cause failure affecting other similar components is therefore higher than an event involving the random failure of the component.

Events in which there is a difficulty in operating some systems as a result of absent or misleading information can also be considered for uprating on the basis of a common cause failure.

5.2.2. Procedural inadequacies

The simultaneous challenge to several layers of the defence in depth may arise because of inadequate procedures. Such inadequacies in procedures are therefore also a possible reason for increasing the basic rating.

Examples include:

— Wrong or inadequate instructions given to operating personnel for coping with an event (e.g. This happened during the Three Mile Island accident in 1979. The procedures to be used by operating personnel in the case of safety injection actuation were not appropriate for the particular situation of a loss of coolant in the steam phase of the pressurizer.)
— Deficiencies in the surveillance programme highlighted by anomalies not discovered during normal procedures or system/equipment unavailabilities well in excess of the test interval.

5.2.3. Safety culture issues

Safety culture has been defined as “that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance”. A good safety culture helps to prevent incidents but, on the other hand, a lack of safety culture could result in operating personnel performing in ways not in accordance with the assumptions of the design. Safety culture has therefore to be considered as part of the defence in depth, and consequently, safety culture issues could justify increasing the rating of an event by one level (INSAG 4 [7] provides further information on safety culture).

To merit increasing the rating due to safety culture issues, the event has to be considered as a real indicator of an issue with the safety culture.

5.2.3.1. Violation of OL&C

One of the most easily defined indicators of a safety culture issue is a violation of OL&C.

OL&C describe the minimum operability of safety systems such that operation remains within the safety requirements of the reactor. They may also include operation with reduced safety system availability for a limited time. In most countries, the OL&C are included within the Technical Specifications. Furthermore, in the event that the OL&C are not met, the Technical Specifications describe the actions to be taken, including times allowed for recovery as well as the appropriate fallback state.

If the system availability is discovered to be less than that defined for Category B (e.g. following a routine test), but the reactor is taken to a safe state in accordance with the Technical Specifications, the event should be rated as described in Sections 5.1.3 and 5.1.4, but the basic rating should not be increased as the requirements of the Technical Specifications have been followed.

If the safety function operability is within that defined for Category B but the operating personnel stay more than the allowed time (as defined in the Technical Specification) in that availability state, the basic rating is Level 0, but the rating should be increased to Level 1 because of safety culture issues.

Equally, if operating personnel take deliberate action that leads to plant availability being outside OL&C, consideration should be given to increasing the basic rating of the event because of safety culture issues.

In addition to the formal OL&C, some countries introduce into their Technical Specifications further requirements such as limits that relate to the long-term safety of components. For events where such limits are exceeded for a short time, Below scale/Level 0 may be more appropriate.

5.2.3.2. Other safety culture issues

Other examples of indicators of safety culture issues could be:

— A violation of a procedure without prior approval;
— A deficiency in the quality assurance process;
— An accumulation of human errors;

- Exposure of a member of the public from a single event in excess of annual statutory dose limits ;
- Cumulative exposure of workers or members of the public in excess of annual statutory dose limits;
- A failure to maintain proper control over radioactive materials, including releases into the environment, spread of contamination or a failure in the systems of dose control;
- The repetition of an event, if there is evidence that the operator has not taken adequate care to ensure that lessons have been learnt or that corrective actions have been taken after the first event.

It is important to note that the intention of this guidance is not to initiate a long and detailed assessment but to consider if there is an immediate judgement that can be made by those rating the event. It is often difficult, immediately after the event, to determine if the rating of the event should be increased due to safety culture. A provisional rating should be provided in this case based on what is known at the time, and a final rating can then take account of the additional information related to safety culture that will have arisen from a detailed investigation.

5.3. WORKED EXAMPLES

Example 27. Reactor scram following the fall of control rods — Below Scale/Level 0

Event description

The unit was operating at rated power. During the movement of a bank of shutdown rods, which was carried out as a periodic control rod surveillance test, the reactor was scrammed as a result of a high negative rate signal of the power range neutron flux. This also caused automatic turbine and generator trip.

The control rod operation was promptly stopped and rod positions checked on the control rod position detector. It was found that the four control rods of the shutdown bank being tested had fallen prior to the reactor shutdown.

The high negative rate signal had been provided to protect against instrument failure and was not claimed as protection against any design basis faults.

An inspection of the control circuit of the control rod drive mechanism showed that the cause of the malfunction was a defective printed circuit board.

The relevant faulty board was replaced with a spare board and, after the integrity of the control circuit had been checked, normal operation was resumed.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	The accidental falling of control rods does not challenge the safety functions and is therefore not an initiator. The reactor trip is an initiator (frequency category — *expected*).
5.1.2. Safety function operability:	The safety function `cooling of the fuel' was *full*.
5.1.3. and 5.1.4. Basic rating:	There was a real initiator. From Section 5.1.3, box A(1) of Table 9 is appropriate, giving a basic rating of Below scale/Level 0.
5.2. Additional factors:	There are no reasons for uprating.
Overall rating:	Below Scale/Level 0.

Example 28. Reactor coolant leak during on power refuelling — Level 1

Event description

During routine refuelling at full power, a heavy water reactor coolant leak of 1.4 t/h developed in the fuelling vault. Operating personnel determined that the east fuelling bridge had dropped 0.4 m. The reactor was shut down and cooled. Coolant pressure was maintained by transfer from other units and recovery from the sump. Total leakage was 22 t (approximately 10% of the inventory). No safety system operation was required with the exception of containment box up on high activity after one hour. There was no abnormal release of radioactivity to the environment. The cause of the problem was failure of an interlock, which was not checked by the surveillance programme.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	Although there was a very small reactor coolant leak, there was no challenge to the safety functions, because action by operating personnel maintained water inventory. Thus there was no real initiator.
5.1.2. Safety function operability:	Had the leak developed into a small loss of coolant accident (LOCA), all the required safety systems were fully available.
5.1.3 and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, row A of Table 10 is appropriate, giving a basic rating of 0. Using the guidance in section 5.1.5, had the leak not been controlled, it would have led to a small LOCA, frequency *possible*. From Box A(2) of Table 9, the rating of the potential event would have been Level 1. As the likelihood of operators failing to control the leak is low, the rating should be reduced to Level 0.
5.2. Additional factors:	The interlock was not checked by the surveillance programme. Also, this deficiency was known before the event. For these reasons, the event was uprated to Level 1.
Final rating:	Level 1.

Example 29. Containment spray not available due to valves being left in the closed position — Level 1

Event description

This two-unit station has to shut down both its reactors annually in order to perform the required tests on the common emergency core cooling system (ECCS) and the related automatic safety actions.

These tests are usually performed when one of the two reactors is in cold shutdown for refuelling.

On 9 October, Units 1 and 2 were subjected to these tests. Unit 1 remained in the cold shutdown condition for refuelling, and Unit 2 resumed power operation on 14 October. On 1 November, it was discovered during the monthly check of the safeguard valves that the four valves on the discharge side of the containment spray pumps were closed. It was concluded that these valves had not been reopened after the tests on 9 October, in contradiction to the requirements of the related test procedure.

Unit 2 had thus operated for 18 days with spray unavailable.

It was concluded that the cause of the event was human error. However, it was recognized that the error occurred at the end of a test period that was longer than usual (as a result of troubleshooting), and that a more formal reporting of actions accomplished could be very useful.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	There was no real initiator. The initiator that would challenge the degraded safety function was a large LOCA (*unlikely*).
5.1.2. Safety function operability:	The operability of the safety function `confinement' was degraded. The operability was less than the *minimum required by OL&C* but more than just *adequate*, as a diverse system was available.
5.1.3. and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, box C(3) of Table 10 is appropriate, giving a basic rating of Level 1.
5.2. Additional factors:	The fault was caused by human error, but it is not considered appropriate to increase the rating of the event due to safety culture issues (Section 5.1.4 explains that the choice of Level 1 rather than zero for the basic rating already took account of the fact that OL&C had been violated.)
Final rating:	Level 1.

Example 30. Primary system water leak through a rupture disc of the pressurizer discharge tank — Level 1

Event description

The unit had been brought to hot shutdown. The residual heat removal (RHR) system had been isolated and partially drained for system tests after modification work and was therefore not available

The periodic test of pressurizer spray system efficiency was under way, and the reactor coolant system was at a pressure of 159 bars. At about 16:00, the pressurizer relief tank high pressure alarm was actuated. The level in the volume control tank fell, indicating leakage of reactor coolant at an estimated rate of 1.5 m^3 per hour. A worker went into the reactor building in an attempt to discover where the leak was located and concluded that it was coming from the stem of a valve on the reactor coolant system (from a manual valve located on the temperature sensor bypass line). The worker checked that the valve was leaktight by placing it in its back seat position by means of the handwheel (in fact, the valve was still not correctly seated).

The leakage continued, and maintenance staff were called in at 18:00, but they too failed to find the source of the leak.

During this time, the pressure and temperature inside the pressurizer relief tank continued to rise. Temperatures were maintained below 50°C by means of feed and bleed operations (i.e. injections of cold make up water and drainage into the reactor coolant drain recovery tank). Two pumps installed in parallel direct this effluent out of the reactor, building towards the boron recycle system tank.

At around 09:00, the activity sensors indicated an increase in radioactivity in the reactor building. At 09:56, the set point for partial isolation of the containment was reached. This resulted notably in closure of the valves inside the containment on the nuclear island vent and drain system. At this point, effluent could no longer be routed to the boron recycle system.

Pressure inside the pressure relief tank continued to rise until, at 21:22, the rupture disks blew. To maintain the temperature in the pressurizer relief tank at around 50°C, water make up had to be continued until 23:36 At 01:45, activity levels inside the reactor building fell below the set point for containment isolation.

At 02:32, the reactor coolant system was at a pressure of 25 bar. The unit had been brought to subcritical hot shutdown conditions with heat being removed by the steam generators, but the RHR system was still unavailable.

The RHR system was reinstated at 10:54 and at 11:45, the leaking valve on the reactor coolant system was disconnected from its remote control to allow it to be reseated, thereby stopping the leak.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	No real initiator occurred, as the emergency core cooling safety systems were not challenged. The initial leakage was controlled by the normal make up systems (see Section 5.1.1).
5.1.2. Safety function operability:	Had the leak developed into a small LOCA, all the required safety systems were fully available.
5.1.3. and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, row A of Table 10 is appropriate, giving a basic rating on Below scale/Level 0. Using the guidance in Section 5.1.5, had the leak worsened with no action by operating personnel, it would have led to a small LOCA, frequency *possible.* From Box A(2) of Table 9, the rating of the potential event would have been Level 1. As the likelihood of the potential event is low, the rating should be reduced to Level 0.
5.2. Additional factors:	The spurious initiator of containment isolation caused operating difficulties and gave misleading information. For these reasons, the event was uprated to Level 1 (see Section 5.2.1).
Final rating:	Level 1.

Example 31. Fuel assembly drop during refuelling — Level 1

Event description

After lifting a new fuel assembly from its cell during refuelling, spontaneous pull out of the refuelling machine telescopic beam occurred, and a fresh fuel assembly slumped onto the central tube of the refuelling machine flask. Interlocks operated as designed and no fuel damage or depressurization occurred.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	Although the event only involved unirradiated fuel, it could have occurred with irradiated fuel. Dropping a single fuel assembly is identified as a *possible* initiator.
5.1.2. Safety function operability:	The provided safety systems were fully available.
5.1.3. and 5.1.4. Basic rating:	There was a real initiator. From Section 5.1.3, box A(2) of Table 9 is appropriate, giving a basic rating of Level 1. Application of the guidance in section 6.3.8 would give the same rating.
5.2. Additional factors:	There are no reasons for uprating.
Final rating:	Level 1.

Example 32. Incorrect calibration of regional overpower detectors — Level 1

Event description

During a routine calibration of the regional overpower detectors for shutdown systems 1 and 2, an incorrect calibration factor was applied. The calibration factor used was for 96% power, although the reactor was at 100% power. This error in calibration was discovered approximately six hours later, at which time all detectors were recalibrated to the correct value for operation at full power. The trip effectiveness of this parameter for both shutdown systems was therefore reduced for approximately six hours. An alternative trip parameter with redundancy was available throughout.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	There was no real initiator The reactor protection system was required for *expected* initiators.
5.1.2. Safety function operability:	The operability of the protection system was reduced. The operability was less than the *minimum allowed by OL&C* but greater than just *adequate*, as a second trip parameter with redundancy remained available. The wrongly calibrated detectors would also have provided protection for most fault conditions.
5.1.3. and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, box C(1) of Table 10 is appropriate, giving Level 1 or 2. Level 1 was chosen, as the operability was considerably more than just *adequate*.
5.2. Additional factors:	In considering whether the basic rating should be adjusted, it is relevant to consider that the fault only existed for a short time. On the other hand, there were deficiencies in the procedure. It was decided to keep the rating at Level 1.
Final rating:	Level 1.

Example 33. Failure of safety system train during routine testing — Level 1

Event description

The unit was operating at nominal power. During the routine testing of one diesel generator, a failure of the diesel generator control system occurred. The diesel was taken out of service for about six hours for maintenance and then returned to service. The Technical Specifications require that if one diesel generator is taken out of service, the other two safety system trains should be tested. This testing was not carried out at the time. Subsequently, the other safety system trains were tested and shown to be available.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	There was no initiator The diesel generators were required for a loss of off-site power (*expected*).
5.1.2. Safety function operability:	The operability was not less than the *minimum allowed by OL&C*, as two trains remained available. The additional testing eventually carried out did show that two trains were available.
5.1.3 and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, box B(1) of Table 10 is appropriate, giving a basic rating of Below scale/Level 0.
5.2. Additional factors:	Workers violated the Technical Specifications without justification, so the event was uprated to Level 1.
Final rating:	Level 1.

Example 34. Plant design for flooding events may not mitigate the consequences of piping system failures — Level 1

Event description

A regulatory inspection identified that the consequences of internal flooding had not been adequately addressed.

Documentation addressing specific flooding events from postulated failures of plant equipment did exist, but a complete internal plant flooding analysis had not been developed during or subsequent to the plant's original design.

In response to the inadequate plant design, some physical changes had been made to minimize challenges to plant equipment and personnel in combating potential flooding events. However, it was not clear that the plant design provided adequate protection against the consequences of non-safety related piping system failures in the turbine building. High water level in the turbine building would result in water flowing into certain engineered safety feature (ESF) equipment rooms because they are only separated from the turbine building by non-water-tight doors and have a common floor drain system. The ESF equipment rooms contain the auxiliary feedwater system (AFW), emergency diesel generators and both 480 V and 4160 V ESF switchgear.

As a result of the inspection, the design and licensing basis for internal flooding was compiled, and seismic qualification of selected piping and components was completed. Design modifications to protect Class 1 plant systems and components as defined in the updated Safety Analysis Report were completed. This included installation of flood barriers at the doors to rooms containing ESF equipment, installation of check valves in selected floor drain lines, and installation of circuitry to trip the circulating water pumps on high water level in the turbine building basement.

Rating explanation

In general, design deficiencies identified during periodic safety reviews or life extension programmes would not be considered as individual events to be rated with INES. However, errors in analysis discovered during other work might well be reported as events. This manual does not seek to define what events should be reported to the public, rather to give guidance on how to rate events that are communicated to the public. This event is included to show how such events can be rated.

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	There was no initiator. The safety systems were required against the initiator of a major power conversion system pipe rupture (an *unlikely* initiator).
5.1.2. Safety function operability:	The safety function of post trip cooling was *inadequate*.
5.1.3 and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, box D(3) of Table 10 is appropriate, giving a basic rating of Level 1.
5.2. Additional factors:	There are no reasons for uprating.
Final rating:	Level 1.

Example 35. Two emergency diesel generators did not start following disconnection from the main grid supplies — Level 2

Event description

An electrical fault in the 400 kV switchyard caused by errors during a test procedure, resulted in the unit being disconnected from the grid. The excitation of the generators caused an increase in the voltage level on the generator bus bars to about 120%. This overvoltage caused two out of four uninterruptible power supply (UPS) DC/AC inverters to trip. About 30 s later in the sequence, when house load mode of operation on both turbo-generators was lost, the trip of the UPS DC/AC inverters prevented connection of two out of four emergency diesel generators to the 500 V bus bars. Approximately 20 min after the initial event, the 500 V diesel bus bars in the affected divisions were manually connected to the 6 kV system, supplied by the off-site auxiliary power, and all electrical systems were thereby operational. The scram of the reactor was successful, and all control rods were inserted as expected. Two valves in the pressure relief system opened because of unwarranted initiation of safety trains. The emergency core cooling system in two out of four trains was however more than sufficient to maintain the reactor level above the core, as there was no additional LOCA. The control room staff had difficulties in supervising the plant properly during the event, as many indications and readings were lost due to the loss of power in the two trains that supplied much of the control room instrumentation. Subsequent investigations showed that the overvoltage on the generator bus bars could easily have prevented all four UPS systems working.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	A reactor trip occurred, which is a frequent initiator. There was also a partial loss of off-site power, requiring initial operation of diesels followed by manual connection to auxiliary supplies.
5.1.2. Safety function operability:	All cooling systems were available, but the supplies for switching were not available on two trains. Unavailability of two out of four trains was permitted for a limited time and so was within OL&C.
5.1.3 and 5.1.4. Basic rating:	There was a real initiator. From Section 5.1.3, box B(1) of Table 9 is appropriate, giving a basic rating of Level 1 or 2. As all cooling systems were actually available, subject to manual switching, the lower rating was chosen.
5.2. Additional factors:	There was clearly a common mode failure issue as all four UPS systems were subject to the same overvoltage problems. For this reason, the basic rating was increased by 1 level.
Final rating:	Level 2.

The event also showed that the safety systems were vulnerable to a loss of off-site power with an associated overvoltage. Therefore it also needs to be rated based on assessing this identified reduction in operability.

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	A full loss of off-site power (LOOP) did not occur but is an *expected* initiator.
5.1.2. Safety function operability:	Assuming the LOOP led to an overvoltage transient (which was probable), the diesels would have started, but there would have been no supplies to connect them. Operating personnel would have had about 40 minutes to find a way of manually connecting the diesels. On that basis, the safety function operability was just *adequate.*
5.1.3 and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, box C(1) of Table 10 is appropriate giving a basic rating of Level 1 or 2. Because all of the cooling systems were actually available, subject to being able to switch in the diesel supplies, the lower rating was chosen.
5.2. Additional factors:	This analysis already assumes failure of all the UPS systems, so there is no basis for further uprating.
Final rating:	Level 2 based on the first analysis with a real initiator.

Example 36. Loss of forced gas circulation for between 15 and 20 minutes — Level 2

Event description

A single phase fault on the instrument power supplies to Reactor 1 was not cleared automatically and persisted until supplies were changed over manually. The fault caused both high pressure and low pressure feed trip valves to close on one boiler, leading to rundown of the corresponding steam driven gas circulator. Much of the instrumentation and automatic control on the boilers and on Reactor 1 was lost. Manual rod insertion was possible and was attempted, but the rate was insufficient to prevent rising temperatures, resulting in Reactor 1 being automatically tripped on high fuel element temperature (approximately 16°C rise). It appeared to the operating personnel that all the rod control systems were rendered inoperable.

The battery backed essential instrumentation, and the reactor protection system remained functional, together with some of the normal control and instrumentation systems.

All gas circulators ran down as the steam to their turbines deteriorated. The instrument power supplies fault prevented engagement of gas circulator pony motors, either automatically or manually. Low pressure feed was maintained throughout to three out of four boilers and was restored to the fourth boiler by manual action. After the initial transient, leading to the reactor tripping, fuel element temperatures fell but then rose as forced gas circulation failed. These temperatures stabilized at about 50°C below normal operational levels before falling once again when gas circulator pony motors were started on engagement of standby instrument supplies. Reactor 2 was unaffected and operated at full output throughout. Reactor 1 was returned to power the following day.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	This event needs to be considered in two parts. The first initiator was the transient caused by loss of feed to one boiler, together with loss of indications. This challenged the protection system, which was still fully available. This part of the event would therefore be rated at Below scale/Level 0. It should be noted that although the first occurrence in the event was a fault in the instrument supplies, this is not the initiator. The instrument fault caused feed to be lost to one boiler but did not directly challenge any safety systems. It is not therefore to be considered as an initiator. The transient that followed challenged the protection system and is therefore an initiator. The second initiator was the reactor trip and rundown of the steam driven gas circulators. This challenged the safety function ‘cooling of the fuel’.

Criteria	Explanation
5.1.2. Safety function operability:	The operability of this safety function was less than the *minimum required by OL&C,* as none of the pony motors could be started, but more than *adequate,* as natural circulation provided effective cooling, and forced circulation was restored before temperatures could have risen to unacceptable levels.
5.1.3 and 5.1.4. Basic rating:	There was a real initiator. From Section 5.1.3, box C(1) of Table 9 is appropriate, giving a basic rating of Level 2 or 3. As explained in that section, the level chosen depends on the extent to which the operability is greater than just *adequate*. In this event, because of the availability of natural circulation and the limited time for which forced circulation was unavailable, Level 2 is appropriate.
5.2. Additional factors:	Regarding possible uprating, there are two issues to be considered, both identified in Section 5.2.1. The fault involved common mode failure of all the circulators. However, this fact has already been taken into account in the basic rating, and to uprate the event would be double counting (see introduction to Section 5.2 item (2)). The other relevant factor is the difficulties caused by absent indications. However, these were more relevant to controlling the initial transient and could not have led to a worsening of the post-trip cooling situation. Furthermore, from item (3) of the introduction to Section 5.2, Level 3 would be inappropriate, as a single further component failure would not have led to an accident.
Final rating:	Level 2.

Example 37. Small primary circuit leak — Level 2

Event description

A very small leak (detected only by humidity measurement) was discovered in the non-isolatable part of one safety injection line owing to defects that were not expected by the surveillance programme (the area was not inspected by the surveillance programme). Similar but smaller defects were present in the other safety injection lines.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	Following section 5.1.5, if the defect had led to failure of the component, a large loss of coolant accident (LOCA) (*unlikely* initiator) would have occurred.
5.1.2. Safety function operability:	The safety function operability for this postulated initiator was *full*.
5.1.3 and 5.1.4. Basic rating:	Following the methodology for structural defects leads to using Section 5.1.3. Box A(3) of Table 9 gives an upper value to the basic rating of 2. As only a leak occurred (no actual failure of the pipework), the rating should be reduced by one level.
5.2. Additional factors:	As the defects could have led to common mode failure of all safety injection lines, the rating was upgraded to Level 2.
Final rating:	Level 2.

Example 38. Partial blockage of the water intake during cold weather — Level 3

Event description

This event affected both units at the station, but to simplify the explanation, only the impact on Unit 2 is considered here.

On-site electrical supplies could be provided either by the other unit or by four auxiliary turbine generator sets.

The source of the event was the cold weather prevailing in the area at the time. Ice flows blocked the water intake, while the low temperatures contributed to the tripping of the conventional unit, followed by a voltage reduction on the transmission grid.

Ice slipped under the skimmer, reaching the trash racks of the Unit 1 pumping station. Further ice formation probably turned the ice flows into a solid block, partially obstructing the trash racks shared by the two screening drums of the Unit 1 pumping station. This would have produced a significant reduction in raw water intake at the pumping station. There was no clear alarm signal indicating the drop in level.

As a result of the drop in level, vacuum loss at the condensers led to automatic tripping of the four auxiliary turbine generator sets at the site (between 09:30 and 09:34); the four corresponding busbars were each resupplied from the grid within one second.

The main turbine generator sets for Unit 1 were switched off at 09:28 and 09:34, and the reactor was shutdown.

Unit 2 remained in operation, although from 09:33 to 10:35, no auxiliary turbine generator set at the site was available (situation not foreseen or permitted in the Technical Specifications), and the only power supplies consisted of the transmission grid and the two main turbine generator sets for the unit. From 10:55 onwards, when a second auxiliary turbine generator was reconnected to its switchboard, two turboblowers were fed by the auxiliary turbine generators in operation and the two other turboblowers drawing from one of the two 400 kV lines.

At 11:43, following voltage reduction in the transmission grid, the two main turbine generator sets at Unit 2 tripped almost simultaneously (unsuccessful house load operation), causing rod drop and reactor scram as well as loss of off-site power (tripping of line circuit breakers).

At this time, only two of the four auxiliary turbine generators had been brought back into service. Consequently, only two of the four turboblowers remained in operation to provide core cooling. The power lines linking Unit 2 to the grid were restored after 10 and 26 minutes, so that the other turboblowers were brought back into service.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	This is a complex set of events, but the event being rated is the operation of Unit 2 without any on-site essential electrical supplies (due to the loss of cooling water following ice formation). There was no initiator, but the initiator that would challenge on-site electrical supplies is loss of off-site power (*expected*).
5.1.2. Safety function operability:	The safety function `cooling of the fuel' was degraded. The operability of the safety function was *inadequate,* as there were no on-site electrical supplies.
5.1.3 and 5.1.4. Basic rating:	There was no real initiator. From section 5.1.4, box D(1) of Table 10 is appropriate, giving a basic rating of Level 3.
5.2. Additional factors:	Although the time of unavailability was short (1 h), the likelihood of loss of off-site power was high. Indeed, it was lost shortly afterwards. It is not appropriate, therefore, to downrate the event.
Final rating:	Level 3.

Example 39. Unit scram caused by grid disturbances due to tornado — Level 3

Event description

As a result of a tornado, transmission lines were damaged. The unit was tripped by system emergency protection due to strong frequency oscillations in the system.

Unit auxiliary power was supplied from the service transformer. Main steam header pressure was maintained and residual heat removed. Core cooling was maintained through natural circulation.

On voltage decrease, the diesel start signal was initiated, but diesel generators (DGs) failed to connect to essential buses. Since the signal for DG start persisted, periodic restarts followed. Subsequent attempts to supply power to auxiliary buses from DGs were unsuccessful due to absence of air in the start-up bottles.

Four hours after the trip, total loss of power occurred for a period of 30 min. Throughout the transient, the core status was being monitored with the help of design provided instrumentation.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	A real initiator occurred, loss of off-site power. The frequency of this initiator is *expected*. The initiator was caused by a tornado, but section 5.1.3 states that the hazard itself should not be used as the initiator.
5.1.2. Safety function operability:	Even though no diesels were available, the availability of the safety function was just *adequate* due to the limited time of loss of off-site supplies.
5.1.3 and 5.1.4. Basic rating:	There was a real initiator. From Section 5.1.3, box C(1) of Table 9 is appropriate, giving a basic rating of Level 2 or 3. As the safety function was only just *adequate*, Level 3 was chosen.
5.2. Additional factors:	There are no reasons for uprating.
Final rating:	Level 3.

Example 40. Complete station blackout owing to a fire in the turbine building — Level 3

Event description

A fire occurred in the turbine building. The PHWR was tripped manually, and a cooldown of the reactor was initiated.

Due to the fire, many cables and other electrical equipment were damaged, which resulted in a complete station blackout. Core decay heat removal was through natural circulation. Water was fed to the secondary side of the steam generators using diesel fire pumps. Borated heavy water was added to the moderator to maintain the reactor in a sub critical state at all stages.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	Loss of on-site electrical power (Class IV, III, II or I) is a *possible* initiator for PHWRs, which actually occurred (i.e. real). As in the previous example, the hazard itself should not be taken as the initiator.
5.1.2. Safety function operability:	The safety function "cooling" was just *adequate* because the secondary side was fed using a diesel fire pump, which is not a normal safety system.
5.1.3 and 5.1.4. Basic rating:	There was a real initiator. From Section 5.1.3, box C(2) of Table 9 is appropriate, giving a basic rating of Level 2 or 3.
5.2. Additional factors:	Level 3 was chosen because there were no safety systems available, and many indications were lost. A number of potential further single failures could have resulted in an accident.
Final rating:	Level 3.

6. ASSESSMENT OF IMPACT ON DEFENCE IN DEPTH FOR EVENTS AT SPECIFIED FACILITIES

This section deals with those events where there are no “actual consequences”, but some of the safety provisions failed. The deliberate inclusion of multiple provisions or barriers is termed “defence in depth”.

The guidance in this section is for all events at fuel cycle facilities, research reactors, accelerators (e.g. linear accelerators and cyclotrons) and events associated with failures of safety provisions at facilities involving the manufacture and distribution of radionuclides or the use of a Category 1 source. It also covers many events at reactor sites. While Section 5 provided guidance for events occurring on power reactors during operation, this section provides guidance on a wide range of other events at reactor sites. These include events involving reactors during shutdown or reactors being decommissioned, whether or not the fuel is still on-site, and other events at reactor sites, such as those associated with waste storage or maintenance facilities. It is based on what is known as the “Safety Layers Approach”.

Defence in depth provisions, such as interlocks, cooling systems, physical barriers, are provided at all installations dealing with radioactive materials. They cover protection of the public and the workforce, and include means to prevent the transfer of material into poorly shielded locations as well as to prevent the release of radioactive material. The concept of defence in depth is not explained in detail here, as it will be familiar to the majority of those applying this manual to events at facilities. However, Annex I does give some additional background material.

This section is divided into four main parts. The first gives the general principles that are to be used to rate events under defence in depth. As they need to cover a wide range of types of installations and events, they are general in nature. In order to ensure that they are applied in a consistent manner, Section 6.2 goes on to give more detailed guidance, including the guidance associated with uprating events. Section 6.3 gives some specific guidance for certain types of events, and Section 6.4 provides a number of worked examples.

6.1. GENERAL PRINCIPLES FOR RATING OF EVENTS

Although INES allocates three levels for the impact on defence in depth, the maximum potential consequences for some facilities or practices, even if all the safety provisions fail, are limited by the inventory of the radioactive material and the release mechanism. It is not appropriate to rate events associated with the defence in depth provisions for such practices at the highest of the defence in depth levels. If the maximum potential consequences for a particular practice cannot be rated higher than Level 4 on the scale, a maximum rating of Level 2 is appropriate under defence in depth. Similarly if the maximum potential consequences cannot be rated higher than Level 2, then the maximum rating under defence in depth is Level 1. One facility can cover a number of practices, and each practice must be considered separately in this context. For example, waste storage and reprocessing should be considered as separate practices, even though they can both occur at one facility.

Having identified the upper limit to the rating under defence in depth, it is then necessary to consider what safety provisions still remain in place (i.e. what additional failures of safety provisions would be required to result in the maximum potential consequences for the practice). This includes consideration of hardware and administrative systems for prevention, control and mitigation, including passive and active barriers. The approach to rating is based on assessing the likelihood that the event could have led to an accident, not by using probabilistic techniques directly, but by considering what additional failures of safety provisions would be required to result in an accident.

Thus a "basic rating" is determined by taking account of the maximum potential consequences and the number and effectiveness of safety provisions available.

To allow for any underlying "additional factors", consideration is also given to increasing the "basic rating". This increase allows for those aspects of the event that may indicate a deeper degradation of the plant or the organizational arrangements of the facility. Factors considered are common cause failures, procedural inadequacies and safety culture issues. Such factors are not included in the basic rating and may indicate that the significance of the event with respect to defence in depth is higher than the one considered in the basic rating process. Accordingly, in order to communicate the true significance of the event to the public, increasing the rating by one level is considered.

The following steps should therefore be followed to rate an event:

(1) The upper limit to the rating under defence in depth should be established by taking account of the maximum potential radiological consequences (i.e. the maximum potential rating for the relevant practices at that facility based on the criteria in Sections 2 and 3). Further guidance on establishing the maximum potential consequences is given in Section 6.2.1.
(2) The basic rating should then be determined by taking account of the number and effectiveness of safety provisions available (hardware and administrative). In identifying the number and effectiveness of such

provisions, it is important to take account of the time available and the time required for identifying and implementing appropriate corrective action. Further guidance on the assessment of safety provisions is provided in Section 6.2.2.

(c) The final rating should be determined by considering whether the basic rating should be increased because of additional factors, as explained in Section 6.2.4. However, the final rating must still remain within the upper limit of the defence in depth rating established in (1).

Clearly, as well as considering the event under defence in depth, each event must also be considered against the criteria in Sections 2 and 3.

6.2. DETAILED GUIDANCE FOR RATING EVENTS

6.2.1. Identification of maximum potential consequences

As stated above, the inventory of radioactive material and timescales of events at installations covered by INES, vary widely. The rating process identifies three categories of maximum potential consequences: Levels 5–7, Levels 3–4 and Levels 1–2.

In assessing the INES level for the maximum potential consequences, the following general principles should be taken into account:

— Any one site may contain a number of facilities with a range of tasks carried out at each facility. Thus, the maximum potential rating should be specific to the type of facility at which the event occurred and the type of operations being undertaken at the time of the event. However, the maximum potential consequences are not specific to the event but apply to a set of operations at a facility
— It is necessary to consider both the radioactive inventory that could potentially have been involved in the event, the physical and chemical properties of the material involved and the mechanisms by which that activity could have been dispersed.
— The consideration should not focus on the scenarios considered in the safety justification of the facility but should consider physically possible accidents had all the safety provisions related to the event been deficient.
— When considering consequences related to worker exposure, the maximum potential consequences should generally be based on exposure of a single inidividual as it is highly unlikely that several workers would all be exposed at the maximum credible level.

These principles can be illustrated by the following examples:

(1) For events associated with maintenance cell entry interlocks, the maximum potential consequences are likely to be related to unplanned worker exposure. If the radiation levels are sufficiently high to cause deterministic effects or death if the cell is entered and no mitigative actions are taken, then the rating of the maximum potential consequences is Level 3 or 4 (from the individual dose criteria in Section 2.3).
(2) For events on small research reactors (power of about 1 MW or less), although the physical mechanisms exist for the dispersal of a significant fraction of the inventory (either through criticality events or loss of fuel cooling), the total inventory is such that the rating of the maximum potential consequences could not be higher than Level 4, even if all the safety provisions fail.
(3) For events on power reactors during shutdown, the inventory and physical mechanisms that exist for the dispersal of a significant fraction of that inventory (through loss of cooling or criticality events), are such that the rating of the maximum potential consequences could exceed Level 4, if all the safety provisions fail.
(4) For reprocessing facilities and other facilities processing plutonium compounds, the inventory and physical mechanisms that exist for the dispersal of a significant fraction of that inventory (either through criticality events, chemical explosions or fires), are such that the rating of the maximum potential consequences could exceed Level 4, if all the safety provisions fail.
(5) For uranium fuel fabrication and enrichment facilities, releases may have chemical and radiation safety aspects. It has to be emphasized that the chemical risk posed by the toxicity of fluorine and uranium predominates over the radiological risk. INES, however, is only related to the assessment of the radiological hazard. Thus, no severe consequences exceeding a rating of Level 4 are conceivable from a release of uranium or its compounds.
(6) For accelerators, the maximum potential consequences are likely to be related to unplanned individual exposure. If the radiation levels are sufficiently high to cause deterministic effects or death in the event of entry into restricted areas, then the rating of the maximum potential consequences is Level 3 or 4 (from the individual dose criteria in Section 2.3).

(7) For irradiators, most events will be associated with unplanned radiation doses. If the potential radiation levels, in the event of failure of all the protective measures, are sufficiently high to cause deterministic effects or death, then the rating of the maximum potential consequences is Level 3 or 4 (from the individual dose criteria in Section 2.3). For events at facilities with Category 1 sources that have safety systems intended to prevent dispersion of radioactive material (e.g. fire protection systems), the potential release may be large enough to give maximum potential consequences rated at Level 5.

6.2.2. Identification of number of safety layers

6.2.2.1. Identifying safety layers

There are a wide range of safety provisions used in the different facilities covered by this section. Some of these may be permanent physical barriers, others may rely on interlocks, others may be active engineered systems such as cooling or injection systems, and others may be based on administrative controls or actions by operating personnel in response to alarms. The methodology for rating events involving such a wide range of safety provisions is to group the safety provisions into separate and independent safety layers. Thus if two separate indications are routed through a single interlock, the indications and interlock together provide a single safety layer. On the other hand, if cooling is provided by two separate 100% pumps, it should be considered as two separate safety layers, unless they have a common non-redundant support system.

When considering the number of safety layers, it is necessary to ensure that the effectiveness of a number of separate hardware layers is not reduced by a common support system or a common action by operating personnel in response to alarms or indications. In such cases, although there may be several hardware layers, there may be only one effective safety layer.

When considering administrative controls as safety layers, it is important to check the extent to which separate procedures can be considered independent and to check that the procedure is of sufficient reliability to be regarded as a safety layer. The time available is considered to have a significant impact on the reliability that can be claimed from operating procedures.

Safety layers can include surveillance procedures, though it should be noted that surveillance alone does not provide a safety layer. The means to implement corrective action are also required.

It is difficult to give more explicit guidance, and inevitably judgement must be used. In general, a safety layer would be expected to have a failure rate approaching 10^{-2} per demand. To help in the identification of the number of independent safety layers, the following list gives some examples of safety layers that may be available, depending on the circumstances of the event and the design and operational safety justification for the facility:

— Electronic personal alarming dosimeters — provided that the personnel are trained in their use, that the dosimeter is reliable and that personnel can and will respond appropriately and quickly enough;
— Installed radiation and/or airborne activity detectors and alarms — provided that they can be shown to be reliable and that personnel can and will respond appropriately and quickly enough;
— Presence of a Radiation Protection technician to detect and alert others to any abnormal levels of radiation or the spread of contamination;
— Leak detection provisions, such as containment, which direct materials to a sump provided with appropriate level measuring instrumentation and/or alarms;
— Surveillance by operating personnel to provide assurance of the safe condition of the facility, provided the surveillance frequency is adequate to identify performance shortfalls, and that the corrective actions required will be reliably carried out;
— Ventilation systems that encourage airborne activity to move through the facility in a safe and controlled manner;
— Shield doors and interlock entry systems;
— Natural ventilation, 'stack effect' or passive cooling/ventilation;
— Actions, instructions or routines that have been developed to mitigate consequences;
— Provision of a diverse system, provided there are not common aspects in supply or control systems;
— Provision of redundancy, provided there is not a non-redundant support system;
— Inerting gas systems as a means of mitigating the evolution of hydrogen in some radioactive waste storage facilities.

6.2.2.2. Confinement

In some situations, confinement will itself provide one or more safety layers, but it must be used with care. As explained in Section 6.2.1, the rating process requires the maximum potential consequences to be placed into one of three categories, Levels 5–7, Levels 3–4 and Levels 1–2. If, following failure of the other safety provisions, successful operation of the confinement system reduces the maximum potential consequences into a lower category of maximum potential consequences, then it should be considered as a safety layer. On the other hand, if the effect of containment is not sufficient to change the category of maximum potential consequences, then it should not be counted as an additional safety layer. For example, a small research reactor would have maximum potential consequences of Level 4, based on fuel melting and maximum release. Successful operation of any containment would not reduce the category of maximum potential consequences as fuel melting is already Level 4. For this reason, the containment would not be considered as an additional safety layer. On the other hand, Example 52 and Example 55 show situations where it is appropriate to take account of containment as a safety layer.

6.2.2.3. High integrity safety layers

In some situations, a high integrity safety layer may be available (e.g. a reactor pressure vessel or a safety provision based on proven and naturally occurring passive phenomena, such as convective cooling). In such cases, because the layer is demonstrated to be of extremely high integrity or reliability, it would clearly be inappropriate to treat such a layer in the same way as other safety layers when applying this guidance.

A high integrity safety layer should have all the following characteristics:

- The safety layer is designed to cope with all relevant design basis faults and is explicitly or implicitly recognized in the facility safety justification as requiring a particularly high reliability or integrity;
- The integrity of the safety layer is assured through appropriate monitoring or inspection such that any degradation of integrity is identified;
- If any degradation of the layer is detected, there are clear means of coping with the event and of implementing corrective actions, either through pre-determined procedures or through long times being available to repair or mitigate the fault.

An example of a high integrity layer would be a vessel or a vault. Administrative controls would not normally meet the requirements of a high integrity layer though, as noted above, certain operating procedures can also be regarded as high integrity safety layers if there are very long timescales available to perform the actions required, to correct errors by operating personnel should they occur, and if there are a wide range of available actions.

6.2.2.4. *Time available*

In some situations, the time available to carry out corrective actions may be significantly greater than the time required for those actions and may therefore allow additional safety layers to be made available. These additional safety layers may be taken into account provided that procedures exist for carrying out the required actions. Where several such layers are made effective by operator action in response to alarms or indications, the reliability of the procedure itself must be considered. The time available to implement the procedure is considered to have a significant impact on the reliability that can be claimed from operating procedures. (See examples in Section 6.4.1.)

In some cases, the time available may be such that there are a whole range of potential safety layers that can be made available and it has not been considered necessary in the safety justification to identify each of them in detail or to include in the procedure the detail of how to make each of them available. In such cases (provided there are a range of practicable measures that could be implemented) this long time available itself provides a highly reliable safety layer.

6.2.3. Assessment of the basic rating

6.2.3.1. *The rating process*

Having identified the maximum potential consequences and the number of effective safety layers, the basic rating should be determined as follows:

(1) The safety analysis for the facility will identify a wide range of events that have been taken into account in the design. It will recognize that a subset of these could reasonably be "expected" to occur over the life of the facility (i.e. they will have a frequency greater that 1/N per year, where N is the facility life). If the challenge to the safety provisions that occurred in the event was such an "expected" event, and the safety systems provided to cope with that event were fully available before the event and behave as expected, the basic rating of the event should be Below Scale/ Level 0.

(2) Similarly, if no actual challenge to the safety provisions occurred, but they were discovered to be degraded, the basic rating of the event should be Below Scale/Level 0 if the degraded operability of the safety provisions was still within authorized limits.

(3) For all other situations, Table 11 should be used to determine the basic rating.
   (a) If only one safety layer remains, but that safety layer meets all the requirements of a high integrity safety layer (Section 6.2.2.3) or the long time available provides a highly reliable safety layer (Section 6.2.2.4), a basic rating of Below Scale/Level 0[18] would be more appropriate.
   (b) If the period of unavailability of a safety layer was very short compared to the interval between tests of the components of the safety layer (e.g. a couple of hours for a component with a monthly test period), consideration should be given to reducing the basic rating of the event

TABLE 11. RATING OF EVENTS USING THE SAFETY LAYERS APPROACH

Number of remaining safety layers		Maximum potential consequences [a]		
		(1) Levels 5, 6, 7	(2) Levels 3, 4	(3) Levels 2 or 1
A	More than 3	0	0	0
B	3	1	0	0
C	2	2	1	0
D	1 or 0	3	2	1

[a] These ratings cannot be increased due to additional factors because they are already the upper limit for defence in depth.

This approach inevitably requires some judgement, but Section 6.3 gives guidance for specific types of events, and Section 6.4 provides some worked examples of the use of the safety layers approach.

6.2.3.2. Potential events (including structural defects)

Some events do not of themselves reduce the number of safety layers but do correspond to an increased likelihood of a reduction. Examples are

[18] If the operability of safety layers was outside the authorized limits, the guidance in Section 6.2 4.3 may lead to a rating of Level 1.

discovery of structural defects, a leak terminated due to action by operating personnel or faults discovered in process control systems. The approach to rating such events is as follows. First, the significance of the potential event should be evaluated by assuming it had actually occurred and applying the guidance of Section 6.2.3.1, based on the number of safety layers that would have remained. Second, the rating should be reduced, depending on the likelihood that the potential event could have developed from the event that actually occurred. The level to which the rating should be reduced must be based on judgement.

One of the most common examples of potential events is the discovery of structural defects. The surveillance programme is intended to identify structural defects before their size becomes unacceptable. If the defect is within this size, then Below scale/Level 0 would be appropriate.

If the defect is larger than expected under the surveillance programme, rating of the event needs to take account of two factors.

Firstly, the rating of the potential event should be determined by assuming that the defect had led to failure of the component and applying the guidance of Section 6.2.3.1. The rating of the potential event derived in this way should then be adjusted depending on the likelihood that the defect would have led to the potential event, and by consideration of the additional factors discussed in Section 6.2.4.

6.2.3.3. Below Scale/Level 0 events

In general, events should be classified Below Scale/Level 0 only if application of the procedures described above does not lead to a higher rating. However, provided none of the additional factors discussed in Section 6.2.4 are applicable, the following types of events are typical of those that will be categorized Below Scale/Level 0:

— Spurious[19] operation of the safety systems, followed by normal return to operation, without affecting the safety of the installation;
— No significant degradation of the barriers (leak rate less than authorized limits);
— Single failures or component inoperability in a redundant system discovered during scheduled periodic inspection or test.

[19] Spurious operation in this respect would include operation of a safety system as a result of a control system malfunction, instrument drift or individual human error. However, the actuation of the safety system initiated by variations in physical parameters that has been caused by unintended actions elsewhere in the plant would not be considered as spurious initiation of the safety system.

6.2.4. Consideration of additional factors

Particular aspects may simultaneously challenge different layers of the defence in depth and are consequently to be considered as additional factors that may justify an event having to be rated one level above the one resulting from the previous guidance.

The main additional factors that act in such a way are:

- Common cause failures;
- Procedural inadequacies;
- Safety culture issues.

Because of such factors, it is possible that an event could be rated at Level 1, even though it is of no safety significance on its own without taking into account these additional factors.

When assessing the increase of the basic rating due to these factors, the following aspects require consideration:

(1) Allowing for all additional factors, the rating of an event can only be increased by one level.

(2) Some of the above factors may have already been included in the basic rating (e.g. common mode failure). It is therefore important to take care that such failures are not double counted.

(3) The event should not be increased above the upper limit derived in accordance with Section 6.2.1, and this upper limit should only be applied to those situations where, had one other event happened (either an event expected within the plant lifetime or a further component failure), an accident would have occurred.

6.2.4.1. Common cause failures

A common cause failure is the failure of a number of devices or components to perform their functions as a result of a single specific event or cause. In particular, it can cause the failure of redundant components or devices intended to perform the same safety function. This may imply that the reliability of the whole safety function could be much lower than expected. The severity of an event affecting a component that identifies a potential common cause failure affecting other similar components is therefore higher than an event involving the random failure of the component.

Events in which there is a difficulty in operating some systems that is caused by absent or misleading information can also be considered for uprating on the basis of a common cause failure.

6.2.4.2. Procedural inadequacies

The simultaneous challenge to several layers of the defence in depth may arise because of inadequate procedures. Such inadequacies in procedures are therefore also a possible reason for increasing the basic rating.

6.2.4.3. Events with implications for safety culture

Safety culture has been defined as "that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance". A good safety culture helps to prevent incidents but, on the other hand, a lack of safety culture could result in operating personnel performing in ways not in accordance with the assumptions of the design. Safety culture has therefore to be considered as part of the defence in depth and consequently, safety culture issues could justify upgrading the rating of an event by one level. (INSAG 4 [7] provides further information on safety culture).

To merit increasing the rating due to a safety culture issue, the event has to be considered as a real indicator of an issue with the safety culture.

Violation of authorized limits

One of the most easily defined indicators of a safety culture issue is a violation of authorized limits, which may also be referred to as OL&C.

In many facilities, the authorized limits include the minimum operability of safety systems such that operation remains within the safety requirements of the plant. They may also include operation with reduced safety system availability for a limited time. In some facilities, Technical Specifications are provided and include authorized limits and furthermore, in the event that the requirements are not met, the Technical Specifications describe the actions to be taken, including times allowed for recovery as well as the appropriate fallback state.

If the operating personnel stay more than the allowed time in a reduced availability state (as defined in the Technical Specification), or if they take deliberate action that leads to plant availability being outside an allowed state, consideration should be given to increasing the basic rating of the event because of safety culture issues.

If the system availability is discovered to be less than that allowed by the authorized limits (e.g. following a routine test), but the operating personnel immediately take the appropriate actions to return the plant to a safe state in accordance with the Technical Specifications, the event should be rated as described in Section 6.2.3.1 but should not be increased, as the requirements of the Technical Specifications have been followed.

In addition to the formal authorized limits, some countries introduce into their Technical Specifications further requirements, such as limits that relate to the long-term safety of components. For events where such limits are exceeded for a short time, Below Scale/Level 0 may be more appropriate.

For reactors in the shutdown state, Technical Specifications will again specify minimum availability requirements but will not generally specify recovery times or fall back states, as it is not possible to identify a safer state. The requirement will be to restore the original plant state as soon as possible. The reduction in plant availability below that required by the Technical Specifications should not be regarded as a violation of authorized limits unless time limits are exceeded.

Other safety culture issues

Other examples of indicators of a deficiency in the safety culture could be:

- A violation of a procedure, without prior approval;
- A deficiency in the quality assurance process;
- An accumulation of human errors;
- Exposure of a member of the public from a single event in excess of annual statutory dose limits;
- Cumulative exposure of workers or members of the public in excess of annual statutory dose limits;
- A failure to maintain proper control over radioactive materials, including releases into the environment, spread of contamination or a failure in the systems of dose control;
- The repetition of an event, if there is evidence that the operator has not taken adequate care to ensure that lessons have been learnt or that corrective actions have been taken after the first event.

It is important to note that the intention of this guidance is not to initiate a long and detailed assessment but to consider if there is an immediate judgement that can be made by those rating the event. It is often difficult, immediately after the event, to determine if the event should be uprated due to safety culture. A provisional rating should be provided in this case based on what is known at the time, and a final rating can then take account of the additional information related to safety culture that will have arisen from a detailed investigation.

6.3. GUIDANCE ON THE USE OF THE SAFETY LAYERS APPROACH FOR SPECIFIC TYPES OF EVENTS

6.3.1. Events involving failures in cooling systems during reactor shutdown

Most reactor safety systems have been designed for coping with initiators occurring during power operation. Events in hot shutdown or startup condition are quite similar to events in power operation and should be rated using Section 5. Once the reactor is shut down, some of these safety systems are still required to assure the safety functions, but usually more time is available. On the other hand, this time available for manual actions may replace part of the safety provisions in terms of redundancy or diversity (i.e. depending on the status of the plant, a reduction in the redundancy of safety equipment and/or barriers may be acceptable during some periods of cold shutdown). In such shutdown conditions, the configurations of the barriers are sometimes also quite different (e.g., an open primary coolant system or an open containment). It is for these reasons that an alternative approach to rating events is provided for shutdown reactors (i.e. the safety layers approach).

The main factors affecting rating are the number of trains of cooling provided, the time available for corrective actions and the integrity of any pipework for cooling vessels. Some examples based on pressurized water reactors during cold shutdown are given in section 6.4.1 (Example 41 to Example 46) to give guidance for rating events following the safety layers approach. For other reactor types, it will be necessary to use this as illustrative guidance together with Section 6.2 to rate such events.

6.3.2. Events involving failures in cooling systems affecting the spent fuel pool

After some years of operation, the radioactive inventory of the spent fuel pool may be high. In this case, the rating of events affecting the spent fuel pool with respect to impact on defence in depth may span the full range up to Level 3.

Because of the large water inventory and the comparably low decay heat, there is usually plenty of time available for corrective actions to be taken for events involving degradation of spent fuel pool cooling. This is equally true for a loss of coolant from the spent fuel pool, since the leakage from the pool is limited by design. Thus, a failure of the spent fuel pool cooling system for some hours or a coolant leakage will not usually affect the spent fuel.

Therefore, minor degradation of the pool cooling system or minor leakages should be typically rated at Below Scale/Level 0.

Operation outside the OL&C or a substantial increase in temperature or decrease of the spent fuel pool coolant level should be rated as Level 1.

An indication of Level 2 could be widespread boiling of coolant or fuel elements becoming uncovered. Substantial fuel element uncovering clearly indicates Level 3.

6.3.3. Criticality control

The behaviour of a critical system and its radiological consequences are heavily dependent on the physical conditions and characteristics of the system. In homogeneous fissile solutions, the possible number of fissions, the power level of the criticality excursion and the potential consequences of a criticality excursion are limited by these characteristics. Experience with criticality excursions in fissile solutions shows that typically the total number of fissions is in the order of 10^{17}–10^{18}.

Heterogeneous critical systems such as fuel rod lattices or dry solid critical systems have the potential for high power peaks leading to explosive release of energy and the release of large amounts of radioactive material due to substantial damage to the installation. For such facilities, the maximum potential consequences could exceed Level 4.

For other facilities, the main hazard from a criticality excursion is exposure of personnel due to high radiation fields from direct neutron and gamma radiation. A second consequence might be a release to the atmosphere of short lived radioactive fission products and potentially severe contamination within the facility. For these two scenarios, the maximum potential consequences would be Level 3 or 4.

In accordance with the general guidance:

- Minor deviations from the criticality safety regime that are within the authorized limits should be rated at Below Scale/Level 0.
- Operation outside authorized limits should be rated at least at Level 1.
- An event where a criticality event would have occurred had there been one further failure in the safety provisions or had conditions been slightly

different, should be rated at Level 2 for facilities, with maximum potential consequences of Levels 3 or 4. If the maximum potential consequences could have been Level 5 or higher, the event should be rated at Level 3.

If more than one safety layer remains, then a lower level would be appropriate and Table 11 should be used to determine the appropriate rating.

6.3.4. Unauthorized release or spread of contamination

Any event involving transfer of radioactive material that results in a contamination level above the investigation level for the area may justify a rating of Level 1, based on safety culture issues (Section 6.2.4 "failure to maintain proper control over radioactive materials"). Contamination levels in excess of the authorized limit for the area should be rated at Level 1. More significant failures in safety provisions should be rated by considering the maximum potential consequences should all the safety provisions fail and the number of safety layers remaining.

Breaches of discharge authorizations should be rated at least at Level 1.

6.3.5. Dose control

Occasionally, situations may arise when the radiological control procedures and managerial arrangements are inadequate, and employees receive unplanned radiation exposures (internal and external). Such events may justify a rating of Level 1 based on Section 6.2.4 (failure to maintain proper control over radioactive materials). If the event results in the cumulative dose exceeding authorized limits, the event should be rated at least at Level 1 as a violation of authorized limits.

In general, the guidance in Section 6.2.4 should not be used to uprate events related to dose control failure from a basic rating of Level 1. Otherwise, events where dose was prevented will be rated at the same level as those where significant doses in excess of dose limits were actually incurred. However, Level 2 would be appropriate under defence in depth if one or no safety layers remain, and the maximum potential consequences should the safety provisions fail are Level 3 or 4.

6.3.6. Interlocks on doors to shielded enclosures

Inadvertent entry to normally shielded locations is generally prevented by the use of radiation activated interlocking systems on the entrance doors, the use of entry authorization procedures and pre-entry checks on radiation dose rates.

Failure of the shield door interlocking protection can result from loss of electrical supply and/or defects in either the detector(s), or the associated electronic equipment or human error.

As the maximum potential consequences for such events are limited to Level 4, events where a further failure in the safety provisions would result in an accident should be rated at Level 2. Events where some provisions have failed but additional safety layers remain, including administrative arrangements governing authorization for entry, should generally be rated at Level 1.

6.3.7. Failures of extract ventilation, filtration and cleanup systems

In facilities working with significant quantities of radioactive material, there could be up to three separate but interrelated extract ventilation systems. They maintain a pressure gradient between the various vessels, cells/glove boxes and operating areas as well as adequate flow rates through apertures in the cell operating area boundary wall to prevent back diffusion of radioactive material. In addition, cleanup systems, such as high-efficiency particulate air (HEPA) filters or scrubbers are provided to reduce discharges to atmosphere to below pre-defined limits and to prevent back diffusion into areas of lower activity.

The first step in rating events associated with the loss of such systems is to determine the maximum potential consequences should all the safety provisions fail. This should consider the material inventory and the possible means for its dispersion both inside and outside the facility. It is also necessary to consider the potential for decrease in the concentration of inerting gases or the buildup of explosive mixtures. In most cases, unless an explosion is possible, it is unlikely that the maximum potential consequences would exceed Level 4, and therefore the maximum under defence in depth would be Level 2.

The second step is to identify the number of remaining safety layers, including procedures to prevent the generation of further activity by cessation of work.

The rating of such events is illustrated by Example 52 in Section 6.4.2.

6.3.8. Handling events and drops of heavy loads

6.3.8.1. Events not involving fuel assemblies

The impact of handling events or failure of lifting equipment depends on the material involved, the area in which the event occurred and the equipment which was or could have been affected.

Events where a dropped load threatens a spillage of radioactive material (either from the dropped load itself or from affected pipework or vessels), should be rated by considering the maximum potential consequences and the likelihood that such a spillage might have occurred. Events where a dropped load only causes limited damage but had a relatively high probability of causing worse consequences should be rated at the maximum level under defence in depth appropriate to the maximum potential consequences. Similarly, events where only one safety layer prevented the damage should also be rated at the maximum level unless that layer is considered to be of especially high reliability or integrity.

Events where the likelihood is lower or there are additional safety layers should be rated following the guidance in Section 6.2.

Minor handling events, which would be expected over the lifetime of the facility, should be rated at Below Scale/Level 0.

6.3.8.2. Fuel handling events

Events during handling of unirradiated uranium fuel elements with no significant implications for the handling of irradiated fuel should typically be rated as Below Scale/Level 0 if there has been no risk of damaging spent fuel elements or safety-related equipment.

For irradiated fuel, the radioactive inventory of a single fuel element is very much lower than the inventory of the spent fuel pool or the reactor core, and hence the maximum potential consequences are less.

As long as the cooling of the spent fuel element is guaranteed, this provides an important safety layer since the integrity of the fuel matrix will not be degraded by overheating. In general, there will be very long timescales associated with fuel overheating. Depending on the facility configuration, containment will also provide a safety layer in most cases.

Events *expected* over the lifetime of the facility that do not affect the cooling of the spent fuel element and only result in a minor release or no release typically should be classified as Below Scale/Level 0.

Level 1 should be considered for events:

— Not expected over the lifetime of the facility;
— Involving operation outside the authorized limits;
— Involving limited degradation of cooling not affecting the integrity of the fuel pins;
— Involving mechanical damage of the fuel pin integrity without degradation of cooling.

Level 2 may be appropriate for events in which there is damage to the fuel pin integrity as a result of substantial heat up of the fuel element.

6.3.9. Loss of electrical power supply

At many facilities, it is often necessary to provide a guaranteed electrical supply to ensure its continued safe operation and to maintain the availability of monitoring equipment and surveillance instruments. Several independent electrical supply routes and diverse supply means are used to prevent common cause failure. While most facilities will be automatically shut down to a safe condition, on total loss of electrical power supplies, in some facilities additional safety provisions, such as the use of inerting gas or backup generators, will be provided.

In order to rate events involving loss of off-site power supplies or failures of on-site supply systems, it is necessary to use the guidance in Section 6.2, taking account of the extent of any remaining supplies, the time for which the supplies were unavailable and the maximum potential consequences. It is particularly important to take account of the time delay acceptable before restoration of supplies is required.

For some facilities, there will be no adverse safety effects, even with a complete loss of power supplies lasting several days, and such events at these facilities should generally be rated at Below Scale/Level 0 or Level 1 as there should be several means available to restore supplies within the available time. Level 1 would be appropriate if the availability of safety systems had been outside the authorized limits.

Partial loss of electric power or loss of electric power from the normal grid with available power supply from standby systems is “expected” over the life of the facility and therefore should be rated Below Scale/Level 0.

6.3.10. Fire and explosion

A fire or explosion within or adjacent to the facility that does not have the potential to degrade any safety provisions would either not be rated on the scale or would be rated Below Scale/Level 0. Fires that are extinguished by the installed protection systems, functioning as intended by design, should be rated similarly.

The significance of fires and explosions at installations depends not only on the material involved but also on the location and the ease with which firefighting operations can be undertaken. The rating depends on the maximum potential consequences, as well as the number and effectiveness of the remaining safety layers, including fire barriers, fire suppression systems and segregated safety systems. The effectiveness of remaining safety layers should take account of the likelihood that they could have been degraded.

Any fire or explosion involving low level waste should be rated at Level 1, owing to deficiencies in procedures or safety culture issues.

6.3.11. External hazards

The occurrence of external hazards, such as external fires, floods, tsunamis, external explosions, hurricanes, tornados or earthquakes may be rated in the same way as other events by considering the effectiveness of remaining safety provisions.

For events involving failures in systems specifically provided for protection against hazards, the number of safety layers should be assessed, including the likelihood of the hazard occurring during the time when the system was unavailable. For most facilities, owing to the low expected frequency of such hazards, a rating greater than Level 1 is unlikely to be appropriate.

6.3.12. Failures in cooling systems

Failures in essential cooling systems can be rated in a similar way to failures in electrical systems by taking account of the maximum potential consequences, the number of safety layers remaining and the time delay that is acceptable before restoration of cooling is required.

In the case of failures in the cooling systems of high level liquid waste or plutonium storage, Level 3 is likely to be appropriate for events where only a single safety layer remains for a significant period of time.

6.4. WORKED EXAMPLES

6.4.1. Events on a shutdown power reactor

Example 41. Loss of shutdown cooling due to increase in coolant pressure — Below Scale/Level 0

Event description

Shutdown cooling was being provided by circulation of coolant through two residual heat removal (RHR) heat exchangers via separate suction lines, each with two isolation valves. The valves in each line were controlled by separate pressure transducers and were operable from the control room. The primary circuit was closed. The steam generators were also available, ensuring that any temperature increases from loss of RHR would be very slow. Safety injection was not available, high pressure safety injection (HPSI) pumps are separate from the charging pumps, and relief valves were available to control primary circuit pressure.

The safety provisions are illustrated in Fig. 1.

The event occurred when a rise in coolant pressure caused the isolation valves to close. Alarms in the control room notified the operating personnel of the valve closure and having reduced the pressure, the valves were re-opened. Temperatures did not rise above the limits in Operational Limits and Conditions.

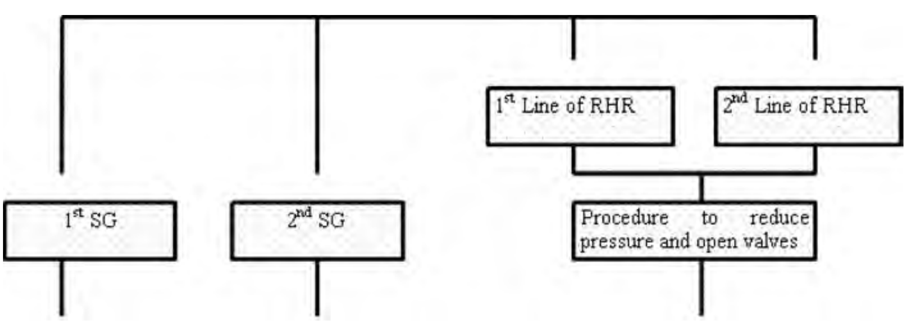


FIG. 1. Illustration of safety provisions for Example 41.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a shutdown power reactor are Levels 5–7.
6.2.2. Identification of number of safety layers:	There were four hardware layers and provided the steam generators remained available, there was plenty of time for the required actions, sufficient even to allow repairs to the RHR system to be carried out. As a result of the long timescales available, the procedure to re-open the valves can be regarded as more reliable than a single layer, and all four layers can be considered as independent.
6.2.3. Assessment of the basic rating:	Based on Table 11, the rating is Below scale/Level 0.
Overall rating:	Below Scale/Level 0.

Example 42. Loss of shutdown cooling due to spurious operation of pressure sensors — Below Scale/Level 0

Event description

Shutdown cooling was being provided by circulation of coolant through a single residual heat removal (RHR) heat exchanger via a single suction pipe with two isolation valves. The valves are operable from the control room. The primary circuit was open with the cavity flooded. The reactor had been shutdown for one week so that any coolant temperature increase would be very slow. Steam generators were open for work and therefore unavailable. Safety injection was not available, high pressure steam injection (HPSI) pumps are separate from the charging pumps and relief valves were available to control primary circuit pressure.

The event occurred when spurious operation of pressure sensors caused the isolation valves to close. Alarms in the control room notified the operating personnel of the valve closure and having checked that the pressure rise was a spurious signal, the valves were re-opened. Temperatures did not rise above the limits in Operational Limits and Conditions; it would have taken 10 hours to reach the operational limits.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a shutdown power reactor are Levels 5–7.
6.2.2. Identification of number of safety layers:	Considering the safety function of fuel cooling, there are two safety layers. The first is the RHR system, and the second is the very long time available to add water so as to maintain the water level as water and heat is lost through evaporation. The second layer can be considered as a highly reliable layer (Section 6.2.2.4) for the following reasons: — there are long times available for action (at least 10 h to reach operational limits) — there are a number of ways of adding additional water (e.g. low pressure safety injection, fire hoses), though boron concentration must be controlled. — this safety layer is recognized in the safety justification as a key safety feature. In addition, the time available is such that there is adequate time for repair of the RHR system if necessary.
6.2.3. Assessment of the basic rating:	The guidance in Section 6.2.3.1 gives a rating of Below Scale/Level 0.
Overall rating:	Below Scale/Level 0.

Example 43. Complete loss of shutdown cooling — Level 1

Event description

The shutdown cooling of the reactor vessel was completely lost for several hours when the suction isolation valves of the RHR system, which was in operation, automatically closed. These valves closed due to the loss of the power supply to Division 2 of the nuclear safety protection system as a result of inappropriate maintenance. The alternate power supply had already been isolated for maintenance. The unit had been in the shutdown condition for a long time (about 16 months), and the decay heat was very low. During the period of time the shutdown cooling was unavailable, water in the reactor vessel began to heat up at a rate of approximately 0.3°C/h. The RHR system was restarted approximately 6 h after the initial event.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a shutdown power reactor are Levels 5–7.
6.2.2. Identification of number of safety layers:	For this particular event, a very long time was available before any significant consequences such as core degradation or significant radiation exposures could occur. This available time allows implementation of a wide range of measures to correct the situation and can therefore be considered as a highly reliable safety layer as mentioned in Section 6.2.2.4.
6.2.3. Assessment of the basic rating:	The basic rating of the event is Below Scale/Level 0.
6.2.4. Additional factors:	The inappropriate maintenance took the reactor outside the OL&C, so the rating was increased to Level 1.
Overall rating:	Level 1.

If the decay heat had not been very low, the available time would have been much shorter, and it could not have been considered as a high integrity layer. In such a case, the effective safety layers are the following:

— Procedures and actions by operating personnel to restore the power supply to Division 2 of the Nuclear Safety Protection system;
— Procedures and actions by operating personnel to restore the RHR cooling with alternative systems.

The number of remaining layers being two, the event would have then been rated at Level 2. It would not have been increased to Level 3, as one further failure would not have led to an accident (see section 6.2.4).

Example 44. Loss of shutdown cooling due to increase in coolant pressure — Level 2

Event description

The design is identical to that in Example 41, but the steam generators were open for work and therefore unavailable. The safety provisions are illustrated in Fig. 2. The event occurred some time after the reactor had been shut down when a rise in coolant pressure caused the RHR isolation valves to close. Alarms in the control room notified the operating personnel of the valve closure and, having reduced the pressure, the valves were re-opened. Temperatures did not rise above the limits in OL&C. Decay heat was sufficiently low that it would have taken five hours to reach the operational limits.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a shutdown power reactor are Levels 5–7.
6.2.2. Identification of number of safety layers:	The safety provisions are illustrated in Fig. 2. There are two hardware safety layers and a software safety layer in series, and there are at least 5 h to carry out the required actions. Because of the long time available, the operating procedure and actions by operating personnel can be regarded as more reliable than a single safety layer. The limiting aspect of the safety provisions is now the two hardware layers.
6.2.3. Assessment of the basic rating:	Based on Table 11, the existence of two hardware layers means that the event should be rated at Level 2.
Overall rating:	Level 2.

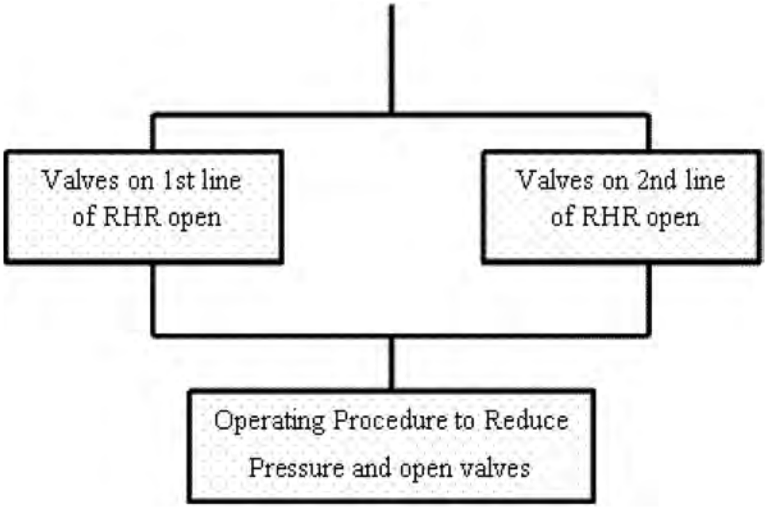


FIG. 2. Illustration of safety layers for Examples 44 and 46.

Example 45. Loss of shutdown cooling due to spurious operation of pressure sensors — Level 3

Event description

The design is the same as in Example 42, but the event occurred soon after shutdown. Shutdown cooling was being provided by circulation of coolant through an RHR heat exchanger via a single suction pipe with two isolation valves. The primary circuit was closed. In the event of closure of the isolating valves, the coolant temperature will rise but will take approximately one hour to reach unacceptable temperatures. The valves are operable from the control room. Steam generators are open for work and therefore unavailable. Safety injection is not available, HPSI pumps are separate from the charging pumps and relief valves are available to control primary circuit pressure.

The event occurred when spurious operation of pressure sensors caused the isolation valves to close. Alarms in the control room notified the operating personnel of the valve closure and, having checked that the pressure rise was a spurious signal, the valves were re-opened. Temperatures did not rise above the limits in OL&C.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a shutdown power reactor are Level 5–7.
6.2.2. Identification of number of safety layers:	The only safety layer is cooling of the primary coolant through the single RHR suction pipe. Again, it is necessary to consider both the hardware and procedural aspects of the safety layer. Consider first the actions required in order to restore cooling. The operating personnel must ensure that the pressure signal was spurious, and that if the rise in coolant temperature has caused a subsequent rise in pressure, the pressure needs to be reduced. A procedure for re-instating RHR after closure of the valves did exist. The operation can be carried out in the time available but not with a large margin. From the hardware viewpoint, failure of either valve to re-open will result in the unavailability of the safety layer. Also, there is certainly not sufficient time to carry out any repairs should the valves fail to open. For these reasons, the single layer is not regarded as a highly reliable safety layer, even though it was the only layer provided by design. The need to be able to open both of the isolating valves in order to restore supplies clearly limits the reliability of the safety layer.
6.2.3. Assessment of the basic rating:	There is only a single safety layer available and therefore based on Table 11, the rating is Level 3.
Overall rating:	Level 3.

Example 46. Loss of shutdown cooling due to increase in coolant pressure — Level 3

Event description

The plant design is the same as in Example 44, but the event occurred soon after shutdown when a rise in coolant pressure caused the isolating valves to close. The safety provisions are illustrated in Fig. 2.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a shutdown power reactor are Levels 5–7.
6.2.2. Identification of number of safety layers:	There now appear to be two safety layers as far as hardware is concerned. However, both still rely on the operating personnel to re-open the valves. The reliability of the safety provisions is limited by the need for action by operating personnel. Given the complexity of the operation and the limited time available, it is considered that there is only one effective safety layer (i.e. an operating procedure requiring pressure reduction and re-opening of the isolation valve).
6.2.3. Assessment of the basic rating:	Based on Table 11, Level 3 is appropriate.
Overall rating:	Level 3.

6.4.2. Events at facilities other than power reactors

Example 47. Pressurization of the void above the liquid level in a fuel element dissolver vessel — Below Scale/Level 0

Event description

The detection of a small pressurization of the space above the liquid level in a reprocessing facility dissolver resulted in the automatic shutting down of the process. The dissolver heating system was switched off and cooling water applied. The nitric acid feed to the vessel was stopped and the dissolution reaction suppressed by the addition of water to the vessel contents. No release of airborne contamination to the plant operating area or the environment occurred.

Subsequent investigations indicated that the pressurization was due to an abnormal release of vapour and an increased rate of nitrous vapour production as a result of a short-term enhanced rate of dissolution of the fuel.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a reprocessing facility areLevels 5–7.
6.2.2. Identification of number of safety layers:	Because of the deviation in the process conditions, the process was automatically shut down. All hutdown steps proceeded normally. No safety layers failed.
6.2.3. Assessment of the basic rating:	Based on point (1) of Section 6.2.3.1, the rating is Below Scale/Level 0.
6.2.4. Additional factors:	There are no reasons to uprate the event.
Overall rating:	Below scale/Level 0.

Example 48. Loss of cooling at a small research reactor — Below Scale/Level 0

Event description

The event occurred at a 100 kW research reactor with a large cooling pool and a heat exchanger/purification system as shown in Fig. 3. In the event of loss of cooling, any heating of the water will be extremely slow.

The event occurred when the pipework downstream of the pump failed, and coolant was pumped out to the bottom of the suction pipe. The pump then failed due to cavitation.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	There are two safety functions to be considered. One is the cooling of the fuel, and the other is the shielding to prevent high worker doses. For both safety functions, due to the low inventory, the maximum potential consequences cannot exceed Level 4, and therefore the maximum under defence in depth is Level 2.
6.2.2. Identification of number of safety layers:	Considering the cooling function, by design there are three safety layers. One is the heat exchanger system, another is the large volume of water in the pool, and the third is the ability to cool the fuel in air. The suction side has been deliberately designed so as to ensure a large volume of water remains in the pool should the pipe fail. Furthermore it is clear that the main safety layer is the volume of water. This can therefore be considered as a high integrity safety layer for the following reasons: — The heat input is small compared to the volume of the water such that any temperature rise will be extremely slow. It should take many days for the water level to decrease significantly. — Any reduction in water level would be readily detected by the operating personnel, and the water level could be simply topped up via a number of routes. — The safety justification for the facility recognizes this as the key safety layer and demonstrates its integrity. The suction pipe to the heat exchanger was carefully designed to ensure that adequate water remained.
6.2.3. Assessment of the basic rating:	The basic rating is considered to be zero because there are two safety layers remaining, and one is of high integrity. Considering the shielding safety function, there is only one safety layer remaining, but it is of high integrity as the level of water remaining at the bottom of the suction pipe provides adequate shielding.
6.2.4. Additional factors:	There are no reasons to uprate the event.
Overall rating:	Below Scale/Level 0.

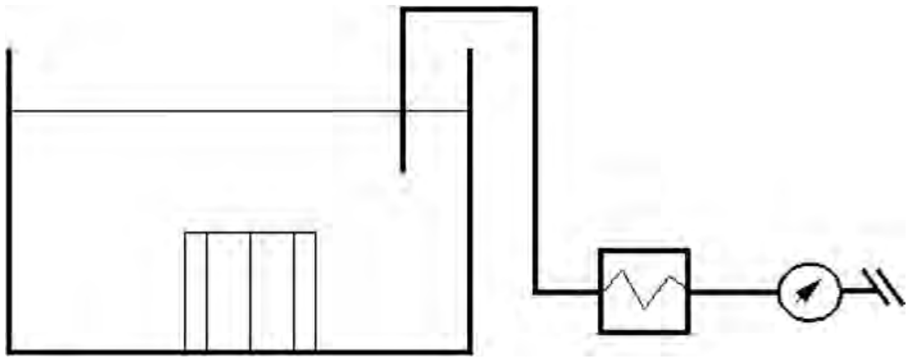


FIG. 3. Diagram of cooling system for Example 48.

Example 49. High radiation levels at a nuclear recycling facility — Below Scale/Level 0

Event description

Operating personnel and a radiation protection technician were undertaking a sampling operation at a facility storing highly radioactive liquid. Specific instructions and equipment were provided for the task, and the individuals concerned had been suitably trained and briefed. In order for the operation to proceed, other personnel were excluded from a large, clearly identified and barred area around the actual work area.

During the operation, an equipment fault led to a small quantity of the highly radioactive liquid being directed to an unshielded pipe, causing high levels of radiation in the surrounding areas.

All personnel were equipped with personal alarming dosimeters and when these alarmed, together with several installed detection systems in the area, the people immediately evacuated the area.

Subsequent assessment showed that the most exposed person was subjected to a dose rate of 350 mSv/h and received an effective dose of 350 μSv.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	The sampling operation was being carried out in an area where there were specific access controls and safety provisions due to the potential for high activity. Therefore the Level 2 dose rate criteria applicable “within an operating area” do not apply (See Section 3.2, which defines operating areas as “areas where worker access is allowed without specific permits. It excludes areas where specific controls are required (beyond the general need for a personal dosimeter and/or coveralls) due to the level of contamination or radiation.”
6.2.1. Maximum potential consequences:	The maximum potential consequences for this activity were exposures greater than ten times the statutory annual limit (i.e. Level 3).
6.2.2. Identification of number of safety layers:	In considering the number of independent safety layers, it is necessary to consider the indications (detectors and alarms) and the response by operating personnel separately. There were four independent safety layers of indications and alarms present. These are: — Electronic personal dosimeters. It was confirmed that these were in *full* working order and operated appropriately. — Installed gamma detectors and alarms. These were in *full* working order and alarmed during the event. — Installed airborne activity alarms. These respond to high gamma radiation, and alarms from them require the prompt evacuation of personnel in the area. — Presence of a radiation protection technician with a radiation detector. The primary purpose of the technician was to monitor the radiation levels during the sampling operation and advise accordingly. This was not required since the operating personnel were already evacuating. Each of these required the operating personnel to respond appropriately to the alarm or verbal advice. It was confirmed that the operating personnel were regularly trained and had no experience of poor response. There was more than one person and an additional radiation protection technician, and in view of the specific nature of the activity and the training and briefing required, it is judged that they can be considered as at least three independent safety layers. The likelihood of all the individuals ignoring all the alarms is vanishingly small.
6.2.3. Assessment of the basic rating:	Using Table 11, there being three safety layers, the basic rating is Level 1.
6.2.4. Additional factors:	There are no reasons to uprate the event.
Overall rating:	Below Scale/Level 0.

Example 50. Worker received cumulative whole body dose above dose limit — Level 1

Event description

The whole body dose received by a facility manager from operations at the end of December was higher than authorized or expected but below the dose constraint. As a result, while the dose from those operations was low, it made his cumulative whole body dose exceed the annual dose limit.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	The dose level from the actual event was below the value given in Section 2 for actual consequences (i.e. less than the dose constraint).
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a worker dose are rated at Level 4.
6.2.2. Identification of number of safety layers:	The basic rating is Below Scale/Level 0 as there was no degradation of the safety layers provided to prevent significant doses to workers.
6.2.3. Assessment of the basic rating:	Based on Table 11, the rating is Below Scale/Level 0.
6.2.4. Additional factors:	Since the annual limit of the cumulative whole body dose was exceeded, the event should be rated at Level 1(Section 6.2.4.3).
Overall rating:	Level 1.

Example 51. Failure of criticality control — Level 1

Event description

A routine check of compliance with the operating rules in a fuel fabrication facility showed that six samples of fuel pellets had been incorrectly packaged. In addition to the permitted packaging, each sample had been placed in a plastic container. The additional plastic container contained the requirement that 'no hydrogenous material in addition to the permitted wrapping' had to be introduced to the store. However, this requirement was not clearly specified for this fuel store. Subsequent investigation showed that the criticality clearance certificate was difficult to interpret, and the related criticality assessment was inadequate to allow full understanding of the safety requirements.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences of a criticality in the fuel store would be rated at Level 4.
6.2.2. Identification of number of safety layers:	Remaining safety layers related to flooding were: — Several controls in place to prevent flooding (assumed in the safety case); — Safety justification that flooding would not lead to criticality Remaining safety layers related to other materials were: — Clear procedures, training and labelling to prevent the addition of hydrogenous material — Inspections to detect deviations from assumptions made in the safety case.
6.2.3. Assessment of the basic rating:	There are two safety layers remaining, and the basic rating from Table 11 is Level 1.
6.2.4. Additional factors:	Level 1 would also be an appropriate rating because: — The operations were outside OL&C. — The safety culture failed to ensure adequate assessments and documentation. It is not considered appropriate to uprate the event to the maximum under defence in depth because several failures were still required before an accident would have occurred (see Section 6.2.4, item (3)).
Overall rating:	Level 1.

Example 52. Prolonged loss of ventilation at a fuel fabrication facility — Level 1

Event description

Following a loss of normal and emergency ventilation and non-compliance with procedures, the operating personnel worked for over an hour without dynamic containment.

The ventilation performs a dual role. Firstly, it directs radioactivity that might be released in a closed room to the controlled release and filtration circuits, and secondly, it creates a slight negative pressure gradient in such a closed room in order to avoid the transfer of radioactivity into other areas. This form of containment is called “dynamic containment”.

The event started with the loss of electrical power supply to the normal ventilation system. The emergency ventilation system, which should have taken over, did not start up. Subsequent investigation indicated that the breakdown of the normal ventilation system and the failure of the emergency ventilation system to come into operation were linked to the presence of a common mode between the electrical power supplies to these ventilation systems. The alarm was signaled in the guard post, but the information reached neither the supervisory staff nor the operating personnel.

The operating personnel were only informed that the alarm had been triggered one hour after a new shift had started.

The results of measurements of atmospheric contamination taken at all the work stations being monitored did not provide any evidence of an increase in atmospheric contamination.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The ventilation system is designed to cascade air flows from areas of low contamination to areas of successively higher or potentially higher contamination. Had there been a coincident event (such as a fire) leading to pressurization, some radioactivity which should otherwise have been discharged through a filtration system would be discharged to the plant operating area and then to the atmosphere without the same degree of filtration. The maximum potential consequence would be Level 4 based on the potential release to atmosphere.
6.2.2. Identification of number of safety layers:	Remaining independent safety provisions, not including ultimate emergency procedures, were: — Automatic firefighting systems; — The building structure that provided both containment and decontamination to reduce exposures to less than 0.1 mSv.
6.2.3. Assessment of the basic rating:	There were at least two effective safety layers, and the basic rating from Table 11 is Level 1.
6.2.4. Additional factors:	Although the procedures were violated (work continued without ventilation) and there were common cause issues with the electrical supplies, it is not considered appropriate to update the event to the maximum under defence in depth because several failures (a fire, failure of the firefighting systems, problems with containment) were still required before an accident would have occurred (see Section 6.2.4 item (3)).
Overall rating:	Level 1.

Example 53. Failure of a shield door interlocking system — Level 2

Event description

The event occurred when a container of highly radioactive vitrified waste was moved into a cell while the shield doors to the cell were open following a maintenance operation. The opening of the doors was controlled by a key exchange system, installed interlocks based on gamma detectors and programmable logic controllers. The original design of the cell access system was modified twice during the commissioning period, in an attempt to improve it. All of these systems failed to prevent the transfer of highly radioactive material into the cell while the shield doors were open.

Entry of personnel to this area is controlled by a permit that requires each person to wear a personal alarming dosimeter.

Personnel who might have been present in the cell or adjacent areas could have received a serious radiation exposure if they had failed to respond to either the container movement or their personal alarming dosimeter sounding a warning. In the event, the operating personnel quickly observed the problem and closed the shield doors. No one received any additional exposure.

The facility design concerning access to the cells had been modified during commissioning, and the consequences of these changes had been inadequately considered.

In particular:

— The commissioning of the interlock key exchange system for the cell shield doors had failed to show that the system was inadequate.
— A programmable logic control system had not been programmed and commissioned correctly.
— The modifications were poorly assessed and controlled because their safety significance was not classified correctly.
— Designers and commissioning staff did not communicate properly.

A permit to work authorization had been closed, indicating that the facility had been returned to its normal state, but in fact it had not.

The temporary plant modification proposal (TPMP) system was too frequently used in this facility and inadequately controlled, and the full PMP system in use required improvement.

Training and supervision of active cell entries was inadequate.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for such practices are rated at Level 4 (fatal radiation dose).
6.2.2. Identification of number of safety layers:	Despite the failure of a number of safety layers, there was one remaining safety layer, namely the permit to work authorization procedure for entry to the cells, requiring the use of personal alarm dosimeters.
6.2.3. Assessment of the basic rating:	Based on Table 11, the maximum rating under defence in depth of Level 2 is appropriate.
6.2.4. Additional factors:	The rating cannot be updated beyond the maximum defence in depth rating.
Overall rating:	Level 2.

Example 54. Power excursion at research reactor during fuel loading — Level 2

Event description

A power excursion, which resulted in a reactor trip on overpower, occurred at a research reactor during a refueling operation. The reactor is a small pool type research reactor. Following replacement of a shim safety rod control assembly, the fuel assemblies were being returned to the core. After loading the fifth fuel assembly, the shim safety rods were withdrawn to check that the reactor was not critical. The rods were then driven to the 85% withdrawn position instead of the required 40% (safeguard position). On insertion of the 6th fuel assembly, a blue glow was seen and the reactor tripped on overpower. The neutron flux trip system had been bypassed to avoid spurious trips, while moving irradiated fuel into position for loading into the core and the bypass had not been turned off. The power transient maximum was estimated to be about 300% of full power. Procedures related to refueling are being reviewed and revised.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences.	It had been shown that the maximum potential rating for this reactor would not exceed Level 4.
6.2.2. Identification of number of safety layers.	The one barrier preventing a significant release was the overpower trip. Details of that protection are not provided, but unless it can be shown that there are two or more redundant trains of protection that remain effective under the prevailing operating conditions, it should be assumed that there was only one safety layer preventing a significant release.
6.2.3. Assessment of the basic rating.	The rating from Table 11 is Level 2.
6.2.4. Additional factors.	The rating cannot be updated beyond the maximum defence in depth rating.
Overall rating:	Level 2.

Example 55. Near criticality at a nuclear recycling facility — Level 2

Event description

At a plutonium recycling facility, a pipe carrying hot plutonium nitrate developed a leak, and over a period of about 24 h, a total of 31 kg leaked into the cell housing the pipe. The leak was identified at the daily visual inspection. The hot plutonium nitrate ran over the outer surfaces of a hot plutonium evaporator and dripped onto the sloping stainless steel clad floor beneath. As the liquid ran over the various surfaces, it evaporated and deposited the plutonium in a crystalline form on the lowest part of the pipe and on the floor beneath, forming structures like a “stalactite” and “stalagmite”. The leak rate was such that the material failed to reach the detection sump as a liquid and was only identified through surveillance tours. The cell was subsequently decontaminated, the pipeline and evaporator replaced and the facility brought back into use.

The quantity of plutonium present on both the pipe and the floor did not exceed the minimum critical mass for the concentration of the material being handled at the time, but had the event taken place when more concentrated material was being handled, then the critical mass may have been exceeded.

Rating explanation

The event needs to be considered in two parts: First, with respect to releases from the facility; and second, with respect to doses to workers.

Possible release from the facility:

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences.	Dispersion of all the material accumulated in the cell could result in an environmental release equivalent to Level 5.
6.2.2. Identification of number of safety layers.	There are at least two safety layers available to prevent such a release: — The concrete structure of the cell containing the plutonium, which would not have failed from the energy that would have been generated, had the material gone critical; and — The remaining building structure together with the ventilation abatement system, which itself consists of primary and secondary ventilation systems.
6.2.3. Assessment of the basic rating.	A basic rating of Level 2 is appropriate from Table 11.
6.2.4. Additional factors.	There are no additional factors that would justify an increase in the basic rating.
Overall rating:	Level 2.

Possible worker doses:

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequence would be rated at Level 4 (fatal radiation exposure).
6.2.2. Identification of number of safety layers:	There were no remaining safety layers to protect against a criticality.
6.2.3. Assessment of the basic rating:	Based on Table 11, the rating is Level 2.
6.2.4. Additional factors:	The rating cannot be uprated beyond the maximum defence in depth rating.
Overall rating:	Level 2.

7. RATING PROCEDURE

The flowcharts provided in the following pages (Figs 4–10) briefly describe INES rating procedure for rating any event associated with radiation sources and the transport, storage and use of radioactive material.

The flow charts are intended to show the logical route to be followed to assess the safety significance of any event. It provides an overview for those new to rating events and a summary of the procedure to those familiar with the INES User's Manual. Explanatory notes and tables are added to the flowcharts as needed; however the flowcharts should not be used in isolation from the detailed guidance provided in this manual. The IAEA has also developed a web tool based on the flow charts to support training on the use of INES rating methodology.

In addition to the flowcharts, two tables of examples (Tables 12 and 13) are provided to illustrate how some actual events are rated.

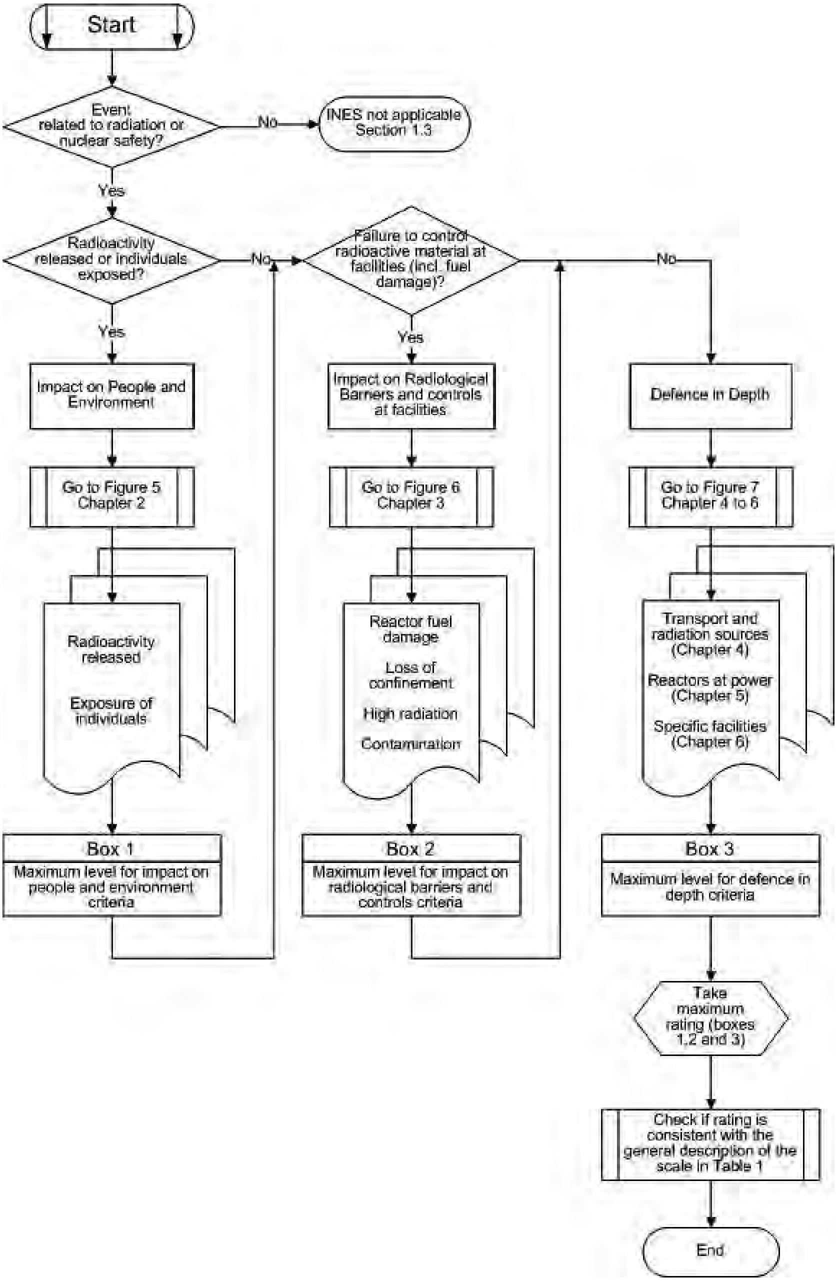
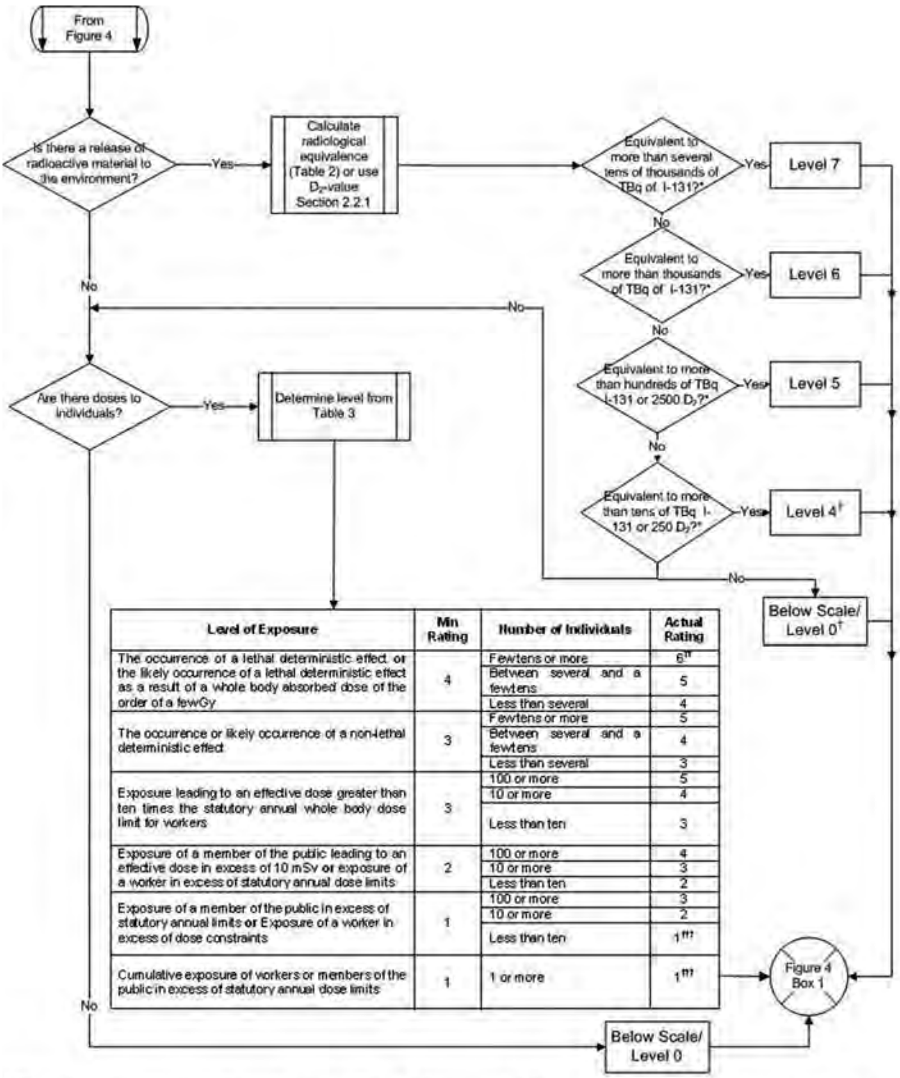


FIG. 4. General INES rating procedure.



Level of Exposure	Min Rating	Number of Individuals	Actual Rating
The occurrence of a lethal deterministic effect or the likely occurrence of a lethal deterministic effect as a result of a whole body absorbed dose of the order of a fewGy	4	Fewtens or more	6††
		Between several and a fewtens	5
		Less than several	4
The occurrence or likely occurrence of a non-lethal deterministic effect	3	Fewtens or more	5
		Between several and a fewtens	4
		Less than several	3
Exposure leading to an effective dose greater than ten times the statutory annual whole body dose limit for workers	3	100 or more	5
		10 or more	4
		Less than ten	3
Exposure of a member of the public leading to an effective dose in excess of 10 mSv **or** exposure of a worker in excess of statutory annual dose limits	2	100 or more	4
		10 or more	3
		Less than ten	2
Exposure of a member of the public in excess of statutory annual limits **or** Exposure of a worker in excess of dose constraints	1	100 or more	3
		10 or more	2
		Less than ten	1†††
Cumulative exposure of workers or members of the public in excess of statutory annual dose limits	1	1 or more	1†††

* These criteria relate to accidents where early estimates of the size of release can only be approximate. For this reason, it is inappropriate to use precise numerical values in the definitions of the levels. However, in order to help ensure consistent interpretation of these criteria internationally, it is suggested that the boundaries between the levels are about 5000 and 50,000 TBq 131I.

† It is also necessary to consider whether a higher rating is appropriate based on assessing the doses to people within the facility using Table 3.

†† Level 6 is not considered credible for any event involving radiation sources.

††† As explained in section 2.4, the Level 1 definitions are based on defence-in-depth criteria explained in Chapters 4 to 6, but they are included here for completeness.

FIG. 5. Procedure for rating the impact on people and the environment.

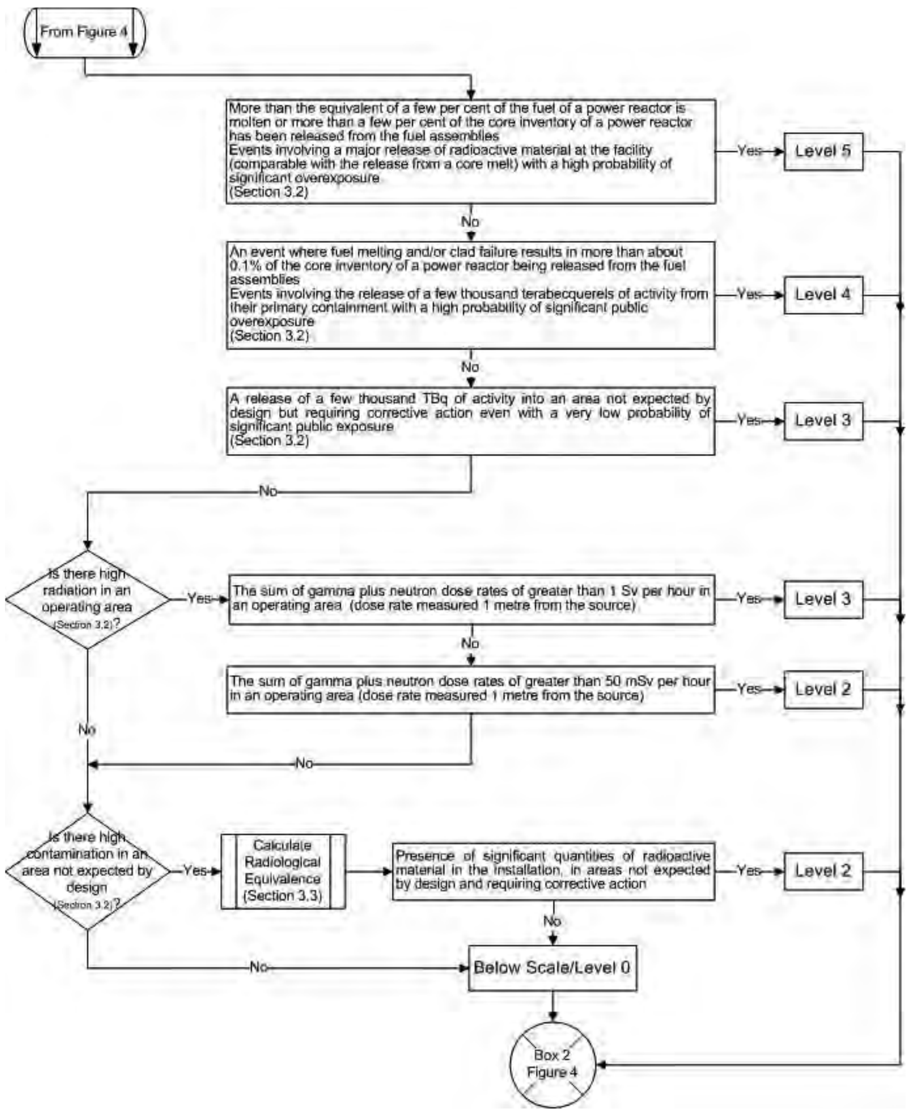


FIG. 6. Procedure for rating the impact on radiological barriers and controls at facilities.

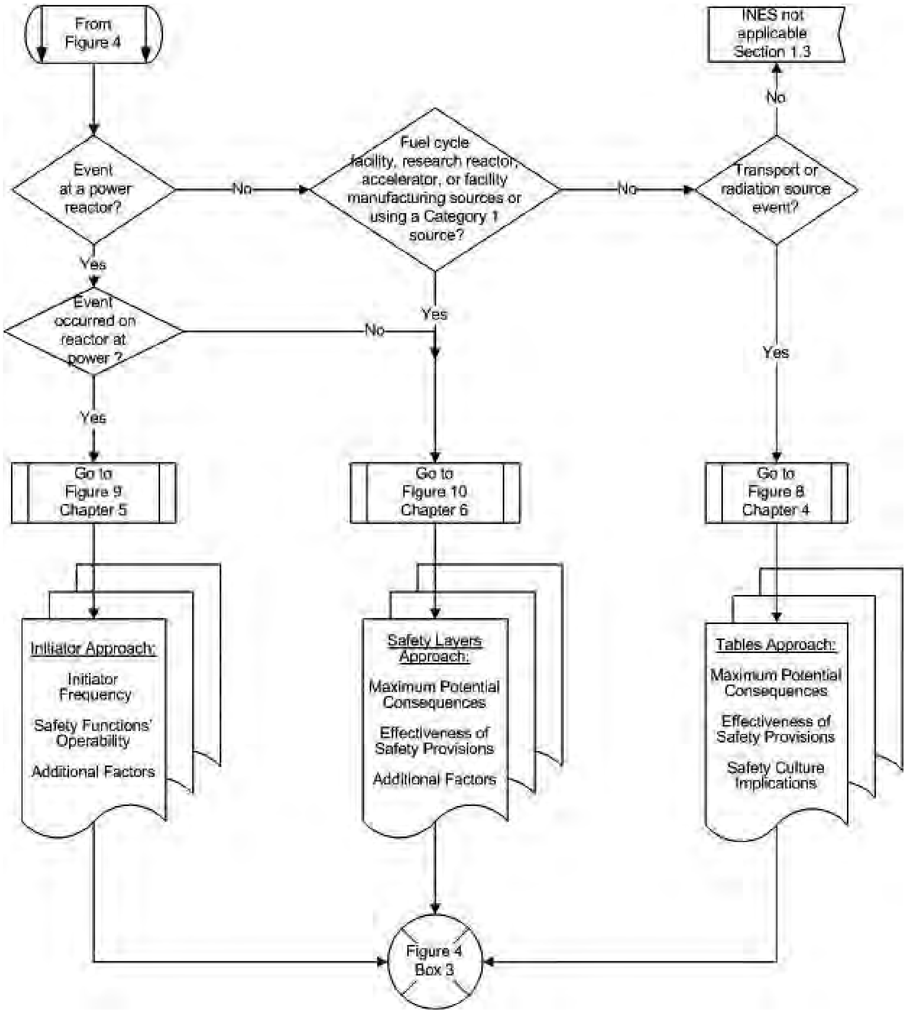
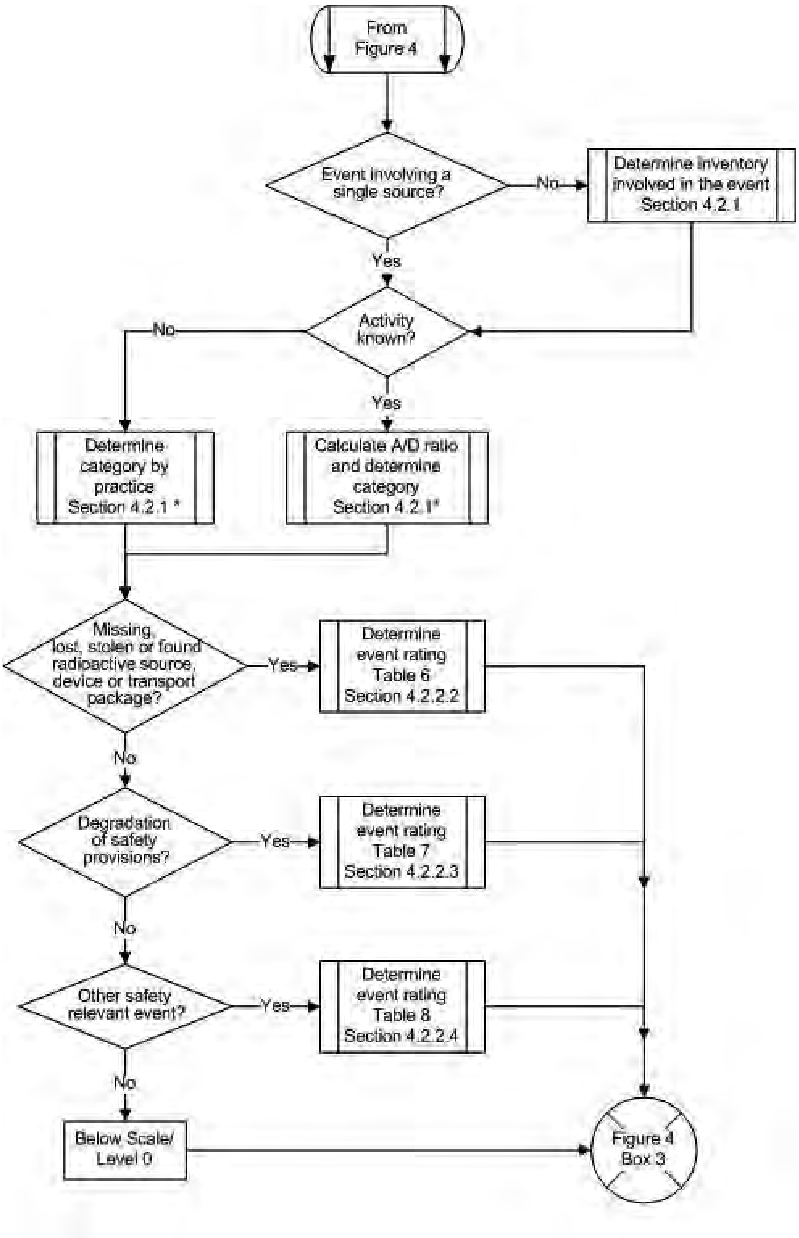
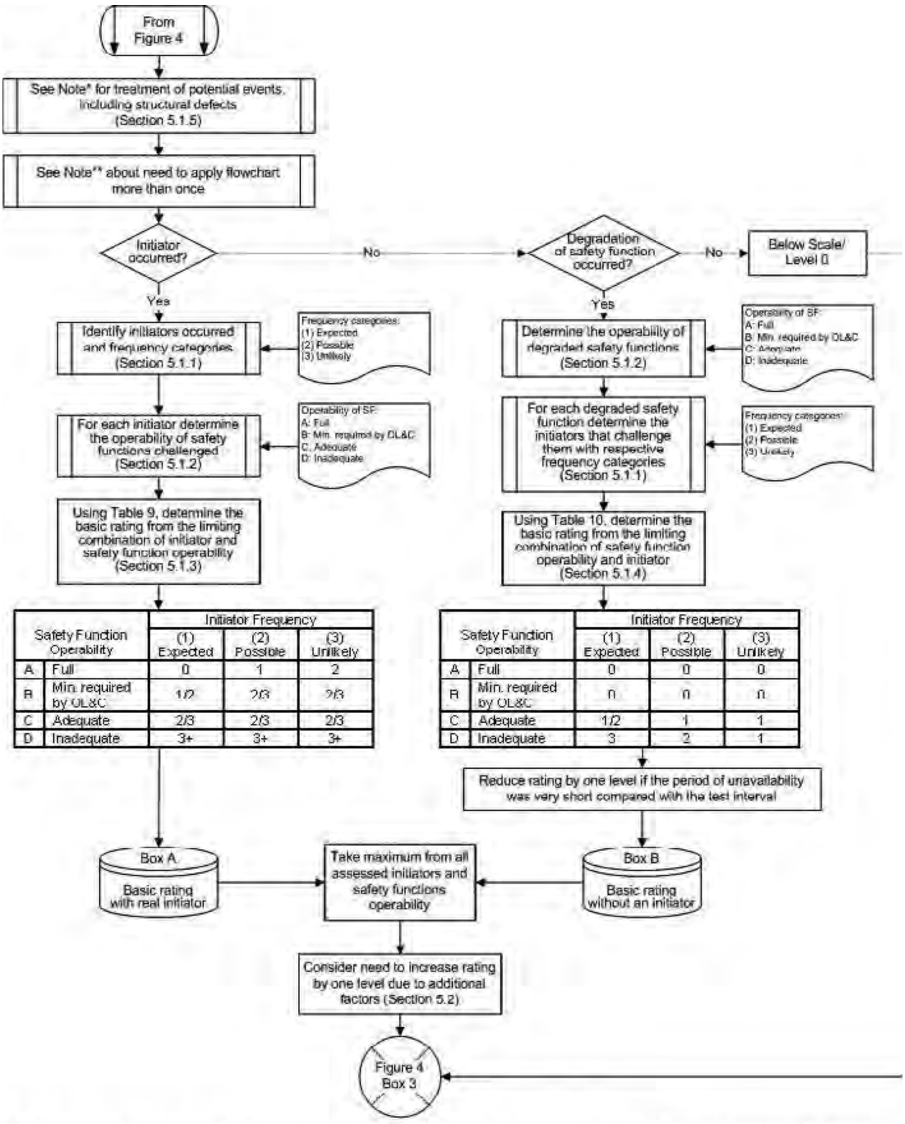


FIG. 7. General procedure for rating impact on defence in depth.



* - Please see also Appendices III and IV

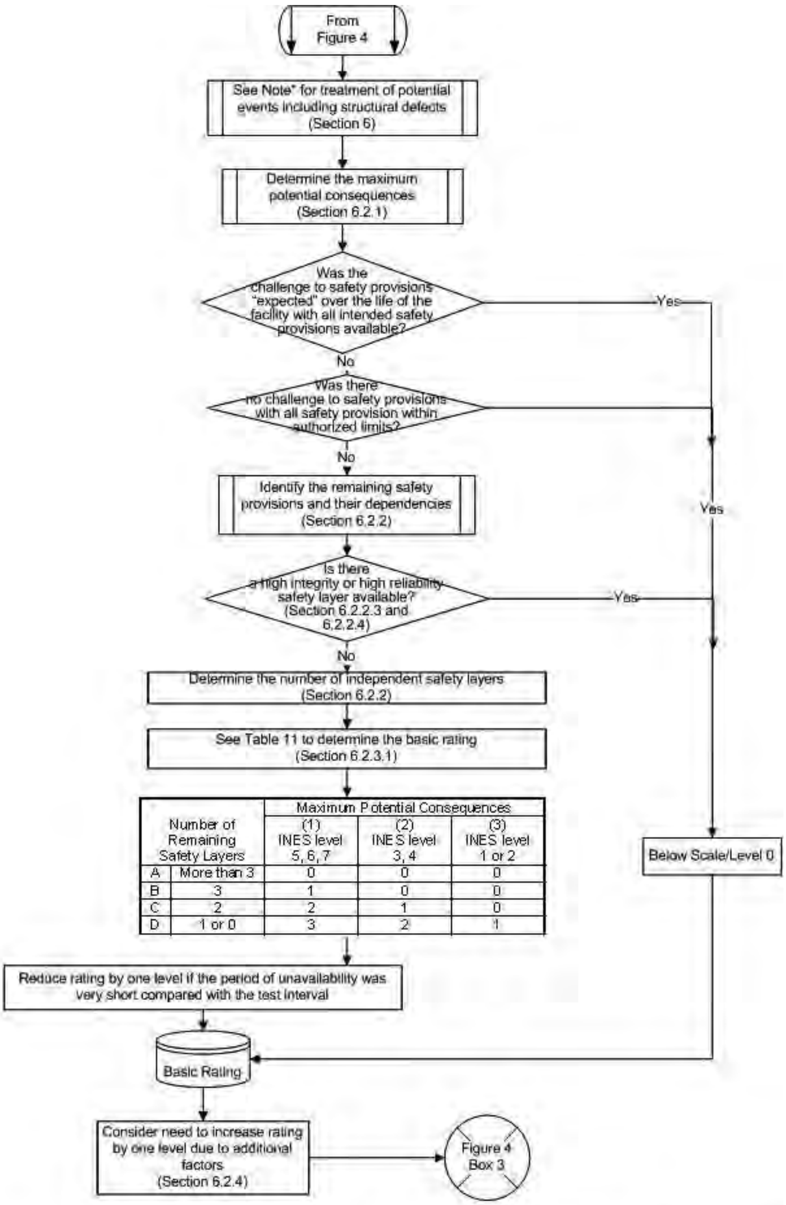
FIG. 8. Procedure for rating the impact on defence in depth for transport and radiation source events.



* - For a potential event, assume that the potential event has actually occurred and evaluate the rating of the potential event using this flowchart. Then reduce the rating, depending on the likelihood that the potential event could have occurred. See section 5.1.5

** - Events can be a combination of initiators and degradation of safety functions. Therefore it may be necessary to go through this flowchart several times to identify the initiator and safety function pairing that gives the highest rating. See section 5.1

FIG. 9. Procedure for rating the impact on defence in depth for reactors at power.



*For a potential event, assume that the potential event has actually occurred and evaluate the rating of the potential event using this flowchart. Then reduce the rating, depending on the likelihood that the failure could have occurred. See section 6.2.3.2

FIG. 10. Procedure for rating the impact on defence in depth for fuel cycle facilities, research reactors, accelerators, or facilities with Category 1 sources, and reactors not at power.

TABLE 12. EXAMPLES ILLUSTRATING INES CRITERIA FOR RATING EVENTS AT NUCLEAR FACILITIES

	People and environment	Radiological barriers and controls	Defence in depth
Major accident **Level 7**	Chernobyl, 1986. Widespread health and environmental effects. External release of a significant fraction of reactor core inventory.		
Serious accident **Level 6**	Kyshtym, Russia, 1957. Significant release of radioactive material to the environment from explosion of a high active waste tank.		
Accident with wider consequences **Level 5**	Windscale Pile, UK, 1957. Release of radioactive material to the environment following a fire in a reactor core.	Three Mile Island, USA, 1979. Severe damage to the reactor core.	
Accident with local consequences **Level 4**	Tokaimura, Japan, 1999. Fatal exposures of workers following a criticality event at a nuclear facility.	Saint Laurent des Eaux, France, 1980. Melting of one channel of fuel in the reactor with no release outside the site.	
Serious incident **Level 3**	*No examples available*	Sellafield, UK, 2005. Release of large quantity of radioactive material contained within the installation.	Vandellos, Spain, 1989. Near accident caused by fire, resulting in loss of safety systems at the nuclear power station.
Incident **Level 2**	Atucha, Argentina, 2005. Overexposure of a worker at a power reactor exceeding the annual limit.	Cadarache, France, 1993. Spread of contamination to an area not expected by design	Forsmark. Sweden. 2006. Degraded safety functions with additional factors for common cause failure in emergency power supply system at nuclear power plant.
Anomaly **Level 1**			Breach of operating limits at a nuclear facility.

TABLE 13. EXAMPLES ILLUSTRATING INES FOR RATING EVENTS INVOLVING RADIATION SOURCES AND TRANSPORT

	People and environment	Defence in depth
Major accident Level 7		
Serious accident Level 6		
Accident with wider consequences Level 5	Goiânia, Brazil, 1987. Four people died and six received doses of a few Gy from an abandoned and ruptured highly radioactive Cs-137 source.	
Accident with local consequences Level 4	Fleurus, Belgium, 2006. Severe health effects for a worker at a commercial irradiation facility as a result of high doses of radiation.	
Serious incident Level 3	Yanango, Peru, 1999. Incident with a radiography source, resulting in severe radiation burns.	Ikitelli, Turkey, 1999. Loss of a highly radioactive Co-60 source.
Incident Level 2	USA, 2005. Overexposure of a radiographer exceeding the annual limit for radiation workers.	France, 1995. Failure of access control systems at accelerator facility.
Anomaly Level 1		Theft of a moisture density gauge.

Appendix I

CALCULATION OF RADIOLOGICAL EQUIVALENCE

I.1. INTRODUCTION

This Appendix shows calculations for multiplying factors that can be applied to the activity released of a specified radionuclide to give an activity that may be compared with those given for ^{131}I. In this analysis, values of inhalation coefficients have been taken from the BSS [14], while the dose factors for ground deposition have been taken from IAEA-TECDOC-1162 [15]. Both publications are in the process of being updated, but such updates are unlikely to have a large impact on the one significant figure radiological equivalence numbers given in Table 14.

While other parts of this manual makes use of D values to compare the relative significance of different isotopes, this appendix uses another approach. This is because the D value calculations are specifically based on scenarios that are only appropriate for the handling and transport of radioactive sources. The radiological equivalence factors calculated here use assumptions based on scenarios more appropriate to accidents at facilities.

I.2. METHOD

The scenarios and methodology are summarized below.

For airborne releases of activity, the following two components were added:

— Effective dose to adult members of the public, D_{inh}, from inhalation of unit airborne concentration [14], with a breathing rate of 3.3×10^{-4} $m^3 \cdot s^{-1}$; and

— Effective dose to adults from ground deposition of radionuclides, integrated over 50 years, including consideration of resuspension, weathering and ground roughness [15]. Ground deposition is related to airborne concentration using deposition velocities (V_g) of 10^{-2} $m \cdot s^{-1}$ for elemental iodine and 1.5×10^{-3} $m \cdot s^{-1}$ for other materials. The integrated dose over 50 years, from unit ground deposition of each radionuclide is used (D_{gnd} (Sv per $Bq \cdot m^{-2}$)).

Ingestion doses are not included in this calculation as the food intervention levels will prevent any significant doses to individuals affected by the accident.

The total dose (D_{tot}) resulting from an activity release Q and time-integrated, ground-level airborne radionuclide concentration of X ($Bq \cdot s \cdot m^{-3}$ per Bq released) is:

$$D_{tot} = Q.X. (D_{inh} \cdot \text{breathing rate} + V_g \cdot D_{gnd})$$

For each radionuclide, the relative radiological equivalence to ^{131}I was calculated as the ratios of $D_{tot}/(Q.X)$.

Facility contamination considers only the inhalation pathway, and the inhalation coefficients are for workers.

I.3. BASIC DATA

The inhalation coefficients for the calculations were taken from the BSS [14], apart from U_{nat}, which is not listed in that document. Values for U_{nat} were calculated by summing the contributions from ^{238}U, ^{235}U, ^{234}U and their main decay products, using the ratios ^{234}U (48.9%), ^{235}U (2.2%) and ^{238}U (48.9%). Where a radionuclide has a number of lung absorption rates, the maximum value of the inhalation coefficient was used except for uranium where all of them are provided.

The 50 year integrated doses from ground deposition were taken from IAEA-TECDOC-1162 [15].

I.4. RESULTS

The multiplying factors applicable to both facility contamination and atmospheric releases are obtained by dividing the value for each radionuclide by that for ^{131}I. These are given in Table 14 and 15. Table 16. lists the results as they should be used in INES (i.e. rounded to one significant figure).

TABLE 14. FACTORS FOR FACILITY CONTAMINATION (INHALATION ONLY)

Nuclide	Inhalation coefficient Sv per Bq [14] (workers)	Ratio to ^{131}I
Am-241	2.70E-05	2454.5
Co-60	1.70E-08	1.5
Cs-134	9.60E-09	0.9
Cs-137	6.70E-09	0.6
H-3	1.80E-11	0.002
I-131	1.10E-08	1.0
Ir-192	4.90E-09	0.4
Mn-54	1.20E-09	0.1
Mo-99	5.60E-10	0.05
P-32	2.90E-09	0.3
Pu-239	3.2E-05	2909.1
Ru-106	3.50E-08	3.2
Sr-90	7.70E-08	7.0
Te-132	3.00E-09	0.3
U-235(S)[a]	6.10E-06	554.5
U-235(M)[a]	1.80E-06	163.6
U-235(F)[a]	6.00E-07	54.5
U-238 (S)[a]	5.70E-06	518.2
U-238(M)[a]	1.60E-06	145.5
U-238 (F)	5.80E-07	52.7
U_{nat}	6.25E-06	567.9

[a] Lung absorption types: S—slow, M—medium, F—fast. If unsure, use the most conservative value.

TABLE 15. ATMOSPHERIC RELEASE: DOSE FROM GROUND DEPOSITION AND INHALATION

	Dose factor for 50-year dose from ground deposition [15]	50-year ground deposition dose	Dose factor for inhalation [14] (public)	Inhalation dose	Total dose	Ratio to ^{131}I
Nuclide	Sv per Bq·m^{-2}	Sv per Bq·s·m^{-3}	Sv per Bq	Sv per Bq·s·m^{-3}	Sv per Bq·s·m^{-3}	
Am-241	6.40E-06	1.01E-08	9.60E-05	3.17E-08	4.17E-08	8100
Co-60	1.70E-07	2.55E-10	3.10E-08	1.02E-11	2.65E-10	51
Cs-134	5.10E-09	7.65E-11	2.00E-08	6.60E-12	1.43E-11	2.8
Cs-137	1.30E-07	1.95E-10	3.90E-08	1.29E-11	2.08E-10	40
H-3	0.00E+00	0.00E+00	2.60E-10	8.58E-14	8.58E-14	0.020
I-131	2.70E-10	2.70E-12	7.40E-09	2.44E-12	5.14E-12	1.0
Ir-192	4.40E-09	6.60E-09	6.60E-09	2.18E-12	8.78E-12	1.7
Mn-54	1.40E-08	2.10E-11	1.50E-09	4.95E-13	2.15E-11	4.2
Mo-99	6.10E-11	9.15E-14	9.90E-10	3.27E-13	4.18E-13	0.08
P-32	6.80E-12	1.02E-14	3.40E-09	1.12E-12	1.13E-12	0.22
Pu-239	8.50E-06	1.28E-08	1.20E-04	3.96E-08	5.24E-08	10 000
Ru-106	4.80E-09	7.20E-12	6.60E-08	2.18E-11	2.90E-11	5.6
Sr-90	2.10E-08	3.15E-11	1.60E-07	5.28E-11	8.43E-11	16
Te-132	6.90E-10	1.04E-12	2.00E-09	6.60E-13	1.70E-12	0.33
U-235(S)[a]	1.50E-06	2.25E-09	8.50E-06	2.81E-09	5.06E-09	980
U-235(M)[a]	1.50E-06	2.25E-09	3.10E-06	1.02E-09	3.27E-09	640
U-235(F)[a]	1.50E-06	2.25E-09	5.20E-07	1.72E-10	2.42E-09	470
U-238(S)[a]	1.40E-06	2.10E-09	8.00E-06	2.64E-09	4.74E-09	920
U-238(M)[a]	1.40E-06	2.10E-09	2.90E-06	9.57E-10	3.06E-09	590
U-238(F)[a]	1.40E-06	2.10E-09	5.00E-07	1.65E-10	2.27E-09	440
U_{nat}	1.80E-06	2.70E-09	1.04E-05	3.42E-09	6.12E-09	1200
Noble gases						Negligible (effectively 0)

[a] Lung absorption types: S—slow, M—medium, F—fast. If unsure, use the most conservative value.

TABLE 16. RADIOLOGICAL EQUIVALENCES

Nuclide	Multiplication factors [a]	
	Facility contamination	Atmospheric release
Am-241	2000	8000
Co-60	2	50
Cs-134	0.9	3
Cs-137	0.6	40
H-3	0.002	0.02
I-131	1	1
Ir-192	0.4	2
Mn-54	0.1	4
Mo-99	0.05	0.08
P-32	0.3	0.2
Pu-239	3000	10 000
Ru-106	3	6
Sr-90	7	20
Te-132	0.3	0.3
U-235(S)[b]	600	1000
U-235(M)[b]	200	600
U-235(F)[b]	50	500
U-238 (S)[b]	500	900
U-238(M)[b]	100	600
U-238 (F)[b]	50	400
U_{nat}	600	1000

[a] Multiplication factors are rounded to one significant figure.

[b] Lung absorption types: S — slow, M — medium, F — fast. If unsure, use the most conservative value.

Appendix II

THRESHOLD LEVELS FOR DETERMINISTIC EFFECTS

The criteria related to deterministic effects in Section 2.3.1 are intended to relate to observable deterministic effects. However, if it is not known at the time of rating whether a deterministic effect will actually occur, the data in this appendix can be used to determine a rating based on dose.

II.1. FATAL DETERMINISTIC EFFECTS

Based on Ref. [10], the likelihood of acute death from radiation, with medical treatment, is provided in Table 17 for a range of exposures.

II.2. OTHER DETERMINISTIC EFFECTS

In the evaluation of external exposure, threshold levels are expressed in terms of RBE-weighted absorbed dose, and are given in Table 18. For internal exposure, threshold levels are expressed in terms of committed RBE-weighted absorbed dose and are given in Table 19. RBEs are provided in Table 20. All tables are simplified from the IAEA EPR-D-values 2006 [5].

TABLE 17. LIKELIHOOD OF FATAL DETERMINISTIC EFFECTS FROM OVEREXPOSURE

Short term whole body dose (Gy)	Likelihood of acute death from radiation with medical treatment (%)
0.5	0
1	0
1.5	< 5
2	< 5
3	15–30
6	50
10	90

TABLE 18. THRESHOLD LEVELS OF RBE-WEIGHTED DOSE FROM EXTERNAL EXPOSURE

Exposure	Effect	Organ or tissue	Threshold level value (Gy)
Local exposure from an adjacent source	Necrosis of soft tissue	Soft tissue[a]	25
Contact exposure from surface contamination	Moist desquamation	Derma or skin	10[c]
Total body exposure from a distant source or immersion	(Footnote b)	Torso	1[b]

[a] Soft tissue over an area of 100 cm^2 and to a depth of about 0.5 cm below the body surface.

[b] The value is the minimum threshold dose for developing any severe deterministic effect from uniform irradiation of the whole body. The threshold level of 1 Gy was selected because it is the lower bound of the threshold levels for onset of severe deterministic effects in the red bone marrow, thyroid, lens of the eye and reproductive organs, as shown in Table I–3 of IAEA-TECDOC-1432 [8].

[c] Exposure at this level to at least 100 cm^2 of the skin is assumed to be required to result in severe deterministic health effects. The dose is to skin structures at a depth of 40 mg/cm^2 (or 0.4 mm) under the surface.

TABLE 19. THRESHOLD LEVELS OF COMMITTED RBE-WEIGHTED DOSE FROM INTERNAL EXPOSURE

Exposure pathway	Effect	Target organ or tissue	Threshold level	
			Value (Gy)	Commitment period (Footnote d)
Inhalation and ingestion	Haematopoietic syndrome	Red marrow[a,b]	0.2[c] 2[d]	30
Inhalation	Pneumonitis	Alveolar-interstitial region or respiratory tract	30	30
Inhalation and ingestion	Gastrointestinal syndrome	Colon	20	30
Inhalation and ingestion	Hypothyroidism	Thyroid	2[e]	365[f]

[a] For cases of supportive medical care.

[b] Radionuclides with $Z \geq 90$ compared with $Z \leq 89$ have different biokinetic processes, hence different dynamics of dose formation in red marrow due to internal exposure. Therefore, radionuclides have been divided into two groups to avoid the over-conservatism in evaluating the risk of the health effect concerned.

[c] For radionuclides with $Z \geq 90$.

[d] For radionuclides with $Z \leq 89$.

[e] The value from Appendix A of Ref. [9] was used.

[f] Considering the biological and physical half-life of the radionuclides that result in significant thyroid dose (isotopes of I and Te), these dose factors were in fact for a commitment period of much less than 365 days; however, the commitment period of 365 days is assigned to this reference level.

TABLE 20. RBEs USED FOR SEVERE DETERMINISTIC HEALTH EFFECTS

Health effect	Critical organ	Exposure[a]	RBE
Haematopoietic syndrome[b]	Red marrow	External γ	1
		External n^0	3
		Internal β, γ	1
		Internal α	2
Pneumonitis	Lung	Internal β, γ	1
		Internal α	7
GI syndrome	Colon	Internal β, γ	1
		Internal α	0[c]
		External n^0	3
Moist desquamation	Skin[d]	External β, γ	1
Acute radiation thyroiditis	Thyroid	Intake of some iodine isotopes[e]	0.2
		Other thyroid seekers	1
Necrosis	Soft tissue[f]	External β, γ	1

[a] External β, γ exposure includes the dose from bremsstrahlung produced within the source materials.

[b] For cases with supportive medical treatment.

[c] For alpha-emitters uniformly distributed in the contents of the colon, it is assumed that irradiation of the walls of the intestine is negligible.

[d] For a skin area of 100 cm^2, which is considered life threatening [9], the skin dose should be calculated for a depth of 0.4 mm, as recommended in Ref. [10], para. (305), (306), and (310), in Ref. [11] and Section 3.4.1 in Ref. [12].

[e] Uniform irradiation of the critical tissue of the thyroid gland is assumed to be five times more likely to produce deterministic health effects than internal exposure to low energy beta-emitting isotopes of iodine such as ^{131}I, ^{129}I, ^{125}I, ^{124}I and ^{123}I [9]. Thyroid seeking radionuclides have a heterogeneous distribution in thyroid tissues. Iodine-131 emits low energy beta particles, which leads to a reduced effectiveness of irradiation of critical thyroid tissues due to the dissipation of their energy in other tissues.

[f] Tissue at a depth of 0.5 cm below the body surface over an area of more than 100 cm^2 results in severe deterministic effects [8, 13].

Appendix III

D VALUES FOR A RANGE OF ISOTOPES

Information is taken from the IAEA's Categorization of Radioactive Sources [1]. In that publication and its supporting reference [5], two types of D values are considered. The D values are a level of activity above which a source is considered to be 'dangerous' and has a significant potential to cause severe deterministic effects if not managed safely and securely.

The D_1 value is the activity of a radionuclide in a source that, if uncontrolled but not dispersed (i.e. it remains encapsulated), might result in an emergency that could reasonably be expected to cause severe deterministic health effects.

The D_2 value is "the activity of a radionuclide in a source that, if uncontrolled and dispersed, might result in an emergency that could reasonably be expected to cause severe deterministic health effects".

The recommended D values are then the most limiting of the D_1 and D_2 values.

To be consistent with this approach, two sets of D values are provided in this Appendix. For Section 2, where the criteria related to dispersed material, the D_2 values are used (Table 21). For Section 4, where the criteria relate to defence in depth, the overall D values should be used (Table 22).

III.1. D_2 VALUES FOR RADIONUCLIDES FOR USE WITH SECTION 2 CRITERIA

TABLE 21. D_2 VALUES FOR A RANGE OF ISOTOPES

Radionuclide	D_2 (TBq)
Am-241	6.E-02
Am-241/Be	6.E-02
Au-198	3.E+01
Cd-109	3.E+01
Cf-252	1.E-02
Cm-244	5.E-02

TABLE 21. D_2 VALUES FOR A RANGE OF ISOTOPES (cont.)

Radionuclide	D_2 (TBq)
Co-57	4.E+02
Co-60	3.E+01
Cs-137	2.E+01
Fe-55	8.E+02
Gd-153	8.E+01
Ge-68	2.E+01
H-3	2.E+03
I-125	2.E-01
I-131	2.E-01
Ir-192	2.E+01
Kr-85	2.E+03
Mo-99	2.E+01
Ni-63	6.E+01
P-32	2.E+01
Pd-103	1.E+02
Pm-147	4.E+01
Po-210	6.E-02
Pu-238	6.E-02
Pu-239/Be	6.E-02
Ra-226	7.E-02
Ru-106(Rh-106)	1.E+01
Se-75	2.E+02
Sr-90(Y-90)	1.E+00
Tc-99^m	7.E+02
Tl-204	2.E+01
Tm-170	2.E+01
Yb-169	3.E+01

III.2. D VALUES FOR RADIONUCLIDES FOR USE WITH SECTION 4 CRITERIA

TABLE 22. D VALUES FOR A RANGE OF ISOTOPES

Radionuclide	D (TBq)
Am-241	6.E-02
Am-241/Be	6.E-02
Au-198	2.E-01
Cd-109	2.E+01
Cf-252	2.E-02
Cm-244	5.E-02
Co-57	7.E-01
Co-60	3.E-02
Cs-137	1.E-01
Fe-55	8.E+02
Gd-153	1.E+00
Ge-68	7.E-01
H-3	2.E+03
I-125	2.E-01
I-131	2.E-01
Ir-192	8.E-02
Kr-85	3.E+01
Mo-99	3.E-01
Ni-63	6.E+01
P-32	1.E+01
Pd-103	9.E+01
Pm-147	4.E+01
Po-210	6.E-02
Pu-238	6.E-02
Pu-239/Be	6.E-02

TABLE 22. D VALUES FOR A RANGE OF ISOTOPES (cont.)

Radionuclide	D (TBq)
Ra-226	4.E-02
Ru-106(Rh-106)	3.E-01
Se-75	2.E-01
Sr-90(Y-90)	1.E+00
Tc-99^m	7.E-01
Tl-204	2.E+01
Tm-170	2.E+01
Yb-169	3.E-01

III.3. CALCULATION OF AGGREGATE VALUES

Where a number of radioactive sources or transport packages are relevant, an aggregate D value should be calculated. Based on the guidance in Categorization of Radioactive Sources [1] and Regulations for the Safe Transport of Radioactive Material [6], the aggregate value is calculated as:

$$1/D = \Sigma f_i/D_i$$

where D is the aggregate value of D, f_i is the fraction of isotope i, and D_i is the D value for isotope i, or

$$A/D = \Sigma A_i/D_i$$

where A is the total activity and A_i is the activity of the isotope.

Appendix IV

RADIOACTIVE SOURCE CATEGORIZATION BASED ON COMMON PRACTICE

Information taken from the IAEA's Categorization of Radioactive Sources [1].

TABLE 23. CATEGORIZATION OF COMMON PRACTICES

Category	Categorization of common practices	Typical isotopes
1	Radioisotope thermoelectric generators (RTGs)	Sr-90, Pu-238
	Irradiators	Co-60, Cs-137
	Teletherapy	Co-60, Cs-137
	Fixed, multi-beam teletherapy (gamma knife)	Co-60
2	Industrial gamma radiography	Co-60, Se-75, Ir-192,Yb-169, Tm-170
	High/medium dose rate brachytherapy	Co-60, Cs-137, Ir-192
3	Fixed industrial gauges:	
	Level gauges	Co-60, Cs-137
	Dredger gauges	Co-60, Cs-137
	Conveyor gauges containing high activity radioactive sources	Cs-137, Cf-252
	Spinning pipe gauges	Cs-137
	Well logging gauges	Am-241/Be, Cs-137, Cf-252
4	Low dose rate brachytherapy (except eye plaques and permanent implant sources)	I-125, Cs-137, Ir-192, Au-198, Ra-226, Cf-252
	Thickness/fill-Level gauges	Kr-85, Sr-90, Cs-137, Am-241, Pm-147, Cm-244
	Portable gauges (e.g. moisture/density gauges)	Cs-137, Ra-226, Am-241/Be, Cf-252
	Bone densitometers	Cd-109, I-125, Gd-153, Am-241
	Static eliminators	Po-210, Am-241

TABLE 23. CATEGORIZATION OF COMMON PRACTICES (cont.)

Category	Categorization of common practices	Typical isotopes
5	Low dose rate brachytherapy eye plaques and permanent implant sources	Sr-90, Ru/Rh-106, Pd-103
	X ray fluorescence devices	Fe-55, Cd-109, Co-57
	Electron capture devices	Ni-63, H-3
	Mossbauer spectrometry	Co-57
	Positron emission tomography (PET) check sources	Ge-68

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Annex I

DEFENCE IN DEPTH

It has often been said that the safe operation of nuclear power plants is assured by maintaining three basic safety functions:

(1) Reactivity control;
(2) Cooling the fuel;
(d) Confinement.

This can be generalized to apply to the safe operation of any activity involving the use of radioactive material by stating that safe operation is assured by maintaining three basic safety functions:

(1) Controlling the reactivity or the process conditions;
(2) Cooling the radioactive material;
(3) Radiological control (e.g. confinement of radioactive material and shielding) .

For some practices, not all of these safety functions are relevant (e.g. for industrial radiography, only the third function is relevant).

Each of the safety functions is assured by good design, well controlled operation and a range of systems and administrative controls. A defence in depth approach is generally applied to each of these aspects, and allowance is made for the possibility of equipment failure, human error and the occurrence of unplanned developments.

Defence in depth is thus a combination of conservative design, quality assurance, surveillance, mitigation measures and a general safety culture that strengthens each of the successive levels.

Defence in depth is fundamental to the design and operation of major nuclear and radiological facilities. IAEA Safety Series No. 75-INSAG-3 [I–1], Basic Safety Principles for Nuclear Power Plants, states:

> "To compensate for potential human and mechanical failures, a defence in depth concept is implemented, centred on several levels of protection including successive barriers preventing the release of radioactive material to the environment. The concept includes protection of the barriers by averting damage to the plant and to the barriers themselves. It includes further measures to protect the public and the environment from harm in case these barriers are not fully effective."

Defence in depth can be considered in a number of different ways. For example, one can consider the number of barriers provided to prevent a release (e.g. fuel, clad, pressure vessel, containment). Equally, one can consider the number of systems that would have to fail before an accident could occur (e.g. loss of off-site power plus failure of all essential diesels). It is the latter approached that is adopted within INES rating procedure.

Within the safety justification for the facility, operational systems may be distinguished from safety provisions. If operational systems fail, then additional safety provisions will operate so as to maintain the safety function. Safety provisions can be either procedures, administrative controls or passive or active systems, which are usually provided in a redundant way, with their availability controlled by OL&C.

The frequency of challenge of the safety provisions is minimized by good design, operation, maintenance and surveillance. For example, the frequency of failure of the primary circuit of a reactor, or of key pipe work and vessels in a reprocessing plant, is minimized by such things as design margins, quality control, operational constraints and surveillance. Similarly, the frequency of reactor transients is minimized by operational procedures and control systems. Normal operational and control systems contribute to minimizing the frequency of challenges to safety provisions.

INSAG-10 [I–2] (written since the development of INES) provides much more detail on the implementation of defence in depth in design and operation, and Table I–1 shows how the concepts described in INSAG-10 are incorporated into INES assessment of defence in depth.

REFERENCES TO ANNEX I

[I–1] INTERNATIONAL NUCLEAR SAFETY ADVISORY GROUP, Basic Safety Principles for Nuclear Power Plants, Safety Series No. 75-INSAG-3, IAEA, Vienna (1999).

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TABLE I–1. DEFENCE IN DEPTH IN DESIGN AND OPERATION

Objective	Means of implementation	Treatment within INES	
		For power reactors (Section 5)	For other facilities (Section 6)
Prevention of abnormal operation and failures.	Conservative design and high quality in construction and operation.	Addressed by considering the likelihood of the initiator.	Each well designed system is considered as one or more safety layers.
Control of abnormal operation and detection of failures.	Control, limiting and protection systems, and other surveillance features.	Control and surveillance features are addressed by considering the likelihood of the initiator. Protection systems are included as safety systems and hence addressed by considering the operability of the safety functions.	Considered as one or more safety layers.
Control of accidents within the design basis.	Engineered safety features and accident procedures.	Addressed by considering the operability of the safety functions.	Considered as ne or more safety layers.
Control of severe plant conditions, including prevention of accident progression and mitigation of the consequences of severe accidents.	Complementary measures and accident management.	Addressed by considering the operability of the safety functions.	Considered as one or more safety layers.
Mitigation of radiological consequences of significant releases of radioactive materials.	Off-site emergency response.	Not considered as part of defence in depth. These actions affect the actual consequences as considered in the earlier sections of the INES User's Manual.	Not considered as part of defence in depth. These actions affect the actual consequences as considered in the earlier sections of the INES User's Manual.

Annex II

EXAMPLES OF INITIATORS AND THEIR FREQUENCY

Each reactor has its own list and classification of initiators as part of its safety justification. This Appendix gives some typical examples of design basis initiators that have been used in the past for power reactors, categorized into 'Expected', 'Possible', 'Unlikely'.

II–1. PRESSURIZED WATER REACTORS (PWR AND WWER)

II–1.1. Category 1 'Expected'

— Reactor trip;
— Inadvertent chemical shim dilution;
— Loss of main feedwater flow;
— Reactor coolant system depressurisation by inadvertent operation of an active component(e.g. a safety or relief valve);
— Inadvertent reactor coolant system depressurisation by normal or auxiliary pressurizer spray cooldown;
— Power conversion system leakage that would not prevent a controlled reactor shutdown and cooldown;
— Steam generator tube leakage in excess of plant technical specifications but less than the equivalent of a full tube rupture;
— Reactor coolant system leakage that would not prevent a controlled reactor shutdown and cooldown;
— Loss of off-site AC power, including consideration of voltage and frequency disturbances;
— Operation with a fuel assembly in any misoriented or misplaced position;
— Inadvertent withdrawal of any single control assembly during refuelling;
— Minor fuel handling incident;
— Complete loss or interruption of forced reactor coolant flow, excluding reactor coolant pump locked rotor;

II–1.2. Category 2 'Possible'

— Small loss of coolant accident (LOCA);
— Full rupture of one steam generator tube;

— Drop of a spent fuel assembly involving only the dropped assembly;
— Leakage from spent fuel pool in excess of normal make-up capability;
— Blowdown of reactor coolant through multiple safety or relief valves.

II–1.3. Category 3 'Unlikely'

— Major LOCA, up to and including the largest justified pipe rupture in the reactor coolant pressure boundary
— Single control rod ejection
— Major power conversion system pipe rupture, up to and including the largest justified pipe rupture
— Drop of a spent fuel assembly onto other spent fuel assemblies.

II–2. BOILING WATER REACTORS

II–2.1. Category 1 'Expected'

— Reactor trip;
— Inadvertent withdrawal of a control rod during reactor operation at power;
— Loss of main feedwater flow;
— Failure of reactor pressure control;
— Leakage from main steam system;
— Reactor coolant system leakage that would not prevent a controlled reactor shutdown and cooldown;
— Loss of off-site power AC, including consideration of voltage and frequency disturbances;
— Operation with a fuel assembly in any misoriented or misplaced position;
— Inadvertent withdrawal of any single control rod assembly during refuelling;
— Minor fuel handling incident;
— Loss of forced reactor coolant flow.

II–2.2. Category 2 'Possible'

— Small LOCA;
— Rupture of main steam piping;

- Drop of spent fuel assembly involving only the dropped assembly;
- Leakage from spent fuel pool in excess of normal make-up capability;
- Blowdown of reactor coolant through multiple safety or relief valves.

II–2.3. Category 3 'Unlikely'

- Major LOCA, up to and including the largest justified pipe rupture in the reactor coolant pressure boundary;
- Single control rod drop;
- Major rupture of main steam pipe;
- Drop of a spent fuel assembly onto the other spent fuel assemblies.

II–3. CANDU PRESSURIZED HEAVY WATER REACTORS

II–3.1. Category 1 'Expected'

- Reactor trip;
- Inadvertent chemical shim dilution;
- Loss of main feedwater flow;
- Loss of reactor coolant system pressure control (high or low) due to failure or inadvertent operation of an active component (e.g. feed, bleed or relief valve);
- Steam generator tube leakage in excess of plant operating specification but less than the equivalent of a full tube rupture;
- Reactor coolant system leakage that would not prevent a controlled reactor shutdown and cooldown;
- Power conversion system leakage that would not prevent a controlled reactor shutdown and cooldown;
- Loss of off-site power AC, including consideration of voltage and frequency disturbances;
- Operation with fuel bundle(s) in any misplaced position;
- Minor fuel handling incident;
- Reactor coolant pump(s) trip;
- Loss of main feedwater flow to one or more steam generators;
- Flow blockage in an individual channel (less than 70%);
- Loss of moderator cooling;
- Loss of computer control;
- Unplanned regional increase in reactivity.

II–3.2. Category 2 ‘Possible’

- Small LOCA (including pressure tube rupture);
- Full rupture of one steam generator tube;
- Blowdown of reactor coolant through multiple safety or relief valves;
- Damage to irradiated fuel or loss of cooling to fuelling machine containing irradiated fuel;
- Leakage from irradiated fuel bay in excess of normal make-up capability;
- Feedwater line break;
- Flow blockage in an individual channel (more than 70%);
- Moderator failure;
- Loss of end shield cooling;
- Shutdown cooling failure;
- Unplanned bulk increase in reactivity;
- Loss of service water (low pressure, high pressure service water or recirculated cooling water);
- Loss of instrument air;
- Loss of on-site electrical power (Class IV, III, II or I).

II–3.3. Category 3 ‘Unlikely’

- Major LOCA, up to and including the largest justified pipe rupture in the reactor coolant pressure boundary;
- Major power conversion system pipe rupture, up to and including the largest justified pipe rupture.

II–4. RBMK REACTORS (LWGR)

II–4.1. Category 1 ‘Expected’

- Reactor trip;
- Malfunction in the system of neutron control of reactor power;
- Loss of main feedwater flow;
- Reactor coolant system (primary circuit) depressurisation due to inadvertent operation of an active component (e.g. a safety or relief valve);
- Primary circuit leak not hindering normal reactor trip and cooldown

— Reduced coolant flow through a group of fuel channels and reactor protection system channels;
— Reduced helium mixture flow in the reactor graphite stacking;
— Loss of off-site AC power, including voltage and frequency disturbances
— Operation with a fuel assembly in any misoriented or misplaced position;
— Minor fuel handling incident;
— Depressurization of the fuel channel in the course of refuelling.

II–4.2. Category 2 'Possible'

— Small LOCA;
— Spent fuel assembly drop;
— Leakage from spent fuel pool in excess of normal make-up capability;
— Primary coolant leak through multiple safety or relief valves;
— Fuel channel or RPS channel rupture;
— Loss of water flow in any fuel channel;
— Loss of water flow in RPS cooling circuit;
— Total loss of helium mixture flow in the reactor graphite stacking;
— Emergency in the course of on-load refuelling machine operation;
— Total loss of auxiliary power;
— Unauthorized supply of cold water from emergency core cooling system (ECCS) into reactor.

II–4.3. Category 3 'Unlikely'

— Major LOCA, up to and including the largest justified pipe rupture in the reactor coolant pressure boundary;
— Main steam pipe break before the main steam isolation valve (MSIV), including the largest justified pipe rupture;
— Drop of a spent fuel assembly onto other spent fuel assemblies;
— Total loss of service water flow;
— Fuel assembly ejection from the fuel channel, including ejection from the fuel channel while in the refuelling machine.

II–5. GAS COOLED REACTORS

II–5.1. Category 1 'Expected'

- — Reactor trip;
- — Loss of main feedwater flow;
- — Very small depressurization;
- — Boiler tube leak;
- — Loss of off-site AC power, including consideration of voltage and frequency disturbances;
- — Inadvertent withdrawal of one or more control rods;
- — Minor fuel handling incident;
- — Some loss of interruption of forced reactor coolant flow.

II–5.2. Category 2 'Possible'

- — Minor depressurization;
- — Inadvertent withdrawal of a group of control rods;
- — Full boiler tube rupture;
- — Dropped fuel stringer (AGR only);
- — Closure of circulator inlet guide vanes (IGVs) (AGR only);
- — Gag closure faults (AGR only).

II–5.3. Category 3 'Unlikely'

- — Major depressurization;
- — Failure of steam pipework;
- — Failure of feed pipework.

Annex III

LIST OF PARTICIPATING COUNTRIES AND ORGANIZATIONS

Argentina
Armenia
Australia
Austria
Bangladesh
Belarus
Belgium
Brazil
Bulgaria
Canada
Chile
China
Congo, Democratic Republic of the
Costa Rica
Croatia
Czech Republic
Denmark
Egypt
Finland
France
Germany
Greece
Guatemala
Hungary
Iceland
India
Iran, Islamic Republic of
Ireland
Italy
Japan
Kazakhstan
Korea, Republic of
Kuwait
Lebanon
Lithuania
Luxembourg
Mexico
Montenegro
Netherlands
Norway
Pakistan
Peru
Poland
Portugal
Romania
Russian Federation
Saudi Arabia
Slovakia

Slovenia

South Africa

Spain

Sri Lanka

Sweden

Switzerland

Syrian Arab Republic

Turkey

Ukraine

United Kingdom

United States of America

Vietnam

The Former Yugoslav Republic of Macedonia

INTERNATIONAL LIAISON

European Commission
European Atomic Forum (Foratom)
World Association of Nuclear Operators
World Nuclear Association

GLOSSARY

This section provides definitions for important words or phrases used in this manual. Many of them are taken from the Basic Safety Standards [14] and the IAEA Safety Glossary [16]. In many cases, more detailed explanation is provided within the manual.

absorbed dose. The fundamental dosimetric quantity D, defined as:

$$D = d\varepsilon/dm$$

where $d\varepsilon$ is the mean energy imparted by ionizing radiation to matter in a volume element, and dm is the mass of matter in the volume element. The SI unit of absorbed dose is the joule per kilogram ($J\cdot kg^{-1}$), termed the gray (Gy) [14].

accident. In the context of the reporting and analysis of events, an accident is an event that has led to significant consequences to people, the environment or the facility. Examples include lethal effects to individuals, large radioactivity release to the environment, reactor core melt. For communicating the significance of events to the public, INES rates events at one of seven levels and uses the term accident to describe events at Level 4 or above. Events of lesser significance are termed incidents.

Note: In safety analyses and the IAEA safety standards, the term ‘accident’ has been used much more generally to mean “Any unintended event, including operating errors, equipment failures or other mishaps, the consequences or potential consequences of which are not negligible from the point of view of protection or safety” [14]. Thus, events that would be considered accidents according to the safety standards definition may be accidents or ‘incidents’ in public communication and INES terminology. This more specific INES definition is used to aid public understanding of safety significance.

actual consequences. In this manual, this refers to consequences rated using these criteria for assessing the impact on people and the environment, as well as radiological barriers and controls at facilities. This is in contrast to events rated using the criteria for degradation of defence in depth, which covers those events with no actual consequences, but where the measures put in place to prevent or cope with accidents did not operate as intended.

additional factors. Factors that can result in an increase in the basic event rating. Additional factors allow for those aspects of the event that may indicate a deeper degradation of the plant or the organizational arrangements of the facility. Factors considered are common cause failures, procedural inadequacies and safety culture deficiencies.

annual dose. The dose due to external exposure in a year plus the committed dose from intakes of radionuclides in that year [16].

authorized facilities. Facilities for which a specific form of authorization has been given. These include: nuclear facilities; irradiation installations; some mining and raw material processing facilities such as uranium mines; radioactive waste management facilities; and any other places where radioactive materials are produced, processed, used, handled, stored or disposed of — or where radiation generators are installed — on such a scale that consideration of protection and safety is required.

authorized limit. A limit on a measurable quantity (including equipment operability) established or formally accepted by a regulatory body (sometimes these limits are established within what are called OL&C).

basic rating. The rating prior to consideration of additional factors. It is based purely on the significance of actual equipment or administrative failures.

common cause failure. Failure of two or more structures, systems or components due to a single specific event or cause [16].
For example, a design deficiency, a manufacturing deficiency, operation and maintenance errors, a natural phenomenon, a human induced event, saturation of signals, or an unintended cascading effect from any other operation or failure within the plant or from a change in ambient conditions.

confinement. Prevention or control of releases of radioactive material to the environment in operation or in accidents [16].

Note: Confinement is closely related in meaning to containment, but confinement is used to refer to the safety function of preventing the 'escape' of radioactive materials, whereas containment refers to the means for achieving that function.

containment. Methods or physical structures designed to prevent or control the release and the dispersion of radioactive materials [16].

defence in depth. A hierarchical deployment of different levels of diverse equipment and procedures to prevent the escalation of anticipated operational occurrences and to maintain the effectiveness of physical barriers placed between a radiation source or radioactive material and workers, members of the public or the environment [16].

See the introduction to Sections 4,5,6, Annex I and INSAG-10 [17] for further information.

deterministic effect. A health effect of radiation for which generally a threshold level of dose exists above which the severity of the effect is greater for a higher dose [14].

Note: The level of the threshold dose is characteristic of the particular health effect but may also depend, to a limited extent, on the exposed individual. Examples of deterministic effects include erythema and acute radiation syndrome (radiation sickness).

dose. A measure of the energy deposited by radiation in a target [16]. Whenever the word is used in specific definitions, it needs further detail such as absorbed dose, effective dose, whole body exposure, RBE weighted dose.

dose constraint. A prospective restriction on the individual dose delivered by a source, which serves as the upper bound on the dose in optimization of protection and safety for the source [16].

dose limit. The value of the effective dose or the equivalent dose to individuals from controlled practices that is required not to be exceeded [14]. There are a range of limits that all need to be considered, including whole body effective dose, doses to skin, doses to extremities and doses to lens of the eye.

effective dose. A measure of dose designed to reflect the amount of radiation detriment likely to result from the dose. Values of effective dose from any type(s) of radiation and mode(s) of exposure can be compared directly. It is defined as the summation of the tissue equivalent doses, each multiplied by the appropriate tissue weighting factor:

$$E = \sum_{T} w_T \cdot H_T$$

where H_T is the equivalent dose in tissue T, and w_T is the tissue weighting factor for tissue T. From the definition of equivalent dose, it follows that:

$$E = \sum_{T} w_{T} \cdot \sum_{R} w_{R} \cdot D_{T,R}$$

where w_R is the radiation weighting factor for radiation R and $D_{T,R}$ is the average absorbed dose in the organ or tissue T [14].

The unit of effective dose is the sievert (Sv), equal to 1 J/kg. The rem, equal to 0.01 Sv, is sometimes used as a unit of equivalent dose and effective dose.

equivalent dose. A measure of the dose to a tissue or organ designed to reflect the amount of harm caused. Values of equivalent dose to a specified tissue from any type(s) of radiation can be compared directly. It is defined as the quantity $H_{T,R}$, where:

$$H_{T,R} = w_{R} \cdot D_{T,R}$$

where $D_{T,R}$ is the absorbed dose delivered by radiation type R averaged over a tissue or organ T and w_R is the radiation weighting factor for radiation type R. When the radiation field is composed of different radiation types with different values of w_R the equivalent dose is:

$$H_{T} = \sum_{R} w_{R} \cdot D_{T,R}$$

The unit of equivalent dose is the sievert (Sv), equal to 1 J/kg. The rem, equal to 0.01 Sv, is sometimes used as a unit of equivalent dose and effective dose.

event. Any occurrence that requires a report to the regulator or the operator or a communication to the public.

exposure. The act or condition of being subject to irradiation [16].

Note: Exposure should not be used as a synonym for dose. Dose is a measure of the effects of exposure.

external exposure. Exposure to radiation from a source outside the body [16].

fissile material. ^{234}U, ^{235}U, ^{239}Pu, ^{241}Pu, or any combination of these radionuclides. Excepted from this definition are:

(a) Natural uranium or depleted uranium that is unirradiated, and
(b) Natural uranium or depleted uranium that has been irradiated in thermal reactors only [16].

high integrity safety layer. A high integrity safety layer has all of the following characteristics:

(a) The safety layer is designed to cope with all relevant design basis faults and is explicitly or implicitly recognized in the plant safety justification as requiring a particularly high reliability or integrity.
(b) The integrity of the safety layer is assured through appropriate monitoring or inspection such that any degradation of integrity is identified.
(c) If any degradation of the layer is detected, there are clear means of coping with the event and of implementing corrective actions, either through pre-determined procedures or through long times being available to repair or mitigate the fault.

highly reliable safety layer. In some cases, the time available may be such that there are a whole range of potential safety layers that can be made available, and it has not been considered necessary in the safety justification to identify each of them in detail or to include in the procedure the detail of how to make each of them available. In such cases (provided there are a range of practicable measures that could be implemented), this long time available itself provides a highly reliable safety layer.

incident. In the context of the reporting and analysis of events, the word incident is used to describe events that are less severe than accidents. For communicating the significance of events to the public, INES rates events at one of seven levels and uses the term incident to describe events up to and including Level 3. Events of greater significance are termed accidents

initiator. (initiating event). An initiator or initiating event is an event identified in the safety analysis that leads to a deviation from the normal operating state and challenges one or more safety functions.

internal exposure. Exposure to radiation from a source within the body [16].

investigation level. The value of a quantity such as *effective dose*, *intake* or *contamination* per unit area or volume at or above which an investigation is recommended to be conducted.

operability of a safety function. The operability of a safety function can be: *full; the minimum required by OL&C*; *adequate;* or *inadequate;* depending upon the operability of the individual redundant and diverse safety systems and components.

operability of equipment. Capability of performing the required function in the required manner.

operational limits and conditions. A set of rules setting forth parameter limits, the functional capability and the performance levels of equipment and personnel approved by the regulatory body for safe operation of an authorized facility [16]. (In most countries, for nuclear power plants, these are included within Technical Specifications).

operating area. Operating areas are areas where worker access is permitted without specific permits. It excludes areas where specific controls are required (beyond the general need for a personal dosimeter and/or coveralls) due to the level of contamination or radiation.

operating organization. An organization applying for authorization or authorized to operate an authorized facility and responsible for its safety.

Note: In practice, for an authorized facility, the operating organization is normally also the licensee or registrant.

See also operator.

operating personnel. Individual workers engaged in the operation of an authorized facility.

operator. Any organization or person applying for authorization or authorized and/or responsible for nuclear, radiation, radioactive waste or transport safety when undertaking activities or in relation to any nuclear facilities or sources of ionizing radiation. This includes, inter alia, private individuals, governmental bodies, consignors or carriers, licensees, hospitals, self-employed persons [16].

Note: Operator includes either those who are directly in control of a facility or an activity during use of a source (such as radiographers or carriers) or, in the case of a source not under control (such as a lost or illicitly removed source or a re-entering satellite), those who were responsible for the source before control over it was lost.
Note: Synonymous with operating organization.

orphan source. A radioactive source that is not under regulatory control, either because it has never been under regulatory control, or because it has been abandoned, lost, misplaced, stolen or otherwise transferred without proper authorization [19].

package. The packaging with its radioactive contents as presented for transport. There are several types of packages:

(1) Excepted package;
(2) Industrial package Type 1 (Type IP-1);
(3) Industrial package Type 2 (Type IP-2);
(4) Industrial package Type 3 (Type IP-3);
(5) Type A package;
(6) Type B(U) package;
(7) Type B(M) package;
(8) Type C package.

The detailed specifications and requirements for each package type are specified in the Transport Regulations [6].

practice. Any human activity that introduces additional sources of exposure or additional exposure pathways or extends exposure to additional people or modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people or the number of people exposed [14].

Note: Terms such as ‘authorized practice’, ‘controlled practice’ and ‘regulated practice’ are used to distinguish those practices that are subject to regulatory control from other activities that meet the definition of practice but do not need or are not amenable to control.

radiation generator. Device capable of generating radiation, such as X rays, neutrons, electrons or other charged particles, which may be used for scientific, industrial or medical purposes [14].

radiation source. A radiation generator, or a radioactive source or other radioactive material outside the nuclear fuel cycles of research and power reactors [16].

radioactive material. Material designated in national law or by a regulatory body as being subject to regulatory control because of its radioactivity.

radioactive source. Radioactive material that is permanently sealed in a capsule or closely bonded and in a solid form and which is not exempt from regulatory control. It also includes any radioactive material released if the radioactive source is leaking or broken, but does not include material encapsulated for disposal, or nuclear material within the nuclear fuel cycles of research and power reactors [19].

radiological. An adjective referring to both radiation and contamination, (surface and airborne).

radiological barriers. Physical barriers which contain radioactive material and/or shield individuals from the radiation emanating from the material.

RBE weighted absorbed dose. A product of the absorbed dose in an organ or tissue and the RBE of the radiation imparting the dose:

$$AD_T = \sum_R D_T^R \times RBE_T^R;$$

where D_T^R is the organ dose from radiation R, in tissue T, and RBE_T^R is the relative biological effectiveness of radiation R, in producing a specific effect in a particular organ or tissue T. The unit of RBE-weighted absorbed dose is $J{\cdot}kg^{-1}$, termed the gray-equivalent (Gy-Eq).
The RBE weighted absorbed dose is intended to account for differences in biological effectiveness in producing deterministic health effects in organs or tissues of reference man due to the quality of the radiation [5].

safety case. A collection of arguments and evidence in support of the safety of a facility or activity.

safety culture. The assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance [14].

safety functions. The three basic safety functions are: (a) controlling the reactivity or the process conditions; (b) cooling the radioactive material; (c) confining the radioactive material.

safety layers. Passive systems, automatically or manually initiated safety systems, or administrative controls that are provided to ensure that the required safety functions are achieved [16]. A safety layer is to be considered as a safety provision that cannot be broken down into redundant parts. See Section 6.2.2 for a detailed definition of how the term is used in this particular document.

safety provisions. Safety provisions can be either procedures, administrative controls, or passive or active systems, which are usually provided in a redundant way with their availability controlled by Operational Limits and Conditions

safety systems. Systems important to safety that are provided to ensure the safety functions.

source. Anything that may cause radiation exposure — such as by emitting ionizing radiation or by releasing radioactive substances or materials — and can be treated as a single entity for protection and safety purposes [16].

For example, materials emitting radon are sources in the environment, a sterilization gamma irradiation unit is a source for the practice of radiation preservation of food, an X ray unit may be a source for the practice of radiodiagnosis; a nuclear power plant is part of the practice of generating electricity by nuclear fission, and may be regarded as a source (e.g. with respect to discharges to the environment) or as a collection of sources (e.g. for occupational radiation protection purposes).

stochastic effect. A radiation induced health effect, the probability of occurrence of which is greater for a higher radiation dose and the severity of which (if it occurs) is independent of dose [16].

Note: Stochastic effects generally occur without a threshold level of dose. Examples include various forms of cancer and leukaemia.

worker. Any person who works, whether full-time, part-time or temporarily, for an employer and who has recognized rights and duties in relation to occupational radiation protection. (A self-employed person is regarded as having the duties of both an employer and a worker.) [14]

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Consultants Meetings

Cape Town, South Africa: 9–13 October 2006
Vienna, Austria: 4–8 June 2007, 10–21 September 2007, 18–22 February 2008

Meetings of the INES Advisory Committee

Vienna, Austria: 19–23 March 2007, 17–20 March 2008

09-14041

INES, the International Nuclear and Radiological Event Scale, was developed in 1990 by experts convened by the IAEA and the OECD Nuclear Energy Agency with the aim of communicating the safety significance of events. This edition of the INES User's Manual is designed to facilitate the task of those who are required to rate the safety significance of events using the scale. It includes additional guidance and clarifications, and provides examples and comments on the continued use of INES. With this new edition, it is anticipated that INES will be widely used by Member States and become the worldwide scale for putting into proper perspective the safety significance of any event associated with the transport, storage and use of radioactive material and radiation sources, whether or not the event occurs at a facility.

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA

Mariah Mills

From: Christine Rowe [crwhnc@gmail.com]
Sent: Sunday, February 09, 2014 4:37 PM
To: DTSC_SSFL_CEQA
Cc: Malinowski, Mark@DTSC; Leclerc, Ray@DTSC; Hume, Richard@DTSC; Rainey, Laura@DTSC; Perez, Marina@DTSC; John Jones; Stephanie Jennings; Bell, Jazmin; Dassler, David W; Kamara Sams; James A. Elliott, (MSFC-AS10); Merrilee Fellows, (HQ-NB000)
Subject: Christine L. Rowe DTSC SSFL PEIR - Final 2
Attachments: INES_Users_Manual_1545.pdf

Dear Mr. Malinowski,

Please do not use the term "meltdown" or "partial meltdown" in your DRAFT Environmental Impact Report (DEIS). The term "partial meltdown" was used by elected officials for SB 990. I believe that has been the basis of this term. However, SB 990 has been overturned at this time, and thus this term should go away with that law.

"Meltdown" and "Partial Meltdown" are non technical terms. They do not explain what occurred during a specific incident in 1959.

There is no evidence of this incident (an incident in July 1959) today to the best of my knowledge. Any remaining contamination at the SRE complex is probably due to the leakage of radioactive waste tanks, not this incident in 1959.

In the statement of Dr. Thomas Cochran of the NRDC, he stated that you could not compare the SRE to Three Mile Island due to the difference in scale.

Most people that see an article in the newspaper reference a partial meltdown at the SSFL site, and they are not aware of the size of the reactor or how that incident would be ranked - a two on the INES scale.

To the best of my knowledge, there was no evidence of any release other than the gases Xenon and Krypton. I believe that is what the EPA HSA said as well.

Due to the controversial nature of this issue, and litigation that occurs when documents reference this incident, I respectfully request that the focus of the DEIS be on what is there today in AREA IV that is a contaminant of concern.

The focus on the DRAFT Environmental Impact Statement should mention the SRE, and it should mention an incident. But it should also point out that there is no evidence of widespread radiation from this incident.

Please see this EPA Power Point regarding the history of AREA IV:
http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/3dc283e6c5d6056f88257426007417a2/db19cbb72e867e3c88257acd00621c69/$FILE/EPA%20Public%20Meeting%20Presentation%2012%20Dec%202012.pdf

Maps should be created that remove Cesium or Strontium that is considered at or below Background so that people do not believe that this contamination came from a discrete event. The maps should show the areas that require remediation.

DTSC needs to put the radionuclides above "Background" in context with the FAL used by the EPA, "Background" Look Up Table" values created by DTSC. and what these values would be at a suburban residential standard, a commercial / industrial standard, and a parkland standard.

Respectfully submitted,

Christine L. Rowe

Newton's Third Law of Motion:

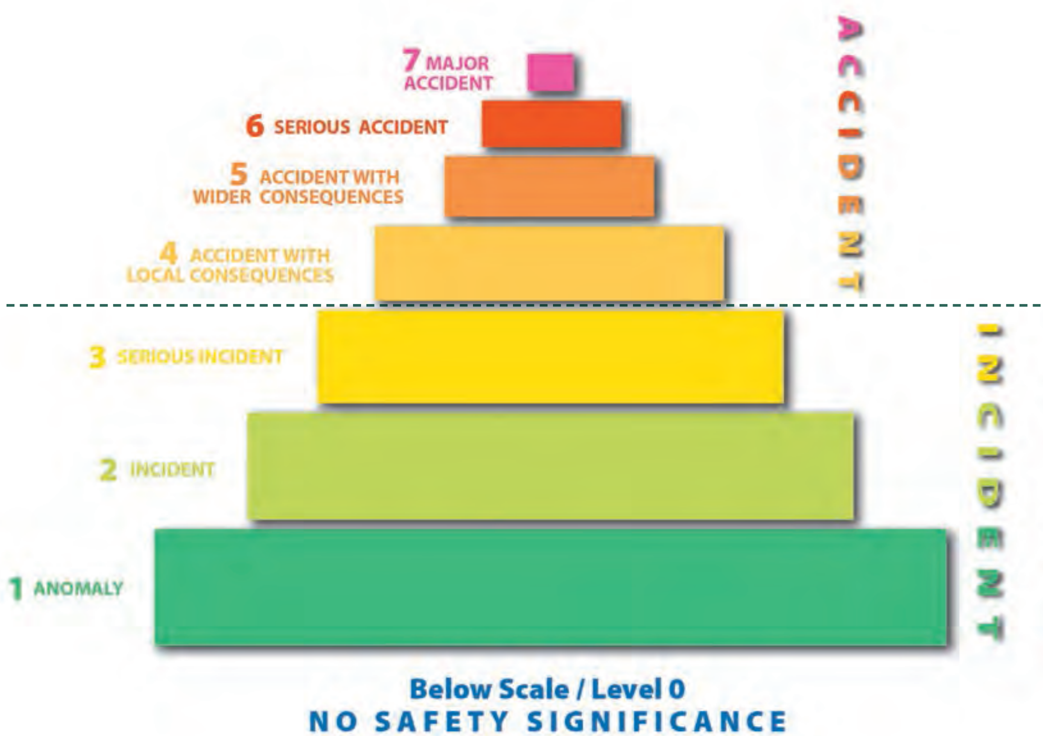
"For every action there is an equal and opposite re-action."

INES

The International Nuclear and Radiological Event Scale

User's Manual

2008 Edition



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FOREWORD

The need for easily communicating the significance of any event related to the operation of nuclear facilities or the conduct of activities that give rise to radiation risks arose in the 1980s following some accidents in nuclear facilities that attracted international media attention. In response, and based on previous national experience in some countries, proposals were made for the development of an international event rating scale similar to scales already in use in other areas (such as those comparing the severity of earthquakes), so that communication on the radiation risks associated with a particular event could be made consistent from one country to another.

The International Nuclear and Radiological Event Scale (INES) was developed in 1990 by international experts convened by the IAEA and the OECD Nuclear Energy Agency (OECD/NEA) with the aim of communicating the safety significance of events at nuclear installations. Since then, INES has been expanded to meet the growing need for communication on the significance of any event giving rise to radiation risks. In order to better meet public expectations, INES was refined in 1992 and extended to be applicable to any event associated with radioactive material and/or radiation, including the transport of radioactive material. In 2001, an updated edition of the INES User's Manual was issued to clarify the use of INES and to provide refinement for rating transport -and fuel cycle-related events. However, it was recognized that further guidance was required and work was already under way, particularly in relation to transport-related events. Further work was carried out in France and in Spain on the potential and actual consequences of radiation source and transport-related events. At the request of INES members, the IAEA and the OECD/NEA Secretariat coordinated the preparation of an integrated manual providing additional guidance for rating any event associated with radiation sources and the transport of radioactive material.

This new edition of the INES User's Manual consolidates the additional guidance and clarifications, and provides examples and comments on the continued use of INES. This publication supersedes earlier editions. It presents criteria for rating any event associated with radiation and radioactive material, including transport-related events. This manual is arranged in such a way as to facilitate the task of those who are required to rate the safety significance of events using INES for communicating with the public.

The INES communication network currently receives and disseminates information on events and their appropriate INES rating to INES National Officers in over 60 Member States. Each country participating in INES has set up a network that ensures that events are promptly rated and communicated

inside or outside the country. The IAEA provides training services on the use of INES on request and encourages Member States to join the system.

This manual was the result of efforts by the INES Advisory Committee as well as INES National Officers representing INES member countries. The contributions of those involved in drafting and reviewing the manual are greatly appreciated. The IAEA and OECD/NEA wish to express their gratitude to the INES Advisory Committee members for their special efforts in reviewing this publication. The IAEA expresses its gratitude for the assistance of S. Mortin in the preparation of this publication and for the cooperation of J. Gauvain, the counterpart at the OECD/NEA. The IAEA also wishes to express its gratitude to the Governments of Spain and the United States of America for the provision of extrabudgetary funds.

The IAEA officer responsible for this publication was R. Spiegelberg Planer of the Department of Nuclear Safety and Security.

EDITORIAL NOTE

CONTENTS

1. SUMMARY OF INES

1.1. BACKGROUND

The International Nuclear and Radiological Event Scale is used for promptly and consistently communicating to the public the safety significance of events associated with sources of radiation. It covers a wide spectrum of practices, including industrial use such as radiography, use of radiation sources in hospitals, activities at nuclear facilities, and the transport of radioactive material. By putting events from all these practices into a proper perspective, use of INES can facilitate a common understanding between the technical community, the media and the public.

The scale was developed in 1990 by international experts convened by the IAEA and the OECD Nuclear Energy Agency (OECD/NEA). It originally reflected the experience gained from the use of similar scales in France and Japan as well as consideration of possible scales in several countries. Since then, the IAEA has managed its development in cooperation with the OECD/NEA and with the support of more than 60 designated National Officers who officially represent the INES member States in the biennial technical meeting of INES.

Initially the scale was applied to classify events at nuclear power plants, and then was extended and adapted to enable it to be applied to all installations associated with the civil nuclear industry. More recently, it has been extended and adapted further to meet the growing need for communication of the significance of all events associated with the transport, storage and use of radioactive material and radiation sources. This revised manual brings together the guidance for all uses into a single document.

1.2. GENERAL DESCRIPTION OF THE SCALE

Events are classified on the scale at seven levels: Levels 4–7 are termed “accidents” and Levels 1–3 “incidents”. Events without safety significance are classified as “Below Scale/Level 0”. Events that have no safety relevance with respect to radiation or nuclear safety are not classified on the scale (see Section 1.3).

For communication of events to the public, a distinct phrase has been attributed to each level of INES. In order of increasing severity, these are: ‘anomaly’, ‘incident’, ‘serious incident’, ‘accident with local consequences’, ‘accident with wider consequences’[1], ‘serious accident’ and ‘major accident’.

The aim in designing the scale was that the severity of an event would increase by about an order of magnitude for each increase in level on the scale (i.e. the scale is logarithmic). The 1986 accident at the Chernobyl nuclear power plant is rated at Level 7 on INES. It had widespread impact on people and the environment. One of the key considerations in developing INES rating criteria was to ensure that the significance level of less severe and more localized events were clearly separated from this very severe accident. Thus the 1979 accident at the Three Mile Island nuclear power plant is rated at Level 5 on INES, and an event resulting in a single death from radiation is rated at Level 4.

The structure of the scale is shown in Table 1. Events are considered in terms of their impact on three different areas: impact on people and the environment; impact on radiological barriers and controls at facilities; and impact on defence in depth. Detailed definitions of the levels are provided in the later sections of this manual.

The impact on people and the environment can be localized (i.e. radiation doses to one or a few people close to the location of the event, or widespread as in the release of radioactive material from an installation). The impact on radiological barriers and controls at facilities is only relevant to facilities handling major quantities of radioactive material such as power reactors, reprocessing facilities, large research reactors or large source production facilities. It covers events such as reactor core melt and the spillage of significant quantities of radioactive material resulting from failures of radiological barriers, thereby threatening the safety of people and the environment. Those events rated using these two areas (people and environment, and radiological barriers and controls) are described in this manual as events with “actual consequences.” Reduction in defence in depth principally covers those events with no actual consequences, but where the measures put in place to prevent or cope with accidents did not operate as intended.

Level 1 covers only degradation of defence in depth. Levels 2 and 3 cover more serious degradations of defence in depth or lower levels of actual consequence to people or facilities. Levels 4 to 7 cover increasing levels of actual consequence to people, the environment or facilities.

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[1] For example, a release from a facility likely to result in some protective action, or several deaths resulting from an abandoned large radioactive source.

TABLE 1. GENERAL CRITERIA FOR RATING EVENTS IN INES

Description and INES Level	People and the environment	Radiological barriers and controls at facilities	Defence in depth
Major accident Level 7	- Major release of radioactive material with widespread health and environmental effects requiring implementation of planned and extended countermeasures.		
Serious accident Level 6	- Significant release of radioactive material likely to require implementation of planned countermeasures.		
Accident with wider consequences Level 5	- Limited release of radioactive material likely to require implementation of some planned countermeasures. - Several deaths from radiation.	- Severe damage to reactor core. - Release of large quantities of radioactive material within an installation with a high probability of significant public exposure. This could arise from a major criticality accident or fire.	
Accident with local consequences Level 4	- Minor release of radioactive material unlikely to result in implementation of planned countermeasures other than local food controls. - At least one death from radiation.	- Fuel melt or damage to fuel resulting in more than 0.1% release of core inventory. - Release of significant quantities of radioactive material within an installation with a high probability of significant public exposure.	
Serious incident Level 3	- Exposure in excess of ten times the statutory annual limit for workers. - Non-lethal deterministic health effect (e.g. burns) from radiation.	- Exposure rates of more than 1 Sv/hr in an operating area. - Severe contamination in an area not expected by design, with a low probability of significant public exposure.	- Near accident at a nuclear power plant with no safety provisions remaining. - Lost or stolen highly radioactive sealed source. - Misdelivered highly radioactive sealed source without adequate radiation procedures in place to handle it.
Incident Level 2	- Exposure of a member of the public in excess of 10mSv. - Exposure of a worker in excess of the statutory annual limits.	- Radiation levels in an operating area of more than 50 mSv/h. - Significant contamination within the facility into an area not expected by design.	- Significant failures in safety provisions but with no actual consequences. - Found highly radioactive sealed orphan source, device or transport package with safety provisions intact. - Inadequate packaging of a highly radioactive sealed source.
Anomaly Level 1			- Overexposure of a member of the public in excess of statutory limits. - Minor problems with safety components with significant defence in depth remaining. - Low activity lost or stolen radioactive source, device or transport package.
	No safety significance (Below scale/Level 0)		

Although INES covers a wide range of practices, it is not credible for events associated with some practices to reach the upper levels of the scale. For example, events associated with the transport of sources used in industrial radiography could never exceed Level 4, even if the source was taken and handled incorrectly.

1.3. SCOPE OF THE SCALE

The scale can be applied to any event associated with the transport, storage and use of radioactive material and radiation sources. It applies whether or not the event occurs at a facility. It includes the loss or theft of radioactive sources or packages and the discovery of orphan sources, such as sources inadvertently transferred into the scrap metal trade. The scale can also be used for events involving the unplanned exposure of individuals in other regulated practices (e.g. processing of minerals).

The scale is only intended for use in civil (non-military) applications and only relates to the safety aspects of an event. The scale is not intended for use in rating security-related events or malicious acts to deliberately expose people to radiation.

When a device is used for medical purposes (e.g. radiodiagnosis and radiotherapy), the guidance in this manual can be used for the rating of events resulting in actual exposure of workers and the public, or involving degradation of the device or deficiencies in the safety provisions. Currently, the scale does not cover the actual or potential consequences on patients exposed as part of a medical procedure. The need for guidance on such exposures during medical procedures is recognized and will be addressed at a later date.

The scale does not apply to every event at a nuclear or radiation facility. The scale is not relevant for events solely associated with industrial safety or other events which have no safety relevance with respect to radiation or nuclear safety. For example, events resulting in only a chemical hazard, such as a gaseous release of non-radioactive material, or an event such as a fall or an electrical shock resulting in the injury or death of a worker at a nuclear facility would not be classified using this scale. Similarly, events affecting the availability of a turbine or generator, if they did not affect the reactor at power, would not be classified on the scale nor would fires if they did not involve any possible radiological hazard and did not affect any equipment associated with radiological or nuclear safety.

1.4. PRINCIPLES OF INES CRITERIA

Each event needs to be considered against each of the relevant areas described in Section 1.2, namely: people and the environment; radiological barriers and controls; and defence in depth. The event rating is then the highest level from consideration of each of the three areas. The following sections briefly describe the principles associated with assessing the impact on each area.

1.4.1. People and the environment

The simplest approach to rating actual consequences to people would be to base the rating on the doses received. However, for accidents, this may not be an appropriate measure to address the full range of consequences. For example, the efficient application of emergency arrangements for evacuation of members of the public may result in relatively small doses, despite a significant accident at an installation. To rate such an event purely on the doses received does not communicate the true significance of what happened at the installation, nor does it take account of the potential widespread contamination. Thus, for the accident levels of INES (4–7), criteria have been developed based on the quantity of radioactive material released, rather than the dose received. Clearly these criteria only apply to practices where there is the potential to disperse a significant quantity of radioactive material.

In order to allow for the wide range of radioactive material that could potentially be released, the scale uses the concept of “radiological equivalence.” Thus, the quantity is defined in terms of terabecquerels of ^{131}I, and conversion factors are defined to identify the equivalent level for other isotopes that would result in the same level of effective dose.

For events with a lower level of impact on people and the environment, the rating is based on the doses received and the number of people exposed.

(The criteria for releases were previously referred to as “off-site” criteria)

1.4.2. Radiological barriers and controls

In major facilities with the potential (however unlikely) for a large release of activity, where a site boundary is clearly defined as part of their licensing, it is possible to have an event where there are significant failures in radiological barriers but no significant consequences for people and the environment (e.g. reactor core melt with radioactive material kept within the containment). It is also possible to have an event at such facilities where there is significant contamination spread or increased radiation, but where there is still considerable defence in depth remaining that would prevent significant consequences to people and the environment. In both cases, there are no significant consequences to individuals outside the site boundary, but in the first case, there is an increased likelihood of such consequences to individuals, and in the second case, such failures represent a major failure in the management of radiological controls. It is important that the rating of such events on INES takes appropriate account of these issues.

The criteria addressing these issues only apply at authorized facilities handling major quantities of radioactive materials. (These criteria, together with the criteria for worker doses, were previously referred to as "on-site" criteria). For events involving radiation sources and the transport of radioactive material, only the criteria for people and the environment, and for defence in depth need to be considered.

1.4.3. Defence in depth

INES is intended to be applicable to all radiological events and all nuclear or radiation safety events, the vast majority of which relate to failures in equipment or procedures. While many such events do not result in any actual consequences, it is recognized that some are of greater safety significance than others. If these types of events were only rated based on actual consequences, all such events would be rated at "Below scale/Level 0", and the scale would be of no real value in putting them into perspective. Thus, it was agreed at its original inception, that INES needed to cover not only actual consequences but also the potential consequences of events.

A set of criteria was developed to cover what has become known as "degradation of defence in depth." These criteria recognize that all applications involving the transport, storage and use of radioactive material and radiation sources incorporate a number of safety provisions. The number and reliability of these provisions depends on their design and the magnitude of the hazard. Events may occur where some of these safety provisions fail but others prevent any actual consequences. In order to communicate the significance of such events, criteria are defined which depend on the amount of radioactive material and the severity of the failure of the safety provisions.

Since these events only involve an increased likelihood of an accident, with no actual consequences, the maximum rating for such events is set at Level 3 (i.e. a serious incident). Furthermore, this maximum level is only applied to practices where there is the potential, if all safety provisions failed, for a significant accident (i.e. one rated at Levels 5, 6 or 7 in INES). For events associated with practices that have a much smaller hazard potential (e.g. transport of small medical or industrial radioactive sources), the maximum rating under defence in depth is correspondingly lower.

One final issue that is addressed under defence in depth is what is described in this document as additional factors, covering as appropriate, common cause failure, issues with procedures and safety culture. To address these additional factors, the criteria allow the rating to be increased by one level from the rating derived solely by considering the significance of the actual equipment or administrative failures. (It should be noted that for events related to radiation sources and transport of radioactive material, the possibility of increasing the level due to additional factors is included as part of the rating tables rather than as a separate consideration.)

The detailed criteria developed to implement these principles are defined in this document. Three specific but consistent approaches are used; one for transport and radiation source events, one specific to events at power reactors in operation and one for events at other authorized facilities (including events at reactors during cold shutdown, research reactors and decommissioning of nuclear facilities). It is for this reason that there are three separate sections for defence in depth, one for each of these approaches. Each section is self-contained, allowing users to focus on the guidance relevant to events of interest.

The criteria for transport and radiation source events are contained in a set of tables that combine all three elements of defence in depth mentioned earlier (i.e. the amount of radioactive material, the extent of any failure of safety provisions and additional factors).

The criteria for power reactors in operation give a basic rating from two tables and allow additional factors to increase the rating by one level. The basic rating from the tables depends on whether the safety provisions were actually challenged, the extent of any degradation of the safety provisions and the likelihood of an event that would challenge such provisions.

The criteria for events at reactors in cold shutdown, research reactors and other authorized facilities give a basic rating from a table, depending on the maximum consequences, were all the safety provisions to fail, and the extent of the remaining safety provisions. This latter factor is accounted for by grouping safety provisions into what are called independent safety layers and counting the number of such safety layers. Additional factors are then considered by allowing a potential increase in the basic rating by one level.

1.4.4. The final rating

The final rating of an event needs to take account of all the relevant criteria described above. Each event should be considered against each of the appropriate criteria and the highest derived rating is the one to be applied to the event. A final check for consistency with the general description of the levels of INES ensures the appropriateness of the rating. The overall approach to rating is summarized in the flow charts of Section 7.

1.5. USING THE SCALE

INES is a communication tool. Its primary purpose is to facilitate communication and understanding between the technical community, the media and the public on the safety significance of events. Some more specific guidance on the use of INES as part of communicating event information is given in Section 1.6.

It is not the purpose of INES or the international communication system associated with it to define the practices or installations that have to be included within the scope of the regulatory control system, nor to establish requirements for events to be reported by the users to the regulatory authority or to the public. The communication of events and their INES ratings is not a formal reporting system. Equally, the criteria of the scale are not intended to replace existing well-established criteria used for formal emergency arrangements in any country. It is for each country to define its own regulations and arrangements for such matters. The purpose of INES is simply to help to put into perspective the safety significance of those events that are to be communicated.

It is important that communications happen promptly; otherwise a confused understanding of the event will occur from media and public speculation. In some situations, where not all the details of the event are known early on, it is recommended that a provisional rating is issued based on the information that is available and the judgement of those understanding the nature of the event. Later on, a final rating should be communicated and any differences explained.

For the vast majority of events, such communications will only be of interest in the region or country where the event occurs, and participating countries will have to set up mechanisms for such communications. However, in order to facilitate international communications for events attracting, or possibly attracting, wider interest, the IAEA and OECD/NEA have developed a communications network that allows details of the event to be input on an event rating form (ERF), which is then immediately disseminated to all INES member States. Since 2001, this web-based INES information service has been used by the INES members to communicate events to the technical community as well as to the media and public.

It is not appropriate to use INES to compare safety performance between facilities, organizations or countries. Arrangements for reporting minor events to the public may be different, and it is difficult to ensure precise consistency in rating events at the boundary between Below scale/Level 0 and Level 1. Although information will be available on events at Level 2 and above, the statistically small number of such events, which also varies from year to year, makes it difficult to put forth meaningful international comparisons.

1.6. COMMUNICATING EVENT INFORMATION

1.6.1. General principles

INES should be used as part of a communications strategy, locally, nationally and internationally. While it is not appropriate for an international document to define exactly how national communications should be carried out, there are some general principles that can be applied. These are provided in this section. Guidance on international communications is provided in Section 1.6.2.

When communicating events using the INES rating, it needs to be remembered that the target audience is primarily the media and the public. Therefore:

- Use plain language and avoid technical jargon in the summary description of the event;
- Avoid abbreviations, especially if equipment or systems are mentioned (e.g. main coolant pump instead of MCP);
- Mention the actual confirmed consequences such as deterministic health effects to workers and/or members of the public;
- Provide an estimate of the number of workers and/or members of the public exposed as well as their actual exposure;
- Affirm clearly when there are no consequences to people and the environment;
- Mention any protective action taken.

The following elements are relevant when communicating events at nuclear facilities:

- Date and time of the event;
- Facility name and location;
- Type of facility;

— Main systems involved, if relevant;
— A general statement saying that there is/is not release of radioactivity to the environment or there are/are not any consequences for people and the environment.

In addition, the following elements are relevant parts of the event description for an event related to radiation sources or the transport of radioactive material:

— The radionuclides involved in the events;
— The practice for which the source was used and its IAEA Category [1];
— The condition of the source and associated device; and if it is lost, any information that will be helpful in identifying the source or device, such as the registration serial number(s).

1.6.2. International communications

As explained in Section 1.5, the IAEA maintains a system to facilitate international communication of events. It is important to recognize that this service is not a formal reporting system, and the system operates on a voluntary basis. Its purpose is to facilitate communication and understanding between the technical community (industry and regulators), the media and the public on the safety significance of events that have attracted or are likely to attract international media interest. There are also benefits in using the system to communicate transboundary transport events.

Many countries have agreed to participate in the INES system because they clearly recognize the importance of open communication of events in a way that clearly explains their significance.

All countries are strongly encouraged to communicate events internationally (within 24 hours if possible) according to the agreed criteria which are:

— Events rated at Level 2 and above; or
— Events attracting international public interest.

It is recognized that there will be occasions when a longer time scale is required to know or estimate the actual consequences of the event. In these circumstances, a provisional rating should be given with a final rating provided at a later date.

Events are posted in the system by the INES national officers, who are officially designated by the Member States. The system includes event descriptions, ratings in INES, press releases (in the national language and in English), and technical documentation for experts. Event descriptions, ratings and press releases are available to the general public without registration. Access to the technical documentation is limited to nominated and registered experts.

The main items to be provided for a specific event are summarized in the ERF. The information being made available to the public should follow the principles listed in Section 1.6.1. When the scale is applied to transport of radioactive material, the multinational nature of some transport events complicates the issue; however, the ERF for each event should only be provided by one country. The ERF, which itself is not available to the public, is posted by the country where the event occurs. The principles to be applied are as follows:

— It is expected that the country in which the event is discovered would initiate the discussion about which country will provide the event rating form.
— As general guidance, if the event involves actual consequences, the country in which the consequences occur is likely to be best placed to provide the event rating form. If the event only involves failures in administrative controls or packaging, the country consigning the package is likely to be best placed to provide the event rating form. In the case of a lost package, the country where the consignment originated is likely to be the most appropriate one to deal with rating and communicating the event.
— Where information is required from other countries, the information may be obtained via the appropriate competent authority and should be taken into account when preparing the event rating form.
— For events related to nuclear facilities, it is essential to identify the facility, its location and type.
— For events related to radiation sources, it may be helpful to include some technical details about the source/device or to include device registration numbers, as the INES system provides a rapid means for disseminating such information internationally.
— For events involving transport of radioactive material, it may be helpful to include the identification of the type of package (e.g. excepted, industrial, Type A, B).
— For nuclear facilities, the basic information to be provided includes the facility name, type and location, and the impact on people and the environment. Although other mechanisms already exist for international exchange of operational feedback, the INES system provides for the initial communication of the event to the media, the public and the technical community.

— The event rating form also includes the basis of the rating. Although this is not part of the material communicated to the public, it is helpful for other national officers to understand the basis of the rating and to respond to any questions. The rating explanation should clearly show how the event rating has been determined referring to the appropriate parts of the rating procedure.

1.7. STRUCTURE OF THE MANUAL

The manual is divided into seven main sections.

Section 1 provides an overview of INES.

Section 2 gives the detailed guidance required to rate events in terms of their impact on people and the environment. A number of worked examples are provided.

Section 3 provides the detailed guidance required to rate events in terms of their impact on radiological barriers and controls at facilities. Several worked examples are also provided.

Sections 4, 5 and 6 provide the detailed guidance required to rate events in terms of their impact on defence in depth.

Section 4 provides the defence in depth guidance for all events associated with transport and radiation sources, except those occurring at:

— Accelerators;
— Facilities involving the manufacture and distribution of radionuclides;
— Facilities involving the use of a Category 1 source [1];

These are all covered in Section 6.

Section 5 provides the defence in depth guidance for events at power reactors. It only relates to events while the reactor is at power. Events on power reactors while in shutdown mode, permanently shutdown or being decommissioned are covered in Section 6. Events at research reactors are also covered in Section 6.

Section 6 provides the defence in depth guidance for events at fuel cycle facilities, research reactors, accelerators (e.g. linear accelerators and cyclotrons) and events associated with failures of safety provisions at facilities involving the manufacture and distribution of radionuclides or the use of a Category 1 source. It also provides the guidance for rating events on nuclear power reactors while in cold shutdown mode (during outage, permanently shutdown or under decommissioning).

The purpose of providing three separate sections for defence in depth is to simplify the task of those determining the rating of events. While there is some duplication between chapters, each chapter contains all that is required for the rating of events of the appropriate type. Relevant worked examples are included in each of the three defence in depth sections.

Section 7 is a summary of the procedure to be used to rate events, including illustrative flowcharts and tables of examples.

Four appendices, two annexes and references provide some further scientific background information.

Definitions and terminology adopted in this manual are presented in the Glossary.

This manual supersedes the 2001 edition [2], the 2006 working material published as additional guidance to National Officers [3] and the clarification for fuel damage events approved in 2004 [4].

2. IMPACT ON PEOPLE AND THE ENVIRONMENT

2.1. GENERAL DESCRIPTION

The rating of events in terms of their impact on people and the environment takes account of the actual radiological impact on workers, members of the public and the environment. The evaluation is based on either the doses to people or the amount of radioactive material released. Where it is based on dose, it also takes account of the number of people who receive a dose. Events must also be rated using the criteria related to defence in depth (Sections 4, 5 or 6) and, where appropriate, using the criteria related to radiological barriers and controls at facilities (Section 3), in case those criteria give rise to a higher rating in INES.

It is accepted that for a serious incident or an accident, it may not be possible during the early stages of the event to determine accurately the doses received or the size of a release. However, it should be possible to make an initial estimate and thus to assign a provisional rating. It needs to be remembered that the purpose of INES is to allow prompt communication of the significance of an event.

In events where a significant release has not occurred, but is possible if the event is not controlled, the provisional level is likely to be based on what has actually occurred so far (using all the relevant INES criteria). It is possible that subsequent re-evaluation of the consequences would necessitate revision of the provisional rating.

The scale should not be confused with emergency classification systems, and should not be used as a basis for determining emergency response actions. Equally, the extent of emergency response to events is not used as a basis for rating. Details of the planning against radiological events vary from one country to another, and it is also possible that precautionary measures may be taken in some cases even where they are not fully justified by the actual size of the release. For these reasons, it is the size of release and the assessed dose that should be used to rate the event on the scale and not the protective actions taken in the implementation of emergency response plans.

Two types of criteria are described in this section:

— Amount of activity released: applicable to large releases of radioactive material into the environment;
— Doses to individuals: applicable to all other situations.

The procedure for applying these criteria is summarized in the flowcharts in Section 7. However, it should be noted that for events associated with transport and radiation sources, it is only necessary to consider the criteria for doses to individuals when there is a significant release of radioactive material.

2.2. ACTIVITY RELEASED

The highest four levels on the scale (Levels 4–7) include a definition in terms of the quantity of activity released, defining its size by its radiological equivalence to a given number of terabecquerels of ^{131}I. (The method for assessing radiological equivalence is given in Section 2.2.1). The choice of this isotope is somewhat arbitrary. It was used because the scale was originally developed for nuclear power plants and ^{131}I would generally be one of the more significant isotopes released.

The reason for using quantity released rather than assessed dose is that for these larger releases, the actual dose received will very much depend on the protective action implemented and other environmental conditions. If the protective actions are successful, the doses received will not increase in proportion to the amount released.

2.2.1. Methods for assessing releases

Two methods are given for assessing the radiological significance of a release, depending on the origin of the release and hence the most appropriate assumptions for assessing the equivalence of releases. If there is an atmospheric release from a nuclear facility, such as a reactor or fuel cycle facility, Table 2 gives conversion factors for radiological equivalence to ^{131}I that should be used. The actual activity of the isotope released should be multiplied by the factor given in Table 2 and then compared with the values given in the definition of each level. If several isotopes are released, the equivalent value for each should be calculated and then summed (see examples 5–7). The derivation of these factors is explained in Appendix I.

If the release occurs during the transport of radioactive material or from the use of radiation sources, D_2 values should be used. The D values are a level of activity above which a source is considered to be ‘dangerous’ and has a significant potential to cause severe deterministic effects if not managed safely and securely. The D_2 value is “the activity of a radionuclide in a source that, if uncontrolled and dispersed, might result in an emergency that could reasonably be expected to cause severe deterministic health effects” [5]. Appendix III lists D_2 values for a range of isotopes.

TABLE 2. RADIOLOGICAL EQUIVALENCE TO ^{131}I FOR RELEASES TO THE ATMOSPHERE

Isotope	Multiplication factor
Am-241	8 000
Co-60	50
Cs-134	3
Cs-137	40
H-3	0.02
I-131	1
Ir-192	2
Mn-54	4
Mo-99	0.08
P-32	0.2
Pu-239	10 000
Ru-106	6
Sr-90	20
Te-132	0.3
U-235(S)[a]	1 000
U-235(M)[a]	600
U-235(F)[a]	500
U-238(S)[a]	900
U-238(M)[a]	600
U-238(F)[a]	400
U nat	1 000
Noble gases	Negligible (effectively 0)

[a] Lung absorption types: S — slow; M — medium; F — fast. If unsure, use the most conservative value.

For events involving releases that do not become airborne (e.g. aquatic releases or ground contamination due to spillage of radioactive material), the rating based on dose should be established, using Section 2.3. Liquid discharges resulting in doses significantly higher than that appropriate for Level 3 would need to be rated at Level 4 or above, but the assessment of radiological equivalence would be site specific, and therefore detailed guidance cannot be provided here.

2.2.2. Definition of levels based on activity released[2]

Level 7

"An event resulting in an environmental release corresponding to a quantity of radioactivity radiologically equivalent to a release to the atmosphere of more than several tens of thousands of terabecquerels of ^{131}I*."*

This corresponds to a large fraction of the core inventory of a power reactor, typically involving a mixture of short and long lived radionuclides. With such a release, stochastic health effects over a wide area, perhaps involving more than one country, are expected, and there is a possibility of deterministic health effects. Long-term environmental consequences are also likely, and it is very likely that protective action such as sheltering and evacuation will be judged necessary to prevent or limit health effects on members of the public.

Level 6

"An event resulting in an environmental release corresponding to a quantity of radioactivity radiologically equivalent to a release to the atmosphere of the order of thousands to tens of thousands of terabecquerels of ^{131}I*."*

With such a release, it is very likely that protective action such as sheltering and evacuation will be judged necessary to prevent or limit health effects on members of the public.

Level 5

"An event resulting in an environmental release corresponding to a quantity of radioactivity radiologically equivalent to a release to the atmosphere of the order of hundreds to thousands of terabecquerels of ^{131}I*."*

or

[2] These criteria relate to accidents where early estimates of the size of release can only be approximate. For this reason, it is inappropriate to use precise numerical values in the definitions of the levels. However, in order to help ensure consistent interpretation of these criteria internationally, it is suggested that the boundaries between the levels are about 500, 5000 and 50 000 TBq ^{131}I.

"An event resulting in a dispersed release of activity from a radioactive source with an activity greater than 2500 times the D_2 value for the isotopes released."

As a result of the actual release, some protective action will probably be required (e.g. localized sheltering and/or evacuation to prevent or minimize the likelihood of health effects).

Level 4

"An event resulting in an environmental release corresponding to a quantity of radioactivity radiologically equivalent to a release to the atmosphere of the order of tens to hundreds of terabecquerels of ^{131}I."

or

"An event resulting in a dispersed release of activity from a radioactive source with an activity greater than 250 times the D_2 value for the isotopes released."

For such a release, protective action will probably not be required, other than local food controls.

2.3. DOSES TO INDIVIDUALS

The most straightforward criterion is that of dose received as a result of the event, and Levels 1 to 6 include a definition based on that criterion[3]. Unless specifically stated (see Level 1 criteria[3]), they apply to doses that were received, or could have easily been received[4], from the single event being rated (i.e. excluding cumulative exposure). They define a minimum rating if one individual is exposed above the given criteria (section 2.3.1) and a higher rating if more individuals are exposed above those criteria (section 2.3.2).

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[3] The Level 1 definitions are based on the defence in depth criteria explained in Sections 4–6 but they are included here for completeness.

[4] The intention here is not to invent scenarios different than the one that occurred but to consider what doses might reasonably have occurred unknowingly. For example if a radioactive source has become separated from its shielding and transported, doses to drivers and package handlers should be estimated.

2.3.1. Criteria for the assessment of the minimum rating when one individual is exposed

Level 4 is the minimum level for events that result in:

(1) *"The occurrence of a lethal deterministic effect;*

or

(2) *The likely occurrence of a lethal deterministic effect as a result of whole body exposure, leading to an absorbed dose*[5] *of the order of a few Gy".*

Appendix II presents further details on the likelihood of fatal deterministic effects and the thresholds for non-lethal deterministic effects.

Level 3 is the minimum level for events that result in:

(1) *"The occurrence or likely occurrence of a non-lethal deterministic effect (see Appendix II for further details);*

or

(2) *Exposure leading to an effective dose greater than ten times the statutory annual whole body dose limit for workers".*

Level 2 is the minimum level for events that result in:

(1) *"Exposure of a member of the public leading to an effective dose in excess of 10 mSv;*

or

(2) *Exposure of a worker in excess of statutory annual dose limits*[6]."

Level 1[3] is the minimum level for events that result in:

(1) "*Exposure of a member of the public in excess of statutory annual dose limits*[6]*;*

or

(2) *Exposure of a worker in excess of dose constraints*[7];

or

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[5] Where high LET radiation is significant, the absorbed dose should take into account the appropriate RBE. The RBE weighted absorbed dose should be used to determine the appropriate INES rating.

[6] The dose limits to be considered are all statutory dose limits including whole body effective dose, doses to skin, doses to extremities and doses to lens of the eye.

[7] Dose constraint is a value below the statutory dose limit that may be established by the country.

(3) *Cumulative exposure of a worker or a member of the public in excess of statutory annual dose limits*[6]*"*.

2.3.2. Criteria for consideration of the number of individuals exposed

If more than one individual is exposed, the number of people falling into each of the defined levels in Section 2.3.1 should be assessed and in each case, the guidance given in the following paragraphs should be used to increase the rating as necessary.

For exposures that do not cause or are unlikely to cause a deterministic effect, the minimum rating assessed in Section 2.3.1 should be increased by one level if doses above the value defined for the level are received by 10 or more individuals, and by two levels if the doses are received by 100 or more individuals.

For exposures that have caused or are likely to cause deterministic effects, a more conservative approach is taken, and the rating should be increased by one level if doses above the value defined for the level are received by several individuals and by two levels if the doses are received by a few tens of individuals[8].

A summary table of the criteria in this section and the preceding section is presented in Section 2.3.4.

Where a number of individuals are exposed at differing levels, the event rating is the highest of the values derived from the process described. For example, for an event resulting in 15 members of the public receiving an effective dose of 20 mSv, the minimum rating applicable to that dose is Level 2. Taking into consideration the number of individuals exposed (15) leads to an increase of one level, giving a rating at Level 3. However if only one member of the public received an effective dose of 20 mSv, and 14 received effective doses between one and 10 mSv, the rating based on those receiving an effective dose of 20 mSv would be Level 2 (minimum rating, not increased, as only one person affected) and the rating based on those receiving an effective dose of more than one but less than 10 mSv would be Level 2 (minimum rating of Level 1, increased by one, as more than 10 people were exposed). Thus the overall rating would be Level 2.

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[8] As guidance to help with a consistent approach to the application of these criteria, it may be considered that "several" is more than three and "a few tens" is more than 30. (These values correspond to approximately half an order of magnitude on a logarithmic basis.)

2.3.3. Dose estimation methodology

The methodology for estimation of doses to workers and the public should be realistic and follow the standard national assumptions for dose assessment. The assessment should be based on the real scenario, including any protective action taken.

If it cannot be known for certain whether particular individuals received a dose (e.g. a transport package subsequently found to have inadequate shielding), the probable doses should be estimated and the level on INES assigned based on a reconstruction of the likely scenario.

2.3.4. Summary

The guidance in Section 2.3 is summarized in Table 3, showing how the level of dose and the number of people exposed are taken into account.

TABLE 3. SUMMARY OF RATING BASED ON DOSES TO INDIVIDUALS

Level of exposure	Minimum rating	Number of individuals	Actual rating
The occurrence of a lethal deterministic effect or the likely occurrence of a lethal deterministic effect as a result of a whole body absorbed dose of the order of a few Gy	4	Few tens or more	6[a]
		Between several and a few tens	5
		Less than several	4
The occurrence or likely occurrence of a non-lethal deterministic effect	3	Few tens or more	5
		Between several and a few tens	4
		Less than several	3
Exposure leading to an effective dose greater than ten times the statutory annual whole body dose limit for workers	3	100 or more	5
		10 or more	4
		Less than ten	3
Exposure of a member of the public leading to an effective dose in excess of 10 mSv or Exposure of a worker in excess of statutory annual dose limits	2	100 or more	4
		10 or more	3
		Less than ten	2

TABLE 3. SUMMARY OF RATING BASED ON DOSES TO INDIVIDUALS (cont.)

Level of exposure	Minimum rating	Number of individuals	Actual rating
Exposure of a member of the public in excess of statutory annual dose limits or Exposure of a worker in excess of dose constraints	1	100 or more 10 or more Less than ten	3 2 1[b]
Cumulative exposure of workers or members of the public in excess of statutory annual dose limits	1	1 or more	1[b]

[a] Level 6 is not considered credible for any event involving radiation sources.

[b] As explained in Section 2.3, the Level 1 definitions are based on defence in depth criteria explained in Sections 4–6, but they are included here for completeness.

2.4. WORKED EXAMPLES

The purpose of these examples is to illustrate the rating guidance contained in this section of the manual. The examples are based on real events but have been modified slightly to illustrate the use of different parts of the guidance. The rating derived in this section is not necessarily the final rating as it would be necessary to consider the criteria in Sections 3 to 6 before defining the final rating.

Example 1. Overexposure of an electrician at a hospital — Level 2

Event description

While a service person was installing and adjusting a new radiotherapy machine in a hospital, he was not aware of an electrician working above the ceiling. He tested the machine, pointing the radiation beam towards the ceiling, and the electrician was probably exposed. The estimated whole body exposure range was between 80 mSv and 100 mSv effective dose. The electrician had no symptoms but as a precaution, a blood test was undertaken. As would be expected for this level of dose, the blood test was negative.

Rating explanation

Criteria	Explanation
2.2.1. Activity released	Not applicable. No release.
2.3. Doses to individuals	One person (not an occupational radiation worker) received an effective dose greater than 10 mSv but less than “ten times the statutory annual whole body dose limit for workers”. There were no deterministic health effects. Rating Level 2.
Rating for impact on people and the environment	Level 2.

Example 2. Overexposure of a radiographer — Level 2

Event description

A radiographer was disconnecting the source guide tube from a radiographic camera and noticed that the source was not in the fully shielded position. The exposure device contained an 807 GBq ^{192}Ir sealed source. The radiographer noticed that his pocket ion chamber was off-scale and notified the radiation safety officer (RSO) of the company. Because extremity dosimeters are not commonly used during radiographic operations, the RSO conducted a dose reconstruction. Based on the dose reconstruction, one individual may have received an extremity dose in the range of 3.3–3.6 Gy, which is in excess of the statutory annual dose limit of 500 mSv to the skin or the extremity. Whole body dosimeter results revealed that the radiographer received a whole body dose of approximately 2 mSv. The radiographer was admitted to the hospital for observation and was later released. No deterministic effects were observed.

Subsequent information obtained indicated that the individual had worn his dosimeter on his hip and his body may have shielded the dosimeter.

Rating explanation

Criteria	Explanation
2.2. Activity released	Not applicable. No release.
2.3. Doses to individuals	One worker received a dose in excess of the annual limit. No deterministic effects were observed, nor would they be expected. Level 2. (Even taking account of the possible shielding of the dosimeter, the effective dose was well below the criteria for Level 3).
Rating for impact on people and the environment	Level 2.

Example 3. Overexposure of an industrial radiographer – Level 3

Event description

Three workers were carrying out industrial radiography using a source of 3.3 TBq of ^{192}Ir on a 22.5 m high tower platform.. For some reason, the ^{192}Ir source (pigtail) was disengaged (or never engaged) from the driver. At the end of the job, one of the workers unscrewed the guide tube, and the source fell on the platform without anyone noticing (no radiation pagers or pocket dosimeters were used). The workers left the work site and the next evening (23:00), an employee found the source and tried to identify it. He showed the source to another employee, and this latter employee noticed that the first employee had a swollen cheek. The first employee handed the source to his colleague and went down to wash his face. The second employee went down the tower with the source in his hand. When both employees decided to hand the source to their supervisor in his office, the alarming dosimeter of a worker from another company started to alarm indicating a high radiation field. The source was identified, and the employees were advised that the piece of metal was a dangerous radioactive source and to put it away immediately. The source was put in a pipe, and the owner of the company was contacted, after which the source was recovered. The time elapsed between identifying that the source was radioactive and the source recovery was about half an hour. The three construction staff members were sent for medical examination (including cytogenetics examination) and were admitted to hospital. One of them showed some deterministic effects (severe radiation burns to one hand). Five employees from the industrial radiography company had blood samples taken for analysis at a cytogenetics laboratory, however no abnormalities were observed.

Rating explanation

Criteria	Explanation
2.2. Activity released	Not applicable.
2.3. Doses to individuals	One person showed deterministic effects from the radiation. This gives a rating of Level 3.
Rating for impact on people and the environment	Level 3.

Example 4. Breakup of an abandoned highly active source — Level 5

Event description

A private radiotherapy institute moved to new premises, taking with it a ^{60}Co teletherapy unit and leaving in place a 51 TBq ^{137}Cs teletherapy unit. They failed to notify the licensing authority as required under the terms of the institute's licence. The former premises were subsequently partly demolished. As a result, the ^{137}Cs teletherapy unit became totally insecure. Two people entered the premises and, not knowing what the unit was, but thinking it might have some scrap value, removed the source assembly from the machine. They took it home and tried to dismantle it. In the attempt, the source capsule was ruptured. The radioactive source was in the form of caesium chloride salt, which is highly soluble and readily dispersible. As a result, several people were contaminated and irradiated.

After the source capsule was ruptured, the remnants of the source assembly were sold for scrap to a junkyard owner. He noticed that the source material glowed blue in the dark. Several persons were fascinated by this and over a period of days, friends and relatives came and saw the phenomenon. Fragments of the source the size of rice grains were distributed to several families. This continued for five days, by which time a number of people were showing gastrointestinal symptoms arising from their exposure to radiation from the source. The symptoms were not initially recognized as being due to irradiation. However, one of the persons irradiated made the connection between the illnesses and the source capsule and took the remnants to the public health department in the city.

This action began a chain of events, which led to the discovery of the accident. A local physicist was the first to monitor and assess the scale of the accident and took actions on his own initiative to evacuate two areas. At the same time, the authorities were informed, upon which the speed and the scale of the response were impressive. Several other sites of significant contamination were quickly identified and residents evacuated. As a result of the event, eight people developed acute radiation syndrome, and four people died from radiation exposure.

Rating explanation

Criteria	Explanation
2.2. Activity released	The source was broken up, and therefore the bulk of the activity was released into the environment. The D_2 value for ^{137}Cs from Appendix III is 20 TBq, so the release was about 2.5 times the D-value, which is well below the value for Level 4 "greater than 250 times the D_2 value".
2.3. Doses to individuals	A single death from radiation would be rated at Level 4. Because four people died, the rating should be increased by one.
Rating for impact on people and the environment	Level 5.

Example 5. Iodine-131 release from reactor — Level 5

Event description

The graphite moderator of an air-cooled plutonium production reactor had a fire, which resulted in a significant release of radioactive material. The fire started during the process of annealing the graphite structure. During normal operation, neutrons striking the graphite result in distortion of the crystal structure of the graphite. This distortion results in a buildup of stored energy in the graphite. A controlled heating annealing process was used to restore the graphite structure and release the stored energy. Unfortunately, in this case, excessive energy was released, resulting in fuel damage. The metallic uranium fuel and the graphite then reacted with air and started burning. The first indication of an abnormal condition was provided by air samplers about 800 m away. Radioactivity levels were 10 times that normally found in air.

Sampling closer to the reactor building confirmed radioactivity releases were occurring. Inspection of the core indicated the fuel elements in approximately 150 channels were overheated. After several hours of trying different methods, the fire was extinguished by a combination of water deluge and switching off the forced air cooling fans. The plant was cooled down. The amount of activity released was estimated to be between 500 and 700 TBq of ^{131}I and 20 to 40 TBq of ^{137}Cs. There were no deterministic effects and no one received a dose approaching ten times the statutory annual whole body dose limit for workers.

Rating explanation

Criteria	Explanation
2.2. Activity released	The factor for the radiological equivalence of ^{137}Cs from Table 2 is 40, so the total release was radiologically equivalent to between 1300 and 2300 TBq ^{131}I. As the upper limit is well below 5000 TBq, this is rated at Level 5, "equivalent to hundreds to thousands of TBq ^{131}I"
2.3. Doses to individuals	Not applicable. Actual individual doses are not given but as no one received doses approaching the Level 3 criteria, the individual dose criteria cannot give rise to a higher rating than that already derived from the large release criteria.
Rating for impact on people and the environment	Level 5.

Example 6. Overheating of high level waste storage tank in a reprocessing facility — Level 6

Event description

The cooling system of a highly radioactive waste storage tank failed, resulting in a temperature increase of the contents of the tank. The subsequent explosion of dry nitrate and acetate salts had a force of 75 tons of TNT. The 2.5 m thick concrete lid was thrown 30 m away. Emergency measures, including evacuation were taken to limit serious health effects.

The most significant component of the release was 1000 TBq of ^{90}Sr and 13 TBq of ^{137}Cs. A large area, measuring 300 × 50 km was contaminated by more than 4 kBq/m² of ^{90}Sr.

Rating explanation

Criteria	Explanation
2.2. Activity released	The factors for the radiological equivalence of ^{90}Sr and ^{137}Cs from Table 2 are 20 and 40 respectively, so the total release was radiologically equivalent to 20 500 TBq ^{131}I. This is rated at Level 6 "equivalent to thousands to tens of thousands of TBq ^{131}I".
2.3. Doses to individuals	Not necessary to consider, as event is already rated at Level 6.
Rating for actual consequences	Level 6.

Example 7. Major release of activity following criticality accident and fire — Level 7

Event description

Design weaknesses and a poorly planned and conducted test led to a reactor going supercritical. Attempts were made to shut the reactor down but an energy spike occurred, and some of the fuel rods began to fracture, placing fragments of the fuel rods in line with the control rod columns. The rods became stuck after being inserted only one-third of the way, and were therefore unable to stop the reaction. The reactor power increased to around 30 GW, which was ten times the normal operational output. The fuel rods began to melt, and the steam pressure rapidly increased, causing a large steam explosion. Generated steam traveled vertically along the rod channels in the reactor, displacing and destroying the reactor lid, rupturing the coolant tubes and then blowing a hole in the roof. After part of the roof blew off, the inrush of oxygen, combined with the extremely high temperature of the reactor fuel and graphite moderator, sparked a graphite fire. This fire was a significant contributor to the spread of radioactive material and the contamination of outlying areas.

The total release of radioactive material was about 14 million TBq, which included 1.8 million TBq of ^{131}I, 85 000 TBq of ^{137}Cs and other caesium radio-isotopes, 10 000 TBq of ^{90}Sr and a number of other significant isotopes.

Rating explanation

Criteria	Explanation
2.2. Activity released	The factors for the radiological equivalence of ^{90}Sr and ^{137}Cs from Table 2 are 20 and 40 respectively, so the total release was radiologically equivalent to 5.4 million TBq ^{131}I. This is rated at the highest level on the scale, Level 7 "equivalent to more than several tens of thousands of TBq ^{131}I". Although other isotopes would have been present, there is no need to include them in the calculation, as the isotopes listed are already equivalent to a Level 7 release.
2.3. Doses to individuals	Not necessary to consider, as event is already rated at Level 7.
Rating for impact on people and the environment	Level 7.

3. IMPACT ON RADIOLOGICAL BARRIERS AND CONTROLS AT FACILITIES

3.1. GENERAL DESCRIPTION

The guidance in this section is only applicable to events within authorized facilities, where a site boundary is clearly defined as part of their licensing. It is only applicable at major facilities where there is the potential (however unlikely) for a release of radioactive material that could be rated at Level 5 or above.

Every event needs to be considered against the criteria for impact on people and the environment and the criteria for impact on defence in depth, and it could be argued that those two sets of criteria cover all the issues that need to be addressed in rating an event. However, if this were done, then two key types of events would not be rated at a level appropriate to their significance.

The first type of event is where significant damage occurs to the primary barriers preventing a large release (e.g. a reactor core melt or loss of confinement of very large quantities of radioactive material at a nuclear fuel reprocessing facility). In this type of event, the principle design protection has failed, and the only barriers preventing a very large release are the remaining containment systems. Without specific criteria to address such events, they would only be rated at Level 3 under defence in depth, the same level as a “near accident with no redundancy remaining”. The criteria for Level 4 and Level 5 specifically address this situation.

The second type of event is where the primary barriers preventing a large release remain intact, but a major spillage of radioactive materials or a significant increase in dose rate occurs at facilities handling large quantities of radioactive material. Such events could well be rated at Level 1 under defence in depth due to the large numbers of barriers that would still be in place. However, these events represent a major failure in the management controls for handling radioactive material and hence in themselves suggest an underlying risk of events with significant impact on people and the environment. The criteria for Levels 2 and 3 specifically address this second type of event.

The significance of contamination is measured either by the quantity of activity spread or the resultant dose rate. These criteria relate to dose rates in an operating area but do not require a worker to be actually present. They should not be confused with the criteria for doses to workers in Section 2.3, which relate to doses actually received.

Contamination levels below the value for Level 2 are considered insignificant for the purpose of rating an event under this criterion; it is only the impact on defence in depth which has to be considered at these lower levels.

It is accepted that the exact nature of damage and/or contamination may not be known for some time following an event with consequences of this nature. However, it should be possible to make a broad estimate in order to decide an appropriate provisional rating on the event rating form. It is possible that subsequent re-evaluation of the situation would necessitate re-rating the event.

For all events, the criteria related to people and the environment (Section 2) and defence in depth (Sections 4, 5 and 6) must also be considered, as they may give rise to a higher rating.

3.2. DEFINITION OF LEVELS

Level 5

For events involving reactor fuel (including research reactors):

"*An event resulting in the melting of more than the equivalent of a few per cent of the fuel of a power reactor or the release*[9] *of more than a few per cent of the core inventory of a power reactor from the fuel assemblies*[10]*.*"

The definition is based on the total inventory of the core of a power reactor, not just the free fission product gases (the "gap inventory"). Such an amount requires significant release from the fuel matrix as well as the gap inventory. It should be noted that the rating based on fuel damage does not depend on the state of the primary circuit.

For research reactors, the fraction of fuel affected should be based on quantities of a 3000 MW(th) power reactor.

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[9] Release here is used to describe the movement of radioactive material from its intended location but still contained within the facility boundary

[10] Since the extent of fuel damage is not easily measurable, utilities and regulators should establish plant specific criteria expressed in terms of symptoms (e.g. activity concentration in the primary coolant, radiation monitoring in the containment building) to facilitate the timely rating of events involving fuel damage.

For other facilities:

"*An event resulting in a major release*[9] *of radioactive material at the facility (comparable with the release from a core melt) with a high probability of significant overexposure*[11]*.*"

Examples of non-reactor accidents would be a major criticality accident, or a major fire or explosion releasing large quantities of radioactive material within the installation.

Level 4

For events involving reactor fuel (including research reactors):

"*An event resulting in the release*[9] *of more than about 0.1% of the core inventory of a power reactor from the fuel assemblies,*[10] *as a result of either fuel melting and/or clad failure.*"

Again this definition is based on the total inventory of the core not just the "gap inventory" and does not depend on the state of the primary circuit. A release of more than 0.1% of the total core inventory could occur if either there is some fuel melting with clad failure, or if there is damage to a significant fraction (~10%) of the clad, thereby releasing the "gap inventory".

For research reactors, the fraction of fuel affected should be based on quantities of a 3000 MW(th) power reactor.

Fuel damage or degradation that does not result in a release of more than 0.1% of the core inventory of a power reactor (e.g. very localized melting or a small amount of clad damage) should be rated at Below scale/Level 0 under this criterion and then considered under the defence in depth criteria.

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[11] 'High probability' implies a similar probability to that of a release from the containment following a reactor accident.

For other facilities:

"An event involving the release[9] of a few thousand terabecquerels of activity from their primary containment[12] with a high probability of significant public overexposure[11]."

Level 3

An event resulting in a release[9] of a few thousand terabecquerels of activity into an area not expected by design[13] which require corrective action, even with a very low probability of significant public exposure."

or

"An event resulting in the sum of gamma plus neutron dose rates of greater than 1 Sv per hour in an operating area[14] *(dose rate measured 1 metre from the source).*

Events resulting in high dose rates in areas not considered as operating areas should be rated using the defence in depth approach for facilities (see Example 49).

Level 2

"An event resulting in the sum of gamma plus neutron dose rates of greater than 50 mSv per hour in an operating area[14](dose rate measured 1 metre from the source)".

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[12] In this context, the terms primary and secondary containment refer to containment of radioactive materials at non-reactor installations and should not be confused with the similar terms used for reactor containments.

[13] Areas not expected by design are those whose design basis, for either permanent or temporary structures, does not assume that during operation or following an incident the area could receive and retain the level of contamination that has occurred and prevent the spread of contamination beyond the area. Examples of events involving contamination of areas not expected by design, are:

— Contamination by radioactive material outside controlled or supervized areas, where normally no such material is present, for example floors, staircases, auxiliary buildings, and storage areas.

— Contamination by plutonium or highly radioactive fission products of an area designed and equipped only for the handling of uranium.

[14] Operating areas are areas where worker access is allowed without specific permits. It excludes areas where specific controls are required (beyond the general need for a personal dosimeter and/or coveralls) due to the level of contamination or radiation.

or

"An event resulting in the presence of significant quantities of radioactive material in the installation, in areas not expected by design[13] and requiring corrective action."

In this context, 'significant quantity' should be interpreted as:

(a) A spillage of liquid radioactive material radiologically equivalent to a spillage of the order of ten terabecquerels of ^{99}Mo.
(b) A spillage of solid radioactive material radiologically equivalent to a spillage of the order of a terabecquerel of ^{137}Cs, if in addition the surface and airborne contamination levels exceed ten times those permitted for operating areas.
(c) A release of airborne radioactive material contained within a building and radiologically equivalent to a release of the order of a few tens of gigabecquerels of ^{131}I.

3.3. CALCULATION OF RADIOLOGICAL EQUIVALENCE

Table 4 gives the isotope multiplication factors for the radiological equivalence of facility contamination. The actual activity released should be multiplied by the factor given and then compared with the values given in the definition of each level for the isotope being used for comparison. If several isotopes are released, the equivalent value for each should be calculated and then summed. The derivation of these factors is given in Appendix I.

3.4. WORKED EXAMPLES

The purpose of these examples is to illustrate the rating guidance contained in this section of the manual. The examples are based on real events but have been modified slightly to illustrate the use of different parts of the guidance. The final row of the table gives the rating based on actual consequences (i.e. taking account of the criteria in Sections 2 and 3). It is not necessarily the final rating as it would be necessary to consider the defence in depth criteria before defining the final rating.

TABLE 4. RADIOLOGICAL EQUIVALENCE FOR FACILITY CONTAMINATION

Isotope	Multiplication factor for airborne contamination based on ^{131}I equivalence	Multiplication factor for solid contamination based on ^{137}Cs equivalence	Multiplication factor for liquid contamination based on ^{99}Mo equivalence
Am-241	2000	4000	50 000
Co-60	2.0	3	30
Cs-134	0.9	1	20
Cs-137	0.6	1	12
H-3	0.002	0.003	0.03
I-131	1	2	20
Ir-192	0.4	0.7	9
Mn-54	0.1	0.2	2
Mo-99	0.05	0.08	1
P-32	0.3	0.4	5
Pu-239	3000	5000	57 000
Ru-106	3	5	60
Sr-90	7	11	140
Te-132	0.3	0.4	5
U-235(S)[a]	600	900	11 000
U-235(M)[a]	200	300	3000
U-235(F)[a]	50	90	1000
U-238(S)[a]	500	900	10 000
U-238(M)[a]	100	200	3000
U-238(F)[a]	50	100	1000
Unat	600	900	11 000
Noble gases	Negligible (effectively 0)	Negligible (effectively 0)	Negligible (effectively 0)

[a] Lung absorption types: S — slow, M — medium, F — fast. If unsure, use most conservative value.

Example 8. Event at a laboratory producing radioactive sources — Below scale/Level 0

Event description

An event occurred at a laboratory in which ^{137}Cs sources are produced. As a result of rebuilding work in another part of the laboratory building, there were problems with keeping a negative pressure differential in the laboratory. This led to airborne contamination with ^{137}Cs of the laboratory and a conduit connected to the laboratory.

The event resulted in low doses (<1 mSv) to both workers and members of the public. Measurements showed that the quantity of activity spread within the facility was approximately 3–4 GBq of ^{137}Cs, and that the quantity of activity released to the environment through the ventilation system was approximately 1–10 GBq.

Rating explanation

Criteria	Explanation
2.2. Activity released	Based on Table 2, 1–10GBq of ^{137}Cs is radiologically equivalent to 40–400GBq ^{131}I, which is much less than the value for rating under the release criteria of "tens to hundreds of terabecquerels of ^{131}I".
2.3. Doses to individuals	All doses are less than 1 mSv so rating based on individual doses is Level 0.
3.2. Radiological barriers and controls at facilities	Based on Table 4, airborne release of 4 GBq of ^{137}Cs is radiologically equivalent to 2.4 GBq ^{131}I, which is much less than the value for rating under the contamination spread criterion of "a few tens of gigabecquerels of ^{131}I".
Rating for actual consequences	Below Scale/Level 0

Example 9. Fuel damage at a reactor — Below Scale/Level 0

Event description

During reactor operation, a slight increase in coolant activity was detected, indicating that some minor damage to the fuel was occurring. However, the level was such that continued operation was determined to be acceptable. Based upon the reactor coolant activity, the operator entered the refueling outage expecting to find a small number of the 3400 fuel rods failed. The actual inspection, however, revealed that about 200 (6% of the total) rods had failed, though there was no fuel melting or significant release of radionuclides from the fuel matrix. The cause was found to be foreign material present in the reactor coolant causing local overheating of the fuel.

Rating explanation

Criteria	Explanation
2.2. Activity released	Not applicable. No release.
2.3. Doses to individuals	Not applicable. No doses.
3.2. Radiological barriers and controls at facilities	6% of the fuel rods failed leads to about 0.06% of the core inventory released into the coolant. This is less than the criterion for Level 4, giving a rating of Level 0 based on this criterion.
Rating for actual consequences	Below Scale/Level 0 (defence in depth criteria would give a higher rating)

Example 10. Spillage of plutonium contaminated liquid onto a laboratory floor — Level 2

Event description

A flexible hose feeding cooling water to a glass condenser in a glove box became detached. Water flooded the glove box and filled the glove until it burst. The spilled water contained about 2.3 GBq of ^{239}Pu.

Rating explanation

Criteria	Explanation
2.2. Activity released	Not applicable.
2.3. Doses to individuals	Because the spillage occurred as a liquid, there was no significant exposure of personnel.
3.2. Radiological barriers and controls at facilities	The laboratory was not designed to contain spillages. The value for Level 2 from liquid spillages is defined as radiologically equgivalent to ten terabecquerels of ^{99}Mo. From section 3.3, 2.3 GBq ^{239}Pu ≡ 130 TBq ^{99}Mo. The Level 3 definition involves a few thousand terabecquerels of activity, so 2.3 GBq is well below this level.
Rating for actual consequences	Level 2.

Example 11. Plutonium uptake at a reprocessing facility – Level 2

Event description

Four employees entered a controlled radiation zone to perform work on a ventilation system. The work involved the removal of a component (baffle box) in a room located in a building that contained a plutonium processing facility. The facility had been non-functional since 1957 and had remained in a dormant state in preparation for decommissioning.

The workers were wearing protective and monitoring equipment. Cutting of the baffle box proceeded for an hour and 40 minutes and dust was observed falling from the box. When they stopped work and left the area, personal contamination monitors detected contamination on the clothing of all the workers. Immediate actions included placing work restrictions on affected personnel and initiating dose assessment through bioassay techniques. Initial exposure estimates were less than 11 mSv effective dose. Subsequently, maximum committed doses of between 24 and 55 mSv effective dose were assessed for the individuals involved. The annual limit at the time was 50 mSv.

Rating explanation

Criteria	Explanation
2.2. Activity released	Not applicable. No release to the environment.
2.3. Doses to individuals	One worker received a dose greater than the annual limit. The number receiving such a dose was less than 10, so the rating is not increased due to the number of people involved. Rating Level 2.
3.2. Radiological barriers and controls at facilities	The contamination occurred during the decommissioning of a specific item in an area which had been prepared for the potential contamination (i.e. an area 'expected by design'). The criteria are therefore not applicable.
Rating for actual consequences	Level 2.

Example 12. Evacuation near a nuclear facility — Level 4

Event description

An accident at a nuclear power station, involving overheating of the fuel, led to failure of about half of the fuel pins and a subsequent release of radioactive material. (Failure of about half the fuel pins, without significant fuel melting would release about 0.5% of the total core inventory.) Local police, in consultation with the licensee and the regulatory authority, took the immediate decision to evacuate people within a 2 km radius of the facility and as a result, no one received doses above 1 mSv. Assessment of the release by experts at the facility suggested that the total activity was about 20 TBq, comprised about 10% ^{131}I, 5% ^{137}Cs and the rest noble gases.

Rating explanation

Criteria	Explanation
2.2. Activity released	The fact that evacuation was undertaken is not relevant to rating. Based on Table 2, 1 TBq of ^{137}Cs is radiologically equivalent to 40 TBq ^{131}I, so that the total release is radiologically equivalent to 42 TBq ^{131}I, which is close to the value for rating under the release criteria at Level 4 of ‘tens to hundreds of terabecquerels of ^{131}I’.
2.3. Doses to individuals	All doses were less than 1 mSv, so rating based on individual dose is Level 0.
3.2. Radiological barriers and controls at facilities	The release from the fuel reaches the value for Level 4, “more than about 0.1% of the core inventory of a power reactor has been released from the fuel assemblies”, but is less than the definition for Level 5, “more than a few per cent of the core inventory of a power reactor has been released from the fuel assemblies”.
Rating for actual consequences	Level 4.

Example 13. Reactor core melt – Level 5

Event description

A valve in the condensate system failed closed, which reduced the amount of water being supplied to the steam generator. The main feedwater pumps and the turbine tripped within seconds.

The emergency feedwater pumps, which started as expected, were unable to inject water into the steam generators because several valves in the system were closed. The reactor coolant pumps continued circulating the water to the steam generators, but no heat could be removed by the secondary side since there was no water in the steam generators.

Pressure rose in the reactor cooling system until the reactor shutdown. A power operated relief valve opened in the line between the pressurizer and the quench tank, but unknown to the operator, this valve failed to reclose, allowing steam to continue discharging to the quench tank. Pressure dropped in the reactor cooling system. The quench tank rupture disc opened, and steam was released to the containment. As coolant pressure dropped, eventually water in the upper-most area of the reactor (about 3–5 m above the fuel) flashed to steam.

The operators turned off the emergency water injection pumps because they thought there was still water in the pressurizer. The operators also turned off the reactor cooling pumps because they were concerned about damage due to potential excessive vibration. This resulted in a steam void forming in the reactor coolant loop. In addition, a steam bubble formed in the upper part of the reactor, above the fuel. Eventually as the fuel heated, this void expanded, the fuel cladding material overheated and more than 10% of the fuel melted. The containment system remained intact.

Water was eventually added to the reactor cooling system, and cooling of the reactor was assured.

Studies indicated that the release from the site was small, and the maximum potential offsite exposure was 0.8 mSv effective dose. Worker doses were well below the annual statutory limits.

Rating explanation

Criteria	Explanation
2.2. Activity released	Although detailed quantities are not provided, it can be inferred from the small doses that the level of release to the environment was orders of magnitude below the value for Level 4.
2.3. Doses to individuals	Doses to members of the public were less than 1 mSv, and the doses to workers did not reach the statutory annual dose limit.
3.2. Radiological barriers and controls at facilities	More than a few per cent of the core was molten, giving a rating of Level 5.
Rating for actual consequences	Level 5.

4. ASSESSMENT OF THE IMPACT ON DEFENCE IN DEPTH FOR TRANSPORT AND RADIATION SOURCE EVENTS

This section deals with those events where there are no ‘actual consequences’, but some of the safety provisions failed. The deliberate inclusion of multiple provisions or barriers is termed ‘defence in depth’. Annex I gives more background on the concept of defence in depth, particularly for major facilities.

The guidance in this section is for practices associated with radiation sources and the transport of radioactive material. Guidance for accelerators and for facilities involving the manufacture and distribution of radionuclides or the use of a Category 1 source is given in Section 6.

The safety of the public and workers during the transport and use of radiation sources is assured by good design, well controlled operation, administrative controls and a range of protection systems (e.g. interlocks, alarms and physical barriers). A defence in depth approach is applied to these safety provisions so that allowance is made for the possibility of equipment failure, human error and the occurrence of unplanned developments.

Defence in depth is thus a combination of conservative design, quality assurance, surveillance, mitigation measures and a general safety culture that strengthens each of the other aspects.

The INES rating methodology considers the number of safety provisions that still remained functional in an event and the potential consequences if all the safety provisions failed.

As well as considering these factors, INES methodology also considers “additional factors” (i.e. those aspects of the event that may indicate a deeper degradation within the management or the arrangements controlling the operations associated with the event).

This section is divided into three main sections. The first (Section 4.1) gives the general principles that are to be used to rate events under defence in depth. Because they need to cover a wide range of types of events, they are general in nature. In order to ensure that they are applied in a consistent manner, Section 4.2 gives more detailed guidance. The third section (Section 4.3) gives a number of worked examples.

4.1. GENERAL PRINCIPLES FOR RATING OF EVENTS

Although INES allocates three levels for the impact on defence in depth, the maximum potential consequences for some practices, even if all the safety provisions fail, are limited by the inventory of the radioactive material and the release mechanism. It is not appropriate to rate events associated with the defence in depth provisions for such practices at the highest of the defence in depth levels. If the maximum potential consequences for a particular practice cannot be rated higher than Level 4 on the scale, a maximum rating of Level 2 is appropriate under defence in depth. Similarly, if the maximum potential consequences cannot be rated higher than Level 2, then the maximum rating under defence in depth is Level 1.

Having identified the upper limit to the rating under defence in depth, it is then necessary to consider what safety provisions still remain in place (i.e. what additional failures of safety provisions would be required to result in the maximum potential consequences for the practice). This includes consideration of hardware and administrative systems for prevention, control and mitigation, including passive and active barriers. Consideration is also given as to whether any underlying safety culture issues are evident in the event that might have increased the likelihood of the event maximum potential consequences occurring.

The following steps should therefore be followed to rate an event:

(1) The upper limit to the rating under defence in depth should be established by determining the rating for the maximum potential consequences of the relevant practices, based on the criteria in Sections 2 and 3 of this manual. Detailed guidance on establishing the maximum potential consequences is given in Section 4.2.1.

(2) The actual rating should then be determined:
   - (a) firstly, by taking account of the number and effectiveness of safety provisions available (hardware and administrative) for prevention, surveillance and mitigation, including passive and active barriers;
   - (b) secondly, by considering those safety culture aspects of the event that may indicate a deeper degradation of the safety provisions or the organizational arrangements.

Detailed guidance on these two aspects of the rating process is given in Section 4.2.

In addition to considering the event under defence in depth, each event must also be considered against the criteria in Sections 2 and 3 (if applicable).

4.2. DETAILED GUIDANCE FOR RATING EVENTS

4.2.1. Identification of maximum potential consequences

The maximum potential consequences are derived from the source category based on the activity of the source (A) and the D value for the source from the IAEA's Categorization of Radioactive Sources [1] and its supporting reference [5]. The maximum potential consequences do not depend on the detailed circumstances of the actual event. The D values are given in terms of an activity above which a source is considered to be 'a dangerous source' and has a significant potential to cause severe deterministic effects if not managed safely and securely. The D values from the Safety Guide [1], which contains the more common isotopes, are reproduced in Appendix III. If D values for other isotopes are required, they can be found in the supporting Ref. [5].

Table 5 shows the relationship between A/D value, source category and the rating of the maximum potential consequences (should all the safety provisions fail). It also shows the maximum rating under defence in depth for each source category in accordance with the general principles for rating events described earlier. The actual ratings will be equal to or less than those shown in the bottom row of this table when the rating guidance given in Section 4.2.2 is applied.

Since the maximum rating under defence in depth is the same for Category 2 and 3 sources, they are considered together in the rest of this section.

TABLE 5. RELATIONSHIP BETWEEN A/D RATIO, SOURCE CATEGORY, MAXIMUM POTENTIAL CONSEQUENCES AND DEFENCE IN DEPTH RATING.

A/D Ratio	0.01 ≤ A/D < 1	1 ≤ A/D < 10	10 ≤ A/D < 1000	1000 ≤ A/D
Source category	Category 4	Category 3	Category 2	Category 1
Rating for the maximum potential consequences for a practice should all safety provisions fail	2	3	4	5[a]
Maximum rating using defence in depth criteria	1	2	2	3

[a] Higher levels are not considered credible for events involving radioactive sources.

D values do not apply specifically to irradiated nuclear fuel. However, events involving the transport of irradiated nuclear fuel should be assessed using the guidance in Section 4.2.2 for Category 1 sources.

As stated earlier, rating of events at accelerators uses the guidance in Section 6. For other machine sources, the guidance in this section is relevant. However, there is no simple method for categorizing machine sources based on their size etc. Therefore, it is necessary to use the general principles of INES. For machines where no event can result in any deterministic effects even when all the safety provisions fail, the events should be rated using the guidance in Section 4.2.2 for Category 4 sources. For machines where deterministic effects could occur if all the safety provisions fail, events should be rated using the guidance in Section 4.2.2 for Category 2 and 3 sources.

Category 5 sources are not included in Table 5, nor are they considered in the rating tables of section 4.2.2. The IAEA's Categorization of Radioactive Sources [1] explains that Category 5 sources cannot cause permanent injury to people. Thus events involving the failure of safety provisions for such sources need only be rated at Below scale/Level 0 or Level 1 under defence in depth. Some simple guidance on whether Below scale/Level 0 or 1 is appropriate is given in the introduction to Section 4.2.2.

Where an event involves a number of sources or a number of transport packages, it is necessary to consider whether to use the inventory of a single item or the total inventory of the packages/sources. If the reduction in safety requirements has the potential to affect all the items (e.g. a fire), then the total inventory should be used. If the reduction in safety requirements can only affect a single item (e.g. inadequate labeling of one transport package), the inventory used should be that of the package affected. Appendix III gives the methodology for calculating an aggregate D value.

In order to allow for the wide range of possible events covered by this guidance, the steps below should be followed to take into account the maximum potential consequences when assessing an event:

— If the activity is known, the A/D value should be determined by dividing the activity (A) of the radionuclide by the defined D value. The A/D ratio should be compared to the A/D ratios in Table 5 and a category assigned.
— If the actual activity is not known (e.g. an unidentified source found in scrap metal), the activity should be estimated from known or measured dose rates and by identification of the radionuclide. The category should then be assigned based on the A/D ratio.

— If the actual activity is not known and no measurements of dose rate are available, a source category should be estimated based on any available knowledge about the use of the source. Appendix IV gives examples of the different uses of sources and their likely category.
— For events involving packages containing fissile material (which is not "fissile-excepted" as defined in the Transport Regulations [6]):
  • Where safety provisions necessary to prevent criticality are affected, the event should be rated as if the package was a Category 1 source.
  • Where there is a failure of a provision that does not relate to criticality safety, for unirradiated fuel, the rating should be based on the actual activity involved using the A/D ratio. For irradiated fuel, the column for Category 1 sources should generally be used, though the actual A/D value could be calculated and used, if the quantities of irradiated material are extremely small.

4.2.2. Rating based on effectiveness of safety provisions

The following sections give guidance on the rating of a number of types of events associated with degradation of safety provisions. Section 4.2.2.2 covers events involving lost or found radioactive sources, devices or transport packages, Section 4.2.2.3 covers events where intended safety provisions have been degraded, and Section 4.2.2.4 covers a number of other safety related events.

In all cases where there is a choice of rating, an issue for consideration will be the underlying safety culture implications. Therefore, further guidance on this aspect is given in Section 4.2.2.1. In some of the cases where there is a choice of rating, other factors also need to be considered, and footnotes are provided to give guidance on the specific factors to be taken into account.

Events associated with Category 5 sources are not included in the sections below because they are generally rated at Below Scale/Level 0. However, a rating of Level 1 would be appropriate if all intended safety provisions had clearly been lost or there is evidence of a significant safety culture deficiency. Where there was no intent to provide specific controls over the location of Category 5 sources, their loss should only be rated at Below Scale/Level 0.

4.2.2.1. Consideration of safety culture implications

Safety culture has been defined as "that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance" [7]. A good safety culture helps to prevent incidents but, on the other hand, a lack of safety culture could result in employees performing in ways not in accordance with the assumptions of the design. Safety culture has therefore to be considered as part of the defence in depth.

To merit the choice of the higher rating due to safety culture issues, the event has to be considered as a real indicator of an issue with the safety culture. Examples of such indications could be:

- A violation of authorized limits or requirements, or a violation of a procedure, without prior approval;
- A deficiency in the quality assurance process;
- An accumulation of human errors;
- A failure to maintain proper control over radioactive materials, including releases into the environment, spread of contamination or a failure in the systems of dose control; or
- The repetition of an event, where there is evidence that the operator has not taken adequate care to ensure that lessons have been learned or that corrective actions have been taken after the first event.

It is important to note that the intention of this guidance is not to initiate a long and detailed assessment but to consider if there is an immediate judgement that can be made by those rating the event. It is often difficult, immediately after the event, to determine if the rating of the event should be increased due to safety culture. A provisional rating should be provided in this case based on what is known at the time and a final rating can then take account of the additional information related to safety culture that will have arisen from a detailed investigation.

4.2.2.2. Events involving a lost or found radioactive source/device

Table 6 should be used for those events involving radioactive sources, devices and transport packages that have been misplaced, lost, stolen or found. If a source, device or transport package cannot be located, it may, in the first instance, be regarded as “missing”. If, however, a search of the likely alternative locations is unsuccessful, it should be considered lost or stolen, in accordance with national requirements.

The loss of a radioactive source, device or transport package should be rated in terms of degradation of defence in depth. If the radioactive source, device or transport package is subsequently found, the earlier loss and subsequent discovery of the source should be considered as a single event. The original rating should be reviewed and the event could be re-rated (up or down) on the basis of any extra information available. Relevant information to be considered should include:

- The location in which the source, device or transport package was found and how it got there;
- The condition of the source, device or transport package;
- The length of time the source, device or transport package was lost;
- The number of persons exposed and possible doses.

The revised rating should cover both the original defence in depth rating and the actual consequences. In most cases, it will be necessary to estimate or calculate the doses that have been received using realistic assumptions, rather than worst case scenarios.

A found radioactive source and a found device are considered together in Table 6. The former is intended to describe an unshielded source. A found device, on the other hand, is intended to describe the discovery of an orphan source still within an intact, shielded container.

There have been many examples of lost or found orphan sources being transferred into the metal recycling trade. As a consequence, it is increasingly common for metal dealers and steel smelters to check for such sources in incoming consignments of scrap metals. The most appropriate rating for such events is determined by using the "found orphan source" row of Table 6. If the source has been melted, the higher rating should be used. If the source is discovered prior to melting, the rating should depend on whether any safety provisions remain, as explained in footnote 1.

For events associated with contaminated metal, it may not be practical to identify the category of the source based on the guidance in Section 4.2.1. In these cases, the dose rate should be measured and the doses to people in the area estimated. The rating should then be based on these potential doses.

4.2.2.3. Events involving degradation of safety provisions

Table 7 should be used for those events where the radiation source, device or transport package is where it is expected to be, but there has been a degradation of safety provisions. These include a range of hardware provisions such as the transport packaging or source housing, other shielding or containment systems, interlocks or other safety/warning devices. They also include administrative controls such as labelling of transport packages, transport documentation, working and emergency procedures, radiological monitoring and use of personal alarm dosimeters. Facilities such as irradiators using a Category 1 source, teletherapy units or linear accelerators are likely to

TABLE 6. EVENT RATING FOR LOST OR FOUND RADIOACTIVE SOURCES, DEVICES OR TRANSPORT PACKAGES

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
Missing radioactive source, device or transport package subsequently recovered intact within an area under control.	1	1	1
Found source, device (including orphan sources and devices) or transport package.	1	1 or 2 (Footnote a)	2 or 3 (Footnote a)
Lost or stolen radioactive source, device or transport package not yet recovered.	1	2	3
Lost or stolen radioactive source, device or transport package subsequently located with confirmation that no unplanned exposures occurred but where a decision has been made and approved not to recover the source as it is in a safe or inaccessible location (e.g. underwater)	1	1	1
Misdelivered transport package, but receiving facility has all the radiation safety procedures required to handle the package.	0 or 1	1	1
Misdelivered transport package, but receiving facility does not have all the radiation safety procedures required to handle the package	1	1 or 2 (Footnote b)	2 or 3 (Footnote b)

[a] The lowest proposed rating is more appropriate where it is clear that some safety provisions have remained effective (e.g. a combination of shielding, locking devices and warning signs).

[b] The lower rating may be more appropriate if the facility has some appropriate radiation safety procedures.

contain high integrity defence in depth provisions. As noted in the introduction to this section, events related to degradation of safety provisions at such facilities should be rated using Section 6.

TABLE 7. EVENT RATING FOR EVENTS INVOLVING DEGRADATION OF SAFETY PROVISIONS[15]

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
A. No degradation of safety provisions.			
Although an abnormal event may have occurred, it has no significance in terms of the effectiveness of the existing safety provisions. Typical events include:			
— Superficial damage to shielding and/or source containers or leaking sources, resulting in minor surface contamination and spillage where low level contamination of persons has occurred.	1	1	1
— Superficial damage to shielding and/or source containers or leaking sources, resulting in minor surface contamination and spillage where the resulting contamination is unusual but of little or no radiological significance.	0 or 1	0 or 1	0 or 1
— Contamination in areas designed to cope with such events.	0 or 1	0 or 1	0 or 1

[15] Wherever there is a choice of rating, a significant factor is whether there are safety culture implications as discussed in Section 4.2.2.1.

TABLE 7. EVENT RATING FOR EVENTS INVOLVING DEGRADATION OF SAFETY PROVISIONS[15] (cont.)

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
— Foreseeable events where safety procedures were effective in preventing unplanned exposures and returning conditions to normal. This could include events such as the non-return of exposed sources (e.g. industrial radiography gamma source or brachytherapy source) provided they are safely recovered in accordance with existing emergency procedures.	0 or 1	0 or 1	0 or 1
— No damage or minor damage to transport package, with no increase in dose rate.	0 or 1	0 or 1	0 or 1
B. Safety provision partially remaining			
One or more safety provisions have failed (for whatever reason), but there is at least one safety provision remaining.			
Typical events include:			
— Failure of part of an installed warning or safety system designed to prevent exposures to high dose rates.	0 or 1 (Footnote a)	1 or 2 (Footnote a)	(Footnote b)
— Failure to follow safety procedures (including radiological monitoring and safety checks), but where other existing safety provisions (hardware) remain effective.	0 or 1 (Footnote a)	1 or 2 (Footnote a)	(Footnote b)

TABLE 7. EVENT RATING FOR EVENTS INVOLVING DEGRADATION OF SAFETY PROVISIONS[15] (cont.)

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
— Significant degradation of containment systems or defective closures.	0 or 1 (Footnote a)	1 or 2 (Footnote a)	(Footnote b)
— Faulty packaging or tie-downs. Tamper indicating devices ineffective.	0 or 1 (Footnote c)	0 or 1 (Footnote c)	0 or 1 (Footnote c)
C. No safety provision remaining			
Event producing a significant potential for unplanned exposures, or which produce a significant risk of spreading contamination into areas where controls are absent.			
Typical events include:			
— Loss of shielding (e.g. due to fire or severe impact, making direct exposure to the source possible).	1	1 or 2 (Footnote d)	2 or 3 (Footnote e)
— Failure of warning and safety devices such that entry into areas of high dose rate is possible.	1	1 or 2 (Footnote d)	2 or 3 (Footnote e)
— Failure to monitor radiation levels where no other safety provisions remain or all other safety provisions have failed (e.g. to check that gamma sources are fully retracted after site radiography exposures).	1	1 or 2 (Footnote d)	2 or 3 (Footnote e)
— Events where a source remains accidentally exposed, and there are no effective procedures in place to cope with the situation, or where such procedures are ignored.	1	1 or 2 (Footnote d)	2 or 3 (Footnote e)

TABLE 7. EVENT RATING FOR EVENTS INVOLVING DEGRADATION OF SAFETY PROVISIONS[15] (cont.)

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
— Packaging found with inadequate or no shielding where there is significant potential for exposures.	1	1 or 2 (Footnote d)	2 or 3 (Footnote e)

[a] The lower rating may be appropriate if there are a number of safety provisions remaining with no significant safety culture implications. Where there is essentially only a single safety layer remaining, the higher rating should be used.

[b] Rating of events involving partial degradation of the safety provisions for Category 1 sources installed in facilities should be based on the safety layer approach to ratings described in Section 6. Rating of other events involving Category 1 sources should be rated Level 1 or 2, the lower rating being more appropriate if there are a number of safety provisions still remaining with no significant safety culture implications.

[c] The upper level would be appropriate unless the level of degradation is very low.

[d] The maximum potential consequences for a Category 3 source installed in a fixed location within a facility cannot be higher than Level 2. Therefore, for events at such facilities, the maximum under defence in depth should be Level 1.

[e] Level 3 is only appropriate when the maximum potential consequences can be greater than Level 4. Facilities using category 1 sources should be rated using the guidance in Section 6. Application of that guidance would give a rating of Level 3 only if there is the potential for dispersion of the radioactive material. If the event relates only to degradation of safety provisions for preventing overexposure of workers, the guidance would give a rating of Level 2.

4.2.2.4. Other safety relevant events

Table 8 should be used for other safety-relevant events that are not covered by the previous tables.

TABLE 8. RATING FOR OTHER SAFETY RELEVANT EVENTS[16]

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
Member of the public receiving a dose from a single event in excess of annual statutory dose limits.	1	1	1
Workers or members of the public receiving cumulative doses in excess of annual statutory dose limits.	1	1	1
Absence of or serious deficiency in records such as source inventories, breakdowns in dosimetry arrangements.	1	1	1
Discharges to the environment in excess of authorized limits.	1	1	1
Non-compliance with licence conditions for transport.	1	1	1
Inadequate radiological survey of transport.	0 or 1 (Footnote a)	0 or 1 (Footnote a)	0 or 1 (Footnote a)
Contamination on packages/ conveyance where the resulting contamination is of little or no radiological significance.	0 or 1	0 or 1	0 or 1
Contamination on packages/ conveyance where a number of measurements reveal excessive contamination above the applicable limits, and there is potential for the public to be contaminated.	1	1	1

[16] Wherever there is a choice of rating, a significant factor is whether there are safety culture implications as discussed in Section 4.2.2.1.

TABLE 8. RATING FOR OTHER SAFETY RELEVANT EVENTS[16] (cont.)

Type of events	Event rating depending on the source category		
	Cat. 4	Cat. 3 or Cat. 2	Cat. 1
Shipping documents, package labels or vehicle placards incorrect or absent. Marking of packages incorrect or absent.	0 or 1	0 or 1	0 or 1
Radioactive material in a supposedly empty package.	1	1 or 2 (Footnote b)	1, 2 or 3 (Footnote b)
Radioactive material in the wrong type or an inappropriate packaging.	0 or 1 (Footnote c)	1 or 2 (Footnote c)	2 or 3 (Footnote c)

[a] The rating should take into account the degree of inadequacy of the surveys as well as any safety culture implications.
[b] The choice of rating should take into account the safety provisions that might still be in place even though the package was supposed to be empty.
[c] The higher rating in each category reflects situations where the wrong or inappropriate packaging could reasonably result in inadvertent exposures.

4.3. WORKED EXAMPLES

Example 14. Detachment and recovery of an industrial radiography source — Below Scale/Level 0

Event description

Industrial radiography was being undertaken at a petrochemical plant using a 1 TBq ^{192}Ir source. During an exposure, the source became detached in the exposed position. This was recognized when the radiographer re-entered the area with a survey meter. The controlled area barriers were checked and left in place, and assistance was sought from the national authorities. The authorities and the radiographers jointly planned the source recovery operation. Twelve hours after the event was first identified, the source was successfully recovered. Doses received (by three persons) as a result of the event, including the recovery of the source, were all below 1 mSv.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Doses received were below the value for Level 1.
4.2.1. Maximum potential consequences:	The D value for ^{192}Ir is 0.08 TBq, so the A/D ratio was 12 (i.e. a Category 2 source).
4.2.2. Effectiveness of safety provisions:	This is a foreseeable event in industrial radiography and contingency plans, and equipment to deal with such events are expected to be available. The monitoring by the radiographer was also effective. Based on the fourth bullet of section A of Table 7, “Foreseeable events where safety procedures were effective in preventing unplanned exposures and returning conditions to normal,” the rating could be either Below scale/Level 0 or Level 1. Below scale/Level 0 is chosen, as there were no indications of safety culture issues.
Overall rating:	Below Scale/Level 0.

Example 15. Derailment of a train carrying spent fuel — Below Scale/Level 0

Event description

A train with three wagons, each containing a package of spent fuel, derailed at a speed of 28 km/h. The rail broke when the train went over it. Two of the rail wagons were derailed but remained upright, the other was leaning over and had to be made stable. Thirty six hours later, the wagons were on their way again. There were no radiological consequences.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	There were no doses reported.
4.2.1. Maximum potential consequences:	Spent fuel packages should be rated using the guidance for Category 1 sources.
4.2.2. Effectiveness of safety provisions:	Based on the fifth bullet of section A in Table 7, ‘no damage or minor damage to transport package, with no increase in dose rate’, the rating could be either Below scale/Level 0 or Level 1. Below scale/Level 0 is chosen, as there were no indications of safety culture issues.
Overall rating:	Below Scale/Level 0.

Example 16. Package damaged by forklift — Below Scale/Level 0

Event description

A Type A package was reported as damaged at an airport. Early reports suggested that the package had only been scuffed by the wheel of a fork lift truck. The consignor was requested to assess the damage to the package and determine what should be done with it. The consignor was able to repackage the contents (two ^{252}Cf sources — 1.98 MBq each) and enable the package to continue. They were also equipped to overpack the Type A package and return it to its origin. It was confirmed that there was minimal damage to the original outer packaging.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Doses received were below the value for Level 1.
4.2.1. Maximum potential consequences:	The D-value for ^{252}Cf is 0.02 TBq, giving an A/D ratio of <0.01. Thus, the package contained Category 5 sources.
4.2.2. Effectiveness of safety provisions:	There was no degradation of safety provisions. According to the introduction to Section 4.2.2, the rating is Below scale/Level 0.
Overall rating:	Below Scale/Level 0.

Example 17. Stolen industrial radiography source — Level 1

Event description

An industrial radiography device containing a 4 TBq ^{192}Ir source was reported as stolen to the national authorities. A press release was issued, and investigation of the surrounding areas was carried out. Twenty four hours later, the device was found in a ditch adjacent to a highway with no damage to the shielding and completely intact. No individuals were believed to have been exposed.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	There were no doses from the event or activity released.
4.2.1. Maximum potential consequences:	The D value for ^{192}Ir is 0.08 TBq, so the A/D ratio was 50 (i.e. a Category 2 source).
4.2.2. Effectiveness of safety provisions:	The initial event is a lost or stolen Category 2 source, which according to row three of Table 6 gives a rating of Level 2. When the device was found, a review of the rating was possible. Since the device was found with all the safety provisions remaining and no indication that they had been breached, a final rating of Level 1 was appropriate based on row 2 of Table 6.
Overall rating:	Level 1.

Example 18. Various radioactive sources found in scrap metal — Level 1

Event description

The regulator was notified by a scrap metal company that it had a radiation alarm from its portal detector. Using handheld survey equipment, the regulator measured an elevated radiation level at the surface of a 12 m container of 30 μSv/h. The container was unloaded by a firm specializing in tracing and recovering radioactive sources in scrap. Three identical stainless steel source holders were found, each containing a ^{137}Cs source but with no shutter mechanisms. Two of the source holders had identification marks which enabled the sources to be characterized as 2 GBq of ^{137}Cs and 8 GBq of ^{137}Cs. The dose rate at the surface of the three separate source holders was about 4.5, 4.2 and 17 mSv/h, and the activity of the separate sources was approximately 1.85 GBq, 1.85 GBq and 7.4 GBq. The container had been in transit for nearly one month, but the origin of the three sources could not be determined. The sources were secured and transported to an appropriate radioactive waste facility.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Considering the potential doses during transportation and handling of these sources, it is not considered credible that doses above 10 mSv could have been received, or that ten or more people could have been exposed (i.e. Level 1).
4.2.1. Maximum potential consequences:	Two of the sources were known to be ^{137}Cs and based on the dose rates and activity measurements, the third source appeared to be the same as the smaller of the two identified sources. The D value for ^{137}Cs is 1×10^{-1} TBq and the total source activity was 11.1 GBq, resulting in an A/D ratio of $0.01 \leq A/D < 1$. Therefore it was a Category 4 source.
4.2.2. Effectiveness of safety provisions:	The event was the discovery of three orphan sources. From the second row of Table 6, Level 1 is appropriate.
Overall rating:	Level 1.

Example 19. Loss of a density gauge — Level 1

Event description

A moisture-density gauge was lost and presumed stolen from a truck at a construction site. The gauge contained a ^{137}Cs source (0.47 GBq) and an Am-241/Be neutron source (1.6 GBq). It was reported to the national authorities, a press release was issued and an investigation of the surrounding areas was undertaken. The gauge was recovered a few days later with no signs of damage.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	There were no doses from the event.
4.2.1. Maximum potential consequences:	It is necessary to calculate the aggregate A/D value as explained in Appendix III. The D value for ^{137}Cs is 0.1 TBq compared to a source activity of 0.47 GBq and the D value for ^{241}Am/Be is 0.06 TBq compared to a source activity of 1.6 GBq, giving an aggregate A/D of 0.47/100 + 1.6/60 = 0.031. Thus the aggregate A/D ratio is between 0.01 and 1 and the source can be categorized as Category 4.
4.2.2. Effectiveness of safety provisions:	From the second row of Table 6 Level 1 is appropriate. Its recovery allowed the event to be reassessed as a ‘Lost or stolen radioactive source subsequently located’ (fourth row), which for a Category 4 source remains at Level 1.
Overall rating:	Level 1.

Example 20. Radioactive source stolen during transport — Level 1

Event description

When a package of a sealed 1.85 GBq ^{60}Co source was delivered by the shipper, it was found to be empty. The source was found seven hours later in a delivery truck. The package had been intentionally opened. 1.85 GBq of ^{60}Co delivers a dose rate of 0.5 mSv/h at a distance of 1 m.

It appeared that the event was a direct result of failure to comply with the regulations for the transport of radioactive materials:

— The security seal required by the regulations was not affixed to the package;
— The shipping declaration had not been completed; and
— The ‘radioactive’ label did not appear to have been fixed to the container (although this was never clearly established).

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Based on interviews of personnel involved and postulation of likely scenarios of what might have happened to the source, dose assessments were carried out. It was concluded that neither the driver nor the delivery personnel received measurable doses.
4.2.1. Maximum potential consequences:	The D value of ^{60}Co is 0.03 TBq, giving an A/D ratio between 0.01 and 1 and hence a Category 4 source.
4.2.2. Effectiveness of safety provisions:	Based on the 5th bullet of section C of Table 7, “packaging found with inadequate or no shielding where there is significant potential for exposures,” the rating is Level 1.
Overall rating:	Level 1.

Example 21. Spillage of radioactive material in a nuclear medicine department — Level 1

Event description

A trolley used to transfer radionuclides from the radiopharmacy to the injection/treatment room in a hospital was involved in a collision. The event occurred in a hospital corridor and a single dosage of ^{131}I (4 GBq in liquid form) was spilled on the floor. Two persons (a nurse and a patient) were contaminated (hands, outer clothing and shoes), each by an estimated activity of 10 MBq of ^{131}I. Staff from the nuclear medicine department were called, and the two people were decontaminated within an hour of the event.

Estimated doses to the two persons involved were minimal (less than 0.5 mSv committed effective dose). The area of the spill was temporarily closed for two weeks (equivalent to two half lives) and was then successfully decontaminated by nuclear medicine staff.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Doses received were below the value for Level 1.
3.2. Radiological barriers and controls at facilities	Not applicable as the facility did not handle large quantities of radioactive material (see 1st paragraph of Section 3.1).
4.2.1. Maximum potential consequences:	The D value of ^{131}I is 0.2 TBq, giving an A/D ratio of between 0.01 and 1, hence it was a Category 4 source.
4.2.2. Effectiveness of safety provisions:	As the source container was broken, there were no safety provisions remaining, and section C of Table 7 is appropriate, giving a rating of Level 1.
Final rating:	Level 1.

Example 22. Train collision with radioactive material packages — Level 1

Event description

A collision occurred between a train and a baggage truck that was crossing the railway line in a station.

Type A packages were amongst the luggage. There were seven cartons containing a range of radionuclides and two drums, each containing a technetium generator (using molybdenum), with an activity of 15 GBq (30 GBq at the start of the journey).

Being light, the cartons were only slightly damaged, and no radioactive material was lost from them. On the other hand, the two drums were thrown from the packages, and one source container broke, contaminating the cab of the locomotive and the gravel under the track. There were 291 persons screened for contamination, and 19 had positive results, which were not found to be significant. All doses received were less than 0.1 mSv. The resulting contamination was no reason for concern in view of the small quantities involved and the short half-lives of the radioisotopes.

A substantial amount of decontamination equipment was deployed. Two tracks were closed for a day and the locomotive was decontaminated.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Doses received were below the value for Level 1.
4.2.1. Maximum potential consequences:	The D value of ^{99}Mo is 300 GBq (and this includes the effects of the daughter product Tc), giving an A/D ratio between 0.01 and 1 and hence the sources were Category 4.
4.2.2. Effectiveness of safety provisions:	As a source container was broken, there were no safety provisions remaining and section C of Table 7 is appropriate, giving a rating of Level 1.
Final rating:	Level 1.

Example 23. Supposedly empty shipping containers found to contain nuclear material — Level 1

Event description

A fuel manufacturing plant routinely receives uranium oxide slightly enriched in ^{235}U from overseas. The material travels in special cans mechanically sealed within a sea container. After taking out the material, the fuel manufacturer sends the empty cans back to their provider.

Upon receiving a container of 150 cans that were supposed to be empty, the uranium oxide provider discovered that two cans were in fact full, containing a total of 100 kg of uranium oxide. The estimated activity of the material was 8 GBq. The outer surface of the cans and the sea container were found to be clean. No worker or member of the public received any unanticipated dose from this event.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	There were no doses reported from this event.
4.2.1. Maximum potential consequences:	Criticality was not an issue here because of the low enrichment, and therefore the event should be categorized based on A/D. (See final bullet of Section 4.2.1). The D value is not specified in Appendix III but is given in [5]. For enrichments of less than 10%, which is the case here, the D value is so high as to be unlimited. Therefore the A/D value is <0.01, which means the material can be treated as Category 5 sources.
4.2.2. Effectiveness of safety provisions:	Although the packaging for empty cans was the same as if they were full (mechanical seal as well as container conditions), labelling for the transport was less demanding and precautions for handling were slightly relaxed. The key point is that authorized limits were breached. There were significant safety culture issues associated with the event, and some of the provided safety provisions failed. Therefore, based on the third paragraph of Section 4.2.2, the event is rated at Level 1.
Final rating:	Level 1.

Example 24. Suspicious dose on film badge — Level 1

Event description

A radiation technician’s annual cumulative exposure level was indicated to be 95 mSv by her film badge record. This was found in the course of an inspection of the hospital at which she worked. The regulatory authority inspected the hospital thoroughly and found one of the individual’s monthly records indicating 54 mSv. However, the hospital had not taken any special actions until the inspection. The hospital has no radiation generator such as a linear accelerator (LINAC), and no obvious reason for the single over-exposure was found. There was some possibility of mischief by a colleague, but no direct evidence was found. According to a medical examination, which included blood tests, no abnormalities were found. The person also had no symptom suggesting a deterministic effect. The person was transferred to another section and was provided with additional training. Making the worst case assumption that the dose was real, she was also barred from entering controlled areas.

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	There were no deterministic effects observed on the technician. While the blood tests showed that no serious doses had been received, it could not be proved that no radiation exposure had taken place. A detailed investigation was carried out to determine whether the radiation exposure took place or not. The investigation took into account: (1) The lack of any sources of high radiation in her normal workplace or anywhere she went during the period since the dosimeter was issued; (2) Colleagues who were always near her during potential exposure periods and whose dosimeters showed normal readings; (3) Additional dosimeters worn during some of the period of interest. It was ultimately concluded that she did not receive the radiation exposure and that the dose should be removed from her record.
4.2.1. Maximum potential consequences:	Not applicable.
4.2.2. Effectiveness of safety provisions:	Although the event involves no real dose, there are other factors involved in the event, such as the failure to monitor personnel radiation exposure records and to follow up on unusual readings. Based on row 3 of Table 8, the event is rated at Level 1.
Final rating:	Level 1.

Example 25. Melting of an orphan source — Level 2

Event description

An orphan source of 1 TBq of ^{137}Cs inadvertently included in scrap metal was melted in a steel factory. Fifty employees at the factory received an estimated dose of 0.3 mSv each.

Rating explanation

Criteria	Explanation
2.2. Activity release	It was estimated that 10% of the activity was released due to the melting, which resulted in an airborne activity release of 0.1 TBq of ^{137}Cs. The D_2 value for ^{137}Cs is 0.1 TBq, so the release is far less than the criterion for Level 5 of 2500 times the D_2 value (section 2.2.2).
2.3. Doses to individuals:	Doses received were below the value for Level 1.
4.2.1. Maximum potential consequences:	The D value for ^{137}Cs is 1×10^{-1} TBq, and the source activity (A) is 1 TBq, resulting in an A/D ratio of $1000 > A/D \geq 10$. Therefore, it is classified as a Category 2 source.
4.2.2. Effectiveness of safety provisions:	Based on the second row of Table 6, the rating should be Level 1 or 2. Considering that the source was melted, the final rating should be Level 2 based on footnote a in Table 6.
Final rating:	Level 2.

Example 26. Loss of a high activity radiotherapy source — Level 3

Event description

A source inventory check at a hospital that had been closed for some time revealed that a teletherapy head containing a 100 TBq ^{60}Co source was missing. The unit had been stored in a dedicated facility, but an inventory check had not been carried out for several weeks. It was suspected that the unit had been taken out of the hospital by unauthorized persons. A search was carried out, and one day later, the source was located on open land two kilometers away.

The unit had been dismantled, and the source was unshielded but not breached. It was recovered by the national authorities.

The subsequent investigation indicated that several people had been exposed as a result of the event, as follows:

- One person: 20 Gy to the hands, 500 mSv effective dose. Radiation injuries observed on one hand, requiring skin grafts and the amputation of one finger;
- Two persons: 2 Gy to hands, 400 mSv effective dose;
- Twelve persons: 100 mSv effective dose. (The statutory annual whole body dose limit for workers was 20 mSv.)

Rating explanation

Criteria	Explanation
2.3. Doses to individuals:	Three people received doses greater than ten times the statutory annual whole body dose limit for workers. One of these people suffered a health effect. Both these aspects give a rating of Level 3. Twelve persons received doses higher than 10 mSv. According to the dose received, the rating is Level 2, and it should be uprated to Level 3 due to the number of persons affected.
4.2.1. Maximum potential consequences:	The D value for ^{60}Co is 0.03 TBq, and the A/D ratio is greater than 1000 (i.e. it was a Category 1 source/device).
4.2.2. Effectiveness of safety provisions:	The initial rating was made before the source was found. Thus the event is a lost or stolen source/device. Using Table 6, the event would be rated at Level 3.
Final rating:	Level 3.

5. ASSESSMENT OF IMPACT ON DEFENCE IN DEPTH SPECIFICALLY FOR EVENTS AT POWER REACTORS WHILE AT POWER

This section deals with those events where there are no "actual consequences," but some of the safety provisions failed. The deliberate inclusion of multiple provisions or barriers is termed "defence in depth."

The concept of defence in depth is not explained in detail here, as it will be familiar to the majority of those applying this manual to events at power reactors. However, Annex I does give some additional background material.

This section applies specifically to rating events at power reactors while at power, but it should also be used to rate events in hot shutdown or startup conditions as the safety case is quite similar to that for power operation. However, once the reactor is in cold shutdown , while some of the safety systems are still required to assure the safety functions, usually more time is available. Also in shutdown conditions, the configurations of the barriers are sometimes quite different (for example, open primary coolant system, open containment). For these reasons a different approach to rating events is proposed, and events during reactor shutdown should generally be rated using the guidance in Section 6. However, if a facility has an approved safety case based on the initiator and safety system approach, it may be possible to use the initiator approach described in this section for rating events.

Events on reactors that are being decommissioned where the fuel has been removed from the reactor should also be rated using Section 6 as should events at research reactors in order to take proper account of the range of maximum potential consequences and design philosophy.

One facility can, of course, cover a number of practices, and each practice must be considered separately in this context. For example, reactor operations, work in hot cells and waste storage, should be considered as separate practices, even though they can all occur at one facility. Rating events associated with hot cells or waste storage should be rated using the guidance in Section 6. This section of the manual is specific to events associated with the operation of power reactors.

The approach to rating is based on assessing the likelihood that the event could have led to an accident, not by using probabilistic techniques directly, but by considering whether safety provisions were challenged and what additional failures of safety provisions would be required to result in an accident. Thus a 'basic rating' is determined by taking account of the number and effectiveness of safety provisions available (hardware and administrative) for prevention, control and mitigation, including passive and active barriers.

To allow for any underlying “additional factors,” consideration is also given to increasing the “basic rating”. This increase allows for those aspects of the event that may indicate a deeper degradation of the plant or the organizational arrangements of the facility. Factors considered are common cause failures, procedural inadequacies and safety culture issues. Such factors may not have been included in the basic rating and may indicate that the significance of the event with respect to defence in depth is higher than the one considered in the basic rating process. Accordingly, in order to communicate the true significance of the event to the public, increasing the rating by one level is considered.

The other two sections on defence in depth include guidance related to the “maximum potential consequences” of events. However, this aspect does not need to be considered here as the inventory of a power reactor is such that, should all the safety provisions fail, an accident with a rating of Level 5 or above is possible. The maximum level under defence in depth is therefore Level 3.

This section of the manual is divided into three main sections. The first gives the guidance for assessing the basic rating for events occurring while the reactor is at power (known as the “initiator approach”). The second section (Section 5.2) gives the guidance associated with uprating events. Section 5.3 provides a number of worked examples.

5.1. IDENTIFICATION OF BASIC RATING TAKING ACCOUNT OF THE EFFECTIVENESS OF SAFETY PROVISIONS

Because the safety analysis for reactor installations during power operation follows a common international practice, it is possible to give fairly specific guidance about how to assess the safety provisions for events involving reactors at power. The approach is based on consideration of initiators, safety functions and safety systems. These terms will be familiar to those involved in safety analysis, but further explanation of the terms is provided below.

An initiator or initiating event is an identified event that leads to a deviation from the normal operating state and challenges one or more safety functions. Initiators are used in safety analysis to evaluate the adequacy of installed safety systems; the initiator is an occurrence that challenges the safety systems and requires them to function.

Events involving an impact on defence in depth will generally be of two possible forms:

(1) Either they include an initiator (initiating event), which requires the operation of some particular safety systems designed to cope with the consequences of this initiator, or
(2) They include the degraded operability of one or more safety systems without the occurrence of the initiator for which the safety systems have been provided.

In both cases the level of operability of safety systems leads to a level of operability for the overall safety function, noting that several safety systems may contribute to one safety function. It is this level of safety function operability that is important in determining the rating.

In the first case, the event rating depends principally on the extent to which the operability of the safety function is degraded. However, the rating also depends on the anticipated frequency of the particular initiator that has occurred.

In the second case, no deviation from normal operation of the plant actually occurs, but the observed degradation of the operability of the safety function could have lead to significant consequences if one of the initiators for which the degraded safety systems are provided had actually occurred. In such a case, the event rating depends on both:

— The anticipated frequency of the potential initiator;
— The operability of the associated safety function assured by the operability of particular safety systems.

It should be noted that one particular event could be categorized under both cases. (See Sections 5.1.3 and 5.1.4 as well as Example 35.)

To illustrate the above principles, consider a reactor where the protection against loss of off-site power is provided by four essential diesels. In order for an accident to occur, the event must challenge the safety of the reactor (in this example, loss of off-site power (LOOP)) and the protection must fail (in this example, all diesels fail to start). The initial challenge to plant safety (LOOP in the example) is termed the 'initiator' and the response of the diesels is defined by the 'Operability of the safety function' (post-trip cooling in this example). Thus for an accident to occur, there needs to be an initiator and inadequate operability of a safety function.

The rating under defence in depth assesses how near the accident is to happening (i.e. whether the initiator has occurred, how likely it was and what the operability of the safety functions were). In the previous example, if off-site power had been lost but all diesels started as intended, an accident was unlikely (such an event would be rated at Below Scale/Level 0). Similarly, if one diesel had failed under a test, but the others were available, and off-site supplies were available, then an accident was unlikely (again such an event would be rated at Below Scale/Level 0).

However, if during operation at power it was discovered that all diesels had been unavailable for a month, then even though off-site power had been available and the diesels were not required to operate, an accident was relatively likely, as the chance of losing off-site power was relatively high (such an event would probably be rated at Level 3, provided there were no other safety provisions).

The rating procedure therefore considers whether the safety functions were required to work (i.e. had an initiator occurred), what was the assumed likelihood of the initiator and what was the operability of the relevant safety functions.

The basic approach to rating events is to identify the frequency of the relevant initiators and the operability of the affected safety functions. Two tables are then used to identify the appropriate basic rating (see Sections 5.1.3 and 5.1.4). Detailed guidance on each aspect of rating is given below.

5.1.1. Identification of initiator frequency

Four different frequency categories have been defined:

(1) *Expected*
This covers initiators expected to occur once or several times during the operating life of the plant (i.e. $> 10^{-2}$ per year).

(2) *Possible*
These are initiators that are not expected but have an anticipated frequency (f) during the plant lifetime of greater than about 1% (i.e. $10^{-4} < f < 10^{-2}$ per year).

(3) *Unlikely*
These are initiators considered in the design of the plant, which are less likely than the above ($\leq 10^{-4}$ per year).

(4) *Beyond design*
These are initiators of very low frequency, not normally included in the conventional safety analysis of the plant. When protection systems are introduced against these initiators, they do not necessarily include the same level of redundancy or diversity as measures against design basis initiators.

Each reactor has its own list and classification of initiators as part of its safety analysis, and these should be used in rating events. Typical examples of design basis initiators that have been used in the past for different reactor systems are given in Annex II categorized into the previous frequency categories. These may provide a guide in applying the rating process, but it is important wherever possible to use the initiators and frequencies specific to the plant where the event occurred.

Small plant perturbations that are corrected by control (as opposed to safety) systems are not included in the initiators. However, if the control systems fail to stabilize the reactor, that will eventually lead to an initiator. For these reasons, the initiator may be different from the occurrence that starts the event (see Example 36); on the other hand, a number of different event sequences can often be grouped under a single initiator.

For many events, it will be necessary to consider more than one initiator, each of which will lead to a rating. The event rating will be the highest of the ratings associated with each initiator. For example, a power excursion in a reactor could be an initiator challenging the protection function. Successful operation of the protection system would then lead to a shutdown. It would then be necessary to consider the reactor trip as an initiator challenging the fuel cooling function.

5.1.2. Safety function operability

The three basic safety functions for reactor operation are:

(1) controlling the reactivity;
(2) cooling the fuel; and
(3) confining the radioactive material.

These functions are provided by passive systems (such as physical barriers) and by active systems (such as the reactor protection system). Several safety systems may contribute to a particular safety function, and the function may still be achieved even with one system unavailable. Following an initiator, non-safety systems may also contribute to a particular safety function (see explanation under definition of Adequate (C). Equally, support systems such as electrical supplies, cooling and instrument supplies will be required to ensure that a safety function is achieved. It is important to evaluate the operability of the safety function when events are rated, not the operability of an individual system. A system or component is considered operable when it is capable of performing its required function in the required manner.

The operational limits and conditions (OL&C) of a plant govern the operability of each safety system. In most countries, they are included within a plant's Technical Specifications.

The operability of a safety function for a particular initiator can range from a state where all the components of the safety systems provided to fulfil that function are fully operable to a state where the operability is insufficient for the safety function to be achieved. To provide a framework for rating events, four categories of operability are considered.

A. Full

This is when all the safety systems and components that are provided by the design to cope with the particular initiator in order to limit its consequences are fully operable (i.e. redundancy/diversity is available).

B. Minimum required by operational limits and conditions

This is when the operability of each of the safety systems required to provide the safety function meets the minimum level for which operation at power can be continued (possibly for a limited time), as specified in the Operational Limits and Conditions.
This level of operability will generally correspond to the minimum operability of the different safety systems for which the safety function can be achieved for all the initiators considered in the design of the plant. However, for certain particular initiators, redundancy and diversity may still exist.

C. Adequate

This is when the operability of at least one of the safety systems required to provide the safety function is sufficient to achieve the safety function challenged by the initiator being considered.
In some cases, categories B and C may be the same (i.e. the operability is inadequate unless all the safety systems meet the OL&C requirements). In other cases, Category C will correspond to a level of operability lower than that required by OL&C. One example would be where diverse safety systems are each required to be operable by OL&C, but only one is operable. Another would be where all safety systems that are designed to assure a safety function are inoperable for such a short time that the safety function can still be assured, even though the safety systems do not meet the OL&C requirements. (For example, the safety function 'cooling of the fuel' may be assured if a total station blackout occurs for only a short time). In identifying the effectiveness of such provisions, it is important to take account of the time available and the time required for identifying and implementing appropriate corrective action.

It is also possible that the safety function may be *adequate* due to the operability of non-safety systems (see Example 40). Non-safety systems can be taken into account if they have been demonstrated (or are known) to be operable during the event. However, care must be taken in including non-safety systems, as their operability is not generally controlled and tested in the same way as it is for safety systems.

D. Inadequate

This is when the operability of the safety systems is such that none of them is capable of achieving the safety function challenged by the initiator being considered.

It should be noted that although operability categories C and D represent a range of plant states, categories A and B represent specific operabilities. Thus, the actual operability may be between that defined by operability categories A and B (i.e. the operability may be less than *full* but more that the minimum allowed for continued operation at power). This is considered in Section 5.1.3.

5.1.3. Assessment of the basic rating for events with a real initiator

In order to obtain a basic rating, firstly decide whether there was an actual challenge to the safety systems (a real initiator). If so, then this Section is appropriate; otherwise Section 5.1.4 is appropriate. It may be necessary to consider an event using both sections if an initiator occurs and reveals a reduced operability in a system not challenged by the real initiator (e.g. if a reactor trip without loss of off-site power reveals a reduced operability of diesels).

For events involving potential failures that could have led to an initiator (e.g. discovery of structural defects or small leaks terminated by operator action), a similar approach is used, but it is also necessary to take into account the likelihood of the potential initiator occurring. This is explained in Section 5.1.5.

5.1.3.1. Basis of rating

The appropriate ratings for events with a real initiator are given in Table 9. The basis of the values given in the table is as follows.

Clearly, if the safety function is *inadequate*, an accident will have occurred, and it will need to be rated based on its actual consequences. Such a rating could well exceed Level 3. However, in terms of defence in depth, Level 3 represents the highest rating. This is expressed by 3+ in Table 9.

If the safety function is just *adequate*, then again Level 3 is appropriate, because a further failure would lead to an accident. However, in other cases even though the operability is less than that required by the OL&C, it may be considerably greater than just *adequate*, particularly for *expected* initiators because OL&C requirements often still incorporate significant redundancy or diversity. Therefore, in Table 9, Level 2 or 3 is shown for *expected* initiators and *adequate* safety function, the choice depending on the extent to which the operability is greater than just *adequate*. For *unlikely* initiators, the operability required by the OL&C is likely to be just *adequate* and, therefore, in general, Level 3 would be appropriate for *adequate* operability. However, there may be particular initiators for which there is redundancy, and therefore Table 9 shows Level 2 or 3 for all initiator frequencies.

If there is *full* safety function operability and an *expected* initiator occurs, this should clearly be Below Scale/Level 0, as shown in Table 9. However, the occurrence of a *possible* or *unlikely* initiator, even though there may be considerable redundancy in the safety systems, represents a failure of one of the important parts of defence in depth, namely the prevention of initiators. For this reason Table 9 shows Level 1 for *possible* initiators and Level 2 for *unlikely* initiators.

If the operability of safety functions is the *minimum required by OL&C*, then in some cases, as already noted, for *possible* and particularly for *unlikely* initiators, there will be no further redundancy. Therefore, Level 2 or 3 is appropriate, depending on the remaining redundancy. For *expected* initiators, there will be additional redundancy, and therefore a lower rating is proposed. Table 9 shows Level 1 or 2, where again the value chosen should depend on the additional redundancy within the safety function. Where the safety function availability is greater than the *minimum required by OL&C* but less than *full*, there may be considerable redundancy and diversity available for *expected* initiators. In such cases, Below Scale/Level 0 would be more appropriate.

TABLE 9. EVENTS WITH A REAL INITIATOR

Safety function operability		Initiator frequency		
		(1) Expected	(2) Possible	(3) Unlikely
A	Full	0	1	2
B	Minimum required by operational limits and conditions	1 or 2	2 or 3	2 or 3
C	Adequate	2 or 3	2 or 3	2 or 3
D	Inadequate	3+	3+	3+

5.1.3.2. Rating procedure

With the background described in the previous section, events should be rated using the following procedure:

(1) Identify the initiator that has occurred.

(2) Determine the category of frequency allocated to that initiator. In deciding the appropriate category, it is the frequency that was assumed in the safety case (the justification of the safety of the plant and its operating envelope) for the plant that is relevant.

(3) Determine the category of operability of the safety functions challenged by the initiator.
   (a) It is important that only those safety functions challenged by the initiator are considered. If the degradation of other safety systems is discovered, it should be assessed using the section on *events without a real initiato*r in Section 5.1.4, using the initiator that would have challenged that safety system.
   (b) In deciding whether the operability is within OL&C, it is the operability requirements prior to the event that must be considered, not those that apply during the event.
   (c) If the operability is within OL&C but also just *adequate*, operability category C should be used as there is no additional redundancy (see earlier paragraphs in this section).

(4) The event rating should then be determined from Table 9. Where a choice of rating is given, the choice should be based on the extent of redundancy and diversity available for the initiator being considered.
   (a) If the safety function operability is just *adequate* (i.e. one further failure would have lead to an accident), Level 3 is appropriate.
   (b) In cell B1 of Table 9, the lower value would be appropriate if there is still considerable redundancy and/or diversity available.
   (c) In some reactor designs, there is a large amount of redundancy/ diversity available for *expected* initiators. If the safety function operability is considerably greater than the *minimum required by OL&C*, but slightly less than *full*, Below Scale/Level 0 would be more appropriate.

Beyond design initiators are not included specifically in Table 9. If such an initiator occurs, then an accident may occur, requiring rating based on actual consequences. If not, Level 2 or 3 is appropriate under defence in depth, depending on the redundancy of the systems providing protection.

The occurrence of internal and external hazards such as fires, floods, tsunamis, explosions, hurricanes, tornados or earthquakes, may be rated using Table 9. The hazard itself should not be considered as the initiator (as the hazard may cause either initiators or degradation of safety systems or both), but the safety systems that remain operable should be assessed against an initiator that occurred and/or against potential initiators.

5.1.4. Assessment of the basic rating for events without a real initiator

As discussed in the previous section, in order to obtain a basic rating, firstly decide whether there was an actual challenge to the safety systems (a real initiator). If so, then Section 5.1.3 is appropriate, otherwise this section is appropriate. It may be necessary to consider an event using both sections if an initiator occurs and reveals a reduced operability in a system not challenged by the real initiator (e.g. if a reactor trip without loss of off-site power reveals a reduced operability of diesels).

For events involving potential failures that could have led to inoperability of safety systems (e.g. discovery of structural defects), a similar approach is used, but it is necessary to take into account the likelihood of inoperability of the safety system. This is explained in Section 5.1.5.

5.1.4.1. Basis of rating

The appropriate ratings for events without a real initiator are given in Table 10. The basis of the values given in the table is as follows.

The rating of an event will depend on the extent to which the safety functions are degraded and on the likelihood of the initiator for which they are provided. Strictly speaking, it is the likelihood of the initiator occurring during the period of safety function degradation, but in general, the methodology does not take account of the time period. However, if the period of degradation is very short, a level lower than that provided in Table 10 may be appropriate (see Section 5.1.4.2).

If the operability of a safety function is *inadequate*, then an accident was only prevented because an initiator did not occur. For such an event, if the safety function is required for *expected* initiators, Level 3 is appropriate. If the *inadequate* safety function is only required for *possible* or *unlikely* initiators, a lower level is clearly appropriate because the likelihood of an accident is much lower. For this reason, Table 10 shows Level 2 for *possible* initiators and Level 1 for *unlikely* initiators.

The level chosen should clearly be less when the safety function is *adequate* than when it is *inadequate*. Thus, if the function is required for *expected* initiators, and the operability is just *adequate*, Level 2 is appropriate. However, in a number of cases, the safety function operability may be considerably greater than just *adequate*, but not within the Operational Limits and Conditions. This is because the *minimum operability required by Operational Limits and Conditions* will often still incorporate redundancy and/or diversity against some *expected* initiators. In such situations, Level 1 would be more appropriate. Thus, Table 10 shows a choice of Level 1 or 2. The appropriate value should be chosen depending on the remaining redundancy and/or diversity.

If the safety function is required for *possible* or *unlikely* initiators, then reduction by one from the level derived above for an *inadequate* system gives Level 1 for *possible* initiators and Below scale/Level 0 for unlikely initiators. However, it is not considered appropriate to categorize at Below Scale/Level 0 a reduction in safety system operability below that required by the OL&C. Thus, Level 1 is shown in Table 10 for both *possible* and *unlikely* initiators.

If the safety function operability is full or within OL&C, the plant has remained within its safe operating envelope, and Below Scale/Level 0 is appropriate for all frequencies of initiators. Thus, Table 10 shows Below Scale/Level 0 for each cell of rows A and B.

TABLE 10. EVENTS WITHOUT A REAL INITIATOR

Safety function operability		Initiator frequency		
		(1) Expected	(2) Possible	(3) Unlikely
A	Full	0	0	0
B	Minimum required by OL&C	0	0	0
C	Adequate	1 or 2	1	1
D	Inadequate	3	2	1

5.1.4.2. Rating procedure

With the background described in the previous section, events should be rated using the following procedure:

(1) Determine the category of safety function operability.
   (a) If the operability is just *adequate* but still within OL&C, operability category B should be used as the plant has remained within its safe operating envelope.
   (b) In practice, safety systems or components may be in a state not fully described by any of the four categories. The operability of the safety function may be less than *full* but more than the *minimum required by OL&C*, or a complete system may be available but degraded by loss of indications. In such cases, the relevant categories should be used to give the possible range of the rating, and judgement used to determine the appropriate rating.
(2) Determine the category of frequency of the initiator for which the safety function is required.
   (a) If there is more than one relevant initiator, then each must be considered, and the one giving the highest rating should be used.
   (b) If the frequency lies on the boundary between two categories, both categories can be used to give the possible range of the rating, and then some judgement will need to be applied.
   (c) For systems specifically provided for protection against hazards, the hazard should be considered as the initiator.
(3) The event rating should be determined from Table 10.
   (a) If the period of inoperability was very short compared to the interval between tests of the components of the safety system (e.g. a couple of hours for a component with a monthly test period), consideration should be given to reducing the basic rating of the event.
   (b) In cell C1 of the table, where choice of rating is given, the choice should be based on whether the operability is just *adequate* or whether redundancy and/or diversity still exist for the initiator being considered.

Beyond design initiators are not included specifically in Table 10. If the operability of the affected safety function is less than the *minimum required by OL&C*, Level 1 is appropriate. If the operability is within the requirements of OL&C, or the OL&C do not provide any limitations on the system operability, Below Scale/Level 0 is appropriate.

5.1.5. Potential events (including structural defects)

Some events do not of themselves result in an initiator or a degraded safety system operability but do correspond to an increased likelihood of such an event. Examples are discovery of structural defects or a leak terminated by operating personnel. The general approach to rating these events is as follows. First, the significance of the potential event should be evaluated by assuming it had actually occurred and applying Section 5.1.3 or 5.1.4, based on the operability of safety provisions that existed at the time. The choice of section depends on whether the potential event was an initiator or a degradation of a safety system. Secondly, the rating should be reduced, depending on the likelihood that the potential event could have developed from the event that actually occurred. The level to which the rating should be reduced must be based on judgement.

One of the most common examples of potential events is the discovery of structural defects. The surveillance programme is intended to identify structural defects before their size becomes unacceptable. If the defect is within this size, then Below Scale/Level 0 would be appropriate.

If the event is the discovery of a defect larger than expected under the surveillance programme, rating of the event needs to take account of two factors.

Firstly, the rating of the potential event should be determined by assuming that the defect had led to failure of the component and applying Section 5.1.3 or 5.1.4. If the defect is in a safety system, applying Section 5.1.4 will give the basic rating of the potential event. The possibility of common mode failure may need to be considered. If failure of the component containing the defect could have led to an initiator, then applying Section 5.1.3 will give the basic rating of the potential event. Although the defect may have been found during shutdown, its significance must be considered over the time during which it is likely to have existed.

The rating of the potential event derived in this way should then be adjusted depending on the likelihood that the defect would have led to component failure, and by consideration of the additional factors discussed in Section 5.2.

5.1.6. Below Scale/Level 0 events

In general, events should be classified Below Scale/Level 0 only if application of the procedures described above does not lead to a higher rating. However, provided none of the additional factors discussed in Section 5.2 are applicable, the following types of events are typical of those that will be categorized as Below Scale/Level 0:

— Reactor trip proceeding normally;
— Spurious[17] operation of the safety systems, followed by normal return to operation, without affecting the safety of the installation;
— Coolant leakage at rate within OL&C;
— Single failures or component inoperability in a redundant system, discovered during scheduled periodic inspection or test.

5.2. CONSIDERATION OF ADDITIONAL FACTORS

Particular aspects may challenge simultaneously different layers of the defence in depth and are consequently to be considered as additional factors that may justify an event having to be rated one level above the one resulting from the previous guidance.

The main additional factors that act in such a way are:

— Common cause failures;
— Procedural inadequacies;
— Safety culture issues.

Because of such factors, it is possible that an event could be rated at Level 1, even though it is of no safety significance on its own without taking into account these additional factors.

When assessing the increase of the basic rating due to these factors, the following aspects require consideration:

(1) Allowing for all additional factors, the level of an event can only be increased by one level.
(2) Some of the above factors may have already been included in the basic rating (e.g. common mode failure). It is therefore important to take care that such failures are not double counted.
(3) The event cannot be increased beyond Level 3, and this upper limit for defence in depth should only be applied to those situations where, had one other event happened (either an *expected* initiator or a further component failure), an accident would have occurred.

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[17] Spurious operation in this respect would include operation of a safety system as a result of a control system malfunction, instrument drift or individual human error. However, the actuation of the safety system initiated by variations in physical parameters which have been caused by unintended actions elsewhere in the plant would not be considered as spurious initiation of the safety system.

5.2.1. Common cause failures

A common cause failure is the failure of a number of devices or components to perform their function as a result of a single specific event or cause. In particular, it can cause the failure of redundant components or devices intended to perform the same safety function. This may imply that the reliability of the whole safety function could be much lower than expected. The severity of an event affecting a component that identifies a potential common cause failure affecting other similar components is therefore higher than an event involving the random failure of the component.

Events in which there is a difficulty in operating some systems as a result of absent or misleading information can also be considered for uprating on the basis of a common cause failure.

5.2.2. Procedural inadequacies

The simultaneous challenge to several layers of the defence in depth may arise because of inadequate procedures. Such inadequacies in procedures are therefore also a possible reason for increasing the basic rating.

Examples include:

- Wrong or inadequate instructions given to operating personnel for coping with an event (e.g. This happened during the Three Mile Island accident in 1979. The procedures to be used by operating personnel in the case of safety injection actuation were not appropriate for the particular situation of a loss of coolant in the steam phase of the pressurizer.)
- Deficiencies in the surveillance programme highlighted by anomalies not discovered during normal procedures or system/equipment unavailabilities well in excess of the test interval.

5.2.3. Safety culture issues

Safety culture has been defined as “that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance”. A good safety culture helps to prevent incidents but, on the other hand, a lack of safety culture could result in operating personnel performing in ways not in accordance with the assumptions of the design. Safety culture has therefore to be considered as part of the defence in depth, and consequently, safety culture issues could justify increasing the rating of an event by one level (INSAG 4 [7] provides further information on safety culture).

To merit increasing the rating due to safety culture issues, the event has to be considered as a real indicator of an issue with the safety culture.

5.2.3.1. Violation of OL&C

One of the most easily defined indicators of a safety culture issue is a violation of OL&C.

OL&C describe the minimum operability of safety systems such that operation remains within the safety requirements of the reactor. They may also include operation with reduced safety system availability for a limited time. In most countries, the OL&C are included within the Technical Specifications. Furthermore, in the event that the OL&C are not met, the Technical Specifications describe the actions to be taken, including times allowed for recovery as well as the appropriate fallback state.

If the system availability is discovered to be less than that defined for Category B (e.g. following a routine test), but the reactor is taken to a safe state in accordance with the Technical Specifications, the event should be rated as described in Sections 5.1.3 and 5.1.4, but the basic rating should not be increased as the requirements of the Technical Specifications have been followed.

If the safety function operability is within that defined for Category B but the operating personnel stay more than the allowed time (as defined in the Technical Specification) in that availability state, the basic rating is Level 0, but the rating should be increased to Level 1 because of safety culture issues.

Equally, if operating personnel take deliberate action that leads to plant availability being outside OL&C, consideration should be given to increasing the basic rating of the event because of safety culture issues.

In addition to the formal OL&C, some countries introduce into their Technical Specifications further requirements such as limits that relate to the long-term safety of components. For events where such limits are exceeded for a short time, Below scale/Level 0 may be more appropriate.

5.2.3.2. Other safety culture issues

Other examples of indicators of safety culture issues could be:

— A violation of a procedure without prior approval;
— A deficiency in the quality assurance process;
— An accumulation of human errors;

— Exposure of a member of the public from a single event in excess of annual statutory dose limits ;
— Cumulative exposure of workers or members of the public in excess of annual statutory dose limits;
— A failure to maintain proper control over radioactive materials, including releases into the environment, spread of contamination or a failure in the systems of dose control;
— The repetition of an event, if there is evidence that the operator has not taken adequate care to ensure that lessons have been learnt or that corrective actions have been taken after the first event.

It is important to note that the intention of this guidance is not to initiate a long and detailed assessment but to consider if there is an immediate judgement that can be made by those rating the event. It is often difficult, immediately after the event, to determine if the rating of the event should be increased due to safety culture. A provisional rating should be provided in this case based on what is known at the time, and a final rating can then take account of the additional information related to safety culture that will have arisen from a detailed investigation.

5.3. WORKED EXAMPLES

Example 27. Reactor scram following the fall of control rods — Below Scale/ Level 0

Event description

The unit was operating at rated power. During the movement of a bank of shutdown rods, which was carried out as a periodic control rod surveillance test, the reactor was scrammed as a result of a high negative rate signal of the power range neutron flux. This also caused automatic turbine and generator trip.

The control rod operation was promptly stopped and rod positions checked on the control rod position detector. It was found that the four control rods of the shutdown bank being tested had fallen prior to the reactor shutdown.

The high negative rate signal had been provided to protect against instrument failure and was not claimed as protection against any design basis faults.

An inspection of the control circuit of the control rod drive mechanism showed that the cause of the malfunction was a defective printed circuit board.

The relevant faulty board was replaced with a spare board and, after the integrity of the control circuit had been checked, normal operation was resumed.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	The accidental falling of control rods does not challenge the safety functions and is therefore not an initiator. The reactor trip is an initiator (frequency category — *expected*).
5.1.2. Safety function operability:	The safety function `cooling of the fuel' was *full*.
5.1.3. and 5.1.4. Basic rating:	There was a real initiator. From Section 5.1.3, box A(1) of Table 9 is appropriate, giving a basic rating of Below scale/Level 0.
5.2. Additional factors:	There are no reasons for uprating.
Overall rating:	Below Scale/Level 0.

Example 28. Reactor coolant leak during on power refuelling — Level 1

Event description

During routine refuelling at full power, a heavy water reactor coolant leak of 1.4 t/h developed in the fuelling vault. Operating personnel determined that the east fuelling bridge had dropped 0.4 m. The reactor was shut down and cooled. Coolant pressure was maintained by transfer from other units and recovery from the sump. Total leakage was 22 t (approximately 10% of the inventory). No safety system operation was required with the exception of containment box up on high activity after one hour. There was no abnormal release of radioactivity to the environment. The cause of the problem was failure of an interlock, which was not checked by the surveillance programme.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	Although there was a very small reactor coolant leak, there was no challenge to the safety functions, because action by operating personnel maintained water inventory. Thus there was no real initiator.
5.1.2. Safety function operability:	Had the leak developed into a small loss of coolant accident (LOCA), all the required safety systems were fully available.
5.1.3 and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, row A of Table 10 is appropriate, giving a basic rating of 0. Using the guidance in section 5.1.5, had the leak not been controlled, it would have led to a small LOCA, frequency *possible*. From Box A(2) of Table 9, the rating of the potential event would have been Level 1. As the likelihood of operators failing to control the leak is low, the rating should be reduced to Level 0.
5.2. Additional factors:	The interlock was not checked by the surveillance programme. Also, this deficiency was known before the event. For these reasons, the event was uprated to Level 1.
Final rating:	Level 1.

Example 29. Containment spray not available due to valves being left in the closed position — Level 1

Event description

This two-unit station has to shut down both its reactors annually in order to perform the required tests on the common emergency core cooling system (ECCS) and the related automatic safety actions.

These tests are usually performed when one of the two reactors is in cold shutdown for refuelling.

On 9 October, Units 1 and 2 were subjected to these tests. Unit 1 remained in the cold shutdown condition for refuelling, and Unit 2 resumed power operation on 14 October. On 1 November, it was discovered during the monthly check of the safeguard valves that the four valves on the discharge side of the containment spray pumps were closed. It was concluded that these valves had not been reopened after the tests on 9 October, in contradiction to the requirements of the related test procedure.

Unit 2 had thus operated for 18 days with spray unavailable.

It was concluded that the cause of the event was human error. However, it was recognized that the error occurred at the end of a test period that was longer than usual (as a result of troubleshooting), and that a more formal reporting of actions accomplished could be very useful.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	There was no real initiator. The initiator that would challenge the degraded safety function was a large LOCA (*unlikely*).
5.1.2. Safety function operability:	The operability of the safety function `confinement' was degraded. The operability was less than the *minimum required by OL&C* but more than just *adequate*, as a diverse system was available.
5.1.3. and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, box C(3) of Table 10 is appropriate, giving a basic rating of Level 1.
5.2. Additional factors:	The fault was caused by human error, but it is not considered appropriate to increase the rating of the event due to safety culture issues (Section 5.1.4 explains that the choice of Level 1 rather than zero for the basic rating already took account of the fact that OL&C had been violated.)
Final rating:	Level 1.

Example 30. Primary system water leak through a rupture disc of the pressurizer discharge tank — Level 1

Event description

The unit had been brought to hot shutdown. The residual heat removal (RHR) system had been isolated and partially drained for system tests after modification work and was therefore not available

The periodic test of pressurizer spray system efficiency was under way, and the reactor coolant system was at a pressure of 159 bars. At about 16:00, the pressurizer relief tank high pressure alarm was actuated. The level in the volume control tank fell, indicating leakage of reactor coolant at an estimated rate of 1.5 m^3 per hour. A worker went into the reactor building in an attempt to discover where the leak was located and concluded that it was coming from the stem of a valve on the reactor coolant system (from a manual valve located on the temperature sensor bypass line). The worker checked that the valve was leaktight by placing it in its back seat position by means of the handwheel (in fact, the valve was still not correctly seated).

The leakage continued, and maintenance staff were called in at 18:00, but they too failed to find the source of the leak.

During this time, the pressure and temperature inside the pressurizer relief tank continued to rise. Temperatures were maintained below 50°C by means of feed and bleed operations (i.e. injections of cold make up water and drainage into the reactor coolant drain recovery tank). Two pumps installed in parallel direct this effluent out of the reactor, building towards the boron recycle system tank.

At around 09:00, the activity sensors indicated an increase in radioactivity in the reactor building. At 09:56, the set point for partial isolation of the containment was reached. This resulted notably in closure of the valves inside the containment on the nuclear island vent and drain system. At this point, effluent could no longer be routed to the boron recycle system.

Pressure inside the pressure relief tank continued to rise until, at 21:22, the rupture disks blew. To maintain the temperature in the pressurizer relief tank at around 50°C, water make up had to be continued until 23:36 At 01:45, activity levels inside the reactor building fell below the set point for containment isolation.

At 02:32, the reactor coolant system was at a pressure of 25 bar. The unit had been brought to subcritical hot shutdown conditions with heat being removed by the steam generators, but the RHR system was still unavailable.

The RHR system was reinstated at 10:54 and at 11:45, the leaking valve on the reactor coolant system was disconnected from its remote control to allow it to be reseated, thereby stopping the leak.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	No real initiator occurred, as the emergency core cooling safety systems were not challenged. The initial leakage was controlled by the normal make up systems (see Section 5.1.1).
5.1.2. Safety function operability:	Had the leak developed into a small LOCA, all the required safety systems were fully available.
5.1.3. and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, row A of Table 10 is appropriate, giving a basic rating on Below scale/Level 0. Using the guidance in Section 5.1.5, had the leak worsened with no action by operating personnel, it would have led to a small LOCA, frequency *possible.* From Box A(2) of Table 9, the rating of the potential event would have been Level 1. As the likelihood of the potential event is low, the rating should be reduced to Level 0.
5.2. Additional factors:	The spurious initiator of containment isolation caused operating difficulties and gave misleading information. For these reasons, the event was uprated to Level 1 (see Section 5.2.1).
Final rating:	Level 1.

Example 31. Fuel assembly drop during refuelling — Level 1

Event description

After lifting a new fuel assembly from its cell during refuelling, spontaneous pull out of the refuelling machine telescopic beam occurred, and a fresh fuel assembly slumped onto the central tube of the refuelling machine flask. Interlocks operated as designed and no fuel damage or depressurization occurred.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	Although the event only involved unirradiated fuel, it could have occurred with irradiated fuel. Dropping a single fuel assembly is identified as a *possible* initiator.
5.1.2. Safety function operability:	The provided safety systems were fully available.
5.1.3. and 5.1.4. Basic rating:	There was a real initiator. From Section 5.1.3, box A(2) of Table 9 is appropriate, giving a basic rating of Level 1. Application of the guidance in section 6.3.8 would give the same rating.
5.2. Additional factors:	There are no reasons for uprating.
Final rating:	Level 1.

Example 32. Incorrect calibration of regional overpower detectors — Level 1

Event description

During a routine calibration of the regional overpower detectors for shutdown systems 1 and 2, an incorrect calibration factor was applied. The calibration factor used was for 96% power, although the reactor was at 100% power. This error in calibration was discovered approximately six hours later, at which time all detectors were recalibrated to the correct value for operation at full power. The trip effectiveness of this parameter for both shutdown systems was therefore reduced for approximately six hours. An alternative trip parameter with redundancy was available throughout.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	There was no real initiator The reactor protection system was required for *expected* initiators.
5.1.2. Safety function operability:	The operability of the protection system was reduced. The operability was less than the *minimum allowed by OL&C* but greater than just *adequate*, as a second trip parameter with redundancy remained available. The wrongly calibrated detectors would also have provided protection for most fault conditions.
5.1.3. and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, box C(1) of Table 10 is appropriate, giving Level 1 or 2. Level 1 was chosen, as the operability was considerably more than just *adequate*.
5.2. Additional factors:	In considering whether the basic rating should be adjusted, it is relevant to consider that the fault only existed for a short time. On the other hand, there were deficiencies in the procedure. It was decided to keep the rating at Level 1.
Final rating:	Level 1.

Example 33. Failure of safety system train during routine testing — Level 1

Event description

The unit was operating at nominal power. During the routine testing of one diesel generator, a failure of the diesel generator control system occurred. The diesel was taken out of service for about six hours for maintenance and then returned to service. The Technical Specifications require that if one diesel generator is taken out of service, the other two safety system trains should be tested. This testing was not carried out at the time. Subsequently, the other safety system trains were tested and shown to be available.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	There was no initiator The diesel generators were required for a loss of off-site power (*expected*).
5.1.2. Safety function operability:	The operability was not less than the *minimum allowed by OL&C*, as two trains remained available. The additional testing eventually carried out did show that two trains were available.
5.1.3 and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, box B(1) of Table 10 is appropriate, giving a basic rating of Below scale/Level 0.
5.2. Additional factors:	Workers violated the Technical Specifications without justification, so the event was uprated to Level 1.
Final rating:	Level 1.

Example 34. Plant design for flooding events may not mitigate the consequences of piping system failures — Level 1

Event description

A regulatory inspection identified that the consequences of internal flooding had not been adequately addressed.

Documentation addressing specific flooding events from postulated failures of plant equipment did exist, but a complete internal plant flooding analysis had not been developed during or subsequent to the plant's original design.

In response to the inadequate plant design, some physical changes had been made to minimize challenges to plant equipment and personnel in combating potential flooding events. However, it was not clear that the plant design provided adequate protection against the consequences of non-safety related piping system failures in the turbine building. High water level in the turbine building would result in water flowing into certain engineered safety feature (ESF) equipment rooms because they are only separated from the turbine building by non-water-tight doors and have a common floor drain system. The ESF equipment rooms contain the auxiliary feedwater system (AFW), emergency diesel generators and both 480 V and 4160 V ESF switchgear.

As a result of the inspection, the design and licensing basis for internal flooding was compiled, and seismic qualification of selected piping and components was completed. Design modifications to protect Class 1 plant systems and components as defined in the updated Safety Analysis Report were completed. This included installation of flood barriers at the doors to rooms containing ESF equipment, installation of check valves in selected floor drain lines, and installation of circuitry to trip the circulating water pumps on high water level in the turbine building basement.

Rating explanation

In general, design deficiencies identified during periodic safety reviews or life extension programmes would not be considered as individual events to be rated with INES. However, errors in analysis discovered during other work might well be reported as events. This manual does not seek to define what events should be reported to the public, rather to give guidance on how to rate events that are communicated to the public. This event is included to show how such events can be rated.

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	There was no initiator. The safety systems were required against the initiator of a major power conversion system pipe rupture (an *unlikely* initiator).
5.1.2. Safety function operability:	The safety function of post trip cooling was *inadequate*.
5.1.3 and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, box D(3) of Table 10 is appropriate, giving a basic rating of Level 1.
5.2. Additional factors:	There are no reasons for uprating.
Final rating:	Level 1.

Example 35. Two emergency diesel generators did not start following disconnection from the main grid supplies — Level 2

Event description

An electrical fault in the 400 kV switchyard caused by errors during a test procedure, resulted in the unit being disconnected from the grid. The excitation of the generators caused an increase in the voltage level on the generator bus bars to about 120%. This overvoltage caused two out of four uninterruptible power supply (UPS) DC/AC inverters to trip. About 30 s later in the sequence, when house load mode of operation on both turbo-generators was lost, the trip of the UPS DC/AC inverters prevented connection of two out of four emergency diesel generators to the 500 V bus bars. Approximately 20 min after the initial event, the 500 V diesel bus bars in the affected divisions were manually connected to the 6 kV system, supplied by the off-site auxiliary power, and all electrical systems were thereby operational. The scram of the reactor was successful, and all control rods were inserted as expected. Two valves in the pressure relief system opened because of unwarranted initiation of safety trains. The emergency core cooling system in two out of four trains was however more than sufficient to maintain the reactor level above the core, as there was no additional LOCA. The control room staff had difficulties in supervising the plant properly during the event, as many indications and readings were lost due to the loss of power in the two trains that supplied much of the control room instrumentation. Subsequent investigations showed that the overvoltage on the generator bus bars could easily have prevented all four UPS systems working.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	A reactor trip occurred, which is a frequent initiator. There was also a partial loss of off-site power, requiring initial operation of diesels followed by manual connection to auxiliary supplies.
5.1.2. Safety function operability:	All cooling systems were available, but the supplies for switching were not available on two trains. Unavailability of two out of four trains was permitted for a limited time and so was within OL&C.
5.1.3 and 5.1.4. Basic rating:	There was a real initiator. From Section 5.1.3, box B(1) of Table 9 is appropriate, giving a basic rating of Level 1 or 2. As all cooling systems were actually available, subject to manual switching, the lower rating was chosen.
5.2. Additional factors:	There was clearly a common mode failure issue as all four UPS systems were subject to the same overvoltage problems. For this reason, the basic rating was increased by 1 level.
Final rating:	Level 2.

The event also showed that the safety systems were vulnerable to a loss of off-site power with an associated overvoltage. Therefore it also needs to be rated based on assessing this identified reduction in operability.

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	A full loss of off-site power (LOOP) did not occur but is an *expected* initiator.
5.1.2. Safety function operability:	Assuming the LOOP led to an overvoltage transient (which was probable), the diesels would have started, but there would have been no supplies to connect them. Operating personnel would have had about 40 minutes to find a way of manually connecting the diesels. On that basis, the safety function operability was just *adequate.*
5.1.3 and 5.1.4. Basic rating:	There was no real initiator. From Section 5.1.4, box C(1) of Table 10 is appropriate giving a basic rating of Level 1 or 2. Because all of the cooling systems were actually available, subject to being able to switch in the diesel supplies, the lower rating was chosen.
5.2. Additional factors:	This analysis already assumes failure of all the UPS systems, so there is no basis for further uprating.
Final rating:	Level 2 based on the first analysis with a real initiator.

Example 36. Loss of forced gas circulation for between 15 and 20 minutes — Level 2

Event description

A single phase fault on the instrument power supplies to Reactor 1 was not cleared automatically and persisted until supplies were changed over manually. The fault caused both high pressure and low pressure feed trip valves to close on one boiler, leading to rundown of the corresponding steam driven gas circulator. Much of the instrumentation and automatic control on the boilers and on Reactor 1 was lost. Manual rod insertion was possible and was attempted, but the rate was insufficient to prevent rising temperatures, resulting in Reactor 1 being automatically tripped on high fuel element temperature (approximately 16°C rise). It appeared to the operating personnel that all the rod control systems were rendered inoperable.

The battery backed essential instrumentation, and the reactor protection system remained functional, together with some of the normal control and instrumentation systems.

All gas circulators ran down as the steam to their turbines deteriorated. The instrument power supplies fault prevented engagement of gas circulator pony motors, either automatically or manually. Low pressure feed was maintained throughout to three out of four boilers and was restored to the fourth boiler by manual action. After the initial transient, leading to the reactor tripping, fuel element temperatures fell but then rose as forced gas circulation failed. These temperatures stabilized at about 50°C below normal operational levels before falling once again when gas circulator pony motors were started on engagement of standby instrument supplies. Reactor 2 was unaffected and operated at full output throughout. Reactor 1 was returned to power the following day.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	This event needs to be considered in two parts. The first initiator was the transient caused by loss of feed to one boiler, together with loss of indications. This challenged the protection system, which was still fully available. This part of the event would therefore be rated at Below scale/Level 0. It should be noted that although the first occurrence in the event was a fault in the instrument supplies, this is not the initiator. The instrument fault caused feed to be lost to one boiler but did not directly challenge any safety systems. It is not therefore to be considered as an initiator. The transient that followed challenged the protection system and is therefore an initiator. The second initiator was the reactor trip and rundown of the steam driven gas circulators. This challenged the safety function ‘cooling of the fuel’.

Criteria	Explanation
5.1.2. Safety function operability:	The operability of this safety function was less than the *minimum required by OL&C,* as none of the pony motors could be started, but more than *adequate,* as natural circulation provided effective cooling, and forced circulation was restored before temperatures could have risen to unacceptable levels.
5.1.3 and 5.1.4. Basic rating:	There was a real initiator. From Section 5.1.3, box C(1) of Table 9 is appropriate, giving a basic rating of Level 2 or 3. As explained in that section, the level chosen depends on the extent to which the operability is greater than just *adequate*. In this event, because of the availability of natural circulation and the limited time for which forced circulation was unavailable, Level 2 is appropriate.
5.2. Additional factors:	Regarding possible uprating, there are two issues to be considered, both identified in Section 5.2.1. The fault involved common mode failure of all the circulators. However, this fact has already been taken into account in the basic rating, and to uprate the event would be double counting (see introduction to Section 5.2 item (2)). The other relevant factor is the difficulties caused by absent indications. However, these were more relevant to controlling the initial transient and could not have led to a worsening of the post-trip cooling situation. Furthermore, from item (3) of the introduction to Section 5.2, Level 3 would be inappropriate, as a single further component failure would not have led to an accident.
Final rating:	Level 2.

Example 37. Small primary circuit leak — Level 2

Event description

A very small leak (detected only by humidity measurement) was discovered in the non-isolatable part of one safety injection line owing to defects that were not expected by the surveillance programme (the area was not inspected by the surveillance programme). Similar but smaller defects were present in the other safety injection lines.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	Following section 5.1.5, if the defect had led to failure of the component, a large loss of coolant accident (LOCA) (*unlikely* initiator) would have occurred.
5.1.2. Safety function operability:	The safety function operability for this postulated initiator was *full*.
5.1.3 and 5.1.4. Basic rating:	Following the methodology for structural defects leads to using Section 5.1.3. Box A(3) of Table 9 gives an upper value to the basic rating of 2. As only a leak occurred (no actual failure of the pipework), the rating should be reduced by one level.
5.2. Additional factors:	As the defects could have led to common mode failure of all safety injection lines, the rating was upgraded to Level 2.
Final rating:	Level 2.

Example 38. Partial blockage of the water intake during cold weather — Level 3

Event description

This event affected both units at the station, but to simplify the explanation, only the impact on Unit 2 is considered here.

On-site electrical supplies could be provided either by the other unit or by four auxiliary turbine generator sets.

The source of the event was the cold weather prevailing in the area at the time. Ice flows blocked the water intake, while the low temperatures contributed to the tripping of the conventional unit, followed by a voltage reduction on the transmission grid.

Ice slipped under the skimmer, reaching the trash racks of the Unit 1 pumping station. Further ice formation probably turned the ice flows into a solid block, partially obstructing the trash racks shared by the two screening drums of the Unit 1 pumping station. This would have produced a significant reduction in raw water intake at the pumping station. There was no clear alarm signal indicating the drop in level.

As a result of the drop in level, vacuum loss at the condensers led to automatic tripping of the four auxiliary turbine generator sets at the site (between 09:30 and 09:34); the four corresponding busbars were each resupplied from the grid within one second.

The main turbine generator sets for Unit 1 were switched off at 09:28 and 09:34, and the reactor was shutdown.

Unit 2 remained in operation, although from 09:33 to 10:35, no auxiliary turbine generator set at the site was available (situation not foreseen or permitted in the Technical Specifications), and the only power supplies consisted of the transmission grid and the two main turbine generator sets for the unit. From 10:55 onwards, when a second auxiliary turbine generator was reconnected to its switchboard, two turboblowers were fed by the auxiliary turbine generators in operation and the two other turboblowers drawing from one of the two 400 kV lines.

At 11:43, following voltage reduction in the transmission grid, the two main turbine generator sets at Unit 2 tripped almost simultaneously (unsuccessful house load operation), causing rod drop and reactor scram as well as loss of off-site power (tripping of line circuit breakers).

At this time, only two of the four auxiliary turbine generators had been brought back into service. Consequently, only two of the four turboblowers remained in operation to provide core cooling. The power lines linking Unit 2 to the grid were restored after 10 and 26 minutes, so that the other turboblowers were brought back into service.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	This is a complex set of events, but the event being rated is the operation of Unit 2 without any on-site essential electrical supplies (due to the loss of cooling water following ice formation). There was no initiator, but the initiator that would challenge on-site electrical supplies is loss of off-site power (*expected*).
5.1.2. Safety function operability:	The safety function `cooling of the fuel' was degraded. The operability of the safety function was *inadequate,* as there were no on-site electrical supplies.
5.1.3 and 5.1.4. Basic rating:	There was no real initiator. From section 5.1.4, box D(1) of Table 10 is appropriate, giving a basic rating of Level 3.
5.2. Additional factors:	Although the time of unavailability was short (1 h), the likelihood of loss of off-site power was high. Indeed, it was lost shortly afterwards. It is not appropriate, therefore, to downrate the event.
Final rating:	Level 3.

Example 39. Unit scram caused by grid disturbances due to tornado — Level 3

Event description

As a result of a tornado, transmission lines were damaged. The unit was tripped by system emergency protection due to strong frequency oscillations in the system.

Unit auxiliary power was supplied from the service transformer. Main steam header pressure was maintained and residual heat removed. Core cooling was maintained through natural circulation.

On voltage decrease, the diesel start signal was initiated, but diesel generators (DGs) failed to connect to essential buses. Since the signal for DG start persisted, periodic restarts followed. Subsequent attempts to supply power to auxiliary buses from DGs were unsuccessful due to absence of air in the start-up bottles.

Four hours after the trip, total loss of power occurred for a period of 30 min. Throughout the transient, the core status was being monitored with the help of design provided instrumentation.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	A real initiator occurred, loss of off-site power. The frequency of this initiator is *expected*. The initiator was caused by a tornado, but section 5.1.3 states that the hazard itself should not be used as the initiator.
5.1.2. Safety function operability:	Even though no diesels were available, the availability of the safety function was just *adequate* due to the limited time of loss of off-site supplies.
5.1.3 and 5.1.4. Basic rating:	There was a real initiator. From Section 5.1.3, box C(1) of Table 9 is appropriate, giving a basic rating of Level 2 or 3. As the safety function was only just *adequate*, Level 3 was chosen.
5.2. Additional factors:	There are no reasons for uprating.
Final rating:	Level 3.

Example 40. Complete station blackout owing to a fire in the turbine building — Level 3

Event description

A fire occurred in the turbine building. The PHWR was tripped manually, and a cooldown of the reactor was initiated.

Due to the fire, many cables and other electrical equipment were damaged, which resulted in a complete station blackout. Core decay heat removal was through natural circulation. Water was fed to the secondary side of the steam generators using diesel fire pumps. Borated heavy water was added to the moderator to maintain the reactor in a sub critical state at all stages.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
5.1.1. Initiator frequency:	Loss of on-site electrical power (Class IV, III, II or I) is a *possible* initiator for PHWRs, which actually occurred (i.e. real). As in the previous example, the hazard itself should not be taken as the initiator.
5.1.2. Safety function operability:	The safety function "cooling" was just *adequate* because the secondary side was fed using a diesel fire pump, which is not a normal safety system.
5.1.3 and 5.1.4. Basic rating:	There was a real initiator. From Section 5.1.3, box C(2) of Table 9 is appropriate, giving a basic rating of Level 2 or 3.
5.2. Additional factors:	Level 3 was chosen because there were no safety systems available, and many indications were lost. A number of potential further single failures could have resulted in an accident.
Final rating:	Level 3.

6. ASSESSMENT OF IMPACT ON DEFENCE IN DEPTH FOR EVENTS AT SPECIFIED FACILITIES

This section deals with those events where there are no “actual consequences”, but some of the safety provisions failed. The deliberate inclusion of multiple provisions or barriers is termed “defence in depth”.

The guidance in this section is for all events at fuel cycle facilities, research reactors, accelerators (e.g. linear accelerators and cyclotrons) and events associated with failures of safety provisions at facilities involving the manufacture and distribution of radionuclides or the use of a Category 1 source. It also covers many events at reactor sites. While Section 5 provided guidance for events occurring on power reactors during operation, this section provides guidance on a wide range of other events at reactor sites. These include events involving reactors during shutdown or reactors being decommissioned, whether or not the fuel is still on-site, and other events at reactor sites, such as those associated with waste storage or maintenance facilities. It is based on what is known as the “Safety Layers Approach”.

Defence in depth provisions, such as interlocks, cooling systems, physical barriers, are provided at all installations dealing with radioactive materials. They cover protection of the public and the workforce, and include means to prevent the transfer of material into poorly shielded locations as well as to prevent the release of radioactive material. The concept of defence in depth is not explained in detail here, as it will be familiar to the majority of those applying this manual to events at facilities. However, Annex I does give some additional background material.

This section is divided into four main parts. The first gives the general principles that are to be used to rate events under defence in depth. As they need to cover a wide range of types of installations and events, they are general in nature. In order to ensure that they are applied in a consistent manner, Section 6.2 goes on to give more detailed guidance, including the guidance associated with uprating events. Section 6.3 gives some specific guidance for certain types of events, and Section 6.4 provides a number of worked examples.

6.1. GENERAL PRINCIPLES FOR RATING OF EVENTS

Although INES allocates three levels for the impact on defence in depth, the maximum potential consequences for some facilities or practices, even if all the safety provisions fail, are limited by the inventory of the radioactive material and the release mechanism. It is not appropriate to rate events associated with the defence in depth provisions for such practices at the highest of the defence in depth levels. If the maximum potential consequences for a particular practice cannot be rated higher than Level 4 on the scale, a maximum rating of Level 2 is appropriate under defence in depth. Similarly if the maximum potential consequences cannot be rated higher than Level 2, then the maximum rating under defence in depth is Level 1. One facility can cover a number of practices, and each practice must be considered separately in this context. For example, waste storage and reprocessing should be considered as separate practices, even though they can both occur at one facility.

Having identified the upper limit to the rating under defence in depth, it is then necessary to consider what safety provisions still remain in place (i.e. what additional failures of safety provisions would be required to result in the maximum potential consequences for the practice). This includes consideration of hardware and administrative systems for prevention, control and mitigation, including passive and active barriers. The approach to rating is based on assessing the likelihood that the event could have led to an accident, not by using probabilistic techniques directly, but by considering what additional failures of safety provisions would be required to result in an accident.

Thus a “basic rating” is determined by taking account of the maximum potential consequences and the number and effectiveness of safety provisions available.

To allow for any underlying “additional factors”, consideration is also given to increasing the “basic rating”. This increase allows for those aspects of the event that may indicate a deeper degradation of the plant or the organizational arrangements of the facility. Factors considered are common cause failures, procedural inadequacies and safety culture issues. Such factors are not included in the basic rating and may indicate that the significance of the event with respect to defence in depth is higher than the one considered in the basic rating process. Accordingly, in order to communicate the true significance of the event to the public, increasing the rating by one level is considered.

The following steps should therefore be followed to rate an event:

(1) The upper limit to the rating under defence in depth should be established by taking account of the maximum potential radiological consequences (i.e. the maximum potential rating for the relevant practices at that facility based on the criteria in Sections 2 and 3). Further guidance on establishing the maximum potential consequences is given in Section 6.2.1.
(2) The basic rating should then be determined by taking account of the number and effectiveness of safety provisions available (hardware and administrative). In identifying the number and effectiveness of such

provisions, it is important to take account of the time available and the time required for identifying and implementing appropriate corrective action. Further guidance on the assessment of safety provisions is provided in Section 6.2.2.

(c) The final rating should be determined by considering whether the basic rating should be increased because of additional factors, as explained in Section 6.2.4. However, the final rating must still remain within the upper limit of the defence in depth rating established in (1).

Clearly, as well as considering the event under defence in depth, each event must also be considered against the criteria in Sections 2 and 3.

6.2. DETAILED GUIDANCE FOR RATING EVENTS

6.2.1. Identification of maximum potential consequences

As stated above, the inventory of radioactive material and timescales of events at installations covered by INES, vary widely. The rating process identifies three categories of maximum potential consequences: Levels 5–7, Levels 3–4 and Levels 1–2.

In assessing the INES level for the maximum potential consequences, the following general principles should be taken into account:

— Any one site may contain a number of facilities with a range of tasks carried out at each facility. Thus, the maximum potential rating should be specific to the type of facility at which the event occurred and the type of operations being undertaken at the time of the event. However, the maximum potential consequences are not specific to the event but apply to a set of operations at a facility

— It is necessary to consider both the radioactive inventory that could potentially have been involved in the event, the physical and chemical properties of the material involved and the mechanisms by which that activity could have been dispersed.

— The consideration should not focus on the scenarios considered in the safety justification of the facility but should consider physically possible accidents had all the safety provisions related to the event been deficient.

— When considering consequences related to worker exposure, the maximum potential consequences should generally be based on exposure of a single inidividual as it is highly unlikely that several workers would all be exposed at the maximum credible level.

These principles can be illustrated by the following examples:

(1) For events associated with maintenance cell entry interlocks, the maximum potential consequences are likely to be related to unplanned worker exposure. If the radiation levels are sufficiently high to cause deterministic effects or death if the cell is entered and no mitigative actions are taken, then the rating of the maximum potential consequences is Level 3 or 4 (from the individual dose criteria in Section 2.3).
(2) For events on small research reactors (power of about 1 MW or less), although the physical mechanisms exist for the dispersal of a significant fraction of the inventory (either through criticality events or loss of fuel cooling), the total inventory is such that the rating of the maximum potential consequences could not be higher than Level 4, even if all the safety provisions fail.
(3) For events on power reactors during shutdown, the inventory and physical mechanisms that exist for the dispersal of a significant fraction of that inventory (through loss of cooling or criticality events), are such that the rating of the maximum potential consequences could exceed Level 4, if all the safety provisions fail.
(4) For reprocessing facilities and other facilities processing plutonium compounds, the inventory and physical mechanisms that exist for the dispersal of a significant fraction of that inventory (either through criticality events, chemical explosions or fires), are such that the rating of the maximum potential consequences could exceed Level 4, if all the safety provisions fail.
(5) For uranium fuel fabrication and enrichment facilities, releases may have chemical and radiation safety aspects. It has to be emphasized that the chemical risk posed by the toxicity of fluorine and uranium predominates over the radiological risk. INES, however, is only related to the assessment of the radiological hazard. Thus, no severe consequences exceeding a rating of Level 4 are conceivable from a release of uranium or its compounds.
(6) For accelerators, the maximum potential consequences are likely to be related to unplanned individual exposure. If the radiation levels are sufficiently high to cause deterministic effects or death in the event of entry into restricted areas, then the rating of the maximum potential consequences is Level 3 or 4 (from the individual dose criteria in Section 2.3).

(7) For irradiators, most events will be associated with unplanned radiation doses. If the potential radiation levels, in the event of failure of all the protective measures, are sufficiently high to cause deterministic effects or death, then the rating of the maximum potential consequences is Level 3 or 4 (from the individual dose criteria in Section 2.3). For events at facilities with Category 1 sources that have safety systems intended to prevent dispersion of radioactive material (e.g. fire protection systems), the potential release may be large enough to give maximum potential consequences rated at Level 5.

6.2.2. Identification of number of safety layers

6.2.2.1. Identifying safety layers

There are a wide range of safety provisions used in the different facilities covered by this section. Some of these may be permanent physical barriers, others may rely on interlocks, others may be active engineered systems such as cooling or injection systems, and others may be based on administrative controls or actions by operating personnel in response to alarms. The methodology for rating events involving such a wide range of safety provisions is to group the safety provisions into separate and independent safety layers. Thus if two separate indications are routed through a single interlock, the indications and interlock together provide a single safety layer. On the other hand, if cooling is provided by two separate 100% pumps, it should be considered as two separate safety layers, unless they have a common non-redundant support system.

When considering the number of safety layers, it is necessary to ensure that the effectiveness of a number of separate hardware layers is not reduced by a common support system or a common action by operating personnel in response to alarms or indications. In such cases, although there may be several hardware layers, there may be only one effective safety layer.

When considering administrative controls as safety layers, it is important to check the extent to which separate procedures can be considered independent and to check that the procedure is of sufficient reliability to be regarded as a safety layer. The time available is considered to have a significant impact on the reliability that can be claimed from operating procedures.

Safety layers can include surveillance procedures, though it should be noted that surveillance alone does not provide a safety layer. The means to implement corrective action are also required.

It is difficult to give more explicit guidance, and inevitably judgement must be used. In general, a safety layer would be expected to have a failure rate approaching 10^{-2} per demand. To help in the identification of the number of independent safety layers, the following list gives some examples of safety layers that may be available, depending on the circumstances of the event and the design and operational safety justification for the facility:

— Electronic personal alarming dosimeters — provided that the personnel are trained in their use, that the dosimeter is reliable and that personnel can and will respond appropriately and quickly enough;
— Installed radiation and/or airborne activity detectors and alarms — provided that they can be shown to be reliable and that personnel can and will respond appropriately and quickly enough;
— Presence of a Radiation Protection technician to detect and alert others to any abnormal levels of radiation or the spread of contamination;
— Leak detection provisions, such as containment, which direct materials to a sump provided with appropriate level measuring instrumentation and/or alarms;
— Surveillance by operating personnel to provide assurance of the safe condition of the facility, provided the surveillance frequency is adequate to identify performance shortfalls, and that the corrective actions required will be reliably carried out;
— Ventilation systems that encourage airborne activity to move through the facility in a safe and controlled manner;
— Shield doors and interlock entry systems;
— Natural ventilation, 'stack effect' or passive cooling/ventilation;
— Actions, instructions or routines that have been developed to mitigate consequences;
— Provision of a diverse system, provided there are not common aspects in supply or control systems;
— Provision of redundancy, provided there is not a non-redundant support system;
— Inerting gas systems as a means of mitigating the evolution of hydrogen in some radioactive waste storage facilities.

6.2.2.2. Confinement

In some situations, confinement will itself provide one or more safety layers, but it must be used with care. As explained in Section 6.2.1, the rating process requires the maximum potential consequences to be placed into one of three categories, Levels 5–7, Levels 3–4 and Levels 1–2. If, following failure of the other safety provisions, successful operation of the confinement system reduces the maximum potential consequences into a lower category of maximum potential consequences, then it should be considered as a safety layer. On the other hand, if the effect of containment is not sufficient to change the category of maximum potential consequences, then it should not be counted as an additional safety layer. For example, a small research reactor would have maximum potential consequences of Level 4, based on fuel melting and maximum release. Successful operation of any containment would not reduce the category of maximum potential consequences as fuel melting is already Level 4. For this reason, the containment would not be considered as an additional safety layer. On the other hand, Example 52 and Example 55 show situations where it is appropriate to take account of containment as a safety layer.

6.2.2.3. High integrity safety layers

In some situations, a high integrity safety layer may be available (e.g. a reactor pressure vessel or a safety provision based on proven and naturally occurring passive phenomena, such as convective cooling). In such cases, because the layer is demonstrated to be of extremely high integrity or reliability, it would clearly be inappropriate to treat such a layer in the same way as other safety layers when applying this guidance.

A high integrity safety layer should have all the following characteristics:

- The safety layer is designed to cope with all relevant design basis faults and is explicitly or implicitly recognized in the facility safety justification as requiring a particularly high reliability or integrity;
- The integrity of the safety layer is assured through appropriate monitoring or inspection such that any degradation of integrity is identified;
- If any degradation of the layer is detected, there are clear means of coping with the event and of implementing corrective actions, either through pre-determined procedures or through long times being available to repair or mitigate the fault.

An example of a high integrity layer would be a vessel or a vault. Administrative controls would not normally meet the requirements of a high integrity layer though, as noted above, certain operating procedures can also be regarded as high integrity safety layers if there are very long timescales available to perform the actions required, to correct errors by operating personnel should they occur, and if there are a wide range of available actions.

6.2.2.4. *Time available*

In some situations, the time available to carry out corrective actions may be significantly greater than the time required for those actions and may therefore allow additional safety layers to be made available. These additional safety layers may be taken into account provided that procedures exist for carrying out the required actions. Where several such layers are made effective by operator action in response to alarms or indications, the reliability of the procedure itself must be considered. The time available to implement the procedure is considered to have a significant impact on the reliability that can be claimed from operating procedures. (See examples in Section 6.4.1.)

In some cases, the time available may be such that there are a whole range of potential safety layers that can be made available and it has not been considered necessary in the safety justification to identify each of them in detail or to include in the procedure the detail of how to make each of them available. In such cases (provided there are a range of practicable measures that could be implemented) this long time available itself provides a highly reliable safety layer.

6.2.3. Assessment of the basic rating

6.2.3.1. *The rating process*

Having identified the maximum potential consequences and the number of effective safety layers, the basic rating should be determined as follows:

(1) The safety analysis for the facility will identify a wide range of events that have been taken into account in the design. It will recognize that a subset of these could reasonably be “expected” to occur over the life of the facility (i.e. they will have a frequency greater that 1/N per year, where N is the facility life). If the challenge to the safety provisions that occurred in the event was such an “expected” event, and the safety systems provided to cope with that event were fully available before the event and behave as expected, the basic rating of the event should be Below Scale/Level 0.

(2) Similarly, if no actual challenge to the safety provisions occurred, but they were discovered to be degraded, the basic rating of the event should be Below Scale/Level 0 if the degraded operability of the safety provisions was still within authorized limits.

(3) For all other situations, Table 11 should be used to determine the basic rating.
   (a) If only one safety layer remains, but that safety layer meets all the requirements of a high integrity safety layer (Section 6.2.2.3) or the long time available provides a highly reliable safety layer (Section 6.2.2.4), a basic rating of Below Scale/Level 0[18] would be more appropriate.
   (b) If the period of unavailability of a safety layer was very short compared to the interval between tests of the components of the safety layer (e.g. a couple of hours for a component with a monthly test period), consideration should be given to reducing the basic rating of the event

TABLE 11. RATING OF EVENTS USING THE SAFETY LAYERS APPROACH

Number of remaining safety layers	Maximum potential consequences [a]		
	(1) Levels 5, 6, 7	(2) Levels 3, 4	(3) Levels 2 or 1
A More than 3	0	0	0
B 3	1	0	0
C 2	2	1	0
D 1 or 0	3	2	1

[a] These ratings cannot be increased due to additional factors because they are already the upper limit for defence in depth.

This approach inevitably requires some judgement, but Section 6.3 gives guidance for specific types of events, and Section 6.4 provides some worked examples of the use of the safety layers approach.

6.2.3.2. Potential events (including structural defects)

Some events do not of themselves reduce the number of safety layers but do correspond to an increased likelihood of a reduction. Examples are

[18] If the operability of safety layers was outside the authorized limits, the guidance in Section 6.2 4.3 may lead to a rating of Level 1.

discovery of structural defects, a leak terminated due to action by operating personnel or faults discovered in process control systems. The approach to rating such events is as follows. First, the significance of the potential event should be evaluated by assuming it had actually occurred and applying the guidance of Section 6.2.3.1, based on the number of safety layers that would have remained. Second, the rating should be reduced, depending on the likelihood that the potential event could have developed from the event that actually occurred. The level to which the rating should be reduced must be based on judgement.

One of the most common examples of potential events is the discovery of structural defects. The surveillance programme is intended to identify structural defects before their size becomes unacceptable. If the defect is within this size, then Below scale/Level 0 would be appropriate.

If the defect is larger than expected under the surveillance programme, rating of the event needs to take account of two factors.

Firstly, the rating of the potential event should be determined by assuming that the defect had led to failure of the component and applying the guidance of Section 6.2.3.1. The rating of the potential event derived in this way should then be adjusted depending on the likelihood that the defect would have led to the potential event, and by consideration of the additional factors discussed in Section 6.2.4.

6.2.3.3. Below Scale/Level 0 events

In general, events should be classified Below Scale/Level 0 only if application of the procedures described above does not lead to a higher rating. However, provided none of the additional factors discussed in Section 6.2.4 are applicable, the following types of events are typical of those that will be categorized Below Scale/Level 0:

— Spurious[19] operation of the safety systems, followed by normal return to operation, without affecting the safety of the installation;
— No significant degradation of the barriers (leak rate less than authorized limits);
— Single failures or component inoperability in a redundant system discovered during scheduled periodic inspection or test.

[19] Spurious operation in this respect would include operation of a safety system as a result of a control system malfunction, instrument drift or individual human error. However, the actuation of the safety system initiated by variations in physical parameters that has been caused by unintended actions elsewhere in the plant would not be considered as spurious initiation of the safety system.

6.2.4. Consideration of additional factors

Particular aspects may simultaneously challenge different layers of the defence in depth and are consequently to be considered as additional factors that may justify an event having to be rated one level above the one resulting from the previous guidance.

The main additional factors that act in such a way are:

- Common cause failures;
- Procedural inadequacies;
- Safety culture issues.

Because of such factors, it is possible that an event could be rated at Level 1, even though it is of no safety significance on its own without taking into account these additional factors.

When assessing the increase of the basic rating due to these factors, the following aspects require consideration:

(1) Allowing for all additional factors, the rating of an event can only be increased by one level.

(2) Some of the above factors may have already been included in the basic rating (e.g. common mode failure). It is therefore important to take care that such failures are not double counted.

(3) The event should not be increased above the upper limit derived in accordance with Section 6.2.1, and this upper limit should only be applied to those situations where, had one other event happened (either an event expected within the plant lifetime or a further component failure), an accident would have occurred.

6.2.4.1. Common cause failures

A common cause failure is the failure of a number of devices or components to perform their functions as a result of a single specific event or cause. In particular, it can cause the failure of redundant components or devices intended to perform the same safety function. This may imply that the reliability of the whole safety function could be much lower than expected. The severity of an event affecting a component that identifies a potential common cause failure affecting other similar components is therefore higher than an event involving the random failure of the component.

Events in which there is a difficulty in operating some systems that is caused by absent or misleading information can also be considered for uprating on the basis of a common cause failure.

6.2.4.2. Procedural inadequacies

The simultaneous challenge to several layers of the defence in depth may arise because of inadequate procedures. Such inadequacies in procedures are therefore also a possible reason for increasing the basic rating.

6.2.4.3. Events with implications for safety culture

Safety culture has been defined as "that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance". A good safety culture helps to prevent incidents but, on the other hand, a lack of safety culture could result in operating personnel performing in ways not in accordance with the assumptions of the design. Safety culture has therefore to be considered as part of the defence in depth and consequently, safety culture issues could justify upgrading the rating of an event by one level. (INSAG 4 [7] provides further information on safety culture).

To merit increasing the rating due to a safety culture issue, the event has to be considered as a real indicator of an issue with the safety culture.

Violation of authorized limits

One of the most easily defined indicators of a safety culture issue is a violation of authorized limits, which may also be referred to as OL&C.

In many facilities, the authorized limits include the minimum operability of safety systems such that operation remains within the safety requirements of the plant. They may also include operation with reduced safety system availability for a limited time. In some facilities, Technical Specifications are provided and include authorized limits and furthermore, in the event that the requirements are not met, the Technical Specifications describe the actions to be taken, including times allowed for recovery as well as the appropriate fallback state.

If the operating personnel stay more than the allowed time in a reduced availability state (as defined in the Technical Specification), or if they take deliberate action that leads to plant availability being outside an allowed state, consideration should be given to increasing the basic rating of the event because of safety culture issues.

If the system availability is discovered to be less than that allowed by the authorized limits (e.g. following a routine test), but the operating personnel immediately take the appropriate actions to return the plant to a safe state in accordance with the Technical Specifications, the event should be rated as described in Section 6.2.3.1 but should not be increased, as the requirements of the Technical Specifications have been followed.

In addition to the formal authorized limits, some countries introduce into their Technical Specifications further requirements, such as limits that relate to the long-term safety of components. For events where such limits are exceeded for a short time, Below Scale/Level 0 may be more appropriate.

For reactors in the shutdown state, Technical Specifications will again specify minimum availability requirements but will not generally specify recovery times or fall back states, as it is not possible to identify a safer state. The requirement will be to restore the original plant state as soon as possible. The reduction in plant availability below that required by the Technical Specifications should not be regarded as a violation of authorized limits unless time limits are exceeded.

Other safety culture issues

Other examples of indicators of a deficiency in the safety culture could be:

— A violation of a procedure, without prior approval;
— A deficiency in the quality assurance process;
— An accumulation of human errors;
— Exposure of a member of the public from a single event in excess of annual statutory dose limits;
— Cumulative exposure of workers or members of the public in excess of annual statutory dose limits;
— A failure to maintain proper control over radioactive materials, including releases into the environment, spread of contamination or a failure in the systems of dose control;
— The repetition of an event, if there is evidence that the operator has not taken adequate care to ensure that lessons have been learnt or that corrective actions have been taken after the first event.

It is important to note that the intention of this guidance is not to initiate a long and detailed assessment but to consider if there is an immediate judgement that can be made by those rating the event. It is often difficult, immediately after the event, to determine if the event should be uprated due to safety culture. A provisional rating should be provided in this case based on what is known at the time, and a final rating can then take account of the additional information related to safety culture that will have arisen from a detailed investigation.

6.3. GUIDANCE ON THE USE OF THE SAFETY LAYERS APPROACH FOR SPECIFIC TYPES OF EVENTS

6.3.1. Events involving failures in cooling systems during reactor shutdown

Most reactor safety systems have been designed for coping with initiators occurring during power operation. Events in hot shutdown or startup condition are quite similar to events in power operation and should be rated using Section 5. Once the reactor is shut down, some of these safety systems are still required to assure the safety functions, but usually more time is available. On the other hand, this time available for manual actions may replace part of the safety provisions in terms of redundancy or diversity (i.e. depending on the status of the plant, a reduction in the redundancy of safety equipment and/or barriers may be acceptable during some periods of cold shutdown). In such shutdown conditions, the configurations of the barriers are sometimes also quite different (e.g., an open primary coolant system or an open containment). It is for these reasons that an alternative approach to rating events is provided for shutdown reactors (i.e. the safety layers approach).

The main factors affecting rating are the number of trains of cooling provided, the time available for corrective actions and the integrity of any pipework for cooling vessels. Some examples based on pressurized water reactors during cold shutdown are given in section 6.4.1 (Example 41 to Example 46) to give guidance for rating events following the safety layers approach. For other reactor types, it will be necessary to use this as illustrative guidance together with Section 6.2 to rate such events.

6.3.2. Events involving failures in cooling systems affecting the spent fuel pool

After some years of operation, the radioactive inventory of the spent fuel pool may be high. In this case, the rating of events affecting the spent fuel pool with respect to impact on defence in depth may span the full range up to Level 3.

Because of the large water inventory and the comparably low decay heat, there is usually plenty of time available for corrective actions to be taken for events involving degradation of spent fuel pool cooling. This is equally true for a loss of coolant from the spent fuel pool, since the leakage from the pool is limited by design. Thus, a failure of the spent fuel pool cooling system for some hours or a coolant leakage will not usually affect the spent fuel.

Therefore, minor degradation of the pool cooling system or minor leakages should be typically rated at Below Scale/Level 0.

Operation outside the OL&C or a substantial increase in temperature or decrease of the spent fuel pool coolant level should be rated as Level 1.

An indication of Level 2 could be widespread boiling of coolant or fuel elements becoming uncovered. Substantial fuel element uncovering clearly indicates Level 3.

6.3.3. Criticality control

The behaviour of a critical system and its radiological consequences are heavily dependent on the physical conditions and characteristics of the system. In homogeneous fissile solutions, the possible number of fissions, the power level of the criticality excursion and the potential consequences of a criticality excursion are limited by these characteristics. Experience with criticality excursions in fissile solutions shows that typically the total number of fissions is in the order of 10^{17}–10^{18}.

Heterogeneous critical systems such as fuel rod lattices or dry solid critical systems have the potential for high power peaks leading to explosive release of energy and the release of large amounts of radioactive material due to substantial damage to the installation. For such facilities, the maximum potential consequences could exceed Level 4.

For other facilities, the main hazard from a criticality excursion is exposure of personnel due to high radiation fields from direct neutron and gamma radiation. A second consequence might be a release to the atmosphere of short lived radioactive fission products and potentially severe contamination within the facility. For these two scenarios, the maximum potential consequences would be Level 3 or 4.

In accordance with the general guidance:

- Minor deviations from the criticality safety regime that are within the authorized limits should be rated at Below Scale/Level 0.
- Operation outside authorized limits should be rated at least at Level 1.
- An event where a criticality event would have occurred had there been one further failure in the safety provisions or had conditions been slightly

different, should be rated at Level 2 for facilities, with maximum potential consequences of Levels 3 or 4. If the maximum potential consequences could have been Level 5 or higher, the event should be rated at Level 3.

If more than one safety layer remains, then a lower level would be appropriate and Table 11 should be used to determine the appropriate rating.

6.3.4. Unauthorized release or spread of contamination

Any event involving transfer of radioactive material that results in a contamination level above the investigation level for the area may justify a rating of Level 1, based on safety culture issues (Section 6.2.4 "failure to maintain proper control over radioactive materials"). Contamination levels in excess of the authorized limit for the area should be rated at Level 1. More significant failures in safety provisions should be rated by considering the maximum potential consequences should all the safety provisions fail and the number of safety layers remaining.

Breaches of discharge authorizations should be rated at least at Level 1.

6.3.5. Dose control

Occasionally, situations may arise when the radiological control procedures and managerial arrangements are inadequate, and employees receive unplanned radiation exposures (internal and external). Such events may justify a rating of Level 1 based on Section 6.2.4 (failure to maintain proper control over radioactive materials). If the event results in the cumulative dose exceeding authorized limits, the event should be rated at least at Level 1 as a violation of authorized limits.

In general, the guidance in Section 6.2.4 should not be used to uprate events related to dose control failure from a basic rating of Level 1. Otherwise, events where dose was prevented will be rated at the same level as those where significant doses in excess of dose limits were actually incurred. However, Level 2 would be appropriate under defence in depth if one or no safety layers remain, and the maximum potential consequences should the safety provisions fail are Level 3 or 4.

6.3.6. Interlocks on doors to shielded enclosures

Inadvertent entry to normally shielded locations is generally prevented by the use of radiation activated interlocking systems on the entrance doors, the use of entry authorization procedures and pre-entry checks on radiation dose rates.

Failure of the shield door interlocking protection can result from loss of electrical supply and/or defects in either the detector(s), or the associated electronic equipment or human error.

As the maximum potential consequences for such events are limited to Level 4, events where a further failure in the safety provisions would result in an accident should be rated at Level 2. Events where some provisions have failed but additional safety layers remain, including administrative arrangements governing authorization for entry, should generally be rated at Level 1.

6.3.7. Failures of extract ventilation, filtration and cleanup systems

In facilities working with significant quantities of radioactive material, there could be up to three separate but interrelated extract ventilation systems. They maintain a pressure gradient between the various vessels, cells/glove boxes and operating areas as well as adequate flow rates through apertures in the cell operating area boundary wall to prevent back diffusion of radioactive material. In addition, cleanup systems, such as high-efficiency particulate air (HEPA) filters or scrubbers are provided to reduce discharges to atmosphere to below pre-defined limits and to prevent back diffusion into areas of lower activity.

The first step in rating events associated with the loss of such systems is to determine the maximum potential consequences should all the safety provisions fail. This should consider the material inventory and the possible means for its dispersion both inside and outside the facility. It is also necessary to consider the potential for decrease in the concentration of inerting gases or the buildup of explosive mixtures. In most cases, unless an explosion is possible, it is unlikely that the maximum potential consequences would exceed Level 4, and therefore the maximum under defence in depth would be Level 2.

The second step is to identify the number of remaining safety layers, including procedures to prevent the generation of further activity by cessation of work.

The rating of such events is illustrated by Example 52 in Section 6.4.2.

6.3.8. Handling events and drops of heavy loads

6.3.8.1. Events not involving fuel assemblies

The impact of handling events or failure of lifting equipment depends on the material involved, the area in which the event occurred and the equipment which was or could have been affected.

Events where a dropped load threatens a spillage of radioactive material (either from the dropped load itself or from affected pipework or vessels), should be rated by considering the maximum potential consequences and the likelihood that such a spillage might have occurred. Events where a dropped load only causes limited damage but had a relatively high probability of causing worse consequences should be rated at the maximum level under defence in depth appropriate to the maximum potential consequences. Similarly, events where only one safety layer prevented the damage should also be rated at the maximum level unless that layer is considered to be of especially high reliability or integrity.

Events where the likelihood is lower or there are additional safety layers should be rated following the guidance in Section 6.2.

Minor handling events, which would be expected over the lifetime of the facility, should be rated at Below Scale/Level 0.

6.3.8.2. Fuel handling events

Events during handling of unirradiated uranium fuel elements with no significant implications for the handling of irradiated fuel should typically be rated as Below Scale/Level 0 if there has been no risk of damaging spent fuel elements or safety-related equipment.

For irradiated fuel, the radioactive inventory of a single fuel element is very much lower than the inventory of the spent fuel pool or the reactor core, and hence the maximum potential consequences are less.

As long as the cooling of the spent fuel element is guaranteed, this provides an important safety layer since the integrity of the fuel matrix will not be degraded by overheating. In general, there will be very long timescales associated with fuel overheating. Depending on the facility configuration, containment will also provide a safety layer in most cases.

Events *expected* over the lifetime of the facility that do not affect the cooling of the spent fuel element and only result in a minor release or no release typically should be classified as Below Scale/Level 0.

Level 1 should be considered for events:

— Not expected over the lifetime of the facility;
— Involving operation outside the authorized limits;
— Involving limited degradation of cooling not affecting the integrity of the fuel pins;
— Involving mechanical damage of the fuel pin integrity without degradation of cooling.

Level 2 may be appropriate for events in which there is damage to the fuel pin integrity as a result of substantial heat up of the fuel element.

6.3.9. Loss of electrical power supply

At many facilities, it is often necessary to provide a guaranteed electrical supply to ensure its continued safe operation and to maintain the availability of monitoring equipment and surveillance instruments. Several independent electrical supply routes and diverse supply means are used to prevent common cause failure. While most facilities will be automatically shut down to a safe condition, on total loss of electrical power supplies, in some facilities additional safety provisions, such as the use of inerting gas or backup generators, will be provided.

In order to rate events involving loss of off-site power supplies or failures of on-site supply systems, it is necessary to use the guidance in Section 6.2, taking account of the extent of any remaining supplies, the time for which the supplies were unavailable and the maximum potential consequences. It is particularly important to take account of the time delay acceptable before restoration of supplies is required.

For some facilities, there will be no adverse safety effects, even with a complete loss of power supplies lasting several days, and such events at these facilities should generally be rated at Below Scale/Level 0 or Level 1 as there should be several means available to restore supplies within the available time. Level 1 would be appropriate if the availability of safety systems had been outside the authorized limits.

Partial loss of electric power or loss of electric power from the normal grid with available power supply from standby systems is "expected" over the life of the facility and therefore should be rated Below Scale/Level 0.

6.3.10. Fire and explosion

A fire or explosion within or adjacent to the facility that does not have the potential to degrade any safety provisions would either not be rated on the scale or would be rated Below Scale/Level 0. Fires that are extinguished by the installed protection systems, functioning as intended by design, should be rated similarly.

The significance of fires and explosions at installations depends not only on the material involved but also on the location and the ease with which firefighting operations can be undertaken. The rating depends on the maximum potential consequences, as well as the number and effectiveness of the remaining safety layers, including fire barriers, fire suppression systems and segregated safety systems. The effectiveness of remaining safety layers should take account of the likelihood that they could have been degraded.

Any fire or explosion involving low level waste should be rated at Level 1, owing to deficiencies in procedures or safety culture issues.

6.3.11. External hazards

The occurrence of external hazards, such as external fires, floods, tsunamis, external explosions, hurricanes, tornados or earthquakes may be rated in the same way as other events by considering the effectiveness of remaining safety provisions.

For events involving failures in systems specifically provided for protection against hazards, the number of safety layers should be assessed, including the likelihood of the hazard occurring during the time when the system was unavailable. For most facilities, owing to the low expected frequency of such hazards, a rating greater than Level 1 is unlikely to be appropriate.

6.3.12. Failures in cooling systems

Failures in essential cooling systems can be rated in a similar way to failures in electrical systems by taking account of the maximum potential consequences, the number of safety layers remaining and the time delay that is acceptable before restoration of cooling is required.

In the case of failures in the cooling systems of high level liquid waste or plutonium storage, Level 3 is likely to be appropriate for events where only a single safety layer remains for a significant period of time.

6.4. WORKED EXAMPLES

6.4.1. Events on a shutdown power reactor

Example 41. Loss of shutdown cooling due to increase in coolant pressure — Below Scale/Level 0

Event description

Shutdown cooling was being provided by circulation of coolant through two residual heat removal (RHR) heat exchangers via separate suction lines, each with two isolation valves. The valves in each line were controlled by separate pressure transducers and were operable from the control room. The primary circuit was closed. The steam generators were also available, ensuring that any temperature increases from loss of RHR would be very slow. Safety injection was not available, high pressure safety injection (HPSI) pumps are separate from the charging pumps, and relief valves were available to control primary circuit pressure.

The safety provisions are illustrated in Fig. 1.

The event occurred when a rise in coolant pressure caused the isolation valves to close. Alarms in the control room notified the operating personnel of the valve closure and having reduced the pressure, the valves were re-opened. Temperatures did not rise above the limits in Operational Limits and Conditions.

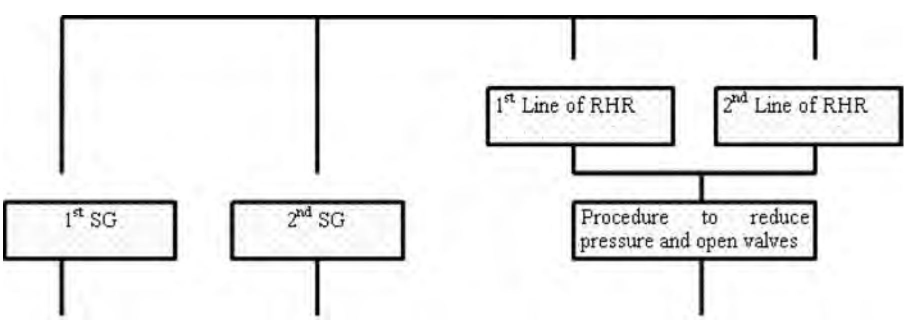


FIG. 1. Illustration of safety provisions for Example 41.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a shutdown power reactor are Levels 5–7.
6.2.2. Identification of number of safety layers:	There were four hardware layers and provided the steam generators remained available, there was plenty of time for the required actions, sufficient even to allow repairs to the RHR system to be carried out. As a result of the long timescales available, the procedure to re-open the valves can be regarded as more reliable than a single layer, and all four layers can be considered as independent.
6.2.3. Assessment of the basic rating:	Based on Table 11, the rating is Below scale/Level 0.
Overall rating:	Below Scale/Level 0.

Example 42. Loss of shutdown cooling due to spurious operation of pressure sensors — Below Scale/Level 0

Event description

Shutdown cooling was being provided by circulation of coolant through a single residual heat removal (RHR) heat exchanger via a single suction pipe with two isolation valves. The valves are operable from the control room. The primary circuit was open with the cavity flooded. The reactor had been shutdown for one week so that any coolant temperature increase would be very slow. Steam generators were open for work and therefore unavailable. Safety injection was not available, high pressure steam injection (HPSI) pumps are separate from the charging pumps and relief valves were available to control primary circuit pressure.

The event occurred when spurious operation of pressure sensors caused the isolation valves to close. Alarms in the control room notified the operating personnel of the valve closure and having checked that the pressure rise was a spurious signal, the valves were re-opened. Temperatures did not rise above the limits in Operational Limits and Conditions; it would have taken 10 hours to reach the operational limits.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a shutdown power reactor are Levels 5–7.
6.2.2. Identification of number of safety layers:	Considering the safety function of fuel cooling, there are two safety layers. The first is the RHR system, and the second is the very long time available to add water so as to maintain the water level as water and heat is lost through evaporation. The second layer can be considered as a highly reliable layer (Section 6.2.2.4) for the following reasons: — there are long times available for action (at least 10 h to reach operational limits) — there are a number of ways of adding additional water (e.g. low pressure safety injection, fire hoses), though boron concentration must be controlled. — this safety layer is recognized in the safety justification as a key safety feature. In addition, the time available is such that there is adequate time for repair of the RHR system if necessary.
6.2.3. Assessment of the basic rating:	The guidance in Section 6.2.3.1 gives a rating of Below Scale/Level 0.
Overall rating:	Below Scale/Level 0.

Example 43. Complete loss of shutdown cooling — Level 1

Event description

The shutdown cooling of the reactor vessel was completely lost for several hours when the suction isolation valves of the RHR system, which was in operation, automatically closed. These valves closed due to the loss of the power supply to Division 2 of the nuclear safety protection system as a result of inappropriate maintenance. The alternate power supply had already been isolated for maintenance. The unit had been in the shutdown condition for a long time (about 16 months), and the decay heat was very low. During the period of time the shutdown cooling was unavailable, water in the reactor vessel began to heat up at a rate of approximately 0.3°C/h. The RHR system was restarted approximately 6 h after the initial event.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a shutdown power reactor are Levels 5–7.
6.2.2. Identification of number of safety layers:	For this particular event, a very long time was available before any significant consequences such as core degradation or significant radiation exposures could occur. This available time allows implementation of a wide range of measures to correct the situation and can therefore be considered as a highly reliable safety layer as mentioned in Section 6.2.2.4.
6.2.3. Assessment of the basic rating:	The basic rating of the event is Below Scale/Level 0.
6.2.4. Additional factors:	The inappropriate maintenance took the reactor outside the OL&C, so the rating was increased to Level 1.
Overall rating:	Level 1.

If the decay heat had not been very low, the available time would have been much shorter, and it could not have been considered as a high integrity layer. In such a case, the effective safety layers are the following:

— Procedures and actions by operating personnel to restore the power supply to Division 2 of the Nuclear Safety Protection system;
— Procedures and actions by operating personnel to restore the RHR cooling with alternative systems.

The number of remaining layers being two, the event would have then been rated at Level 2. It would not have been increased to Level 3, as one further failure would not have led to an accident (see section 6.2.4).

Example 44. Loss of shutdown cooling due to increase in coolant pressure — Level 2

Event description

The design is identical to that in Example 41, but the steam generators were open for work and therefore unavailable. The safety provisions are illustrated in Fig. 2. The event occurred some time after the reactor had been shut down when a rise in coolant pressure caused the RHR isolation valves to close. Alarms in the control room notified the operating personnel of the valve closure and, having reduced the pressure, the valves were re-opened. Temperatures did not rise above the limits in OL&C. Decay heat was sufficiently low that it would have taken five hours to reach the operational limits.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a shutdown power reactor are Levels 5–7.
6.2.2. Identification of number of safety layers:	The safety provisions are illustrated in Fig. 2. There are two hardware safety layers and a software safety layer in series, and there are at least 5 h to carry out the required actions. Because of the long time available, the operating procedure and actions by operating personnel can be regarded as more reliable than a single safety layer. The limiting aspect of the safety provisions is now the two hardware layers.
6.2.3. Assessment of the basic rating:	Based on Table 11, the existence of two hardware layers means that the event should be rated at Level 2.
Overall rating:	Level 2.

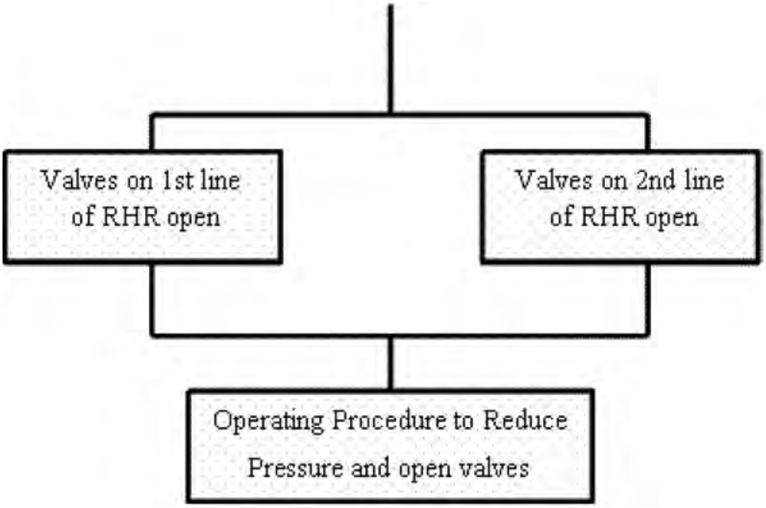


FIG. 2. Illustration of safety layers for Examples 44 and 46.

Example 45. Loss of shutdown cooling due to spurious operation of pressure sensors — Level 3

Event description

The design is the same as in Example 42, but the event occurred soon after shutdown. Shutdown cooling was being provided by circulation of coolant through an RHR heat exchanger via a single suction pipe with two isolation valves. The primary circuit was closed. In the event of closure of the isolating valves, the coolant temperature will rise but will take approximately one hour to reach unacceptable temperatures. The valves are operable from the control room. Steam generators are open for work and therefore unavailable. Safety injection is not available, HPSI pumps are separate from the charging pumps and relief valves are available to control primary circuit pressure.

The event occurred when spurious operation of pressure sensors caused the isolation valves to close. Alarms in the control room notified the operating personnel of the valve closure and, having checked that the pressure rise was a spurious signal, the valves were re-opened. Temperatures did not rise above the limits in OL&C.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a shutdown power reactor are Level 5–7.
6.2.2. Identification of number of safety layers:	The only safety layer is cooling of the primary coolant through the single RHR suction pipe. Again, it is necessary to consider both the hardware and procedural aspects of the safety layer. Consider first the actions required in order to restore cooling. The operating personnel must ensure that the pressure signal was spurious, and that if the rise in coolant temperature has caused a subsequent rise in pressure, the pressure needs to be reduced. A procedure for re-instating RHR after closure of the valves did exist. The operation can be carried out in the time available but not with a large margin. From the hardware viewpoint, failure of either valve to re-open will result in the unavailability of the safety layer. Also, there is certainly not sufficient time to carry out any repairs should the valves fail to open. For these reasons, the single layer is not regarded as a highly reliable safety layer, even though it was the only layer provided by design. The need to be able to open both of the isolating valves in order to restore supplies clearly limits the reliability of the safety layer.
6.2.3. Assessment of the basic rating:	There is only a single safety layer available and therefore based on Table 11, the rating is Level 3.
Overall rating:	Level 3.

Example 46. Loss of shutdown cooling due to increase in coolant pressure — Level 3

Event description

The plant design is the same as in Example 44, but the event occurred soon after shutdown when a rise in coolant pressure caused the isolating valves to close. The safety provisions are illustrated in Fig. 2.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a shutdown power reactor are Levels 5–7.
6.2.2. Identification of number of safety layers:	There now appear to be two safety layers as far as hardware is concerned. However, both still rely on the operating personnel to re-open the valves. The reliability of the safety provisions is limited by the need for action by operating personnel. Given the complexity of the operation and the limited time available, it is considered that there is only one effective safety layer (i.e. an operating procedure requiring pressure reduction and re-opening of the isolation valve).
6.2.3. Assessment of the basic rating:	Based on Table 11, Level 3 is appropriate.
Overall rating:	Level 3.

6.4.2. Events at facilities other than power reactors

Example 47. Pressurization of the void above the liquid level in a fuel element dissolver vessel — Below Scale/Level 0

Event description

The detection of a small pressurization of the space above the liquid level in a reprocessing facility dissolver resulted in the automatic shutting down of the process. The dissolver heating system was switched off and cooling water applied. The nitric acid feed to the vessel was stopped and the dissolution reaction suppressed by the addition of water to the vessel contents. No release of airborne contamination to the plant operating area or the environment occurred.

Subsequent investigations indicated that the pressurization was due to an abnormal release of vapour and an increased rate of nitrous vapour production as a result of a short-term enhanced rate of dissolution of the fuel.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a reprocessing facility areLevels 5–7.
6.2.2. Identification of number of safety layers:	Because of the deviation in the process conditions, the process was automatically shut down. All hutdown steps proceeded normally. No safety layers failed.
6.2.3. Assessment of the basic rating:	Based on point (1) of Section 6.2.3.1, the rating is Below Scale/Level 0.
6.2.4. Additional factors:	There are no reasons to uprate the event.
Overall rating:	Below scale/Level 0.

Example 48. Loss of cooling at a small research reactor — Below Scale/Level 0

Event description

The event occurred at a 100 kW research reactor with a large cooling pool and a heat exchanger/purification system as shown in Fig. 3. In the event of loss of cooling, any heating of the water will be extremely slow.

The event occurred when the pipework downstream of the pump failed, and coolant was pumped out to the bottom of the suction pipe. The pump then failed due to cavitation.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	There are two safety functions to be considered. One is the cooling of the fuel, and the other is the shielding to prevent high worker doses. For both safety functions, due to the low inventory, the maximum potential consequences cannot exceed Level 4, and therefore the maximum under defence in depth is Level 2.
6.2.2. Identification of number of safety layers:	Considering the cooling function, by design there are three safety layers. One is the heat exchanger system, another is the large volume of water in the pool, and the third is the ability to cool the fuel in air. The suction side has been deliberately designed so as to ensure a large volume of water remains in the pool should the pipe fail. Furthermore it is clear that the main safety layer is the volume of water. This can therefore be considered as a high integrity safety layer for the following reasons: — The heat input is small compared to the volume of the water such that any temperature rise will be extremely slow. It should take many days for the water level to decrease significantly. — Any reduction in water level would be readily detected by the operating personnel, and the water level could be simply topped up via a number of routes. — The safety justification for the facility recognizes this as the key safety layer and demonstrates its integrity. The suction pipe to the heat exchanger was carefully designed to ensure that adequate water remained.
6.2.3. Assessment of the basic rating:	The basic rating is considered to be zero because there are two safety layers remaining, and one is of high integrity. Considering the shielding safety function, there is only one safety layer remaining, but it is of high integrity as the level of water remaining at the bottom of the suction pipe provides adequate shielding.
6.2.4. Additional factors:	There are no reasons to uprate the event.
Overall rating:	Below Scale/Level 0.

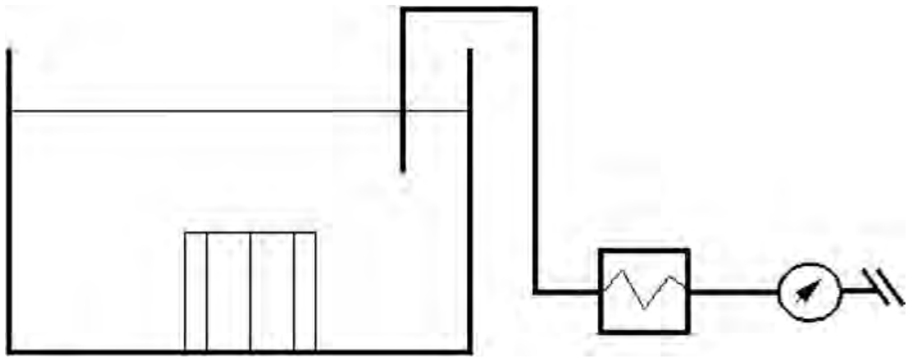


FIG. 3. Diagram of cooling system for Example 48.

Example 49. High radiation levels at a nuclear recycling facility — Below Scale/Level 0

Event description

Operating personnel and a radiation protection technician were undertaking a sampling operation at a facility storing highly radioactive liquid. Specific instructions and equipment were provided for the task, and the individuals concerned had been suitably trained and briefed. In order for the operation to proceed, other personnel were excluded from a large, clearly identified and barred area around the actual work area.

During the operation, an equipment fault led to a small quantity of the highly radioactive liquid being directed to an unshielded pipe, causing high levels of radiation in the surrounding areas.

All personnel were equipped with personal alarming dosimeters and when these alarmed, together with several installed detection systems in the area, the people immediately evacuated the area.

Subsequent assessment showed that the most exposed person was subjected to a dose rate of 350 mSv/h and received an effective dose of 350 μSv.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	The sampling operation was being carried out in an area where there were specific access controls and safety provisions due to the potential for high activity. Therefore the Level 2 dose rate criteria applicable "within an operating area" do not apply (See Section 3.2, which defines operating areas as "areas where worker access is allowed without specific permits. It excludes areas where specific controls are required (beyond the general need for a personal dosimeter and/or coveralls) due to the level of contamination or radiation."
6.2.1. Maximum potential consequences:	The maximum potential consequences for this activity were exposures greater than ten times the statutory annual limit (i.e. Level 3).
6.2.2. Identification of number of safety layers:	In considering the number of independent safety layers, it is necessary to consider the indications (detectors and alarms) and the response by operating personnel separately. There were four independent safety layers of indications and alarms present. These are: — Electronic personal dosimeters. It was confirmed that these were in *full* working order and operated appropriately. — Installed gamma detectors and alarms. These were in *full* working order and alarmed during the event. — Installed airborne activity alarms. These respond to high gamma radiation, and alarms from them require the prompt evacuation of personnel in the area. — Presence of a radiation protection technician with a radiation detector. The primary purpose of the technician was to monitor the radiation levels during the sampling operation and advise accordingly. This was not required since the operating personnel were already evacuating. Each of these required the operating personnel to respond appropriately to the alarm or verbal advice. It was confirmed that the operating personnel were regularly trained and had no experience of poor response. There was more than one person and an additional radiation protection technician, and in view of the specific nature of the activity and the training and briefing required, it is judged that they can be considered as at least three independent safety layers. The likelihood of all the individuals ignoring all the alarms is vanishingly small.
6.2.3. Assessment of the basic rating:	Using Table 11, there being three safety layers, the basic rating is Level 1.
6.2.4. Additional factors:	There are no reasons to uprate the event.
Overall rating:	Below Scale/Level 0.

Example 50. Worker received cumulative whole body dose above dose limit — Level 1

Event description

The whole body dose received by a facility manager from operations at the end of December was higher than authorized or expected but below the dose constraint. As a result, while the dose from those operations was low, it made his cumulative whole body dose exceed the annual dose limit.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	The dose level from the actual event was below the value given in Section 2 for actual consequences (i.e. less than the dose constraint).
6.2.1. Maximum potential consequences:	The maximum potential consequences for an event associated with a worker dose are rated at Level 4.
6.2.2. Identification of number of safety layers:	The basic rating is Below Scale/Level 0 as there was no degradation of the safety layers provided to prevent significant doses to workers.
6.2.3. Assessment of the basic rating:	Based on Table 11, the rating is Below Scale/Level 0.
6.2.4. Additional factors:	Since the annual limit of the cumulative whole body dose was exceeded, the event should be rated at Level 1(Section 6.2.4.3).
Overall rating:	Level 1.

Example 51. Failure of criticality control — Level 1

Event description

A routine check of compliance with the operating rules in a fuel fabrication facility showed that six samples of fuel pellets had been incorrectly packaged. In addition to the permitted packaging, each sample had been placed in a plastic container. The additional plastic container contained the requirement that ‘no hydrogenous material in addition to the permitted wrapping’ had to be introduced to the store. However, this requirement was not clearly specified for this fuel store. Subsequent investigation showed that the criticality clearance certificate was difficult to interpret, and the related criticality assessment was inadequate to allow full understanding of the safety requirements.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences of a criticality in the fuel store would be rated at Level 4.
6.2.2. Identification of number of safety layers:	Remaining safety layers related to flooding were: — Several controls in place to prevent flooding (assumed in the safety case); — Safety justification that flooding would not lead to criticality Remaining safety layers related to other materials were: — Clear procedures, training and labelling to prevent the addition of hydrogenous material — Inspections to detect deviations from assumptions made in the safety case.
6.2.3. Assessment of the basic rating:	There are two safety layers remaining, and the basic rating from Table 11 is Level 1.
6.2.4. Additional factors:	Level 1 would also be an appropriate rating because: — The operations were outside OL&C. — The safety culture failed to ensure adequate assessments and documentation. It is not considered appropriate to uprate the event to the maximum under defence in depth because several failures were still required before an accident would have occurred (see Section 6.2.4, item (3)).
Overall rating:	Level 1.

Example 52. Prolonged loss of ventilation at a fuel fabrication facility — Level 1

Event description

Following a loss of normal and emergency ventilation and non-compliance with procedures, the operating personnel worked for over an hour without dynamic containment.

The ventilation performs a dual role. Firstly, it directs radioactivity that might be released in a closed room to the controlled release and filtration circuits, and secondly, it creates a slight negative pressure gradient in such a closed room in order to avoid the transfer of radioactivity into other areas. This form of containment is called “dynamic containment”.

The event started with the loss of electrical power supply to the normal ventilation system. The emergency ventilation system, which should have taken over, did not start up. Subsequent investigation indicated that the breakdown of the normal ventilation system and the failure of the emergency ventilation system to come into operation were linked to the presence of a common mode between the electrical power supplies to these ventilation systems. The alarm was signaled in the guard post, but the information reached neither the supervisory staff nor the operating personnel.

The operating personnel were only informed that the alarm had been triggered one hour after a new shift had started.

The results of measurements of atmospheric contamination taken at all the work stations being monitored did not provide any evidence of an increase in atmospheric contamination.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The ventilation system is designed to cascade air flows from areas of low contamination to areas of successively higher or potentially higher contamination. Had there been a coincident event (such as a fire) leading to pressurization, some radioactivity which should otherwise have been discharged through a filtration system would be discharged to the plant operating area and then to the atmosphere without the same degree of filtration. The maximum potential consequence would be Level 4 based on the potential release to atmosphere.
6.2.2. Identification of number of safety layers:	Remaining independent safety provisions, not including ultimate emergency procedures, were: — Automatic firefighting systems; — The building structure that provided both containment and decontamination to reduce exposures to less than 0.1 mSv.
6.2.3. Assessment of the basic rating:	There were at least two effective safety layers, and the basic rating from Table 11 is Level 1.
6.2.4. Additional factors:	Although the procedures were violated (work continued without ventilation) and there were common cause issues with the electrical supplies, it is not considered appropriate to update the event to the maximum under defence in depth because several failures (a fire, failure of the firefighting systems, problems with containment) were still required before an accident would have occurred (see Section 6.2.4 item (3)).
Overall rating:	Level 1.

Example 53. Failure of a shield door interlocking system — Level 2

Event description

The event occurred when a container of highly radioactive vitrified waste was moved into a cell while the shield doors to the cell were open following a maintenance operation. The opening of the doors was controlled by a key exchange system, installed interlocks based on gamma detectors and programmable logic controllers. The original design of the cell access system was modified twice during the commissioning period, in an attempt to improve it. All of these systems failed to prevent the transfer of highly radioactive material into the cell while the shield doors were open.

Entry of personnel to this area is controlled by a permit that requires each person to wear a personal alarming dosimeter.

Personnel who might have been present in the cell or adjacent areas could have received a serious radiation exposure if they had failed to respond to either the container movement or their personal alarming dosimeter sounding a warning. In the event, the operating personnel quickly observed the problem and closed the shield doors. No one received any additional exposure.

The facility design concerning access to the cells had been modified during commissioning, and the consequences of these changes had been inadequately considered.

In particular:

— The commissioning of the interlock key exchange system for the cell shield doors had failed to show that the system was inadequate.
— A programmable logic control system had not been programmed and commissioned correctly.
— The modifications were poorly assessed and controlled because their safety significance was not classified correctly.
— Designers and commissioning staff did not communicate properly.

A permit to work authorization had been closed, indicating that the facility had been returned to its normal state, but in fact it had not.

The temporary plant modification proposal (TPMP) system was too frequently used in this facility and inadequately controlled, and the full PMP system in use required improvement.

Training and supervision of active cell entries was inadequate.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequences for such practices are rated at Level 4 (fatal radiation dose).
6.2.2. Identification of number of safety layers:	Despite the failure of a number of safety layers, there was one remaining safety layer, namely the permit to work authorization procedure for entry to the cells, requiring the use of personal alarm dosimeters.
6.2.3. Assessment of the basic rating:	Based on Table 11, the maximum rating under defence in depth of Level 2 is appropriate.
6.2.4. Additional factors:	The rating cannot be updated beyond the maximum defence in depth rating.
Overall rating:	Level 2.

Example 54. Power excursion at research reactor during fuel loading — Level 2

Event description

A power excursion, which resulted in a reactor trip on overpower, occurred at a research reactor during a refueling operation. The reactor is a small pool type research reactor. Following replacement of a shim safety rod control assembly, the fuel assemblies were being returned to the core. After loading the fifth fuel assembly, the shim safety rods were withdrawn to check that the reactor was not critical. The rods were then driven to the 85% withdrawn position instead of the required 40% (safeguard position). On insertion of the 6th fuel assembly, a blue glow was seen and the reactor tripped on overpower. The neutron flux trip system had been bypassed to avoid spurious trips, while moving irradiated fuel into position for loading into the core and the bypass had not been turned off. The power transient maximum was estimated to be about 300% of full power. Procedures related to refueling are being reviewed and revised.

Rating explanation

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences.	It had been shown that the maximum potential rating for this reactor would not exceed Level 4.
6.2.2. Identification of number of safety layers.	The one barrier preventing a significant release was the overpower trip. Details of that protection are not provided, but unless it can be shown that there are two or more redundant trains of protection that remain effective under the prevailing operating conditions, it should be assumed that there was only one safety layer preventing a significant release.
6.2.3. Assessment of the basic rating.	The rating from Table 11 is Level 2.
6.2.4. Additional factors.	The rating cannot be updated beyond the maximum defence in depth rating.
Overall rating:	Level 2.

Example 55. Near criticality at a nuclear recycling facility — Level 2

Event description

At a plutonium recycling facility, a pipe carrying hot plutonium nitrate developed a leak, and over a period of about 24 h, a total of 31 kg leaked into the cell housing the pipe. The leak was identified at the daily visual inspection. The hot plutonium nitrate ran over the outer surfaces of a hot plutonium evaporator and dripped onto the sloping stainless steel clad floor beneath. As the liquid ran over the various surfaces, it evaporated and deposited the plutonium in a crystalline form on the lowest part of the pipe and on the floor beneath, forming structures like a “stalactite” and “stalagmite”. The leak rate was such that the material failed to reach the detection sump as a liquid and was only identified through surveillance tours. The cell was subsequently decontaminated, the pipeline and evaporator replaced and the facility brought back into use.

The quantity of plutonium present on both the pipe and the floor did not exceed the minimum critical mass for the concentration of the material being handled at the time, but had the event taken place when more concentrated material was being handled, then the critical mass may have been exceeded.

Rating explanation

The event needs to be considered in two parts: First, with respect to releases from the facility; and second, with respect to doses to workers.

Possible release from the facility:

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences.	Dispersion of all the material accumulated in the cell could result in an environmental release equivalent to Level 5.
6.2.2. Identification of number of safety layers.	There are at least two safety layers available to prevent such a release: — The concrete structure of the cell containing the plutonium, which would not have failed from the energy that would have been generated, had the material gone critical; and — The remaining building structure together with the ventilation abatement system, which itself consists of primary and secondary ventilation systems.
6.2.3. Assessment of the basic rating.	A basic rating of Level 2 is appropriate from Table 11.
6.2.4. Additional factors.	There are no additional factors that would justify an increase in the basic rating.
Overall rating:	Level 2.

Possible worker doses:

Criteria	Explanation
2. and 3. Actual consequences:	There were no actual consequences from the event.
6.2.1. Maximum potential consequences:	The maximum potential consequence would be rated at Level 4 (fatal radiation exposure).
6.2.2. Identification of number of safety layers:	There were no remaining safety layers to protect against a criticality.
6.2.3. Assessment of the basic rating:	Based on Table 11, the rating is Level 2.
6.2.4. Additional factors:	The rating cannot be uprated beyond the maximum defence in depth rating.
Overall rating:	Level 2.

7. RATING PROCEDURE

The flowcharts provided in the following pages (Figs 4–10) briefly describe INES rating procedure for rating any event associated with radiation sources and the transport, storage and use of radioactive material.

The flow charts are intended to show the logical route to be followed to assess the safety significance of any event. It provides an overview for those new to rating events and a summary of the procedure to those familiar with the INES User's Manual. Explanatory notes and tables are added to the flowcharts as needed; however the flowcharts should not be used in isolation from the detailed guidance provided in this manual. The IAEA has also developed a web tool based on the flow charts to support training on the use of INES rating methodology.

In addition to the flowcharts, two tables of examples (Tables 12 and 13) are provided to illustrate how some actual events are rated.

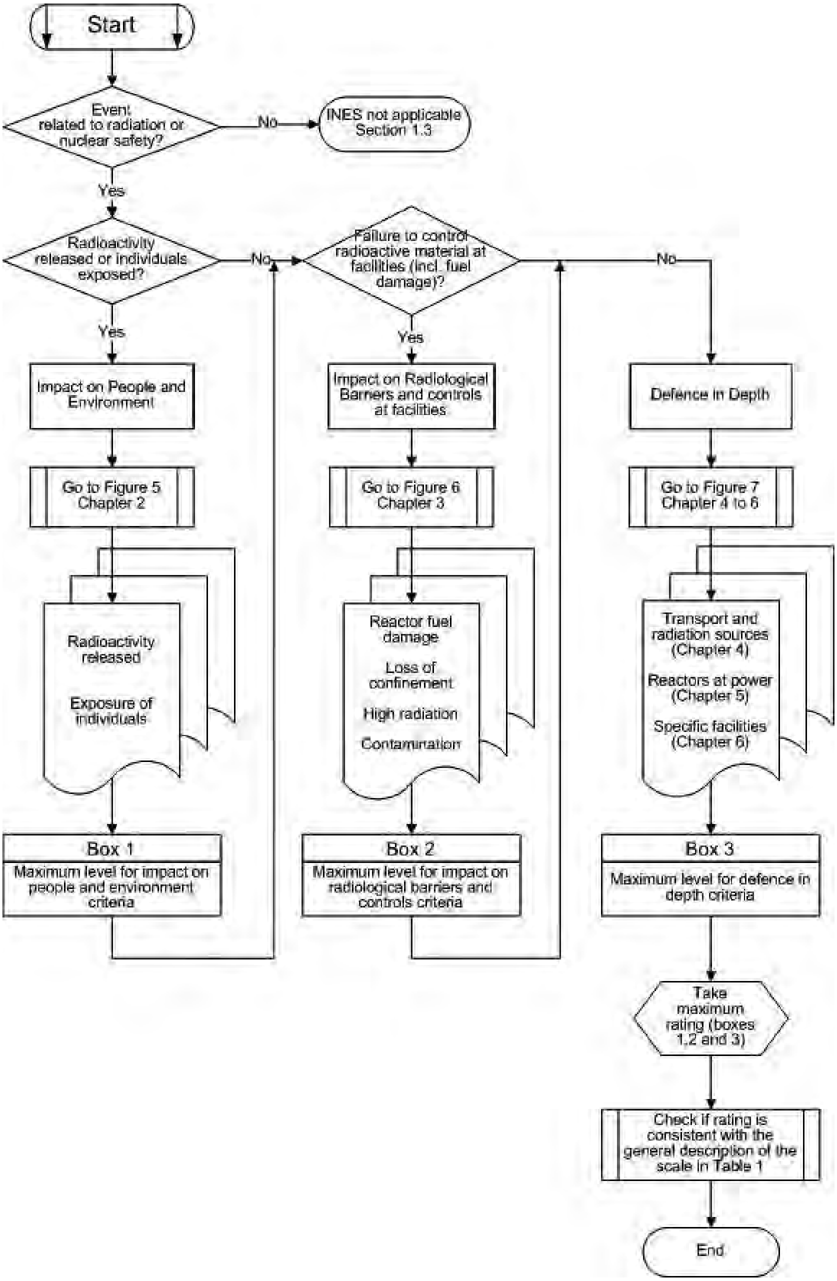
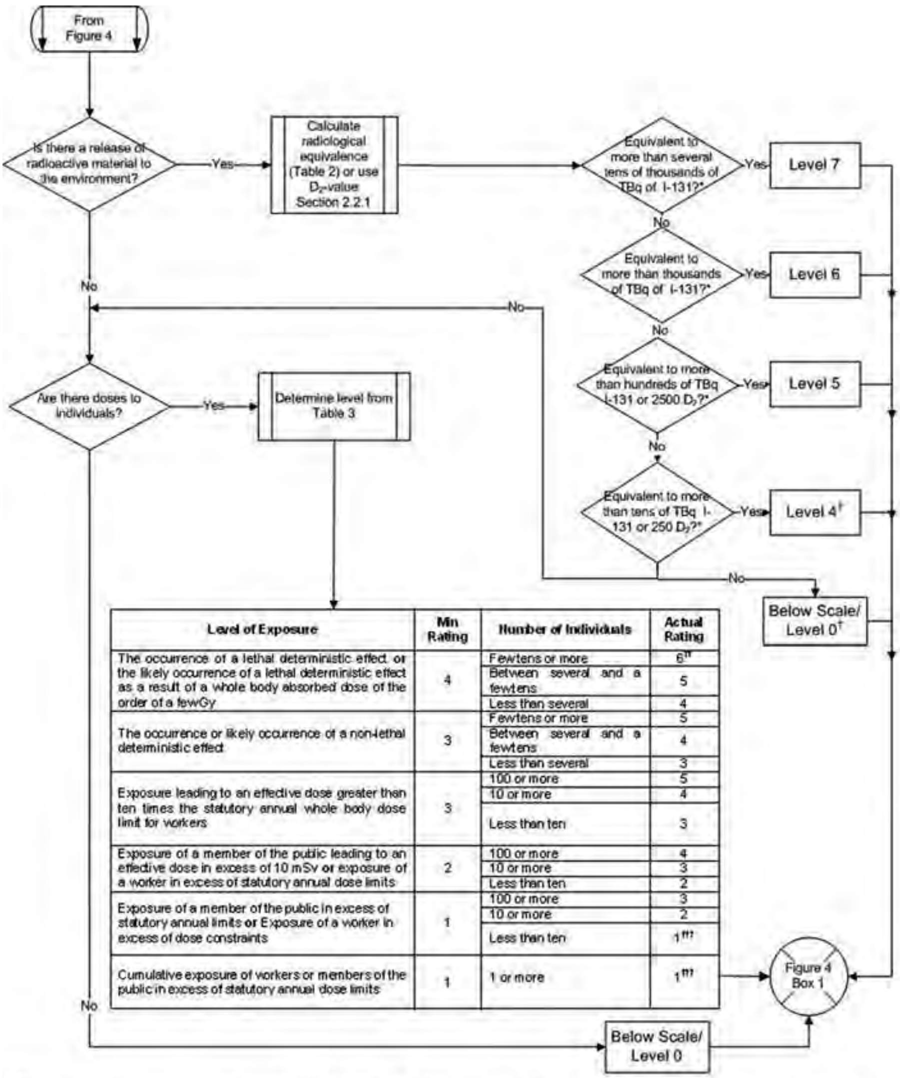


FIG. 4. General INES rating procedure.



Level of Exposure	Min Rating	Number of Individuals	Actual Rating
The occurrence of a lethal deterministic effect or the likely occurrence of a lethal deterministic effect as a result of a whole body absorbed dose of the order of a few Gy	4	Few tens or more	6††
		Between several and a few tens	5
		Less than several	4
The occurrence or likely occurrence of a non-lethal deterministic effect	3	Few tens or more	5
		Between several and a few tens	4
		Less than several	3
Exposure leading to an effective dose greater than ten times the statutory annual whole body dose limit for workers	3	100 or more	5
		10 or more	4
		Less than ten	3
Exposure of a member of the public leading to an effective dose in excess of 10 mSv **or** exposure of a worker in excess of statutory annual dose limits	2	100 or more	4
		10 or more	3
		Less than ten	2
Exposure of a member of the public in excess of statutory annual limits **or** Exposure of a worker in excess of dose constraints	1	100 or more	3
		10 or more	2
		Less than ten	1†††
Cumulative exposure of workers or members of the public in excess of statutory annual dose limits	1	1 or more	1†††

* These criteria relate to accidents where early estimates of the size of release can only be approximate. For this reason, it is inappropriate to use precise numerical values in the definitions of the levels. However, in order to help ensure consistent interpretation of these criteria internationally, it is suggested that the boundaries between the levels are about 5000 and 50,000 TBq 131I.

† It is also necessary to consider whether a higher rating is appropriate based on assessing the doses to people within the facility using Table 3.

†† Level 6 is not considered credible for any event involving radiation sources.

††† As explained in section 2.4, the Level 1 definitions are based on defence-in-depth criteria explained in Chapters 4 to 6, but they are included here for completeness.

FIG. 5. Procedure for rating the impact on people and the environment.

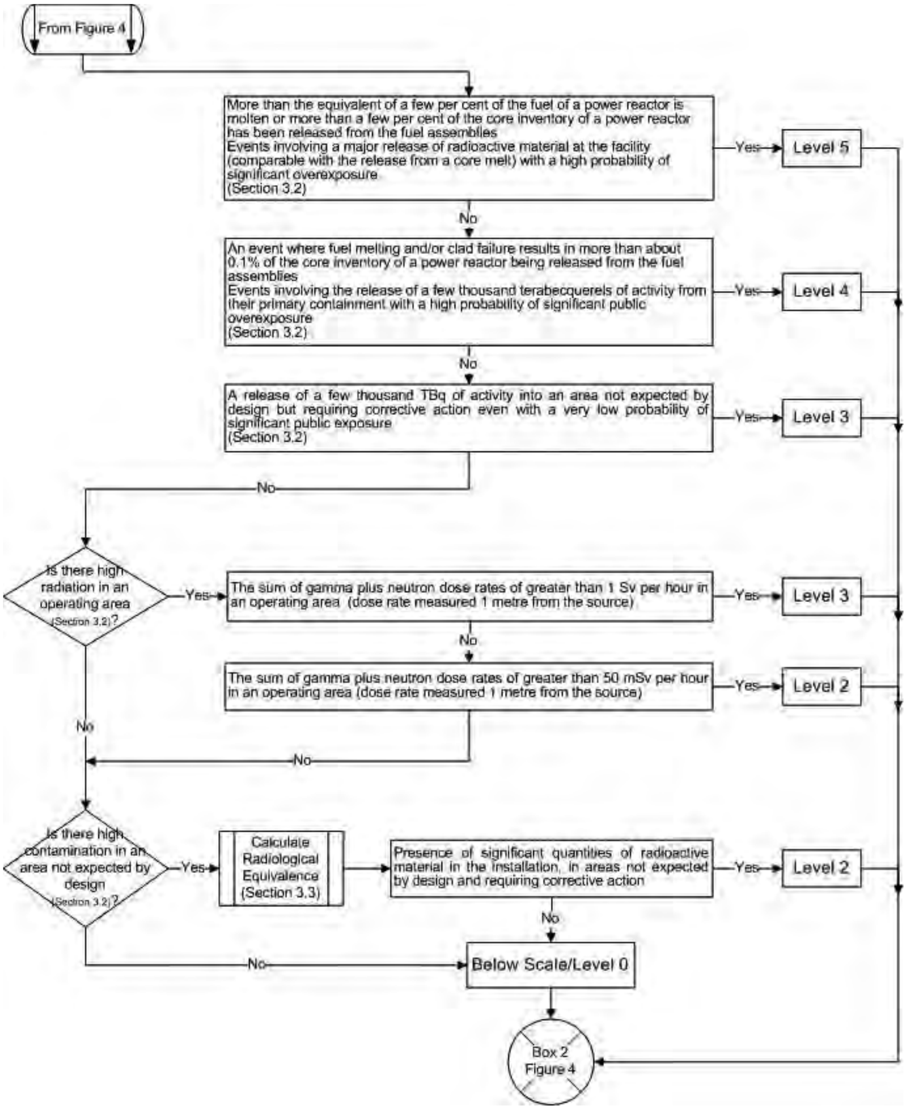


FIG. 6. Procedure for rating the impact on radiological barriers and controls at facilities.

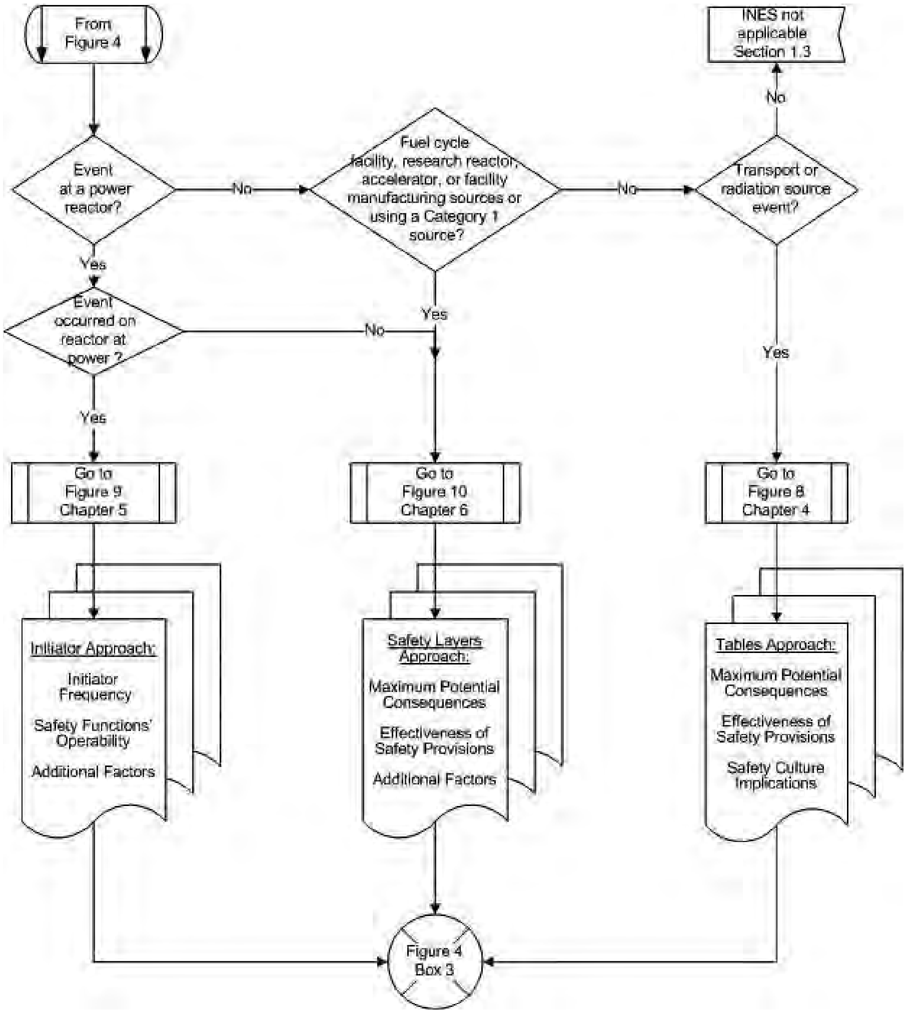


FIG. 7. General procedure for rating impact on defence in depth.

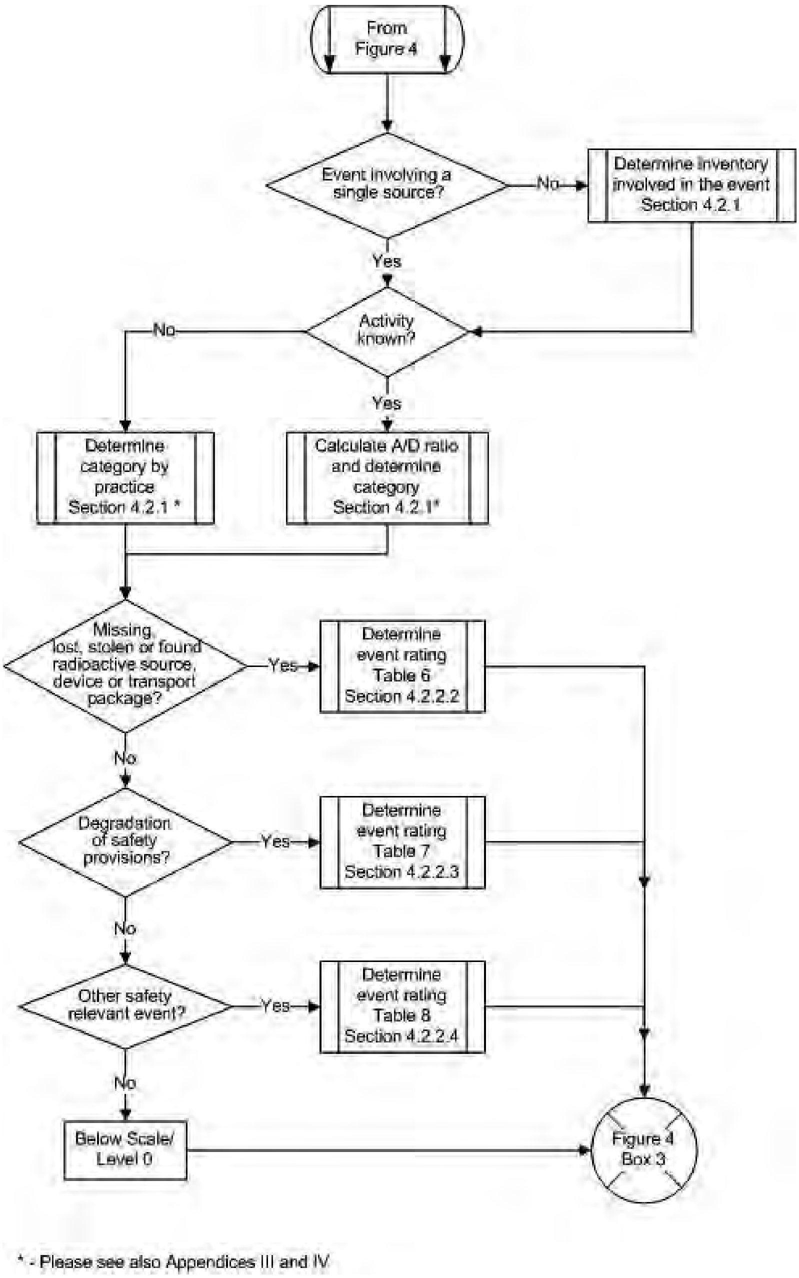
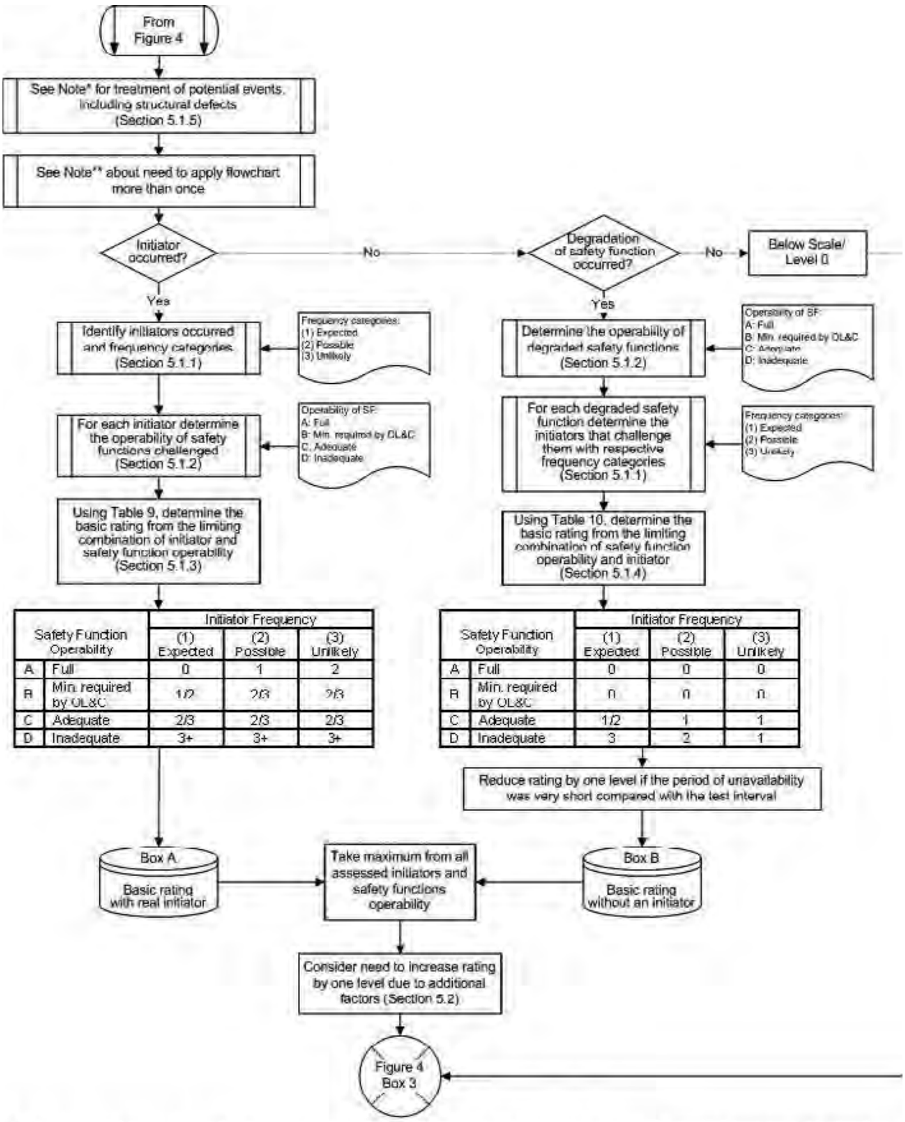


FIG. 8. Procedure for rating the impact on defence in depth for transport and radiation source events.



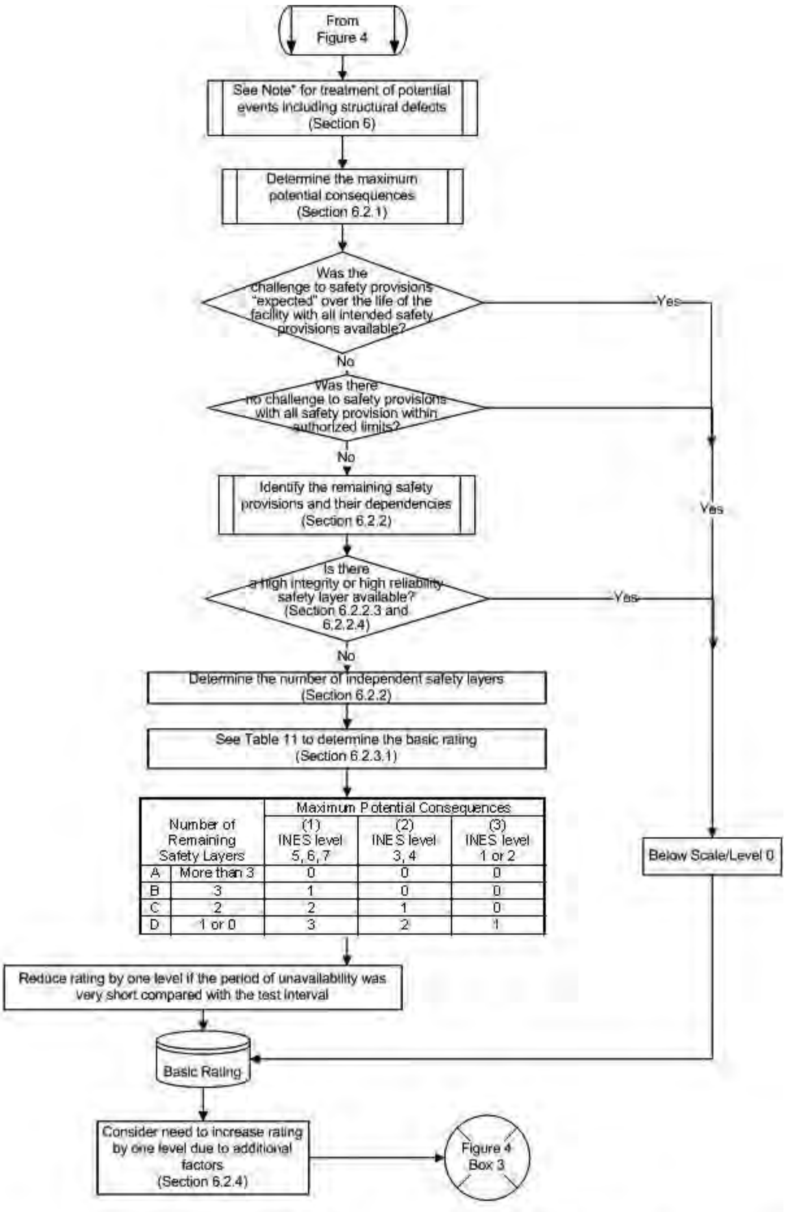
Safety Function Operability		Initiator Frequency (1) Expected	(2) Possible	(3) Unlikely
A	Full	0	1	2
B	Min. required by OL&C	1/2	2/3	2/3
C	Adequate	2/3	2/3	2/3
D	Inadequate	3+	3+	3+

Safety Function Operability		Initiator Frequency (1) Expected	(2) Possible	(3) Unlikely
A	Full	0	0	0
B	Min. required by OL&C	0	0	0
C	Adequate	1/2	1	1
D	Inadequate	3	2	1

* - For a potential event, assume that the potential event has actually occurred and evaluate the rating of the potential event using this flowchart. Then reduce the rating, depending on the likelihood that the potential event could have occurred. See section 5.1.5

** - Events can be a combination of initiators and degradation of safety functions. Therefore it may be necessary to go through this flowchart several times to identify the initiator and safety function pairing that gives the highest rating. See section 5.1

FIG. 9. Procedure for rating the impact on defence in depth for reactors at power.



*For a potential event, assume that the potential event has actually occurred and evaluate the rating of the potential event using this flowchart. Then reduce the rating, depending on the likelihood that the failure could have occurred. See section 6.2.3.2

FIG. 10. Procedure for rating the impact on defence in depth for fuel cycle facilities, research reactors, accelerators, or facilities with Category 1 sources, and reactors not at power.

TABLE 12. EXAMPLES ILLUSTRATING INES CRITERIA FOR RATING EVENTS AT NUCLEAR FACILITIES

	People and environment	**Radiological barriers and controls**	**Defence in depth**
Major accident **Level 7**	Chernobyl, 1986. Widespread health and environmental effects. External release of a significant fraction of reactor core inventory.		
Serious accident **Level 6**	Kyshtym, Russia, 1957. Significant release of radioactive material to the environment from explosion of a high active waste tank.		
Accident with wider consequences **Level 5**	Windscale Pile, UK, 1957. Release of radioactive material to the environment following a fire in a reactor core.	Three Mile Island, USA, 1979. Severe damage to the reactor core.	
Accident with local consequences **Level 4**	Tokaimura, Japan, 1999. Fatal exposures of workers following a criticality event at a nuclear facility.	Saint Laurent des Eaux, France, 1980. Melting of one channel of fuel in the reactor with no release outside the site.	
Serious incident **Level 3**	*No examples available*	Sellafield, UK, 2005. Release of large quantity of radioactive material contained within the installation.	Vandellos, Spain, 1989. Near accident caused by fire, resulting in loss of safety systems at the nuclear power station.
Incident **Level 2**	Atucha, Argentina, 2005. Overexposure of a worker at a power reactor exceeding the annual limit.	Cadarache, France, 1993. Spread of contamination to an area not expected by design	Forsmark. Sweden. 2006. Degraded safety functions with additional factors for common cause failure in emergency power supply system at nuclear power plant.
Anomaly **Level 1**			Breach of operating limits at a nuclear facility.

TABLE 13. EXAMPLES ILLUSTRATING INES FOR RATING EVENTS INVOLVING RADIATION SOURCES AND TRANSPORT

	People and environment	Defence in depth
Major accident Level 7		
Serious accident Level 6		
Accident with wider consequences Level 5	Goiânia, Brazil, 1987. Four people died and six received doses of a few Gy from an abandoned and ruptured highly radioactive Cs-137 source.	
Accident with local consequences Level 4	Fleurus, Belgium, 2006. Severe health effects for a worker at a commercial irradiation facility as a result of high doses of radiation.	
Serious incident Level 3	Yanango, Peru, 1999. Incident with a radiography source, resulting in severe radiation burns.	Ikitelli, Turkey, 1999. Loss of a highly radioactive Co-60 source.
Incident Level 2	USA, 2005. Overexposure of a radiographer exceeding the annual limit for radiation workers.	France, 1995. Failure of access control systems at accelerator facility.
Anomaly Level 1		Theft of a moisture density gauge.

Appendix I

CALCULATION OF RADIOLOGICAL EQUIVALENCE

I.1. INTRODUCTION

This Appendix shows calculations for multiplying factors that can be applied to the activity released of a specified radionuclide to give an activity that may be compared with those given for ^{131}I. In this analysis, values of inhalation coefficients have been taken from the BSS [14], while the dose factors for ground deposition have been taken from IAEA-TECDOC-1162 [15]. Both publications are in the process of being updated, but such updates are unlikely to have a large impact on the one significant figure radiological equivalence numbers given in Table 14.

While other parts of this manual makes use of D values to compare the relative significance of different isotopes, this appendix uses another approach. This is because the D value calculations are specifically based on scenarios that are only appropriate for the handling and transport of radioactive sources. The radiological equivalence factors calculated here use assumptions based on scenarios more appropriate to accidents at facilities.

I.2. METHOD

The scenarios and methodology are summarized below.

For airborne releases of activity, the following two components were added:

— Effective dose to adult members of the public, D_{inh}, from inhalation of unit airborne concentration [14], with a breathing rate of 3.3×10^{-4} $m^3 \cdot s^{-1}$; and

— Effective dose to adults from ground deposition of radionuclides, integrated over 50 years, including consideration of resuspension, weathering and ground roughness [15]. Ground deposition is related to airborne concentration using deposition velocities (V_g) of 10^{-2} $m \cdot s^{-1}$ for elemental iodine and 1.5×10^{-3} $m \cdot s^{-1}$ for other materials. The integrated dose over 50 years, from unit ground deposition of each radionuclide is used (D_{gnd} (Sv per $Bq \cdot m^{-2}$)).

Ingestion doses are not included in this calculation as the food intervention levels will prevent any significant doses to individuals affected by the accident.

The total dose (D_{tot}) resulting from an activity release Q and time-integrated, ground-level airborne radionuclide concentration of X ($Bq \cdot s \cdot m^{-3}$ per Bq released) is:

$$D_{tot} = Q.X. (D_{inh} \cdot \text{breathing rate} + V_g \cdot D_{gnd})$$

For each radionuclide, the relative radiological equivalence to ^{131}I was calculated as the ratios of $D_{tot}/(Q.X)$.

Facility contamination considers only the inhalation pathway, and the inhalation coefficients are for workers.

I.3. BASIC DATA

The inhalation coefficients for the calculations were taken from the BSS [14], apart from U_{nat}, which is not listed in that document. Values for U_{nat} were calculated by summing the contributions from ^{238}U, ^{235}U, ^{234}U and their main decay products, using the ratios ^{234}U (48.9%), ^{235}U (2.2%) and ^{238}U (48.9%). Where a radionuclide has a number of lung absorption rates, the maximum value of the inhalation coefficient was used except for uranium where all of them are provided.

The 50 year integrated doses from ground deposition were taken from IAEA-TECDOC-1162 [15].

I.4. RESULTS

The multiplying factors applicable to both facility contamination and atmospheric releases are obtained by dividing the value for each radionuclide by that for ^{131}I. These are given in Table 14 and 15. Table 16. lists the results as they should be used in INES (i.e. rounded to one significant figure).

TABLE 14. FACTORS FOR FACILITY CONTAMINATION (INHALATION ONLY)

Nuclide	Inhalation coefficient Sv per Bq [14] (workers)	Ratio to ^{131}I
Am-241	2.70E-05	2454.5
Co-60	1.70E-08	1.5
Cs-134	9.60E-09	0.9
Cs-137	6.70E-09	0.6
H-3	1.80E-11	0.002
I-131	1.10E-08	1.0
Ir-192	4.90E-09	0.4
Mn-54	1.20E-09	0.1
Mo-99	5.60E-10	0.05
P-32	2.90E-09	0.3
Pu-239	3.2E-05	2909.1
Ru-106	3.50E-08	3.2
Sr-90	7.70E-08	7.0
Te-132	3.00E-09	0.3
U-235(S)[a]	6.10E-06	554.5
U-235(M)[a]	1.80E-06	163.6
U-235(F)[a]	6.00E-07	54.5
U-238 (S)[a]	5.70E-06	518.2
U-238(M)[a]	1.60E-06	145.5
U-238 (F)	5.80E-07	52.7
U_{nat}	6.25E-06	567.9

[a] Lung absorption types: S—slow, M—medium, F—fast. If unsure, use the most conservative value.

TABLE 15. ATMOSPHERIC RELEASE: DOSE FROM GROUND DEPOSITION AND INHALATION

	Dose factor for 50-year dose from ground deposition [15]	50-year ground deposition dose	Dose factor for inhalation [14] (public)	Inhalation dose	Total dose	Ratio to ^{131}I
Nuclide	Sv per Bq·m^{-2}	Sv per Bq·s·m^{-3}	Sv per Bq	Sv per Bq·s·m^{-3}	Sv per Bq·s·m^{-3}	
Am-241	6.40E-06	1.01E-08	9.60E-05	3.17E-08	4.17E-08	8100
Co-60	1.70E-07	2.55E-10	3.10E-08	1.02E-11	2.65E-10	51
Cs-134	5.10E-09	7.65E-11	2.00E-08	6.60E-12	1.43E-11	2.8
Cs-137	1.30E-07	1.95E-10	3.90E-08	1.29E-11	2.08E-10	40
H-3	0.00E+00	0.00E+00	2.60E-10	8.58E-14	8.58E-14	0.020
I-131	2.70E-10	2.70E-12	7.40E-09	2.44E-12	5.14E-12	1.0
Ir-192	4.40E-09	6.60E-09	6.60E-09	2.18E-12	8.78E-12	1.7
Mn-54	1.40E-08	2.10E-11	1.50E-09	4.95E-13	2.15E-11	4.2
Mo-99	6.10E-11	9.15E-14	9.90E-10	3.27E-13	4.18E-13	0.08
P-32	6.80E-12	1.02E-14	3.40E-09	1.12E-12	1.13E-12	0.22
Pu-239	8.50E-06	1.28E-08	1.20E-04	3.96E-08	5.24E-08	10 000
Ru-106	4.80E-09	7.20E-12	6.60E-08	2.18E-11	2.90E-11	5.6
Sr-90	2.10E-08	3.15E-11	1.60E-07	5.28E-11	8.43E-11	16
Te-132	6.90E-10	1.04E-12	2.00E-09	6.60E-13	1.70E-12	0.33
U-235(S)[a]	1.50E-06	2.25E-09	8.50E-06	2.81E-09	5.06E-09	980
U-235(M)[a]	1.50E-06	2.25E-09	3.10E-06	1.02E-09	3.27E-09	640
U-235(F)[a]	1.50E-06	2.25E-09	5.20E-07	1.72E-10	2.42E-09	470
U-238(S)[a]	1.40E-06	2.10E-09	8.00E-06	2.64E-09	4.74E-09	920
U-238(M)[a]	1.40E-06	2.10E-09	2.90E-06	9.57E-10	3.06E-09	590
U-238(F)[a]	1.40E-06	2.10E-09	5.00E-07	1.65E-10	2.27E-09	440
U_{nat}	1.80E-06	2.70E-09	1.04E-05	3.42E-09	6.12E-09	1200
Noble gases						Negligible (effectively 0)

[a] Lung absorption types: S—slow, M—medium, F—fast. If unsure, use the most conservative value.

TABLE 16. RADIOLOGICAL EQUIVALENCES

Nuclide	Multiplication factors [a]	
	Facility contamination	Atmospheric release
Am-241	2000	8000
Co-60	2	50
Cs-134	0.9	3
Cs-137	0.6	40
H-3	0.002	0.02
I-131	1	1
Ir-192	0.4	2
Mn-54	0.1	4
Mo-99	0.05	0.08
P-32	0.3	0.2
Pu-239	3000	10 000
Ru-106	3	6
Sr-90	7	20
Te-132	0.3	0.3
U-235(S)[b]	600	1000
U-235(M)[b]	200	600
U-235(F)[b]	50	500
U-238 (S)[b]	500	900
U-238(M)[b]	100	600
U-238 (F)[b]	50	400
U_{nat}	600	1000

[a] Multiplication factors are rounded to one significant figure.

[b] Lung absorption types: S — slow, M — medium, F — fast. If unsure, use the most conservative value.

Appendix II

THRESHOLD LEVELS FOR DETERMINISTIC EFFECTS

The criteria related to deterministic effects in Section 2.3.1 are intended to relate to observable deterministic effects. However, if it is not known at the time of rating whether a deterministic effect will actually occur, the data in this appendix can be used to determine a rating based on dose.

II.1. FATAL DETERMINISTIC EFFECTS

Based on Ref. [10], the likelihood of acute death from radiation, with medical treatment, is provided in Table 17 for a range of exposures.

II.2. OTHER DETERMINISTIC EFFECTS

In the evaluation of external exposure, threshold levels are expressed in terms of RBE-weighted absorbed dose, and are given in Table 18. For internal exposure, threshold levels are expressed in terms of committed RBE-weighted absorbed dose and are given in Table 19. RBEs are provided in Table 20. All tables are simplified from the IAEA EPR-D-values 2006 [5].

TABLE 17. LIKELIHOOD OF FATAL DETERMINISTIC EFFECTS FROM OVEREXPOSURE

Short term whole body dose (Gy)	Likelihood of acute death from radiation with medical treatment (%)
0.5	0
1	0
1.5	< 5
2	< 5
3	15–30
6	50
10	90

TABLE 18. THRESHOLD LEVELS OF RBE-WEIGHTED DOSE FROM EXTERNAL EXPOSURE

Exposure	Effect	Organ or tissue	Threshold level value (Gy)
Local exposure from an adjacent source	Necrosis of soft tissue	Soft tissue[a]	25
Contact exposure from surface contamination	Moist desquamation	Derma or skin	10[c]
Total body exposure from a distant source or immersion	(Footnote b)	Torso	1[b]

[a] Soft tissue over an area of 100 cm^2 and to a depth of about 0.5 cm below the body surface.

[b] The value is the minimum threshold dose for developing any severe deterministic effect from uniform irradiation of the whole body. The threshold level of 1 Gy was selected because it is the lower bound of the threshold levels for onset of severe deterministic effects in the red bone marrow, thyroid, lens of the eye and reproductive organs, as shown in Table I–3 of IAEA-TECDOC-1432 [8].

[c] Exposure at this level to at least 100 cm^2 of the skin is assumed to be required to result in severe deterministic health effects. The dose is to skin structures at a depth of 40 mg/cm^2 (or 0.4 mm) under the surface.

TABLE 19. THRESHOLD LEVELS OF COMMITTED RBE-WEIGHTED DOSE FROM INTERNAL EXPOSURE

Exposure pathway	Effect	Target organ or tissue	Threshold level	
			Value (Gy)	Commitment period (Footnote d)
Inhalation and ingestion	Haematopoietic syndrome	Red marrow[a,b]	0.2[c] 2[d]	30
Inhalation	Pneumonitis	Alveolar-interstitial region or respiratory tract	30	30
Inhalation and ingestion	Gastrointestinal syndrome	Colon	20	30
Inhalation and ingestion	Hypothyroidism	Thyroid	2[e]	365[f]

[a] For cases of supportive medical care.

[b] Radionuclides with $Z \geq 90$ compared with $Z \leq 89$ have different biokinetic processes, hence different dynamics of dose formation in red marrow due to internal exposure. Therefore, radionuclides have been divided into two groups to avoid the over-conservatism in evaluating the risk of the health effect concerned.

[c] For radionuclides with $Z \geq 90$.

[d] For radionuclides with $Z \leq 89$.

[e] The value from Appendix A of Ref. [9] was used.

[f] Considering the biological and physical half-life of the radionuclides that result in significant thyroid dose (isotopes of I and Te), these dose factors were in fact for a commitment period of much less than 365 days; however, the commitment period of 365 days is assigned to this reference level.

TABLE 20. RBEs USED FOR SEVERE DETERMINISTIC HEALTH EFFECTS

Health effect	Critical organ	Exposure[a]	RBE
Haematopoietic syndrome[b]	Red marrow	External γ	1
		External n^0	3
		Internal β, γ	1
		Internal α	2
Pneumonitis	Lung	Internal β, γ	1
		Internal α	7
GI syndrome	Colon	Internal β, γ	1
		Internal α	0[c]
		External n^0	3
Moist desquamation	Skin[d]	External β, γ	1
Acute radiation thyroiditis	Thyroid	Intake of some iodine isotopes[e]	0.2
		Other thyroid seekers	1
Necrosis	Soft tissue[f]	External β, γ	1

[a] External β, γ exposure includes the dose from bremsstrahlung produced within the source materials.

[b] For cases with supportive medical treatment.

[c] For alpha-emitters uniformly distributed in the contents of the colon, it is assumed that irradiation of the walls of the intestine is negligible.

[d] For a skin area of 100 cm^2, which is considered life threatening [9], the skin dose should be calculated for a depth of 0.4 mm, as recommended in Ref. [10], para. (305), (306), and (310), in Ref. [11] and Section 3.4.1 in Ref. [12].

[e] Uniform irradiation of the critical tissue of the thyroid gland is assumed to be five times more likely to produce deterministic health effects than internal exposure to low energy beta-emitting isotopes of iodine such as ^{131}I, ^{129}I, ^{125}I, ^{124}I and ^{123}I [9]. Thyroid seeking radionuclides have a heterogeneous distribution in thyroid tissues. Iodine-131 emits low energy beta particles, which leads to a reduced effectiveness of irradiation of critical thyroid tissues due to the dissipation of their energy in other tissues.

[f] Tissue at a depth of 0.5 cm below the body surface over an area of more than 100 cm^2 results in severe deterministic effects [8, 13].

Appendix III

D VALUES FOR A RANGE OF ISOTOPES

Information is taken from the IAEA's Categorization of Radioactive Sources [1]. In that publication and its supporting reference [5], two types of D values are considered. The D values are a level of activity above which a source is considered to be 'dangerous' and has a significant potential to cause severe deterministic effects if not managed safely and securely.

The D_1 value is the activity of a radionuclide in a source that, if uncontrolled but not dispersed (i.e. it remains encapsulated), might result in an emergency that could reasonably be expected to cause severe deterministic health effects.

The D_2 value is "the activity of a radionuclide in a source that, if uncontrolled and dispersed, might result in an emergency that could reasonably be expected to cause severe deterministic health effects".

The recommended D values are then the most limiting of the D_1 and D_2 values.

To be consistent with this approach, two sets of D values are provided in this Appendix. For Section 2, where the criteria related to dispersed material, the D_2 values are used (Table 21). For Section 4, where the criteria relate to defence in depth, the overall D values should be used (Table 22).

III.1. D_2 VALUES FOR RADIONUCLIDES FOR USE WITH SECTION 2 CRITERIA

TABLE 21. D_2 VALUES FOR A RANGE OF ISOTOPES

Radionuclide	D_2 (TBq)
Am-241	6.E-02
Am-241/Be	6.E-02
Au-198	3.E+01
Cd-109	3.E+01
Cf-252	1.E-02
Cm-244	5.E-02

TABLE 21. D_2 VALUES FOR A RANGE OF ISOTOPES (cont.)

Radionuclide	D_2 (TBq)
Co-57	4.E+02
Co-60	3.E+01
Cs-137	2.E+01
Fe-55	8.E+02
Gd-153	8.E+01
Ge-68	2.E+01
H-3	2.E+03
I-125	2.E-01
I-131	2.E-01
Ir-192	2.E+01
Kr-85	2.E+03
Mo-99	2.E+01
Ni-63	6.E+01
P-32	2.E+01
Pd-103	1.E+02
Pm-147	4.E+01
Po-210	6.E-02
Pu-238	6.E-02
Pu-239/Be	6.E-02
Ra-226	7.E-02
Ru-106(Rh-106)	1.E+01
Se-75	2.E+02
Sr-90(Y-90)	1.E+00
Tc-99^m	7.E+02
Tl-204	2.E+01
Tm-170	2.E+01
Yb-169	3.E+01

III.2. D VALUES FOR RADIONUCLIDES FOR USE WITH SECTION 4 CRITERIA

TABLE 22. D VALUES FOR A RANGE OF ISOTOPES

Radionuclide	D (TBq)
Am-241	6.E-02
Am-241/Be	6.E-02
Au-198	2.E-01
Cd-109	2.E+01
Cf-252	2.E-02
Cm-244	5.E-02
Co-57	7.E-01
Co-60	3.E-02
Cs-137	1.E-01
Fe-55	8.E+02
Gd-153	1.E+00
Ge-68	7.E-01
H-3	2.E+03
I-125	2.E-01
I-131	2.E-01
Ir-192	8.E-02
Kr-85	3.E+01
Mo-99	3.E-01
Ni-63	6.E+01
P-32	1.E+01
Pd-103	9.E+01
Pm-147	4.E+01
Po-210	6.E-02
Pu-238	6.E-02
Pu-239/Be	6.E-02

TABLE 22. D VALUES FOR A RANGE OF ISOTOPES (cont.)

Radionuclide	D (TBq)
Ra-226	4.E-02
Ru-106(Rh-106)	3.E-01
Se-75	2.E-01
Sr-90(Y-90)	1.E+00
Tc-99^{m}	7.E-01
Tl-204	2.E+01
Tm-170	2.E+01
Yb-169	3.E-01

III.3. CALCULATION OF AGGREGATE VALUES

Where a number of radioactive sources or transport packages are relevant, an aggregate D value should be calculated. Based on the guidance in Categorization of Radioactive Sources [1] and Regulations for the Safe Transport of Radioactive Material [6], the aggregate value is calculated as:

$$1/D = \Sigma f_i/D_i$$

where D is the aggregate value of D, f_i is the fraction of isotope i, and D_i is the D value for isotope i, or

$$A/D = \Sigma A_i/D_i$$

where A is the total activity and A_i is the activity of the isotope.

Appendix IV

RADIOACTIVE SOURCE CATEGORIZATION BASED ON COMMON PRACTICE

Information taken from the IAEA's Categorization of Radioactive Sources [1].

TABLE 23. CATEGORIZATION OF COMMON PRACTICES

Category	Categorization of common practices	Typical isotopes
1	Radioisotope thermoelectric generators (RTGs)	Sr-90, Pu-238
	Irradiators	Co-60, Cs-137
	Teletherapy	Co-60, Cs-137
	Fixed, multi-beam teletherapy (gamma knife)	Co-60
2	Industrial gamma radiography	Co-60, Se-75, Ir-192,Yb-169, Tm-170
	High/medium dose rate brachytherapy	Co-60, Cs-137, Ir-192
3	Fixed industrial gauges:	
	Level gauges	Co-60, Cs-137
	Dredger gauges	Co-60, Cs-137
	Conveyor gauges containing high activity radioactive sources	Cs-137, Cf-252
	Spinning pipe gauges	Cs-137
	Well logging gauges	Am-241/Be, Cs-137, Cf-252
4	Low dose rate brachytherapy (except eye plaques and permanent implant sources)	I-125, Cs-137, Ir-192, Au-198, Ra-226, Cf-252
	Thickness/fill-Level gauges	Kr-85, Sr-90, Cs-137, Am-241, Pm-147, Cm-244
	Portable gauges (e.g. moisture/density gauges)	Cs-137, Ra-226, Am-241/Be, Cf-252
	Bone densitometers	Cd-109, I-125, Gd-153, Am-241
	Static eliminators	Po-210, Am-241

TABLE 23. CATEGORIZATION OF COMMON PRACTICES (cont.)

Category	Categorization of common practices	Typical isotopes
5	Low dose rate brachytherapy eye plaques and permanent implant sources	Sr-90, Ru/Rh-106, Pd-103
	X ray fluorescence devices	Fe-55, Cd-109, Co-57
	Electron capture devices	Ni-63, H-3
	Mossbauer spectrometry	Co-57
	Positron emission tomography (PET) check sources	Ge-68

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Annex I

DEFENCE IN DEPTH

It has often been said that the safe operation of nuclear power plants is assured by maintaining three basic safety functions:

(1) Reactivity control;
(2) Cooling the fuel;
(d) Confinement.

This can be generalized to apply to the safe operation of any activity involving the use of radioactive material by stating that safe operation is assured by maintaining three basic safety functions:

(1) Controlling the reactivity or the process conditions;
(2) Cooling the radioactive material;
(3) Radiological control (e.g. confinement of radioactive material and shielding) .

For some practices, not all of these safety functions are relevant (e.g. for industrial radiography, only the third function is relevant).

Each of the safety functions is assured by good design, well controlled operation and a range of systems and administrative controls. A defence in depth approach is generally applied to each of these aspects, and allowance is made for the possibility of equipment failure, human error and the occurrence of unplanned developments.

Defence in depth is thus a combination of conservative design, quality assurance, surveillance, mitigation measures and a general safety culture that strengthens each of the successive levels.

Defence in depth is fundamental to the design and operation of major nuclear and radiological facilities. IAEA Safety Series No. 75-INSAG-3 [I–1], Basic Safety Principles for Nuclear Power Plants, states:

> "To compensate for potential human and mechanical failures, a defence in depth concept is implemented, centred on several levels of protection including successive barriers preventing the release of radioactive material to the environment. The concept includes protection of the barriers by averting damage to the plant and to the barriers themselves. It includes further measures to protect the public and the environment from harm in case these barriers are not fully effective."

Defence in depth can be considered in a number of different ways. For example, one can consider the number of barriers provided to prevent a release (e.g. fuel, clad, pressure vessel, containment). Equally, one can consider the number of systems that would have to fail before an accident could occur (e.g. loss of off-site power plus failure of all essential diesels). It is the latter approached that is adopted within INES rating procedure.

Within the safety justification for the facility, operational systems may be distinguished from safety provisions. If operational systems fail, then additional safety provisions will operate so as to maintain the safety function. Safety provisions can be either procedures, administrative controls or passive or active systems, which are usually provided in a redundant way, with their availability controlled by OL&C.

The frequency of challenge of the safety provisions is minimized by good design, operation, maintenance and surveillance. For example, the frequency of failure of the primary circuit of a reactor, or of key pipe work and vessels in a reprocessing plant, is minimized by such things as design margins, quality control, operational constraints and surveillance. Similarly, the frequency of reactor transients is minimized by operational procedures and control systems. Normal operational and control systems contribute to minimizing the frequency of challenges to safety provisions.

INSAG-10 [I–2] (written since the development of INES) provides much more detail on the implementation of defence in depth in design and operation, and Table I–1 shows how the concepts described in INSAG-10 are incorporated into INES assessment of defence in depth.

REFERENCES TO ANNEX I

[I–1] INTERNATIONAL NUCLEAR SAFETY ADVISORY GROUP, Basic Safety Principles for Nuclear Power Plants, Safety Series No. 75-INSAG-3, IAEA, Vienna (1999).

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TABLE I–1. DEFENCE IN DEPTH IN DESIGN AND OPERATION

Objective	Means of implementation	Treatment within INES	
		For power reactors (Section 5)	For other facilities (Section 6)
Prevention of abnormal operation and failures.	Conservative design and high quality in construction and operation.	Addressed by considering the likelihood of the initiator.	Each well designed system is considered as one or more safety layers.
Control of abnormal operation and detection of failures.	Control, limiting and protection systems, and other surveillance features.	Control and surveillance features are addressed by considering the likelihood of the initiator. Protection systems are included as safety systems and hence addressed by considering the operability of the safety functions.	Considered as one or more safety layers.
Control of accidents within the design basis.	Engineered safety features and accident procedures.	Addressed by considering the operability of the safety functions.	Considered as ne or more safety layers.
Control of severe plant conditions, including prevention of accident progression and mitigation of the consequences of severe accidents.	Complementary measures and accident management.	Addressed by considering the operability of the safety functions.	Considered as one or more safety layers.
Mitigation of radiological consequences of significant releases of radioactive materials.	Off-site emergency response.	Not considered as part of defence in depth. These actions affect the actual consequences as considered in the earlier sections of the INES User's Manual.	Not considered as part of defence in depth. These actions affect the actual consequences as considered in the earlier sections of the INES User's Manual.

Annex II

EXAMPLES OF INITIATORS AND THEIR FREQUENCY

Each reactor has its own list and classification of initiators as part of its safety justification. This Appendix gives some typical examples of design basis initiators that have been used in the past for power reactors, categorized into 'Expected', 'Possible', 'Unlikely'.

II–1. PRESSURIZED WATER REACTORS (PWR AND WWER)

II–1.1. Category 1 'Expected'

— Reactor trip;
— Inadvertent chemical shim dilution;
— Loss of main feedwater flow;
— Reactor coolant system depressurisation by inadvertent operation of an active component(e.g. a safety or relief valve);
— Inadvertent reactor coolant system depressurisation by normal or auxiliary pressurizer spray cooldown;
— Power conversion system leakage that would not prevent a controlled reactor shutdown and cooldown;
— Steam generator tube leakage in excess of plant technical specifications but less than the equivalent of a full tube rupture;
— Reactor coolant system leakage that would not prevent a controlled reactor shutdown and cooldown;
— Loss of off-site AC power, including consideration of voltage and frequency disturbances;
— Operation with a fuel assembly in any misoriented or misplaced position;
— Inadvertent withdrawal of any single control assembly during refuelling;
— Minor fuel handling incident;
— Complete loss or interruption of forced reactor coolant flow, excluding reactor coolant pump locked rotor;

II–1.2. Category 2 'Possible'

— Small loss of coolant accident (LOCA);
— Full rupture of one steam generator tube;

— Drop of a spent fuel assembly involving only the dropped assembly;
— Leakage from spent fuel pool in excess of normal make-up capability;
— Blowdown of reactor coolant through multiple safety or relief valves.

II–1.3. Category 3 'Unlikely'

— Major LOCA, up to and including the largest justified pipe rupture in the reactor coolant pressure boundary
— Single control rod ejection
— Major power conversion system pipe rupture, up to and including the largest justified pipe rupture
— Drop of a spent fuel assembly onto other spent fuel assemblies.

II–2. BOILING WATER REACTORS

II–2.1. Category 1 'Expected'

— Reactor trip;
— Inadvertent withdrawal of a control rod during reactor operation at power;
— Loss of main feedwater flow;
— Failure of reactor pressure control;
— Leakage from main steam system;
— Reactor coolant system leakage that would not prevent a controlled reactor shutdown and cooldown;
— Loss of off-site power AC, including consideration of voltage and frequency disturbances;
— Operation with a fuel assembly in any misoriented or misplaced position;
— Inadvertent withdrawal of any single control rod assembly during refuelling;
— Minor fuel handling incident;
— Loss of forced reactor coolant flow.

II–2.2. Category 2 'Possible'

— Small LOCA;
— Rupture of main steam piping;

— Drop of spent fuel assembly involving only the dropped assembly;
— Leakage from spent fuel pool in excess of normal make-up capability;
— Blowdown of reactor coolant through multiple safety or relief valves.

II–2.3. Category 3 'Unlikely'

— Major LOCA, up to and including the largest justified pipe rupture in the reactor coolant pressure boundary;
— Single control rod drop;
— Major rupture of main steam pipe;
— Drop of a spent fuel assembly onto the other spent fuel assemblies.

II–3. CANDU PRESSURIZED HEAVY WATER REACTORS

II–3.1. Category 1 'Expected'

— Reactor trip;
— Inadvertent chemical shim dilution;
— Loss of main feedwater flow;
— Loss of reactor coolant system pressure control (high or low) due to failure or inadvertent operation of an active component (e.g. feed, bleed or relief valve);
— Steam generator tube leakage in excess of plant operating specification but less than the equivalent of a full tube rupture;
— Reactor coolant system leakage that would not prevent a controlled reactor shutdown and cooldown;
— Power conversion system leakage that would not prevent a controlled reactor shutdown and cooldown;
— Loss of off-site power AC, including consideration of voltage and frequency disturbances;
— Operation with fuel bundle(s) in any misplaced position;
— Minor fuel handling incident;
— Reactor coolant pump(s) trip;
— Loss of main feedwater flow to one or more steam generators;
— Flow blockage in an individual channel (less than 70%);
— Loss of moderator cooling;
— Loss of computer control;
— Unplanned regional increase in reactivity.

II–3.2. Category 2 ‘Possible’

- Small LOCA (including pressure tube rupture);
- Full rupture of one steam generator tube;
- Blowdown of reactor coolant through multiple safety or relief valves;
- Damage to irradiated fuel or loss of cooling to fuelling machine containing irradiated fuel;
- Leakage from irradiated fuel bay in excess of normal make-up capability;
- Feedwater line break;
- Flow blockage in an individual channel (more than 70%);
- Moderator failure;
- Loss of end shield cooling;
- Shutdown cooling failure;
- Unplanned bulk increase in reactivity;
- Loss of service water (low pressure, high pressure service water or recirculated cooling water);
- Loss of instrument air;
- Loss of on-site electrical power (Class IV, III, II or I).

II–3.3. Category 3 ‘Unlikely’

- Major LOCA, up to and including the largest justified pipe rupture in the reactor coolant pressure boundary;
- Major power conversion system pipe rupture, up to and including the largest justified pipe rupture.

II–4. RBMK REACTORS (LWGR)

II–4.1. Category 1 ‘Expected’

- Reactor trip;
- Malfunction in the system of neutron control of reactor power;
- Loss of main feedwater flow;
- Reactor coolant system (primary circuit) depressurisation due to inadvertent operation of an active component (e.g. a safety or relief valve);
- Primary circuit leak not hindering normal reactor trip and cooldown

- Reduced coolant flow through a group of fuel channels and reactor protection system channels;
- Reduced helium mixture flow in the reactor graphite stacking;
- Loss of off-site AC power, including voltage and frequency disturbances
- Operation with a fuel assembly in any misoriented or misplaced position;
- Minor fuel handling incident;
- Depressurization of the fuel channel in the course of refuelling.

II–4.2. Category 2 'Possible'

- Small LOCA;
- Spent fuel assembly drop;
- Leakage from spent fuel pool in excess of normal make-up capability;
- Primary coolant leak through multiple safety or relief valves;
- Fuel channel or RPS channel rupture;
- Loss of water flow in any fuel channel;
- Loss of water flow in RPS cooling circuit;
- Total loss of helium mixture flow in the reactor graphite stacking;
- Emergency in the course of on-load refuelling machine operation;
- Total loss of auxiliary power;
- Unauthorized supply of cold water from emergency core cooling system (ECCS) into reactor.

II–4.3. Category 3 'Unlikely'

- Major LOCA, up to and including the largest justified pipe rupture in the reactor coolant pressure boundary;
- Main steam pipe break before the main steam isolation valve (MSIV), including the largest justified pipe rupture;
- Drop of a spent fuel assembly onto other spent fuel assemblies;
- Total loss of service water flow;
- Fuel assembly ejection from the fuel channel, including ejection from the fuel channel while in the refuelling machine.

II–5. GAS COOLED REACTORS

II–5.1. Category 1 'Expected'

— Reactor trip;
— Loss of main feedwater flow;
— Very small depressurization;
— Boiler tube leak;
— Loss of off-site AC power, including consideration of voltage and frequency disturbances;
— Inadvertent withdrawal of one or more control rods;
— Minor fuel handling incident;
— Some loss of interruption of forced reactor coolant flow.

II–5.2. Category 2 'Possible'

— Minor depressurization;
— Inadvertent withdrawal of a group of control rods;
— Full boiler tube rupture;
— Dropped fuel stringer (AGR only);
— Closure of circulator inlet guide vanes (IGVs) (AGR only);
— Gag closure faults (AGR only).

II–5.3. Category 3 'Unlikely'

— Major depressurization;
— Failure of steam pipework;
— Failure of feed pipework.

Annex III

LIST OF PARTICIPATING COUNTRIES AND ORGANIZATIONS

Argentina
Armenia
Australia
Austria
Bangladesh
Belarus
Belgium
Brazil
Bulgaria
Canada
Chile
China
Congo, Democratic Republic of the
Costa Rica
Croatia
Czech Republic
Denmark
Egypt
Finland
France
Germany
Greece
Guatemala
Hungary
Iceland
India
Iran, Islamic Republic of
Ireland
Italy
Japan
Kazakhstan
Korea, Republic of
Kuwait
Lebanon
Lithuania
Luxembourg
Mexico
Montenegro
Netherlands
Norway
Pakistan
Peru
Poland
Portugal
Romania
Russian Federation
Saudi Arabia
Slovakia

Slovenia
South Africa
Spain
Sri Lanka
Sweden
Switzerland
Syrian Arab Republic
Turkey
Ukraine
United Kingdom
United States of America
Vietnam
The Former Yugoslav Republic of Macedonia

INTERNATIONAL LIAISON

European Commission
European Atomic Forum (Foratom)
World Association of Nuclear Operators
World Nuclear Association

GLOSSARY

This section provides definitions for important words or phrases used in this manual. Many of them are taken from the Basic Safety Standards [14] and the IAEA Safety Glossary [16]. In many cases, more detailed explanation is provided within the manual.

absorbed dose. The fundamental dosimetric quantity D, defined as:

$$D = d\varepsilon/dm$$

where $d\varepsilon$ is the mean energy imparted by ionizing radiation to matter in a volume element, and dm is the mass of matter in the volume element. The SI unit of absorbed dose is the joule per kilogram ($J{\cdot}kg^{-1}$), termed the gray (Gy) [14].

accident. In the context of the reporting and analysis of events, an accident is an event that has led to significant consequences to people, the environment or the facility. Examples include lethal effects to individuals, large radioactivity release to the environment, reactor core melt. For communicating the significance of events to the public, INES rates events at one of seven levels and uses the term accident to describe events at Level 4 or above. Events of lesser significance are termed incidents.

Note: In safety analyses and the IAEA safety standards, the term 'accident' has been used much more generally to mean "Any unintended event, including operating errors, equipment failures or other mishaps, the consequences or potential consequences of which are not negligible from the point of view of protection or safety" [14]. Thus, events that would be considered accidents according to the safety standards definition may be accidents or 'incidents' in public communication and INES terminology. This more specific INES definition is used to aid public understanding of safety significance.

actual consequences. In this manual, this refers to consequences rated using these criteria for assessing the impact on people and the environment, as well as radiological barriers and controls at facilities. This is in contrast to events rated using the criteria for degradation of defence in depth, which covers those events with no actual consequences, but where the measures put in place to prevent or cope with accidents did not operate as intended.

additional factors. Factors that can result in an increase in the basic event rating. Additional factors allow for those aspects of the event that may indicate a deeper degradation of the plant or the organizational arrangements of the facility. Factors considered are common cause failures, procedural inadequacies and safety culture deficiencies.

annual dose. The dose due to external exposure in a year plus the committed dose from intakes of radionuclides in that year [16].

authorized facilities. Facilities for which a specific form of authorization has been given. These include: nuclear facilities; irradiation installations; some mining and raw material processing facilities such as uranium mines; radioactive waste management facilities; and any other places where radioactive materials are produced, processed, used, handled, stored or disposed of — or where radiation generators are installed — on such a scale that consideration of protection and safety is required.

authorized limit. A limit on a measurable quantity (including equipment operability) established or formally accepted by a regulatory body (sometimes these limits are established within what are called OL&C).

basic rating. The rating prior to consideration of additional factors. It is based purely on the significance of actual equipment or administrative failures.

common cause failure. Failure of two or more structures, systems or components due to a single specific event or cause [16].
For example, a design deficiency, a manufacturing deficiency, operation and maintenance errors, a natural phenomenon, a human induced event, saturation of signals, or an unintended cascading effect from any other operation or failure within the plant or from a change in ambient conditions.

confinement. Prevention or control of releases of radioactive material to the environment in operation or in accidents [16].

Note: Confinement is closely related in meaning to containment, but confinement is used to refer to the safety function of preventing the ‘escape’ of radioactive materials, whereas containment refers to the means for achieving that function.

containment. Methods or physical structures designed to prevent or control the release and the dispersion of radioactive materials [16].

defence in depth. A hierarchical deployment of different levels of diverse equipment and procedures to prevent the escalation of anticipated operational occurrences and to maintain the effectiveness of physical barriers placed between a radiation source or radioactive material and workers, members of the public or the environment [16].

See the introduction to Sections 4,5,6, Annex I and INSAG-10 [17] for further information.

deterministic effect. A health effect of radiation for which generally a threshold level of dose exists above which the severity of the effect is greater for a higher dose [14].

Note: The level of the threshold dose is characteristic of the particular health effect but may also depend, to a limited extent, on the exposed individual. Examples of deterministic effects include erythema and acute radiation syndrome (radiation sickness).

dose. A measure of the energy deposited by radiation in a target [16]. Whenever the word is used in specific definitions, it needs further detail such as absorbed dose, effective dose, whole body exposure, RBE weighted dose.

dose constraint. A prospective restriction on the individual dose delivered by a source, which serves as the upper bound on the dose in optimization of protection and safety for the source [16].

dose limit. The value of the effective dose or the equivalent dose to individuals from controlled practices that is required not to be exceeded [14]. There are a range of limits that all need to be considered, including whole body effective dose, doses to skin, doses to extremities and doses to lens of the eye.

effective dose. A measure of dose designed to reflect the amount of radiation detriment likely to result from the dose. Values of effective dose from any type(s) of radiation and mode(s) of exposure can be compared directly. It is defined as the summation of the tissue equivalent doses, each multiplied by the appropriate tissue weighting factor:

$$E = \sum_{T} w_T \cdot H_T$$

where H_T is the equivalent dose in tissue T, and w_T is the tissue weighting factor for tissue T. From the definition of equivalent dose, it follows that:

$$E = \sum_{T} w_T \cdot \sum_{R} w_R \cdot D_{T,R}$$

where w_R is the radiation weighting factor for radiation R and $D_{T,R}$ is the average absorbed dose in the organ or tissue T [14].

The unit of effective dose is the sievert (Sv), equal to 1 J/kg. The rem, equal to 0.01 Sv, is sometimes used as a unit of equivalent dose and effective dose.

equivalent dose. A measure of the dose to a tissue or organ designed to reflect the amount of harm caused. Values of equivalent dose to a specified tissue from any type(s) of radiation can be compared directly. It is defined as the quantity $H_{T,R}$, where:

$$H_{T,R} = w_R \cdot D_{T,R}$$

where $D_{T,R}$ is the absorbed dose delivered by radiation type R averaged over a tissue or organ T and w_R is the radiation weighting factor for radiation type R. When the radiation field is composed of different radiation types with different values of w_R the equivalent dose is:

$$H_T = \sum_{R} w_R \cdot D_{T,R}$$

The unit of equivalent dose is the sievert (Sv), equal to 1 J/kg. The rem, equal to 0.01 Sv, is sometimes used as a unit of equivalent dose and effective dose.

event. Any occurrence that requires a report to the regulator or the operator or a communication to the public.

exposure. The act or condition of being subject to irradiation [16].

Note: Exposure should not be used as a synonym for dose. Dose is a measure of the effects of exposure.

external exposure. Exposure to radiation from a source outside the body [16].

fissile material. ^{234}U, ^{235}U, ^{239}Pu, ^{241}Pu, or any combination of these radionuclides. Excepted from this definition are:

(a) Natural uranium or depleted uranium that is unirradiated, and
(b) Natural uranium or depleted uranium that has been irradiated in thermal reactors only [16].

high integrity safety layer. A high integrity safety layer has all of the following characteristics:

(a) The safety layer is designed to cope with all relevant design basis faults and is explicitly or implicitly recognized in the plant safety justification as requiring a particularly high reliability or integrity.
(b) The integrity of the safety layer is assured through appropriate monitoring or inspection such that any degradation of integrity is identified.
(c) If any degradation of the layer is detected, there are clear means of coping with the event and of implementing corrective actions, either through pre-determined procedures or through long times being available to repair or mitigate the fault.

highly reliable safety layer. In some cases, the time available may be such that there are a whole range of potential safety layers that can be made available, and it has not been considered necessary in the safety justification to identify each of them in detail or to include in the procedure the detail of how to make each of them available. In such cases (provided there are a range of practicable measures that could be implemented), this long time available itself provides a highly reliable safety layer.

incident. In the context of the reporting and analysis of events, the word incident is used to describe events that are less severe than accidents. For communicating the significance of events to the public, INES rates events at one of seven levels and uses the term incident to describe events up to and including Level 3. Events of greater significance are termed accidents

initiator. (initiating event). An initiator or initiating event is an event identified in the safety analysis that leads to a deviation from the normal operating state and challenges one or more safety functions.

internal exposure. Exposure to radiation from a source within the body [16].

investigation level. The value of a quantity such as *effective dose*, *intake* or *contamination* per unit area or volume at or above which an investigation is recommended to be conducted.

operability of a safety function. The operability of a safety function can be: *full; the minimum required by OL&C*; *adequate;* or *inadequate;* depending upon the operability of the individual redundant and diverse safety systems and components.

operability of equipment. Capability of performing the required function in the required manner.

operational limits and conditions. A set of rules setting forth parameter limits, the functional capability and the performance levels of equipment and personnel approved by the regulatory body for safe operation of an authorized facility [16]. (In most countries, for nuclear power plants, these are included within Technical Specifications).

operating area. Operating areas are areas where worker access is permitted without specific permits. It excludes areas where specific controls are required (beyond the general need for a personal dosimeter and/or coveralls) due to the level of contamination or radiation.

operating organization. An organization applying for authorization or authorized to operate an authorized facility and responsible for its safety.

Note: In practice, for an authorized facility, the operating organization is normally also the licensee or registrant.

See also operator.

operating personnel. Individual workers engaged in the operation of an authorized facility.

operator. Any organization or person applying for authorization or authorized and/or responsible for nuclear, radiation, radioactive waste or transport safety when undertaking activities or in relation to any nuclear facilities or sources of ionizing radiation. This includes, inter alia, private individuals, governmental bodies, consignors or carriers, licensees, hospitals, self-employed persons [16].

Note: Operator includes either those who are directly in control of a facility or an activity during use of a source (such as radiographers or carriers) or, in the case of a source not under control (such as a lost or illicitly removed source or a re-entering satellite), those who were responsible for the source before control over it was lost.
Note: Synonymous with operating organization.

orphan source. A radioactive source that is not under regulatory control, either because it has never been under regulatory control, or because it has been abandoned, lost, misplaced, stolen or otherwise transferred without proper authorization [19].

package. The packaging with its radioactive contents as presented for transport. There are several types of packages:

(1) Excepted package;
(2) Industrial package Type 1 (Type IP-1);
(3) Industrial package Type 2 (Type IP-2);
(4) Industrial package Type 3 (Type IP-3);
(5) Type A package;
(6) Type B(U) package;
(7) Type B(M) package;
(8) Type C package.

The detailed specifications and requirements for each package type are specified in the Transport Regulations [6].

practice. Any human activity that introduces additional sources of exposure or additional exposure pathways or extends exposure to additional people or modifies the network of exposure pathways from existing sources, so as to increase the exposure or the likelihood of exposure of people or the number of people exposed [14].

Note: Terms such as 'authorized practice', 'controlled practice' and 'regulated practice' are used to distinguish those practices that are subject to regulatory control from other activities that meet the definition of practice but do not need or are not amenable to control.

radiation generator. Device capable of generating radiation, such as X rays, neutrons, electrons or other charged particles, which may be used for scientific, industrial or medical purposes [14].

radiation source. A radiation generator, or a radioactive source or other radioactive material outside the nuclear fuel cycles of research and power reactors [16].

radioactive material. Material designated in national law or by a regulatory body as being subject to regulatory control because of its radioactivity.

radioactive source. Radioactive material that is permanently sealed in a capsule or closely bonded and in a solid form and which is not exempt from regulatory control. It also includes any radioactive material released if the radioactive source is leaking or broken, but does not include material encapsulated for disposal, or nuclear material within the nuclear fuel cycles of research and power reactors [19].

radiological. An adjective referring to both radiation and contamination, (surface and airborne).

radiological barriers. Physical barriers which contain radioactive material and/or shield individuals from the radiation emanating from the material.

RBE weighted absorbed dose. A product of the absorbed dose in an organ or tissue and the RBE of the radiation imparting the dose:

$$AD_T = \sum_R D_T^R \times RBE_T^R;$$

where D_T^R is the organ dose from radiation R, in tissue T, and RBE_T^R is the relative biological effectiveness of radiation R, in producing a specific effect in a particular organ or tissue T. The unit of RBE-weighted absorbed dose is $J{\cdot}kg^{-1}$, termed the gray-equivalent (Gy-Eq).
The RBE weighted absorbed dose is intended to account for differences in biological effectiveness in producing deterministic health effects in organs or tissues of reference man due to the quality of the radiation [5].

safety case. A collection of arguments and evidence in support of the safety of a facility or activity.

safety culture. The assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance [14].

safety functions. The three basic safety functions are: (a) controlling the reactivity or the process conditions; (b) cooling the radioactive material; (c) confining the radioactive material.

safety layers. Passive systems, automatically or manually initiated safety systems, or administrative controls that are provided to ensure that the required safety functions are achieved [16]. A safety layer is to be considered as a safety provision that cannot be broken down into redundant parts. See Section 6.2.2 for a detailed definition of how the term is used in this particular document.

safety provisions. Safety provisions can be either procedures, administrative controls, or passive or active systems, which are usually provided in a redundant way with their availability controlled by Operational Limits and Conditions

safety systems. Systems important to safety that are provided to ensure the safety functions.

source. Anything that may cause radiation exposure — such as by emitting ionizing radiation or by releasing radioactive substances or materials — and can be treated as a single entity for protection and safety purposes [16].

For example, materials emitting radon are sources in the environment, a sterilization gamma irradiation unit is a source for the practice of radiation preservation of food, an X ray unit may be a source for the practice of radiodiagnosis; a nuclear power plant is part of the practice of generating electricity by nuclear fission, and may be regarded as a source (e.g. with respect to discharges to the environment) or as a collection of sources (e.g. for occupational radiation protection purposes).

stochastic effect. A radiation induced health effect, the probability of occurrence of which is greater for a higher radiation dose and the severity of which (if it occurs) is independent of dose [16].

Note: Stochastic effects generally occur without a threshold level of dose. Examples include various forms of cancer and leukaemia.

worker. Any person who works, whether full-time, part-time or temporarily, for an employer and who has recognized rights and duties in relation to occupational radiation protection. (A self-employed person is regarded as having the duties of both an employer and a worker.) [14]

LIST OF FIGURES

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Vienna, Austria: 1–4 July 2008

Consultants Meetings

Cape Town, South Africa: 9–13 October 2006
Vienna, Austria: 4–8 June 2007, 10–21 September 2007, 18–22 February 2008

Meetings of the INES Advisory Committee

Vienna, Austria: 19–23 March 2007, 17–20 March 2008

09-14041

INES, the International Nuclear and Radiological Event Scale, was developed in 1990 by experts convened by the IAEA and the OECD Nuclear Energy Agency with the aim of communicating the safety significance of events. This edition of the INES User's Manual is designed to facilitate the task of those who are required to rate the safety significance of events using the scale. It includes additional guidance and clarifications, and provides examples and comments on the continued use of INES. With this new edition, it is anticipated that INES will be widely used by Member States and become the worldwide scale for putting into proper perspective the safety significance of any event associated with the transport, storage and use of radioactive material and radiation sources, whether or not the event occurs at a facility.

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA

Mark Malinowski December 10, 2013 DTSC
Project Team Manager – Santa Susana Field Laboratory
8800 Cal Center Drive Sacramento, CA 95825
Phone: (916) 255-3717 Fax: (916) 255-3596
Email: Mark.Malinowski@dtsc.ca.gov

February 7, 2014

Re: California Department of Toxic Substance Control –
Scoping for the Environmental Impact Report for the Santa Susana Field Laboratory

Dear Mr. Malinowski,
On Thursday, February 6th, 2014, I attended a Department of Energy Soil Treatability Investigation Group (STIG) meeting. I have been a member of this technical group for a number of years.

In this meeting, in which DTSC employees Laura Rainey and Roger Paulson were also present, we discussed the alternative remediation technologies that are currently under review by the University of California Riverside and by Cal Poly San Luis Obispo. As a result of this meeting, there are other issues that must be considered by DTSC in their Draft Environmental Impact Report.

I. Issues that DTSC must consider in their Draft Environmental Impact Report

1) **The Administrative Orders on Consent calls for a 2017 deadline for remediation of soil.** At the STIG meeting, we learned that the estimate for soil removal just by DOE for AREA IV is 1.7 million cubic yards of soil. (5) **Of this, 82,000 cubic yards of soil are considered radiologically contaminated above the Preliminary DTSC Radiological Look Up Table (LUTS) values.** When the information related to the soil volume with what is considered above the LUT value is released publicly I believe that tremendous fear and possible hysteria in my community will occur until this soil is removed. And when I say removed, I mean removed with the utmost of care.
2) **What is the risk from the SSFL site today?** At the recent SSFL Workgroup meeting, I spoke to Mary Aycock of the federal Environmental Protection Agency. I mentioned to her that the EPA – in their May 2012 fact sheet – stated that: "Site access is restricted and therefore, the public is not exposed to this contamination." (1) Ms. Aycock's response was that she did not recall this fact sheet, but that we had not done a risk assessment yet had we?
   DTSC has stated in their letter to the Mayor of Simi Valley that they do not know of any offsite risk today.(2) This was again stated by Ray Leclerc the Project Director of DTSC at the SSFL workgroup on February 5th, 2014. However, I do not believe that community HEARD or BELIEVED that statement based upon statements made by non agency people on the stage.
3) At the SSFL Workgroup, a physician with Physicians for Social Responsibility spoke of the Linear No Threshold Model. Many local stakeholders believe that there is no safe level of radiological

contamination. Therefore, **a risk assessment for radionuclides must be addressed** to discuss the naturally occurring radionuclides on the SSFL site, and our risk of removing these radionuclides and making them airborne while we remediate other contaminants of concern. We must discuss the risk from these radionuclides above local background – is it safe to leave any levels of these radionuclides in place? At what depths?

4) **DTSC must bring in health physicists and toxicologists to discuss risk related to the site with us before DTSC should consider plans for remediation.** They must discuss the Linear No Threshold Model, and if they do or do not support this model. They must also discuss how the federal EPA cleans up other sites based upon risk. Some people are stating that the EPA would come in and do a better cleanup than DTSC.
5) **DTSC must address the risk from the chemicals –** prioritize the chemicals from a risk based screening level, and show which areas pose the greatest risk to human health, to biota, and are the most likely due to their location and chemical makeup to migrate in some manner.
6) **Epidemiologists should be brought in to discuss the former worker and community health studies**. It is my opinion that health studies are cited by "stakeholders" that show a correlation with illness in the former employees, but they do not consider other employee studies that show the healthy worker effect. Furthermore, community health studies are quoted at community meetings without naming the source of the information, nor do these people state information from these studies such as this statement from the Morgenstern 2007 community health study (3):

   "Conclusion: Despite the methodologic limitations of this study, the findings suggest there may be elevated incidence rates of certain cancers near SSFL that have been linked in previous studies with hazardous substances used at Rocketdyne, some of which have been observed or projected to exist offsite. **There is no direct evidence from this investigation, however, that these observed associations reflect the effects of environmental exposures originating at SSFL.** Given these provocative findings and unanswered questions, it is tempting to recommend further analyses or future studies to address the health concerns of the community.

   Unfortunately, it is not clear at this time whether such additional analyses or studies will be sufficient to determine whether operations and activities at Rocketdyne affected, or will affect, the risk of cancer in the surrounding neighborhoods."
7) "Water Water Everywhere but not a drop to drink". **DTSC must consider the volume of water that will be necessary to remediate the whole SSFL site.** Soil will need to be dampened to loosen it for dig and hauling. Soil will need to be kept most to prevent it from becoming airborne. Water will be needed to wash-down trucks. Water will be necessary to start new seeds. Water could be used to wash soil on site. Water may be a component of alternative treatments. **Where is the water going to come from?** The Governor has stated that we are under Emergency Water conditions due to the drought throughout the State, and that water needs to be used for drinking and for emergency purposes. (4)
8) **Removal of the top soil**. In the STIG meeting, there were discussions related to soil removal. **What volume of the total soil in AREA IV is being removed to comply with the Look up table values**?

9) **Where can we get back fill soil that meets the AOC requirements**? Are we going to have that soil removed before we have found replacement soil? DOE Project Director John Jones stated at the STIG meeting that he sent for soil at the store to have it analyzed – it was more contaminated than the soil on site. I have spoken to my local nursery regarding the source of bark for example. I was told to use care because some bark is from trees that fell from Hurricane Sandy. You do not know what contaminants are in those bags of bark. We do not know the source of soil sold at stores.

10) **If we remove the top two feet of soil on the Federal Government property, and possibly the same amount or more in AREA IV, we will have removed all of the microorganisms that are a part of the native soil, and therefore, our in situ remediation will most likely not work**.

11) **Soil volume** – Based upon the estimated soil volume from the DOE that requires removal or remediation – 1.7 million cubic yards (we were not given the number of trucks that would be necessary to remove that soil volume at the STIG meeting), I am estimating that DOE will need at least three times the number of trucks that NASA projected for their soil removal since NASA states in their DEIS that they will be removing at least 500,000 cubic yards of soil. **This totals more than 2.2 million cubic yards of soil just for the two Responsible Parties – DOE and NASA**.

12) **NASA has estimated that they will require 26, 441 trucks for 500,000 cubic yards of soil. NASA DEIS – Table on 4 - 89**

"Impacts from soil cleanup to this resource area would result primarily from ground disturbance as a result of 320,000 yd_3 of contaminated soil or more being excavated." NASA DEIS – page ES6
"As discussed in ES Section 3.1.2, NASA is evaluating whether technologies can effectively treat rather than excavate some soil to Look-Up Table values. This approach could reduce the volume of soil to be transported offsite for disposal by approximately 36 percent (320,000 yd_3 compared to 500,000 $yd_3$of soil); therefore, fewer truck trips would be needed." NASA DEIS – page ES8
Using an estimate of 18.9 cubic yards per truck**, I estimate that the DOE would require more than 89,947 truckloads – roughly 90,000 truckloads to remove their soil to the AOC. This is a total of 116,388 truckloads of soil just for the NASA and DOE projects. This is not including the number of trucks that are necessary for building demolition, replacement soil, and other necessary materials. If you estimate 6 trucks per hour x 8 hours per day, 5 days per week, and 50 weeks per year, you get 12,000 trucks per year. If you divide the 116,388 by 12,000, that will take 9.699 years or roughly <u>10 years</u> for just the DOE and NASA soil to be removed from the SSFL site per the AOC.**

13) **This does not take into consideration the soil volume or number of trucks that Boeing will have to use for future demolition and disposal of the remaining structures and the removal of soil.**

II. Issues that DTSC must consider in their Draft Environmental Impact Report

DTSC must consider the statements in the recent ruling of Judge Sumner regarding CEQA.

- **"CEQA is designed to provide long-term protection of the environment."**

- **"It achieves this goal by requiring public agencies to inform themselves about and consider the environmental effects of projects they carry out or approve."**

- **"CEQA does not compel a particular environmental outcome. Instead, its purpose is to require government agencies to make decisions with environmental consequences in mind."**

- **"CEQA "is to assist public agencies in evaluating whether projects which they have discretion to approve or disapprove will have a significant adverse effect upon the environment."**

- **" CEQA also gives the public an opportunity to review and comment on the adequacy of the government's environmental review."**

- **"CEQA is thus designed to force the government to think about the environmental effects of its activities in a meaningful way, to mitigate those effects where feasible, and to give the public access to the decision-making process."**

- **"CEQA must be given a "broad interpretation" to maximize protection of the environment."**

III. DTSC must consider whether the 2010 Administrative Order on Consent was created to comply with SB 990, and whether if the ruling on SB 990 to strike it down is upheld at the 9th Circuit Court of Appeals, the 2010 Administrative Order on Consent should be renegotiated.

IV. DTSC must consider a risk based cleanup and the potential impact of this soil volume remediation in an area that is about only one third of the whole SSFL site. (NASA and DOE soil volumes only)

V. DTSC must consider the impact of removing all vegetation and soil on 105 acres of the "NASA" property and on what appears per maps to be almost all of AREA IV – roughly 200 acres?

VI. DTSC must consider the impact that this soil remediation – dig and haul – will potentially have on the whole SSFL site due to the recent designation of the whole site as Sacred Lands.

VII. What impacts will this project have according to Fish and Wildlife?

VIII. DTSC must consider not only the air quality on the site during excavation, but the impact of dust emissions from this site to the community. Many communities including Bell Canyon, West Hills, and Woodland Hills are in the prevailing winds area of the SSFL site.

IX. DTSC must consider the potential for increased lung diseases such as Chronic Obstructive Pulmonary Disease and Asthma, heart disease, increased incidence of bladder and lung cancer per the World Health Organization, and the potential for increased Valley Fever.

X. DTSC must consider the impacts of the truck emissions not only in terms of public health but in terms of greenhouse gases. Mitigating greenhouse gases with carbon offsets does not protect the community from the trucks.

XI. DTSC must consider the comments from the Federal EPA to NASA in their NASA DEIS comments where they recommend to NASA to clean up radiological contaminants to Background, but cleanup chemical contaminants based upon risk.

XII. DTSC must consider per the EPA letter to NASA for the NASA DEIS the comments regarding the soil volumes that NASA would be sending to landfills – the DOE soil volume is three times that of NASA's.

In conclusion, DTSC must show clear alternatives in their Draft Environmental Impact Statement to show that the Administrative Order on Consent is not the only alternative that is being considered; it is predecisional under CEQA and NEPA. DTSC must show that it has considered all alternative cleanup scenarios, and they must justify for all decision makers why cleaning up to "Background" is in the best interest of public health public safety, and the environment. Any CEQA document without considering all alternatives would be in a direct violation of the statements of Judge Sumner in his ruling for a temporary injunction. (PSR – LA et al v DTSC et al)

Respectfully submitted,

Christine L. Rowe

Impacted stakeholder
36 year resident of West Hills
In the prevailing winds area of the SSFL site.
Trucks will travel within about one mile from my home

(1) EPA Fact Sheet – May 2012: http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/3dc283e6c5d6056f88257426007417a2/4dee7be2e6b520f3882579f800639852/$FILE/SSFL%205_12%20307kb.pdf

(2) Letter to Mayor Huber of Simi Valley from DTSC: http://ssfl.msfc.nasa.gov/documents/comm/2013-04-03_DTSC_Mayor_Huber.pdf

(3) Morgenstern et al: Cancer Incidence in the community surrounding the Rocketdyne Santa Susana Facility - March 2007: http://www.ph.ucla.edu/erg/final_epi_report.pdf

(4) "GOVERNOR BROWN DECLARES DROUGHT STATE OF EMERGENCY": http://gov.ca.gov/news.php?id=18368

(5) "Rough Order of Magnitude Estimates for AOC Soil Cleanup Volumes in Area IV, and Associated Truck Transport Estimates based on DTSC Look-up Table Values – DRAFT" http://www.etec.energy.gov/Library/Cleanup_and_Characterization/EIS/Draft_Area_IV_ROM_Soil_Volume_Estimate_020714.pdf

Jason Ricks

From: Malinowski, Mark@DTSC <Mark.Malinowski@dtsc.ca.gov>
Sent: Friday, November 22, 2013 1:33 PM
To: Jason Ricks; Deanna Hansen
Cc: Karen P. Snyder (KSnyder@KatzandAssociates.com); Joan Isaacson (jisaacson@KatzandAssociates.com); Hume, Richard@DTSC; Perez, Marina@DTSC; Leclerc, Ray@DTSC
Subject: FW: Christine L. Rowe DTSC SSFL PEIR - Comment 1
Attachments: Update of Regional Map.jpg; WHNC11.pdf; Chatsworth NC map.pdf; BOUNDARY_MAP_CANOGA_PARK_NEIGHBORHOOD_COUNCIL.pdf; Woodland Hiills Warner Center NC.pdf

Hello,

FYI. I'll take this as the first comment on the PEIR scope. MM

From: Christine Rowe [mailto:crwhnc@gmail.com]
Sent: Friday, November 22, 2013 3:30 AM
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Subject: Christine L. Rowe DTSC SSFL PEIR - Comment 1

Dear Mr. Malinoski,

I have submitted maps to DTSC and other SSFL related groups for years. In order for DTSC to do the appropriate outreach, DTSC must have the best maps.

I found that the regional map on your notice of the SSFL PEIR lacked key communities on it.

Most specifically, it lacked my community of West Hills which is one of the most impacted communities from the project. I have attached an updated regional map that I submitted to DTSC years ago.

I recommend that DTSC's CEQA consultant find the real boundaries of the communities that will be impacted by the site cleanup and traffic - at a minimum, I recommend the boundaries of communities within the five mile radius. In fact, I would like to see maps with a two mile, five mile, and 10 mile periphery from the SSFL boundaries be made available in the future DTSC documents. These maps are important because health studies refer to distances from the SSFL site - 2 miles, 5 miles, and 10 miles.

The five mile radius of DTSC is referenced in the DTSC Community Survey in 2003: http://www.dtsc.ca.gov/SiteCleanup/Projects/upload/SSFL_CommunitySurveyResults2003_0203.pdf - page 4 Adobe. Yet even that map fails to include West Hills and Bell Canyon - two of the most impacted communities from this site.

If you look at the **West Hills Neighborhood Council map** (attached), you can see exactly where the route from the Santa Susana Field Laboratory enters the community of West Hills towards the bottom of Woolsey Canyon Road (the upper left corner of the map).

On the **Chatsworth Neighborhood Council map** (attached), you can see where trucks may go should they take the Plummer route to Topanga Canyon Blvd.

On the **Canoga Park NC map** (attached), you can see where traffic that is routed via Roscoe Blvd will go whether the trucks turn north or south onto Topanga Canyon Blvd.

Finally, the **Woodland Hills Warner Center Neighborhood Council map** (attached) should show you not only the potential routes of trucks moving south on Valley Circle that trucks could potentially take, it also shows the route south on Topanga Canyon to the 101 freeway.

These maps should be created in an overlay with the SSFL regional map to show the true orientation of these communities to the Santa Susana Field Laboratory site.

Each of these routes will impact school routes - public, private, Pierce College, and preschools. They will go past facilities for the elderly including in West Hills.

DTSC as the lead agency must consider the impact of cleaning up the SSFL site on the public health of these communities which are the most likely truck routes. Many of the possible routes should be ruled out because of the potential weight of the heaviest trucks.

The hours that the trucks leave the site should be limited to daylight hours only due to the steepness of Woolsey Canyon Road and due to the potential impact of noise and safety on the local communities. To me, that means ending the trucks by 4:30 PM at the latest due to traffic and lighting conditions.

Therefore, DTSC should be considering a risk based cleanup for the whole Santa Susana Field Laboratory site based upon the original agreements in the 2007 Consent Order which was negotiated by DTSC personnel to lessen the burden on the communities due to truck traffic.

NASA must still complete its NEPA process and its Section 106 process among other applicable laws.

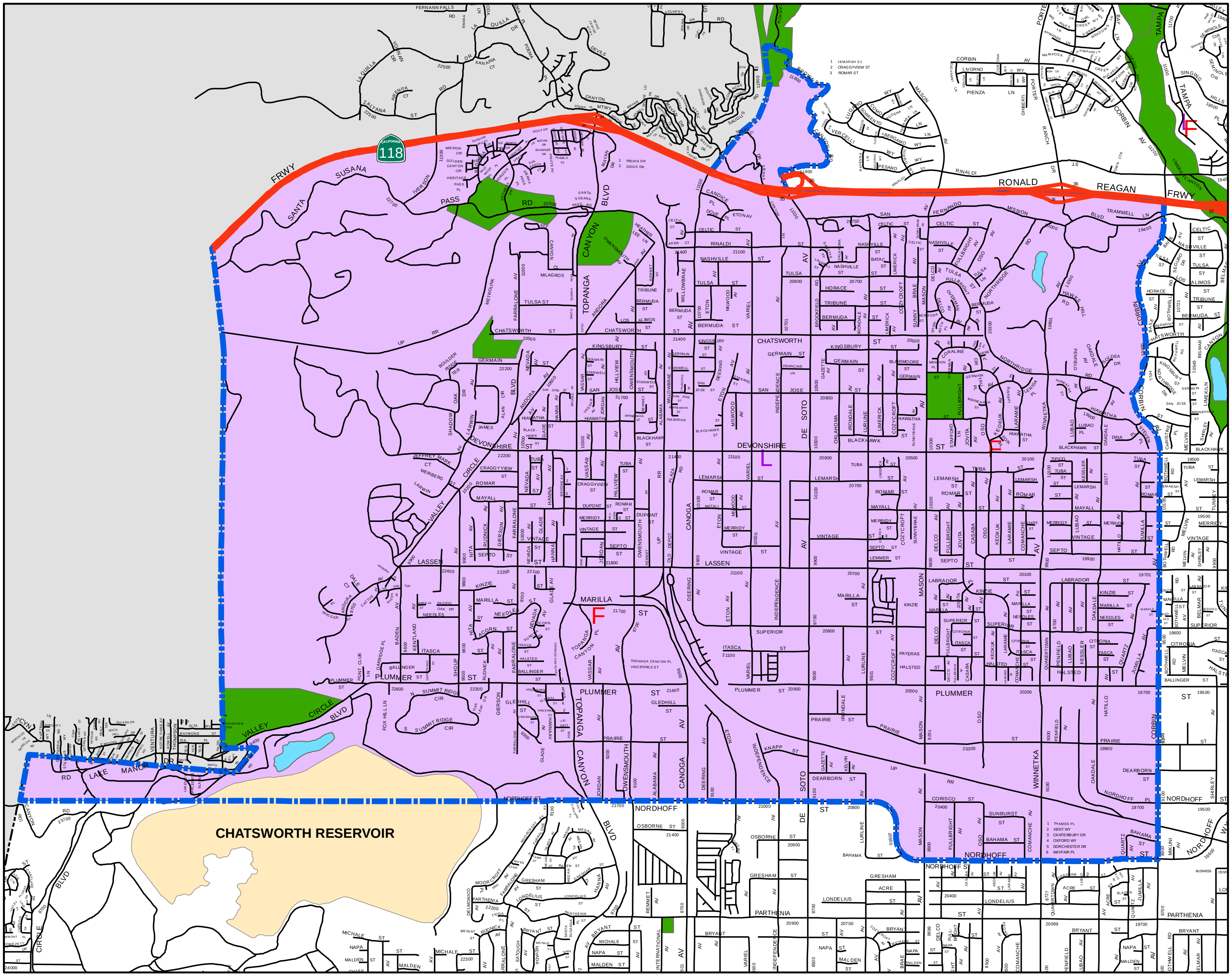
The DOE must still complete its EIS process which has been held under the Federal court's jurisdiction since 2007.

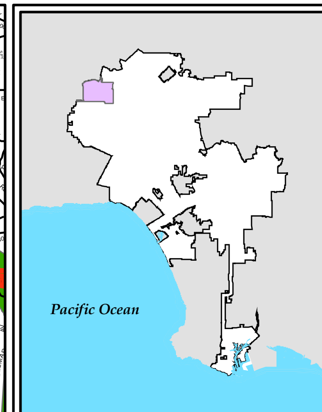
I respectfully request that DTSC renegotiate the SSFL clean up standards based upon the potential health risk and safety to my local communities of interest - Bell Canyon, Chatsworth, West Hills, Canoga Park, and Woodland Hills. Communities of interest is a legal term used to redistrict the State of California and other entities;
http://redistrictinggroup.org/wp-content/uploads/2011/04/Communities-of-Interest_2pagehandout_byTRGBL.pdf

In this instance, these communities of interest are contiguous, compact, they share numerous things in common including transportation routes from the SSFL site.

Respectfully submitted,

Christine L. Rowe
West Hills, California resident of 35 years





NORTH VALLEY AREA

COUNCIL DISTRICT: 12

CHATSWORTH NC

CERTIFIED: 04/29/2003

Department of Neighborhood Empowerment
(213) 485-1360 or dial 311
www.lacityneighborhoods.com

- P Police Station
- F Fire Station
- L Library
- Park
- Recreation Area
- Water
- Freeway
- Street

N

NOT TO SCALE

CHATSWORTH

NEIGHBORHOOD COUNCIL

DEPARTMENT OF NEIGHBORHOOD EMPOWERMENT

CITY OF LOS ANGELES

ANTONIO R. VILLARAIGOSA
MAYOR

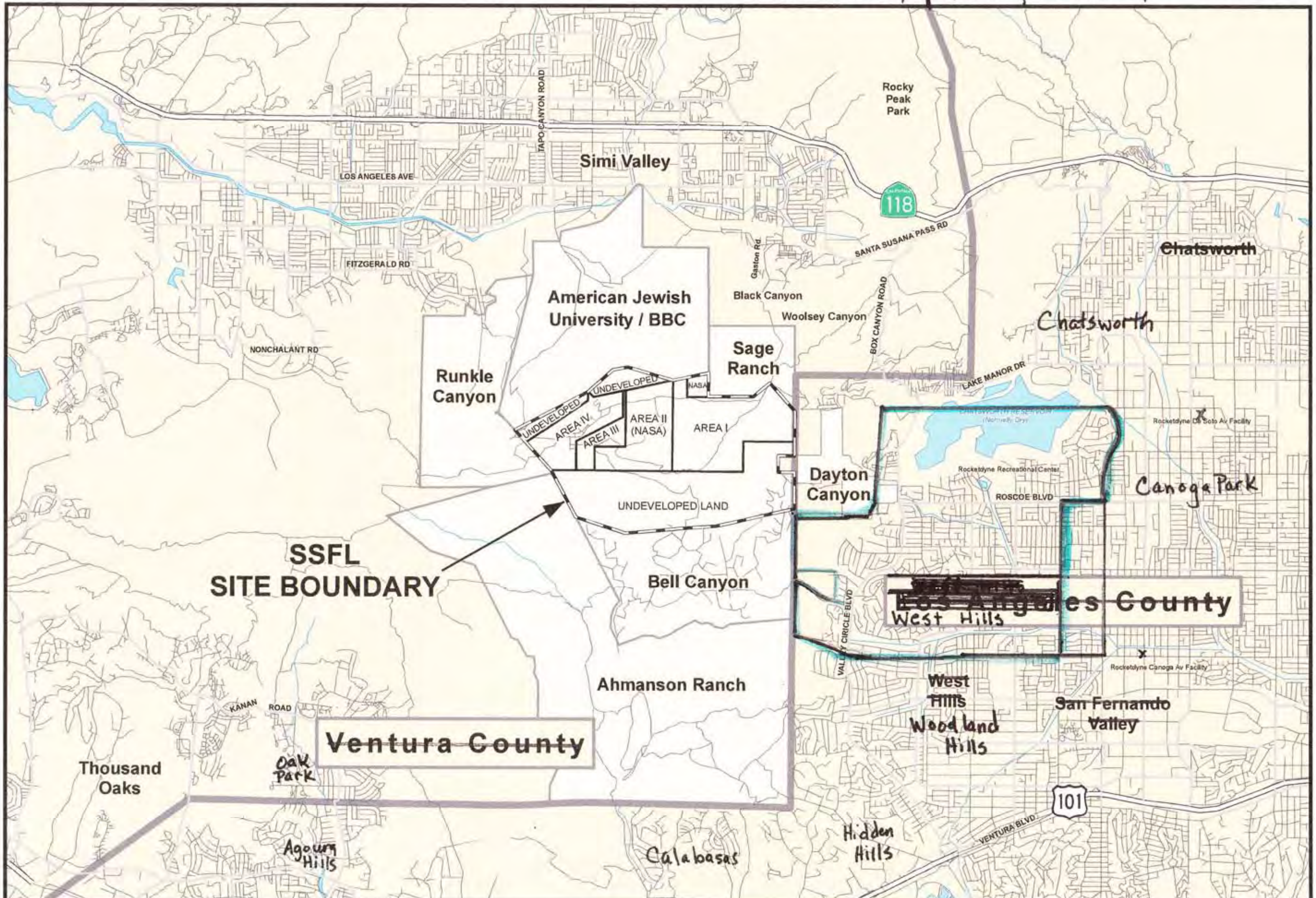
LA DPW ENGINEERING
Serving the Present; Designing the Future

GARY LEE MOORE, P.E.
CITY ENGINEER

1) These are rough estimates due to the size of this map

San Fernando Valley is an area - it looks like a town - like Simi Valley

Ventura County | Los Angeles County - Remove labels on map



1 inch equals 1.5 miles

0 | 1.5 | 3 Miles

SANTA SUSANA FIELD LABORATORY

Document: Offsite-Report-Regional_Map.mxd

Date: Dec 10, 2007

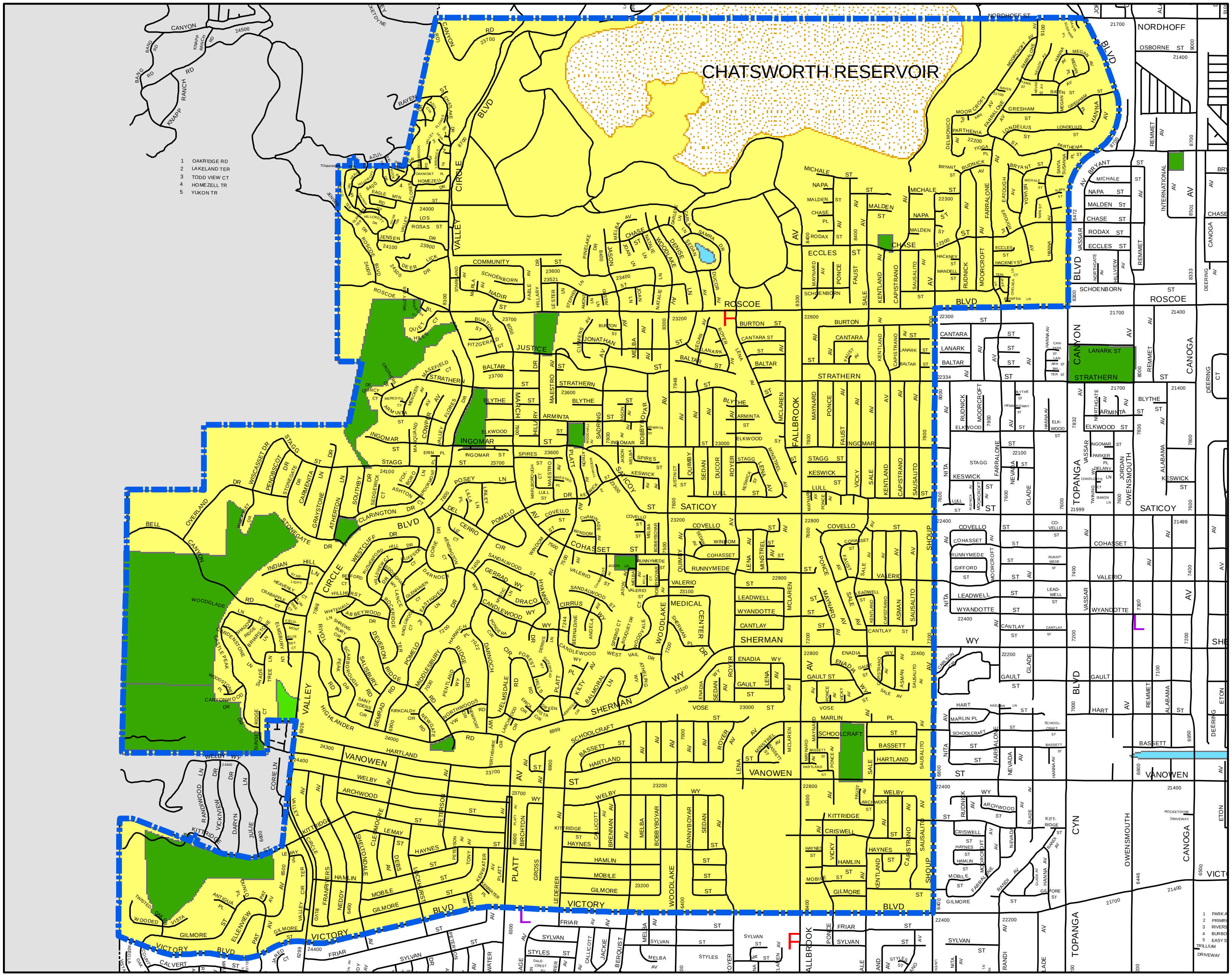
Regional Map

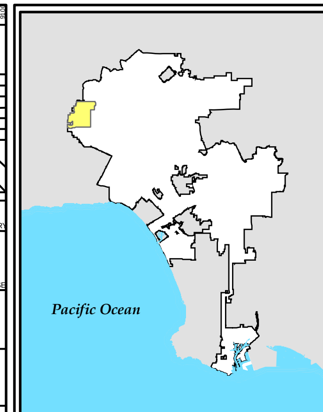
FIGURE 1-1

Chatsworth, West Hills, Canoga Park, and Woodland Hills are a part of the city of Los Angeles. Bell Canyon and Hidden Hills, Calabasas,

The northern boundary is Nordhoff through the Chatsworth Nature Preserve

The Western Border of West Hills is very rough. The eastern border is Topanga @ Nordhoff, and moves to Shoup South of Roscoe. Victory is the southern Boundary





SOUTH VALLEY AREA

COUNCIL DISTRICTS: 3 & 12

WEST HILLS NC

CERTIFIED: 01/22/2002

Department of Neighborhood Empowerment
(213) 485-1360 or dial 311
www.lacityneighborhoods.com

- P Police Station
- F Fire Station
- L Library
- Park
- Recreation Area
- Water
- Freeway
- Street

N

NOT TO SCALE

WEST HILLS

NEIGHBORHOOD COUNCIL

DEPARTMENT OF NEIGHBORHOOD EMPOWERMENT
CITY OF LOS ANGELES

ANTONIO R. VILLARAIGOSA
MAYOR

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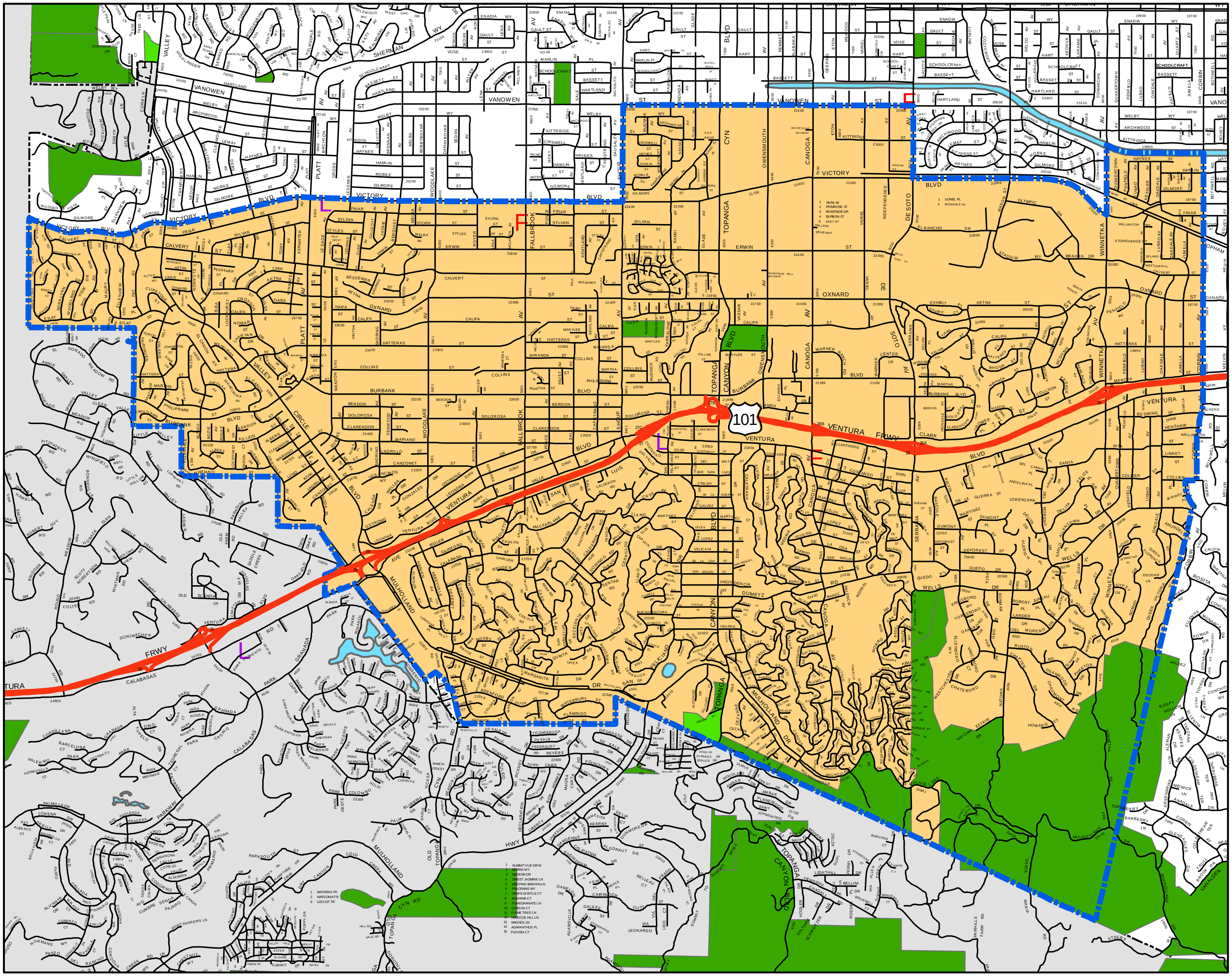
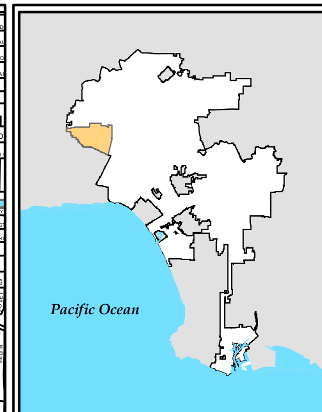
CITY ENGINEER





SOUTH VALLEY AREA

COUNCIL DISTRICTS:
3 & 11

WOODLAND HILLS-WARNER CENTER NC

CERTIFIED: 03/06/2002

Department of
Neighborhood Empowerment
(213) 485-1360 or dial 311
www.lacityneighborhoods.com

- P Police Station
- F Fire Station
- L Library
- Park
- Recreation Area
- Water
- Freeway
- Street

N

NOT TO SCALE

WOODLAND HILLS-WARNER CENTER

NEIGHBORHOOD COUNCIL
DEPARTMENT OF NEIGHBORHOOD EMPOWERMENT
CITY OF LOS ANGELES

ANTONIO R. VILLARAIGOSA
MAYOR

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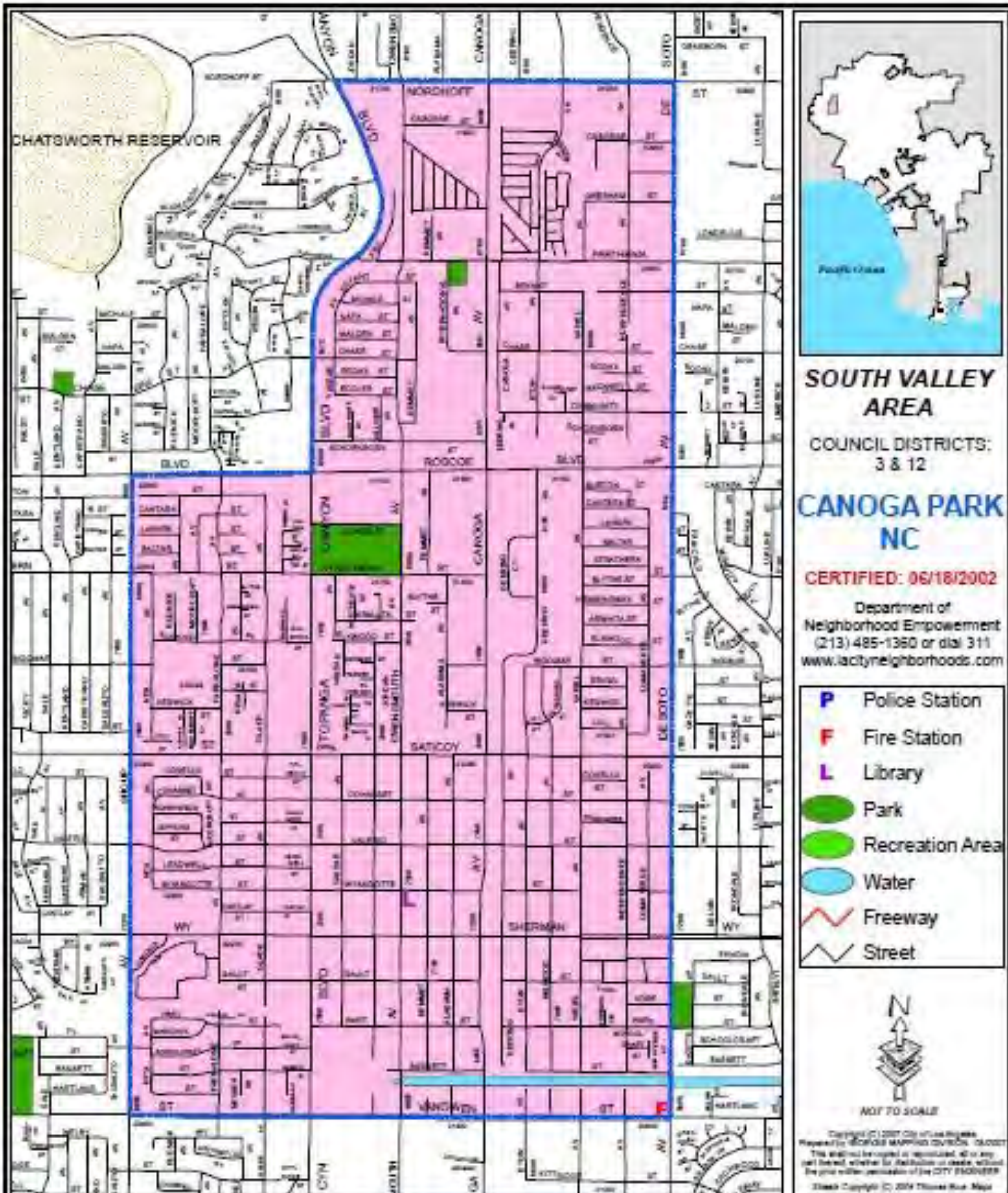
CITY ENGINEER



CANOGA PARK

NEIGHBORHOOD COUNCIL

DEPARTMENT OF NEIGHBORHOOD EMPOWERMENT

CITY OF LOS ANGELES

ANTONIO R. VILLARAIGOSA
MAYOR

LA DPW ENGINEERING

GARY LEE MOORE, P.E.
CITY ENGINEER

Cristina Gispert

From: Christine Rowe <crwhnc@gmail.com>
Sent: Thursday, December 12, 2013 8:56 AM
To: DTSC_SSFL_CEQA
Subject: Fwd: Christine L. Rowe DTSC SSFL PEIR - Comment 2

---------- Forwarded message ----------
From: **Christine Rowe** <crwhnc@gmail.com>
Date: Mon, Dec 2, 2013 at 5:31 AM
Subject: Christine L. Rowe DTSC SSFL PEIR - Comment 2
To: "Malinowski, Mark@DTSC" <Mark.Malinowski@dtsc.ca.gov>
Cc: "Leclerc, Ray@DTSC" <Ray.Leclerc@dtsc.ca.gov>, Marina Perez <Marina.Perez@dtsc.ca.gov>, "Bothwell, Nancy@DTSC" <Nancy.Bothwell@dtsc.ca.gov>, John Jones <john.jones@emcbc.doe.gov>, Stephanie Jennings <stephanie.jennings@emcbc.doe.gov>, "Bell, Jazmin" <jazmin.bell@emcbc.doe.gov>, "James A. Elliott, (MSFC-AS10)" <allen.elliott@nasa.gov>, "Merrilee Fellows, (HQ-NB000)" <mfellows@nasa.gov>, "Dassler, David W" <David.W.Dassler@boeing.com>, "paul. j. costa@boeing. com" <paul.j.costa@boeing.com>, Kamara Sams <Kamara.Sams@boeing.com>, "Owens, Cassandra@Waterboards" <Cassandra.Owens@waterboards.ca.gov>, "GROMAN, JENNIFER A. (HQ-LD020)" <jennifer.a.groman@nasa.gov>

Dear Mr. Malinowski,

In my research, I happened upon this document which is a NEPA related document.

http://www.gjem.energy.gov/moab/documents/eis/final_eis/Volume_I/Chapters5_11.pdf

Since it is for a DOE site, I feel that it may have particular implications to future SSFL NEPA and CEQA related documents.

The first paragraph of this section refers to the cumulative impact of a project under NEPA including past, present, and reasonably foreseeable future actions whether a federal or non federal agency or person takes those actions.

There are many laws that appear applicable to the SSFL site in this document. It even mentions Sacred Lands.

It is my opinion that for the DTSC Programmatic Draft Environmental Impact Report (PEIR) for the Santa Susana Field Laboratory site, that DTSC must consider all aspects -

- previous demolition of structures in all areas;
- previous remediation activities which includes the remediation of the Northern Drainage under an Imminent and Substantial Endangerment Order by DTSC;
- the removal action and implemented Best Management Practices under the orders of the Los Angeles Regional Water Quality Control Board and their Boeing Expert Storm Water Panel (the Interim Source Removal Activity - ISRA);
- planned demolition of structures in the future for all three Responsible Parties.
- groundwater treatment previous, present, and future anticipated actions.

Furthermore, it is my opinion that when the parties: ***NRDC, Committee to Bridge the Gap, and the City of Los Angeles*** sued the ***Department of Energy*** - and won - which required them to do an Environmental Impact Statement under NEPA after the DOE did an Environmental Assessment and had a decision of No Further Action - it is my opinion that the parties should have been asking the judge for a complete Environmental Impact Statement (EIS) for the whole SSFL site. I say this because *it is my understanding* that if any part of a property has been used for federal contracts, it *may be* subject to NEPA as well as CEQA.

Therefore, DTSC in its PEIR for the SSFL site must consider the impacts of past remediation on my community - and consider those impacts which includes the past, present, and future trucks necessary for remediation and their impact on my community.

Furthermore, DTSC must consider the impact of this cleanup when wildlife and endangered species may have already been displaced from previous remediation activities as well as from natural burns.

Finally, DTSC must consider the whole site as Sacred Land, and how the language of the Administrative Order on Consent uses the term: ***artifacts*** which is a "limiting term".
"Native American *artifacts* that are formally recognized as Cultural Resources".

Furthermore, The Boeing Company is not subject to the Administrative Orders on Consent (AOC), and they are the largest land owner of the Santa Susana Field Laboratory property. Therefore, a new agreement that recognizes that the whole site is sacred lands must be negotiated with all three Responsible Parties, and this negotiation should be done in consultation with the State Office of Historic Preservation (SHPO) and the Native American Heritage Commission (NAHC) as well as any applicable federal groups and local groups. This document needs to spell out how the remainder of the SSFL site will be demolished, remediated, or **preserved.**

It is my opinion due to the amount of demolition and remediation done to date at the SSFL site, and in the interest of getting this site cleanup finished by 2017, and in consideration of the potential risk to my community and to the environment (local and global), that DTSC must consider all alternatives and their potential impacts in their PEIR based upon risk. Please see the discussion regarding risk in the referenced document, and please consider the potential risk to my community under the AOCs, as well as the potential risk to those on the surface roads and freeways, as well as the risk to those that live near the waste receiving facilities.

Respectfully submitted,

Christine L. Rowe
West Hills resident

5.0 Cumulative Impacts

This chapter addresses the potential for cumulative environmental impacts resulting from implementation of the on-site or off-site disposal alternatives and other past, present, and reasonably foreseeable future actions in the affected region.

Council on Environmental Quality regulations implementing the procedural provisions of NEPA require federal agencies to consider the cumulative impacts of a proposal (40 CFR 1508.25[c]). A cumulative impact on the environment is the impact that would result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR 1508.7). This type of assessment is important because significant cumulative impacts can result from several smaller actions that by themselves do not have significant impacts.

The on-site and off-site alternative locations under consideration are located in rural areas with no major industrial or commercial centers nearby. No past, present, or reasonably foreseeable future actions are anticipated to result in cumulative impacts when considered with the proposed alternative. However, other present and reasonably foreseeable future actions could result in cumulative impacts to the other sites when considered together with the on-site or off-site disposal alternatives. These actions are

- Seasonal tourism in and around Moab
- Widening of US-191 between Moab and Crescent Junction
- Planned Williams Petroleum Products pipeline project
- Ongoing activities at the White Mesa Mill site

These actions, and the potential for creating cumulative impacts, are addressed below.

5.1 Seasonal Tourism

Several national parks are in the vicinity of the Moab site and the off-site alternatives. Arches National Park is adjacent to the north border of the Moab site, and Canyonlands National Park is approximately 12 miles southwest of the site. In 2002, 765,000 visitor days were recorded at Arches National Park; 41,524 of that number included at least one overnight stay. Most of the land in the area is open to recreational uses, and tourism is an important part of the Moab economy. Favorable weather allows recreational access for hikers, bikers, and off-highway vehicle users and others in all seasons. The Colorado River adjacent to the Moab site is a source of extensive recreational use for spring and summer water sports. The land directly south of the Moab site is often used by campers and hikers throughout the summer. Activities at the Moab site, together with tourism, could have a cumulative impact on traffic congestion (e.g., increases in truck traffic as high as 186 percent; see Table 2–28) in central Moab.

5.2 Widening of US-191

US-191 has been upgraded to four lanes between Moab and the intersection of US-191 and SR-313. The upgrades also include adding two turn lanes at the entrance to Arches National Park, at Gemini Bridges, and at SR-313; adding a 2-mile-long bicycle lane on the northeast side of US-191; and adding center divides along some stretches of the highway. Because these upgrades were completed in 2004, and no definitive plans for additional improvements are known, it is unlikely that this highway construction project and the transport of uranium mill tailings from the Moab site would result in cumulative impacts.

5.3 Williams Petroleum Products Pipeline Project

The Williams Petroleum Products pipeline project is a recently approved project that would extend from Bloomfield, New Mexico, to Salt Lake City, Utah. The pipeline project would include (1) converting approximately 220 miles of an existing natural gas pipeline system to transport refined petroleum products from Bloomfield to Crescent Junction and (2) constructing approximately 260 miles of new refined petroleum product pipeline extending west from Crescent Junction to a terminal just north of Salt Lake City. The Williams pipeline project was approved by BLM in a ROD signed October 12, 2001; however, construction has not begun because of ongoing litigation (Mackiewicz 2003). This pipeline project would include aboveground and underground facilities near the proposed Crescent Junction disposal site. However, according to the company, as of May of 2005 there are no plans to implement the Crescent Junction aspects of this project in the foreseeable future, and the schedule for the other aspects of the propose actions is uncertain.

The purpose of the Williams pipeline project would be to transport refined petroleum products from northwest New Mexico to intermediate storage locations at Crescent Junction and Nephi, Utah, and ultimately to a terminal north of Salt Lake City, where the petroleum products could be distributed to markets in Utah and western Colorado. The pipeline project is being designed to transport up to 75,000 barrels per day of gasoline, diesel, and jet fuel (a barrel of petroleum contains 42 gallons). The project would involve

- Converting 220 miles of existing 10- and 12-inch-diameter natural-gas pipelines to transport refined petroleum products from Bloomfield to a proposed terminal east of Crescent Junction.
- Constructing a new 12-inch refined-petroleum pipeline on a 50-ft-wide right-of-way extending from the new Crescent Junction terminal to a terminal with existing refineries in the north Salt Lake City area.
- Constructing new product terminals consisting of storage tanks and truck-loading facilities at Crescent Junction and Nephi.

The portion of the project between Bloomfield and Crescent Junction is further outlined below because this segment of the pipeline project could lead to future interactions with the disposal of mill tailings at the Crescent Junction site alternative.

The 220-mile, 10- and 12-inch conversion segment would extend north from Williams Kutz Pump Station near Bloomfield to the proposed Crescent Junction terminal near the US-191/I-70 junction. The existing 10- and 12-inch pipelines currently carry natural-gas products. These pipeline segments would be retrofitted by installing 43 motor and manual valves that could be used to shut down the pipeline in the event of a large leak or failure. In addition, a new pump station would be built on approximately 4 acres near DOE's proposed Crescent Junction site. The existing pipeline segments to be converted would be used in their present condition once the valves, end piping, and pump stations are completed. Because these sections already comply with current pipeline safety requirements, they are not subject to hydrostatic testing or inspection in association with the proposed change in service (DOI 2001). The existing pipelines are situated within an existing utility corridor that includes several other utility lines, including natural gas pipelines and electric transmission lines.

The new 12-inch pipeline segment would extend from the proposed Crescent Junction terminal to an existing terminal north of Salt Lake City. Proceeding west from Crescent Junction, the first 98 miles of new pipeline would be installed within a new 75-foot-wide construction right-of-way generally running parallel to an existing utility corridor. The construction right-of-way would revert to a 50-foot-wide permanent right-of-way after surface rehabilitation. This section of new pipeline would cross the Green River once and the Price River twice. The remaining sections of new pipeline extending from Price to the Salt Lake City area would also lie within existing utility corridors. These pipeline sections are not discussed further because these areas are a considerable distance from the actions associated with the Moab project.

If implemented as conceived, the Crescent Junction terminal would be constructed on a 65-acre tract of BLM-administered land in Section 26, T. 22 S., R. 19 E. This site is adjacent to existing railroad lines and just east of the US-191/I-70 junction. The terminal facility would include petroleum product storage tanks, a truck-loading rack, vapor combustion system, electrical substation, offices, and warehouse buildings, all to be situated within a 50-acre fenced area served by a new access road connecting to US-191. The terminal offices would house control equipment and serve as an office for station operations. A technician shop and product-testing laboratory building would also be constructed at this terminal facility. The total terminal tank storage capacity would be approximately 190,000 barrels. Tanks would include three gasoline storage tanks; two fuel oil storage tanks; individual storage tanks for gasoline mix, fuel oil mix, and butane; and one relief tank. All tanks would be enclosed within an earthen berm of sufficient height to contain 110 percent of the total contents of the largest tank. Initial products planned for truck loading and shipment include regular and premium unleaded gasoline and low-sulfur No. 2 fuel oil. Vapors produced during truck loading would be collected into a positive, closed-loop system and disposed of by combustion. Average throughput for truck dispatch is estimated to be approximately 10,000 barrels per day. On the basis of use of single trucks that could load 180 barrels per load, the expected truck traffic visits would likely range from 50 to 60 trucks per day.

The new pipeline would be built in three different pipeline construction spreads. The Crescent Junction-to-Price pump station spread is considered a high-production spread that would require about 90 to 150 workers. The new pipeline construction would involve several sequences of construction, starting with clearing and grading and ending with placement of final erosion-control features and reclamation. After ground clearing and leveling, heavy equipment would be brought in to dig ditches. Ditches could be open several days until the pipe is placed and backfilled. Typical soil cover depth after placement would be approximately 3 ft or less in rocky terrain. Pump stations would be located adjacent to the right-of-way, and construction would involve the installation of pump equipment and piping. The pumps would be connected to the pipeline by lateral lines, and shutoff valves would be installed to isolate the pump stations from the pipeline in the event of an emergency. Construction of the Crescent Junction pump station would follow the same general construction procedures for the Crescent Junction terminal except that no large tanks or truck racks would be constructed. Approximately 20 to 50 workers would be needed to construct the proposed Crescent Junction pump station. Construction of the Crescent Junction terminal would require a construction crew of 20 to 30 workers for initial site work and 40 to 60 workers for tank erection and installation of the mechanical and electrical facilities. The terminal would require an estimated 8 to 12 months to complete. Construction crews would consist of general contractors, heavy equipment operators, pipe welders, electricians, instrumentation specialists, millwrights, laborers, and quality assurance specialists.

The completed pipeline would be patrolled from the air every 3 weeks at a minimum and at least 26 times per year. Williams would employ a leak-detection system integrated with its SCADA monitoring system. To help prevent external corrosion leading to leaks, a protective coating would be applied to the exterior of the new pipeline segments, and cathodic protection would be used on all pipeline segments to help minimize corrosion.

The impacts of constructing and operating the Williams pipeline project, including increases in truck traffic and consequences of an accident, could result in cumulative impacts when considered together with the impacts of constructing a uranium mill tailings disposal cell at the Crescent Junction site alternative. Even if both DOE and Williams decide to implement these projects at the same time, the magnitude of potential traffic impacts would be small, as the extent of overlapping use of roadways within the Crescent Junction area would be a mile or less before Williams employees would merge onto I-70 and no longer compete with DOE traffic.

5.4 Ongoing Operations at White Mesa Mill

The White Mesa Mill site is a 5,415-acre parcel that is privately owned by IUC. On-site facilities consist of a uranium mill, uranium-ore storage pad, and four lined uranium mill-tailings disposal cells. Since 1997, the mill has processed more than 100,000 tons of uranium ore. Although mill operations and disposal of tailings from the Moab site would occur on the White Mesa Mill site, the two operations are not expected to result in cumulative doses to the workforces for each operation because there would be sufficient distance between the two operations. This expectation is based on the assumption that there would be two separate groups of workers: one group that would work exclusively on the IUC areas of the White Mesa facility and one group that would work exclusively on the disposal cell for the Moab tailings. For each group of workers, the radon and gamma dose would be predominantly from the tailings in their immediate vicinity, not from tailings located at a distance. For example, the radon dose from tailings in a person’s immediate vicinity is about 10 times greater than the radon dose from tailings located in an adjacent cell. For gamma doses, the dose from tailings in a person’s immediate vicinity is more than 10 times greater than the gamma doses from tailings located in an adjacent cell.

If IUC decides to expand its operations at the White Mesa Mill site, this expansion would result in an increase in the disturbed area and a potential increase in the disturbance of cultural resources. Although expansion is unlikely given the foreseeable business climate and the available capacity in the existing disposal cells, an expansion of the facility, together with the potential use of approximately 346 acres for a disposal cell for the Moab tailings, could result in cumulative impacts to cultural resources.

5.5 References

40 CFR 1500-1508. Council on Environmental Quality, "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act."

DOI (U.S. Department of the Interior), 2001. *Final Environmental Impact Statement, Questar, Williams, and Kern River Pipeline Project*, June.

Mackiewicz, M., 2003. Personal communication, M. Mackiewicz, BLM Realty Specialist, Price (Utah) Field Office, with G. Karriker, S.M. Stoller Corporation, July 25.

End of current text

6.0 Unavoidable Impacts, Short-Term Uses and Long-Term Productivity, and Irreversible or Irretrievable Commitment of Resources

In addition to a discussion of the environmental impacts of the proposed action and a discussion of alternatives, NEPA requires that an EIS contain information on any adverse environmental impacts that are unavoidable, on short-term uses and long-term productivity of the environment, and on any irreversible or irretrievable commitment of resources.

6.1 Unavoidable Adverse Impacts

Under all action alternatives, there would be a very slight increase in radiation doses to the public and workers as a result of remediation and disposal activities, which could result in a very slight increase in excess cancer risk based on a 5-year remediation period and a 30-year post remediation exposure period. For these activities, the highest increased total risk of a latent cancer fatality for the maximally exposed member of the public in Moab for the duration of the activities would be 3.9E-3 under the on-site disposal alternative; the total risk of a latent cancer fatality for the maximally exposed member of the public in Moab for the duration of the activities under the off-site disposal alternatives would be 8.8E-3. In addition, radon exposures at the off-site disposal sites would result in a latent cancer fatality risk to the maximally exposed member of the public of 2.2E-5 at Klondike Flats, 9.4E-5 at Crescent Junction, and 9.7E-6 at White Mesa Mill.

For the population around Moab, the total risk of a latent cancer fatality would be 0.26 for the on-site disposal alternative. The total risk of a latent cancer fatality for the population around Moab for the off-site disposal alternatives would be 1.0 if the truck or rail transportation options were used, or 0.74 latent cancer fatalities if the slurry pipeline option were used. In addition, radon exposures at the off-site disposal sites would result in a latent cancer fatality risk of 0.014 for the population around Klondike, 0.010 for the population around Crescent Junction, and 0.015 for the population around White Mesa.

Under the action alternatives, it is estimated that there would be 12 latent cancer fatalities in the population exposed at vicinity properties. If the vicinity properties were not remediated, it is estimated that there would be 26 latent cancer fatalities in the population exposed at vicinity properties. For the maximally exposed individual at the vicinity properties, the risk of a latent cancer fatality is estimated to be 0.029 for the action alternatives and 0.067 if the vicinity properties were not remediated.

Under the action alternatives, there would be an unavoidable increase in truck and other construction-related traffic and traffic due to commuting workers. This unavoidable adverse impact would occur 5 to 7 days a week, would last for the duration of Moab site surface remediation activities (up to 8 years), and would primarily but not exclusively impact US-191. Off-site transportation of tailings by truck would result in the greatest increase in traffic. The highest traffic impacts would occur if tailings were trucked to White Mesa Mill. Under this disposal alternative and transportation mode there would be an unavoidable impact (121 percent increase in truck traffic) on the already congested traffic situation in downtown Moab.

Additional traffic and noise associated with remediation activities would result in displacement and increased mortality of wildlife close to construction areas and transportation routes.

Under all off-site alternatives, projected annual withdrawals of Colorado River water would exceed the 100-acre-foot protective limit set by USF&WS. Maximum estimated annual requirements range from 235 to 730 acre-feet and would continue for 3 to 5 years, depending on work schedules and transportation modes. Pipeline transportation to Klondike Flats or Crescent Junction would require the greatest volume of Colorado River water; river water requirements for a pipeline to White Mesa Mill would be partially offset by the use of Recapture Reservoir for recycle water.

Unavoidable adverse impacts to cultural resources and traditional cultural properties would likely occur under all but the No Action alternative. Unavoidable impacts would be greatest under the White Mesa Mill alternative. The density, variety, and complexity of cultural resources that would be unavoidably and adversely affected would be so great under the White Mesa Mill alternative that mitigation would be extremely difficult. Although a similar potential for unavoidable adverse effects would occur under the other alternatives, the lower densities of known resources would allow mitigation measures to be more easily implemented.

6.2 Relationship Between Local Short-Term Uses of the Environment and Long-Term Productivity

Implementation of the alternatives would create a conflict between the local short-term uses of the environment and long-term productivity. Under all alternatives, land required for the disposal cell would be unavailable for other uses in perpetuity. This conflict would be more significant for the on-site disposal alternative, given the proximity of the Moab site to the city of Moab and to heavily used recreation areas such as Arches National Park. Under the on-site alternative, at least the entire 130-acre pile would be unavailable for other uses in perpetuity. Moreover, under all alternatives, the area at the Moab site used for ground water treatment would be unavailable for at least 75 years. This area could be 40 acres or more if an evaporation technology were implemented. Also under any alternative, the final decisions on possible future release and uses of the approximately 309-acre off-pile area of the Moab site must be deferred pending a determination of the success of surface remediation.

Under the off-site alternatives, the 346- to 439-acre disposal cell areas would be unavailable in perpetuity. This conflict would be the least significant for the White Mesa Mill site alternative because that site already includes four uranium mill tailings disposal cells.

6.3 Irreversible or Irretrievable Commitment of Resources

The irreversible or irretrievable commitment of resources that would occur if the on-site or off-site disposal alternatives were implemented are (1) the use of fossil fuels in the transport of tailings and borrow materials, (2) the use of borrow materials, (3) the use of steel if the slurry pipeline transport were chosen, and (4) the use of land for the disposal cell in perpetuity. All alternatives would require an irretrievable commitment of millions of gallons of diesel fuel. The estimated total diesel fuel consumption for the on-site disposal alternative would be 4 to 5 million gallons (see Section 2.1.5.4). The estimated total diesel fuel consumption for off-site disposal would range from 12 to 20 million gallons for truck transportation, from 10 to

11 million gallons for rail transportation, and from 7 to 9 million gallons for slurry pipeline transportation.

Implementation of any of the alternatives would also require the use of borrow materials to cap the tailings pile and for site reclamation. These materials would include cover soils, radon/infiltration barrier soils, sand and gravel, and riprap. DOE estimates that the total volume of irretrievably committed borrow material would be approximately 1.7 million yd^3 for the on-site disposal alternative and 2.2 million yd^3 for each of the off-site disposal alternatives. DOE estimates that the maximum area of land that would be disturbed to extract borrow materials would be 550 acres for the on-site disposal alternative, 690 acres for the Klondike Flats or the Crescent Junction off-site disposal alternatives, and 174 acres for the White Mesa Mill off-site disposal alternative. The estimated acres of disturbed land do not include disturbances associated with obtaining sand, gravel, or riprap from commercial vendors. DOE believes these estimates represent maximum areas of disturbance; however, the final acreage of disturbed land would depend on the selection of borrow areas and depths to which borrow soils would be extracted.

Pipeline transport of tailings for off-site disposal would use between 4,400 tons (for Klondike Flats) and 24,000 tons (for White Mesa Mill) of steel that may become sufficiently contaminated to require disposal in the cell.

Under any alternative, there would be an irreversible and irretrievable commitment of the land that would be dedicated to the disposal cell. These commitments are described in Section 6.2.

All alternatives would result in the irretrievable commitment of Colorado River water, although the usages would all be within the limits of DOE’s Colorado River water usage rights. Much of the use would be irretrievable because the water would be used for on-site or off-site decontamination, other construction-related uses, or possibly slurry production and ultimately would evaporate in double-lined evaporation ponds. The estimated maximum annual consumption of nonpotable water is 130 to 235 acre-feet for the rail transportation option, 135 to 240 acre-feet for truck transportation, and 730 acre-feet for slurry pipeline transportation (see Table 2–24). This water would be drawn from the Colorado River for the Klondike Flats and Crescent Junction alternatives. For the White Mesa Mill alternative, part of the decontamination water and the slurry pipeline makeup water would be drawn from the Recapture Reservoir. These annual figures are conservative upper bounds for irretrievable commitments of nonpotable water.

End of current text

7.0 Regulatory Requirements

This chapter presents descriptions of federal, tribal, and state regulatory requirements that may be applicable to the on-site and off-site disposal alternatives.

For this EIS, regulatory requirements are the laws, regulations, executive orders, and regulatory guidance that are, or may be, applicable to the alternatives analyzed in this EIS and that are critical to the decision-making process. The discussion of regulatory requirements is divided into three categories: federal, Native American, and state.

7.1 Federal Regulatory Requirements

7.1.1 National Environmental Policy Act, 42 *United States Code* (U.S.C.) §§ 4321 et seq.

NEPA requires that a federal agency evaluate the potential environmental effects of implementing a proposed action. The Council on Environmental Quality has promulgated regulations to implement the procedural provisions of NEPA. These regulations are binding on all federal agencies and are codified at 40 CFR 1500–1508. These regulations specify the content of an EIS and include requirements for cooperating agency and public involvement. In addition, DOE has promulgated its own NEPA-implementing regulations, which are codified at 10 CFR 1021. DOE has complied, or is complying, with these requirements in generating this EIS.

This EIS is also intended for use by the BLM and the NPS to meet NEPA requirements for decisions they may need to make with respect to the proposed remediation and disposal of the Moab uranium mill tailings pile. The *Bureau of Land Management Manual 1790* (BLM 1988a) and *National Environmental Policy Act Handbook* (BLM 1988b) implement BLM NEPA regulations. NPS NEPA regulations are implemented under Director's Order 12 *Conservation Planning and Environmental Impact Analysis and Decision-Making* (NPS 2001).

7.1.2 Uranium Mill Tailings Radiation Control Act, 42 U.S.C. §§ 7901 et seq., as amended

In 1978, public concern about potential human health and environmental effects of uranium mill tailings led Congress to pass UMTRCA, which amended the Atomic Energy Act. In UMTRCA (Title I), Congress acknowledged the potentially harmful health effects associated with uranium mill tailings and identified 24 inactive uranium-ore processing sites that must be considered for remedial action. UMTRCA directs EPA, DOE, and NRC to undertake certain actions as described below.

Title I of UMTRCA provides the basis for

- EPA standards for the remediation of RRM-contaminated soils, buildings, and materials that ensure protection of human health and the environment.
- EPA standards and compliance options for RRM-contaminated ground water, including supplemental standards, ACLs, and institutional controls.
- EPA standards for remediation of vicinity properties.

- NRC review of completed site remediation for compliance with EPA standards.
- NRC licensing of the site, property transfers to states, or DOE long-term surveillance and maintenance.

In 1983, Congress amended UMTRCA, directing EPA to promulgate general environmental standards for the processing, possession, transfer, and disposal of uranium mill tailings. These standards, titled "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings" (codified at 40 CFR 192 [Subparts A, B, and C]), include exposure limits for surface contamination and concentration limits for ground water contamination. DOE is responsible for ensuring compliance with surface and ground water standards at Title I sites.

Title II of UMTRCA provides the basis for regulating active uranium-ore processing sites licensed by NRC. Although it is not applicable to the inactive Moab site, it is applicable to the currently operating White Mesa Mill.

The 40 CFR 192 Subpart A disposal standards for control of RRM are design based with specific performance requirements: ensure that a disposal cell will be reasonably effective for up to 1,000 years (and a minimum of 200 years); limit the release of radon-222 to the atmosphere; and provide ground water protection. Numerical standards are provided for radon-222 releases to the atmosphere and for ground water protection. Corrective actions are required within an 18-month period if contaminant concentrations in ground water at disposal sites exceed the ground water protection standards. Provisions in 40 CFR 192 also allow for the application of supplemental standards and ACLs for ground water contaminants based on site-specific circumstances.

Subpart B standards for cleanup provide numerical standards for cleanup that are based on concentrations of radium-226 in surface materials (e.g., soils) and for exposure to radiation in buildings. Ground water cleanup standards are the same as the protection standards specified in Subpart A. In addition to active remediation, natural flushing is an acceptable means of meeting the standards if they can be met within 100 years and if enforceable institutional controls can be put in place during this time.

Subpart C of 40 CFR 192 provides guidance for implementing Subparts A and B. Subpart C requires that standards be met on a site-specific basis using information gathered during site characterization and monitoring. A RAP is required to demonstrate how requirements of Subparts A and B are to be met. Criteria are also presented for determining the applicability of supplemental standards.

Radon-222

Radon is a naturally occurring inert radioactive gas found in soil, rock, and water throughout the United States. It has numerous isotopes, but radon-220 and radon-222 are the most common. Radon causes lung cancer and is a threat to human health because it tends to collect in homes, sometimes to very high concentrations. As a result, radon is the largest source of exposure to naturally occurring radiation.

Radon-222 is the decay product of radium-226. Radon-222 and its parent, radium-226, are part of the long decay chain for uranium-238. Because uranium is essentially ubiquitous in the Earth's crust, radium-226 and radon-222 are present in almost all rock, soil, and water.

Following a decision to remediate the Moab site, DOE would prepare a remedial action plan for the site. The plan would describe the site restoration activities that, when remedial action was completed, would result in compliance with applicable environmental standards. This plan would be reviewed by NRC, which must approve the plan.

UMTRCA Title I also requires that upon completion of remedial action, each designated disposal site must be monitored and maintained by a federal agency under the NRC general license at 10 CFR 40.27. To meet this requirement, DOE would prepare a long-term surveillance plan for the disposal site. The plan would specify how DOE would care for and operate the disposal site. Upon NRC concurrence in the plan, the disposal site would be accepted under the general license. The NRC license does not expire. Thus, DOE, or a successor federal or state agency, would have responsibility to care for the disposal site in perpetuity.

7.1.3 Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001 (Public Law No. 106-398)

The Floyd D. Spence National Defense Authorization Act, enacted in October 2000, gave DOE responsibility for remediation of the Moab site and mandated that the site be remediated in accordance with Title I of UMTRCA. The act also directed that a Plan for Remediation be completed and that NAS provide assistance to DOE in evaluating costs, benefits, and risks associated with remediation alternatives.

7.1.4 Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)

The ESA provides for the protection of threatened and endangered species and designated critical habitat. Section 7 of the act requires federal agencies, having reason to believe that a prospective action may affect an endangered or threatened species or its critical habitat, to consult with USF&WS to ensure that the action does not jeopardize the continued existence of the species or destroy critical habitat. Endangered species and critical habitat exist in the vicinity of the Moab site.

7.1.5 Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.)

The Fish and Wildlife Coordination Act promotes more effectual planning and cooperation between federal, state, public, and private agencies for the conservation and rehabilitation of the nation’s fish and wildlife and authorizes the U.S. Department of the Interior to provide assistance. This act requires consultation with USF&WS on the possible effects on wildlife if there is construction, modification, or control of bodies of water in excess of 10 acres in surface area.

7.1.6 Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703 et seq.)

The Migratory Bird Treaty Act, as amended, is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. It regulates the harvest of migratory birds by specifying conditions such as the mode of harvest, hunting seasons, and bag limits. The act stipulates that it is unlawful to “take, possess, . . . any migratory bird,” unless obtained under a permit. Migratory birds may be affected by one or more of the alternatives.

7.1.7 Clean Water Act, 33 U.S.C. §§ 1251 et seq.

This act and its implementing regulations (40 CFR Parts 110−112, 122−125, 130−131, 230−231, and 404; and 33 CFR 322−330) regulate pollution prevention and discharges of point and non-point discharges, establish water quality standards, and regulate discharges of dredged or fill material into waters of the United States. Although mill tailings are exempt from the definition of a pollutant, discharges from wastewater treatment facilities (if required) may be subject to regulation under the Clean Water Act. Construction activities that disturb more than 1 acre of land require compliance with storm-water management and erosion-control regulations and require storm-water discharge permits. Dredging or filling activities of the Colorado River would also require a U.S. Army Corps of Engineers Clean Water Act Section 404 permit.

7.1.8 Rivers and Harbors Act of 1899, Section 10, 33 U.S.C. 403

This provision regulates the construction of any development or building that affects the "navigable capacity of any of the waters of the United States" and requires the U.S. Army Corps of Engineers' approval of any action "to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of, any port, roadstead, haven, harbor, canal, lake, harbor of refuge, or enclosure within the limits of any breakwater, or of the channel of any navigable water of the United States. . . ."

7.1.9 Floodplain Management and Protection of Wetlands, 10 CFR 1022

DOE regulations codified at 10 CFR 1022 implement the requirements of Executive Orders 11988 (*Floodplain Management*) and 11990 (*Protection of Wetlands*) for actions that may affect these areas. Specifically, they require federal agencies to evaluate actions they may take to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain or a wetland. A portion of the Moab site falls within the 100-year floodplain of the Colorado River, and wetlands exist within and adjacent to the site; however, a formal wetlands delineation has not been conducted to date. A "Floodplain and Wetlands Assessment for Remedial Action at the Moab Site" and a Statement of Findings as required by the DOE regulations is attached as Appendix F to this EIS. Any wetland area disturbance during remediation and restoration must comply with the appropriate requirements. Wetland areas must be identified and delineated for the Moab site and any off-site project locations.

7.1.10 Safe Drinking Water Act, 42 U.S.C. 300f et seq.

The primary objective of this act is to protect the quality of public water supplies. This law grants EPA the authority to protect the quality of public drinking water supplies by establishing national primary drinking water regulations. EPA has delegated authority for enforcement of drinking water standards to the states. EPA regulations (codified at 40 CFR Parts 123, 141, 145, 147, and 149) specify maximum contaminant levels, including those for radioactivity, in public water systems, which are generally defined as systems that serve at least 15 service connections or serve at least 25 year-round residents. The city of Moab derives most of its drinking water from a well field in the Glen Canyon aquifer near the northeast canyon wall of Spanish Valley. Two water-supply wells located near the entrance to Arches National Park are located in the Navajo Formation. The Colorado River is not currently used as a drinking water supply for the City of Moab.

7.1.11 Clean Air Act, 42 U.S.C. §§ 7401 et seq., as amended

This act and its implementing regulations regulate air emissions from treatment processes and construction equipment, fugitive dust, and radon emissions from the tailings pile. The National and Secondary Ambient Air Quality Standards (codified at 40 CFR Parts 50 and 53) address standards and monitoring requirements for PM_{10} and for lead in ambient air. The National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61 Subpart T) requirements are applicable to control radon emissions from the disposal of uranium mill tailings and apply to the final tailings disposal location after long-term stabilization of the disposal site has been completed as described at 40 CFR 61.221(a) and 40 CFR 61.223(e). However, the NESHAP requirements for radon emissions do not apply during periods of active remediation.

7.1.12 Archaeological Resources Protection Act, 16 U.S.C. §§ 470aa et seq., and National Historic Preservation Act, 16 U.S.C. §§ 470 et seq.

Cultural and historic resources are protected by these acts and their implementing regulations and by Executive Orders 11593 (*Protection and Enhancement of the Cultural Environment*) and 13007 (*Protection and Accommodation of Access to Indian Sacred Sites*). The regulations at 36 CFR 800 require federal agencies to take into account the effect of a proposed action on a structure or object that is included on or is eligible for the National Register of Historic Places and to establish procedures to identify and provide for preservation of historic and archeological data that might be destroyed through alteration of terrain as a result of a federal action. Cultural resources may be present in areas of the proposed alternatives.

7.1.13 Antiquities Act, 16 U.S.C. 431 et seq.

The Antiquities Act protects historic and prehistoric ruins, monuments, and objects of antiquity (including paleontological resources) on lands owned or controlled by the federal government. If historic or prehistoric ruins or objects were identified during the construction or operation of facilities, DOE would have to determine if adverse effects to these ruins or objects would occur. If so, the Secretary of the Interior would have to grant permission to proceed with the activity (36 CFR 296 and 43 CFR Parts 3 and 7).

7.1.14 Federal Land Policy and Management Act, 43 U.S.C. 1701 et seq.

The Federal Land Policy and Management Act (FLPMA), Title V, governs rights-of-way and withdrawals on federal lands administered by BLM (U.S. Department of the Interior). This act requires an application, review, and study by the administering agency and decisions by the Secretary of the Interior on withdrawal of federal lands, including terms and conditions of withdrawals. Access to and use of public lands administered by BLM are primarily governed by regulations regarding rights-of-way (43 CFR 2800) and withdrawals of public domain land from public use (43 CFR 2300).

7.1.15 Noise Control Act of 1972, 42 U.S.C. 4901 et seq., as amended

Section 4 of the Noise Control Act of 1972, as amended, directs all federal agencies to carry out "to the fullest extent within their authority" programs within their jurisdictions in a manner that furthers a national policy of promoting an environment free from noise jeopardizing health and welfare.

7.1.16 Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901 et seq., as amended

RCRA gives EPA the authority to control hazardous waste from "cradle to grave," including the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also established a framework for the management of nonhazardous wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. RCRA focuses only on active and future facilities and does not address abandoned or historical sites. However, based on historical practices at UMTRA sites, there is the potential for RCRA-regulated waste to be "commingled" with RRM at some vicinity properties. Regulations governing RCRA-regulated waste are in 40 CFR 260–273. This includes waste that may be subject to recycling provisions of the regulations. For the purpose of analysis in this EIS, DOE assumed that all commingled waste would ultimately be approved for management and disposal as RRM and would be disposed of in the selected disposal cell.

7.1.17 Hazardous Materials Transportation Act, 49 U.S.C 1801 et seq.

Transportation of hazardous and radioactive materials in commerce must be conducted in compliance with all applicable state and federal regulations as codified at 49 CFR 130–180. The DOT exemption at 40 CFR 761 may be applied to the bulk transportation of regulated radioactive mill tailings. This exemption provides relief from labeling, placarding, and manifesting requirements that are normally applicable to individual bulk shipments. Bulk transportation packaging requirements for haul trucks and rail cars (e.g., diapering tailgates on haul trucks, covering loads, reducing moisture content) would apply.

7.1.18 Toxic Substances Control Act, 7 U.S.C. 136 et seq.

Some of the provisions of the Toxic Substances Control Act regulate the management and disposal of asbestos and polychlorinated biphenyls (PCBs) that may be present at the site. Although these materials would be managed as RRM on the site, regulations in 40 CFR 761 and 763 would be applicable as best management practices. Both asbestos and PCBs are eligible for disposal in UMTRA disposal cells.

7.1.19 Executive Order 12898 (*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, February 11, 1994)

This executive order requires each federal agency to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.

7.2 Native American Regulatory Requirements

7.2.1 American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)

This act reaffirms Native American religious freedom under the first amendment to the U.S. Constitution and establishes policy to protect and preserve the inherent and constitutional right of Native Americans to believe, express, and exercise their traditional religions. This law ensures the protection of sacred locations and access of Native Americans to those sacred locations and traditional resources that are integral to the practice of their religions. Further, it establishes requirements that would apply to Native American sacred locations, traditional resources, or traditional religious practices potentially affected by construction and operation activities.

7.2.2 Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001)

The Native American Graves Protection and Repatriation Act directs the Secretary of the Interior to guide the repatriation of federal archaeological collections and collections that are culturally affiliated with Native American tribes and held by museums that receive federal funding. Major actions to be taken under this law include (1) the establishment of a review committee with monitoring and policy-making responsibilities; (2) the development of regulations for repatriation, including procedures for identifying lineal descent or cultural affiliation needed for claims; (3) the oversight of museum programs designed to meet the inventory requirements and deadlines of this law; and (4) the development of procedures to handle unexpected discoveries of graves or grave goods during activities on federal or tribal land. The provisions of the act would be invoked if any excavations associated with construction or operation activities led to unexpected discoveries of Native American graves or grave artifacts.

7.2.3 Executive Order 13007, Indian Sacred Sites

This order directs federal agencies, to the extent permitted by law and not inconsistent with agency missions, to avoid adverse effects to sacred sites and to provide access to those sites to Native Americans for religious practices. The order directs agencies to plan projects to provide protection of and access to sacred sites to the extent compatible with the project.

7.2.4 Executive Order 13175, Consultation and Coordination with Indian Tribal Governments

This order directs federal agencies to establish regular and meaningful consultation and collaboration with tribal governments in the development of federal policies that have tribal implications, to strengthen U.S. government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates on tribal governments.

7.3 State Regulatory Requirements

7.3.1 Clean Water Act Implementing Regulations

Utah Administrative Code (U.A.C.) Section R317-2-13 (Water Quality Standards) classifies the Colorado River and its tributaries as

1C Protected as a raw water source for domestic purposes with prior treatment processes as required by the Utah Department of Health;
2B Protected for boating, water skiing, and similar uses, excluding swimming;
3B Protected for warmwater species of game fish and other warmwater aquatic life, including the necessary aquatic organisms in their food chain; and
4 Protected for agricultural uses, including irrigation of crops and stock watering.

Numeric criteria specific to each of these use designations are specified at U.A.C. Section R317-2-14.

7.3.2 State Water Appropriations

Uses of surface water and ground water require compliance with water rights appropriations requirements that are administered by the Utah State Engineer's Office, Department of Natural Resources, Division of Water Rights. Ponding of ground water, construction dewatering of ground water, and use of surface water (i.e., Colorado River) for dust suppression and tailings compaction may be considered consumptive use.

7.3.3 Clean Air Act Implementing Regulations

Utah Air Conservation Rules (19 U.A.C. Section 19-2-101 et seq.) require that fugitive dust be minimized or that measures be taken to prevent its occurrence. Air emissions from a ground water treatment system could also potentially be regulated by these requirements and would require a permit. The Utah Administrative Code requires that ambient air quality be monitored during construction activities.

7.3.4 Radioactive Materials Licensing

As authorized by the Atomic Energy Act of 1954, as amended, the State of Utah is an Agreement State under NRC's program for regulating uranium mills. The *Utah Administrative Code* (UAC) R313-24-4(1)(b) requires the White Mesa Mill site to comply with State requirements for ground water protection. In addition, NRC transferred authority for the regulation of the possession of by-product material by persons to the State of Utah in August 2004. The State's regulatory authority would not apply to DOE's actions at Moab, Klondike Flats, or Crescent Junction.

7.4 References

10 CFR 40. U.S. Nuclear Regulatory Commission, “Domestic Licensing of Source Material.”

10 CFR 1021. U.S. Department of Energy, “National Environmental Policy Act (NEPA) Implementing Procedures.”

10 CFR 1022. U.S. Department of Energy, “Compliance with Floodplain and Wetlands Environmental Review Requirements.”

33 CFR 322-330. U.S. Department of Defense, “Navigation and Navigable Waters.”

36 CFR 296. U.S. Department of Agriculture, “Protection of Archaeological Resources: Uniform Regulations.”

36 CFR 800. Advisory Council on Historic Preservation, “Protection of Historic Properties.”

40 CFR 50. U.S. Environmental Protection Agency, “National Primary and Secondary Ambient Air Quality Standards.”

40 CFR 53. U.S. Environmental Protection Agency, “Ambient Air Monitoring Reference and Equivalent Methods.”

40 CFR 61. U.S. Environmental Protection Agency, “National Emission Standards for Hazardous Air Pollutants.”

40 CFR 110-112, 122-125, 130-131, 230-231, and 404. U.S. Environmental Protection Agency, “Protection of the Environment.”

40 CFR 192. U.S. Environmental Protection Agency, “Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings.”

40 CFR 260. U.S. Environmental Protection Agency, “Hazardous Waste Management System: General.”

40 CFR 761. U.S. Environmental Protection Agency, “Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions.”

40 CFR 763. U.S. Environmental Protection Agency, “Asbestos.”

40 CFR 1500-1508. Council on Environmental Quality, “Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act.”

43 CFR 3. U.S. Department of the Interior, “Preservation of American Antiquities.”

43 CFR 7. U.S. Department of the Interior, “Protection of Archaeological Resources.”

43 CFR 2300. U.S. Department of the Interior, “Land Withdrawals.”

43 CFR 2800. U.S. Department of the Interior, “Rights-of-Way, Principles and Procedures.”

49 CFR 130. U.S. Department of Transportation, “Oil Spill Prevention and Response Plans.”

BLM (Bureau of Land Management), 1988a. *BLM Manual Section 1790, National Environmental Policy Act of 1969* MS 1790, October 25.

BLM (Bureau of Land Management), 1988b. *National Environmental Policy Act Handbook*, BLM Handbook H-1790-1, October 25.

NPS (National Park Service), 2001. *Conservation Planning and Environmental Impact Analysis and Decision-Making*, NPS Director’s Order and Handbook 12, January 8.

8.0 List of Preparers and Disclosure Statements

This chapter identifies the individuals who were principal preparers of this document and provides the disclosure statement of all contractors participating in the preparation of this EIS.

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	EIS Responsibility	Project Manager and text preparation
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James M. Becker	*Affiliation*	Battelle
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	EIS Responsibility	Terrestrial ecology; affected environment, environmental consequences, and biological assessment
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	EIS Responsibility	General project coordination for Chapter 3.0, "Affected Environment"; preparation of transportation and traffic sections

Joel Berwick	*Affiliation*	U.S. Department of Energy
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	EIS Responsibility	DOE Project Engineer for Moab
Robert W. Bleil	*Affiliation*	Battelle
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Laura E. Cummins	*Affiliation*	S.M. Stoller Corporation
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	EIS Responsibility	Human health and ecological risk, water quality issues, and ground water compliance
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	EIS Responsibility	Review document redlines and prepared .pdf files
John E. Elmer	*Affiliation*	S.M. Stoller Corporation
	Education	M.B.A. Western State University B.S. Civil Engineering, Colorado State University
	Technical Experience	10 years of experience in managing civil and environmental remediation projects, including studies, design, and construction and 15 years of experience managing environmental remediation projects for DOE involving low-level radioactive waste.
	EIS Responsibility	Lead for engineering and construction; text preparation
William E. Fallon	*Affiliation*	Battelle
	Education	Ph.D. Pharmaceutical Sciences, University of Rhode Island
	Technical Experience	25 years of experience as manager of and technical contributor to large DOE and EPA programs.
	EIS Responsibility	Chapter 2.0 text preparation, integration, and technical coordination; cross-chapter consistency review
David S. Foster	*Affiliation*	S.M. Stoller Corporation
	Education	B.A. Philosophy, University of Colorado; additional coursework in chemistry, geology, and hydrology
	Technical Experience	25 years of experience: analyst, Union Carbide Corporation Environmental Laboratory; health physics technician, Oak Ridge Associated Universities; chemical sampling coordinator and technical writer/editor, Oak Ridge National Laboratory; technical writer/editor, S.M. Stoller Corporation
	EIS Responsibility	Technical editor

Brad Fritz	*Affiliation*	Battelle
	Education	M.S. Environmental Engineering, Washington State University B.S. Physics, Eastern Oregon University
	Technical Experience	3 years of experience in data analysis.
	EIS Responsibility	Conducting and writing noise and vibration analyses
John Fritz	*Affiliation*	Subcontractor to S.M. Stoller Corporation
	Education	Ph.D. University of Utah B.S. Eastern New Mexico University
	Technical Experience	30 years of experience in cultural, archaeological, and traditional cultural property research and instruction.
	EIS Responsibility	Lead investigator for cultural archaeological and traditional cultural properties characterization
Michael J. Gardner	*Affiliation*	Battelle
	Education	M.A. Public Administration, University of Colorado B.S. Geological Engineering, Brigham Young University
	Technical Experience	16 years of environmental engineering and regulatory compliance experience associated with various DOE environmental restoration projects.
	EIS Responsibility	Collection of environmental monitoring data and text preparation
Craig S. Goodknight	*Affiliation*	S.M. Stoller Corporation
	Education	M.S. Geology, University of New Mexico B.S. Geology, University of Tulsa
	Technical Experience	30 years of experience in geology of western Colorado and eastern Utah, includes experience as BLM District Geologist in eastern Utah, National Uranium Resource Evaluation program, and UMTRA Title I and II sites.
	EIS Responsibility	Technical Lead for preparation of geology section of EIS
Kenneth E. Karp	*Affiliation*	MFG, Inc.
	Education	B.S. Geology, Mesa State College
	Technical Experience	15 years of experience in site investigations and feasibility and alternative evaluation studies; 10 years of experience managing environmental restoration and compliance projects related to CERCLA, RCRA, and UMTRA sites.
	EIS Responsibility	Lead for ground and surface water; text preparation

Marilyn K. Kastens	*Affiliation*	Battelle
	Education	M.S. Soil Science, Oregon State University B.A. Geography, Oklahoma University
	Technical Experience	20 years of experience in environmental compliance and NEPA issues with DOE and BLM.
	EIS Responsibility	Prepared cultural resource and visual resource sections of EIS
N. Edward LaBonte	*Affiliation*	S.M. Stoller Corporation
	Education	B.S. Computer Management Science, Metropolitan State College
	Technical Experience	18 years of experience in Geographic Information Systems (GIS).
	EIS Responsibility	EIS Figure Coordinator and GIS Data Manager
Susan D. Lyon	*Affiliation*	S.M. Stoller Corporation
	Education	Certificate, Mesa State College
	Technical Experience	20 years of experience in document production.
	EIS Responsibility	Word process document and review redlines
Melvin W. Madril, P.E.	*Affiliation*	S.M. Stoller Corporation
	Education	B.S. Civil Engineering, University of Southern Colorado
	Technical Experience	25 years of civil engineering experience in site development, infrastructure design, and project and construction management; the last 18 years in engineering design and project management for radioactive contaminated soils and ground water remediation at various DOE sites.
	EIS Responsibility	Transportation studies, infrastructure conceptual design, labor, and equipment and natural resources consumption estimates
Steven J. Maheras	*Affiliation*	Battelle
	Education	Ph.D. Health Physics, Colorado State University
	Technical Experience	15 years of experience in health physics, transportation risk assessment, and radiological assessment.
	EIS Responsibility	Transportation risk assessment, air quality analysis, human health and safety analysis
Thomas I. McSweeney	*Affiliation*	Battelle
	Education	Ph.D. Chemical Engineering, University of Michigan
	Technical Experience	32 years of experience in risk assessment and safety analysis.
	EIS Responsibility	Transportation risk assessment

Donald R. Metzler, P.Hg.	*Affiliation*	U.S. Department of Energy
	Education	M.S. Hydrogeology, San Diego State University Registered geologist in California and Arizona and certified professional hydrogeologist with the American Institute of Hydrology B.S. Agricultural Science, California Polytechnic State University
	Technical Experience	Project Manager of the UMTRA Ground Water Project and involved in the UMTRA Program for 14 years. Work with uranium mill tailings has involved characterization, disposal cell cover performance, compliance strategy development, remedial action, and project management.
	EIS Responsibility	DOE Federal Project Director for the Moab, Utah, Uranium Mill Tailings Remediation Project. Development of ground water remediation strategy and technical reviewer of ground water modeling and disposal cell cover design
Judith D. Miller	*Affiliation*	S.M. Stoller Corporation
	Education	B.A. Communications, Mesa State College
	Technical Experience	Graphics design.
	EIS Responsibility	Graphics preparation
Duane A. Neitzel	*Affiliation*	Battelle
	Education	M.S. Biological Sciences, Washington State University B.S. Zoology, University of Washington
	Technical Experience	30 years of experience in managing and preparing NEPA documents for DOE and NRC.
	EIS Responsibility	Aquatic ecology; affected environment, environmental consequences, and biological assessment
Daniel W. Nordeen	*Affiliation*	S.M. Stoller Corporation
	Education	B.S. Civil Engineering, Colorado State University
	Technical Experience	15 years of experience in civil engineering site design and cost estimating with all aspects of the DOE UMTRA Project and CERCLA projects for disposal of low-level nuclear waste.
	EIS Responsibility	Conceptual design of alternatives, cost estimates, and text preparation
Douglas M. Osborn	*Affiliation*	Battelle
	Education	B.S. Chemical Engineering, Ohio State University
	Technical Experience	6 years of experience operating nuclear reactors in the U.S. Navy; 3 years experience in managing and maintaining a mechanical engineering laboratory at Ohio State University; 3 months of experience as nuclear engineering research intern.
	EIS Responsibility	Technical support
Desiree Padgett	*Affiliation*	Battelle
	Education	B.A. Journalism, University of New Mexico
	Technical Experience	18 years of experience editing technical documents for the U.S. Department of Defense and DOE, including 8 years of experience editing NEPA documents.
	EIS Responsibility	Technical Editor

Ray Plieness	*Affiliation*	U.S. Department of Energy
	Education	B.S. Civil Engineering, Montana State University
	Technical Experience	25 years of experience managing construction, hazardous waste, and nuclear remediation projects.
	EIS Responsibility	Contractor EIS Project Manager and text preparation
Ted M. Poston	*Affiliation*	Battelle
	Education	M.S. Fisheries, University of Washington
	Technical Experience	29 years of experience in ecological, environmental and toxicological research with 22 years of NEPA experience in community noise assessments and ecology.
	EIS Responsibility	Coordinated noise and ground vibration section and consulted on ecology sections
Barbara Price	*Affiliation*	S.M. Stoller Corporation
	Education	B.A. Sociology, Anthropology, Adams State College B.S. Computer Science, Math, Mesa State College
	Technical Experience	17 years of professional experience as a computer programmer and analyst. 14 years of supporting various areas of business administration for DOE contractors with an emphasis on financial software development and support.
	EIS Responsibility	Database developer/Administrator
Phyllis Price	*Affiliation*	S.M. Stoller Corporation
	Education	A.A.S. Ferris State University
	Technical Experience	28 years of experience in graphic design and illustration.
	EIS Responsibility	Graphics preparation
Cynthia L. Rakowski	*Affiliation*	Battelle
	Education	M.S. Watershed Science, Utah State University B.S. Physics, Montana State University
	Technical Experience	10 years of experience integrating geomorphology and habitat availability for endangered fishes.
	EIS Responsibility	Aquatic ecology
Michael T. Rectanus	*Affiliation*	Battelle
	Education	B.S. Chemical Engineering, Ohio University
	Technical Experience	6 years of experience conducting air quality impact assessments for EISs and PSD construction permit applications.
	EIS Responsibility	Air quality analysis
Donna L. Riddle	*Affiliation*	S.M. Stoller Corporation
	Education	B.S. Environmental Restoration, Mesa State College
	Technical Experience	20 years of experience in quality assurance program definition and implementation and monitoring for DOE contractors.
	EIS Responsibility	Contractor QA Manager; quality consultation on EIS

Christine D. Ross	*Affiliation*	Battelle
	Education	A.A. Microcomputer Management, Specializing in Multimedia, Albuquerque Technical Vocational Institute
	Technical Experience	9 years of experience in graphic and desktop publishing work, 4 years of experience in GIS software and technology.
	EIS Responsibility	Prepared population, low-income, and minority maps for Chapter 3.0.
Wendee K. Ryan	*Affiliation*	S.M. Stoller Corporation
	Education	B.A. Speech Communication, Colorado State University
	Technical Experience	7 years of experience in Public Affairs for DOE contractors.
	EIS Responsibility	Public relations
Linda Sheader	*Affiliation*	Battelle
	Education	M.A. Botany, University of California Berkeley B.A. Biology, Adams State College
	Technical Experience	6 years of experience in wetlands delineation, restoration designs and monitoring, reclamation, botany, and plant ecology.
	EIS Responsibility	Revise floodplains and wetlands assessment and related sections
Gregory M. Smith	*Affiliation*	S.M. Stoller Corporation
	Education	M.S. Civil (Geotechnical) Engineering, Colorado State University
	Technical Experience	20 years of experience designing and constructing low-level uranium waste disposal cells for DOE.
	EIS Responsibility	Wind rose diagrams and affected environment text
J. Amanda Stegen	*Affiliation*	Battelle
	Education	M.S. Biology, University of Washington B.S. Wildlife Biology, Washington State University
	Technical Experience	10 years of experience in preparing ecological evaluations for NEPA documents and ecological risk assessment and biological assessments for energy-related projects.
	EIS Responsibility	Aquatic ecology, affected environment, environmental consequences, and biological assessment
Karen Sutton	*Affiliation*	S.M. Stoller Corporation
	Education	Various business training courses
	Technical Experience	23 years; United Banks of Colorado; 16 years Training and Employee Safety; 4 years Records
	EIS Responsibility	Reproduction and assembly

Lucinda Low Swartz	*Affiliation*	Battelle
	Education	J.D. Washington College of Law, The American University B.A. Political Science and Administrative Studies (joint major), University of California at Riverside
	Technical Experience	23 years of experience in environmental law and regulation.
	EIS Responsibility	Summary; Chapters 1.0 and 5.0 through 7.0, environmental laws and regulations; and technical review
Cathy Thomas	*Affiliation*	S.M. Stoller Corporation
	Education	M.L.S. Emporia State University B.S. Education, Emporia State University
	Technical Experience	30 years of experience in educational, medical, and corporate libraries conducting research for educators and clients.
	EIS Responsibility	Assisted in preparation of bibliographies
Carlos A. Ulibarri	*Affiliation*	New Mexico Institute of Mining and Technology and Battelle
	Education	Ph.D. Economics, University of New Mexico
	Technical Experience	10 years of experience in evaluating socioeconomic impacts of DOE projects involving environmental, energy, and nuclear regulatory programs.
	EIS Responsibility	Technical lead for socioeconomic impact evaluation
Gretchen Van Reyper	*Affiliation*	HRL Compliance, independent subcontractor
	Education	B.S. Environmental Studies/Biology, Minnesota State University-Mankato
	Technical Experience	10 years of wetland and botany experience in federal and private sectors; 3 years of NEPA document assistance.
	EIS Responsibility	Floodplain and wetland sections and sensitive plant species list
Paul G. Wetherstein	*Affiliation*	Battelle
	Education	A.A.S. Environmental Restoration Technology, Mesa State College
	Technical Experience	16 years of experience in environmental remediation, including 10 years in hazardous waste management involving DOE's uranium mill tailings work.
	EIS Responsibility	Research waste management issues for each alternative site
Toby Wright	*Affiliation*	MFG, Inc
	Education	M.S. Civil Engineering, Colorado State University B.S. Geosciences, University of Arizona
	Technical Experience	17 years of experience in environmental characterization, restoration and remediation design and management of private and federal clients.
	EIS Responsibility	Contractor Project Manager

Julio Zimbron	*Affiliation*	MFG, Inc.
	Education	Ph.D. Chemical Engineering, Colorado State University M.Sc. Chemical Engineering, Colorado State University B.S. Biochemical Engineering, Monterrey Institute of Technology, Mexico
	Technical Experience	Engineering design of water and air pollution control systems, including bioremediation, chemical treatment, and solids separation technologies.
	EIS Responsibility	Water treatment alternatives screening

Subcontract Agreement #STLR-3730-002-CP
NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE REMEDIATION OF THE MOAB URANIUM MILL TAILINGS SITE, GRAND COUNTY, UTAH ENVIRONMENTAL IMPACT STATEMENT

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require a contractor who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. In accordance with these requirements, Battelle Memorial Institute hereby certifies that to the best of its knowledge it has no financial or other interest in the outcome of the referenced EIS project.

In accordance with these requirements, **Battelle Memorial Institute** hereby certifies as follows: check either (a) or (b).

(a) _X_ To the best of **Battelle Memorial Institute's** knowledge, it has no financial or other interest in the outcome of the referenced EIS project.

(b) ___ Battelle Memorial Institute has the following financial or other interest in the outcome of the referenced EIS projects hereby agree to divest themselves of such interest prior to the start of the work.

Financial or Other Interest
1.
2.
3.

Certified by:
Lorraine N. Stein
Signature

for Ralph K. Henricks
Name

Contracting Officer
Title

02/18/2003
Date

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE REMEDIATION OF THE MOAB MILL TAILINGS SITE IN GRAND COUNTY, UTAH ENVIRONMENTAL IMPACT STATEMENT

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require a contractor who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial or other interest in the outcome of the project" for purposes of this disclosure, is defined in the March 23, 1981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Questions 71a and b.

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)" 46 FR 18026-18038 at 18031.

In accordance with these requirements, **Intera Incorporated**, hereby certifies as follows: check either (a) or (b).

(a) X **Intera Incorporated** has no financial or other interest in the outcome of the referenced EIS projects.

(b) ____ ________________ has the following financial or other interest in the outcome of the referenced EIS projects hereby agree to divest themselves of such interest prior to the start of the work.

Financial or Other Interest

1.
2.
3.

Certified by:

[signature]
Signature

Patrick F. Malone
Name

Contracting Officer
Title

January 20, 2003
Date

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE REMEDIATION OF THE MOAB MILL TAILINGS SITE IN GRAND COUNTY, UTAH ENVIRONMENTAL IMPACT STATEMENT

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require a contractor who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial or other interest in the outcome of the project" for purposes of this disclosure, is defined in the March 23, 1981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Questions 71a and b.

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)" 46 FR 18026-18038 at 18031.

In accordance with these requirements, MFG hereby certifies as follows: check either (a) or (b).

(a) X MFG has no financial or other interest in the outcome of the referenced EIS projects.

(b) ___ ______________________________, has the following financial or other interest in the outcome of the referenced EIS projects hereby agree to divest themselves of such interest prior to the start of the work.

Financial or Other Interest

1.
2.
3.

Certified by:

Craig A. Hamilton
Signature

Craig A. Hamilton
Name

President/COO
Title

January 17, 2003
Date

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE REMEDIATION OF THE MOAB MILL TAILINGS SITE IN GRAND COUNTY, UTAH ENVIRONMENTAL IMPACT STATEMENT

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require a contractor who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial or other interest in the outcome of the project" for purposes of this disclosure, is defined in the March 23, 1981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Questions 71a and b.

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)" 46 FR 18026-18038 at 18031.

In accordance with these requirements, **S.M. Stoller Corporation** hereby certifies as follows: check either (a) or (b).

(a) X **S.M. Stoller Corporation** has no financial or other interest in the outcome of the referenced EIS projects.

(b) ____ ________________________________ has the following financial or other interest in the outcome of the referenced EIS projects hereby agree to divest themselves of such interest prior to the start of the work.

Financial or Other Interest

1.
2.
3.

Certified by:

[signature]
Signature

James K. Archibald
Name

V.P. and General Manager
Title

January 17, 2003
Date

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE REMEDIATION OF THE MOAB MILL TAILINGS SITE IN GRAND COUNTY, UTAH ENVIRONMENTAL IMPACT STATEMENT

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require a contractor who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial or other interest in the outcome of the project" for purposes of this disclosure, is defined in the March 23, 1981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 FR 18026-18038 at Questions 71a and b.

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)" 46 FR 18026-18038 at 18031.

In accordance with these requirements, **Teledyne Brown Engineering, Inc**.hereby certifies as follows: check either (a) or (b).

(a) **X** **Teledyne Brown Engineering, Inc.** has no financial or other interest in the outcome of the referenced EIS projects.

(b) ____ ________________________________ has the following financial or other interest in the outcome of the referenced EIS projects hereby agree to divest themselves of such interest prior to the start of the work.

Financial or Other Interest

1.
2.
3.

Certified by:

Renee H. Varner
Signature

Renee H. Varner
Name

Sr. Contract Administrator
Title

January 17, 2003
Date

End of current text

9.0 List of Agencies, Organizations, and Individuals Receiving Copies of the EIS

Government Officials—Federal

Mr. Frank Bain, Bureau of Land Management
Mr. Matthew Blevins, U.S. Nuclear Regulatory Commission
Mr. Jim Carter, Bureau of Land Management
Mr. Tom Chart, U.S. Fish and Wildlife Service
Mr. Jim Fairchild, U.S. Geological Survey
Mr. Scott Flanders, U.S. Nuclear Regulatory Commission
Mr. Myron Fliegel, U.S. Nuclear Regulatory Commission
Dr. Richard Graham, U.S. EPA Region 8
Mr. Paul Henderson, Canyonlands National Park
Mr. Norm Henderson, National Park Service
Mr. Steven Hoffman, Office of the Regional Solicitor, U.S. Department of the Interior
Ms. Cherie Hutchison, U.S. Department of Labor, Mine Safety and Health Administration
Mr. Ken Jacobson, U.S. Army Corps of Engineers
Mr. Sam Keith, Center for Disease Control
Mr. Henry Maddux, U.S. Fish and Wildlife Service
Ms. Camille Mittelholtz, U.S. Department of Transportation
Ms. Anne Norton Miller, U.S. EPA Headquarters
Mr. Peter Penoyer, National Park Service
Mr. Robert E. Roberts, U.S. Environmental Protection Agency
Mr. Cordell Roy, National Park Service
Mr. Dan Schultheisz, U.S. EPA
Mr. Fred Skaer, Office of NEPA Facilitation (HEPE-1)
Mr. Robert F. Stewart, U.S. Department of Interior
Mr. Larry Svoboda, U.S. EPA Region 8
Mr. Willie Taylor, U.S. Department of the Interior, Office of Environmental Policy and Compliance
Mr. Gary Torres, Bureau of Land Management
Mr. Daryl Trotter, Bureau of Land Management
Ms. Mary von Koch, Bureau of Land Management
Mr. Bruce Waddell, U.S. Fish and Wildlife Service
Mr. Dave Wood, National Park Service
Ms. Margaret Wyatt, Bureau of Land Management

Elected Officials and Staffers—Federal

The Honorable Wayne Allard, United States Senate
The Honorable Joe Baca, U.S. House of Representatives
The Honorable Joe Barton, U.S. House of Representatives
The Honorable Xavier Becerra, U.S. House of Representatives
The Honorable Robert F. Bennett, United States Senate
Mr. Mike Reberg, Office of Congressman James Matheson

The Honorable Shelley Berkley, U.S. House of Representatives
The Honorable Howard L. Berman, U.S. House of Representatives
The Honorable Marion Berry, U.S. House of Representatives
The Honorable Jeff Bingaman, United States Senate
The Honorable Rob Bishop, U.S. House of Representatives
The Honorable Mary Bono, U.S. House of Representatives
The Honorable Barbara Boxer, United States Senate
The Honorable Robert C. Byrd, United States Senate
The Honorable Ken Calvert, U.S. House of Representatives
The Honorable Chris Cannon, U.S. House of Representatives
The Honorable Lois Capps, U.S. House of Representatives
The Honorable Thad Cochran, United States Senate
The Honorable Jim Costa, U.S. House of Representatives
The Honorable Christopher Cox, U.S. House of Representatives
The Honorable Randy (Duke) Cunningham, U.S. House of Representatives
The Honorable Susan Davis, U.S. House of Representatives
The Honorable John Dingell, U.S. House of Representatives
The Honorable Pete Domenici, United States Senate
The Honorable John Doolittle, U.S. House of Representatives
The Honorable David Dreier, U.S. House of Representatives
The Honorable Chet Edwards, U.S. House of Representatives
The Honorable Jo Ann Emerson, U.S. House of Representatives
The Honorable John Ensign, United States Senate
The Honorable Terry Everett, U.S. House of Representatives
The Honorable Diane Feinstein, United States Senate
The Honorable Bob Filner, U.S. House of Representatives
The Honorable Jeff Flake, U.S. House of Representatives
The Honorable Trent Franks, U.S. House of Representatives
The Honorable Elton Gallegly, U.S. House of Representatives
The Honorable Jim Gibbons, U.S. House of Representatives
The Honorable Raul Grijalva, U.S. House of Representatives
The Honorable Jane Harman, U.S. House of Representatives
The Honorable Orrin Hatch, United States Senate
The Honorable J. D. Hayworth, U.S. House of Representatives
The Honorable David L. Hobson, U.S. House of Representatives
The Honorable Duncan Hunter, U.S. House of Representatives
The Honorable Darrell E. Issa, U.S. House of Representatives
The Honorable Jim Kolbe, U.S. House of Representatives
The Honorable Jon Kyl, United States Senate
The Honorable Tom Latham, U.S. House of Representatives
The Honorable Carl Levin, United States Senate
The Honorable Jerry Lewis, U.S. House of Representatives
The Honorable James Matheson, U.S. House of Representatives
The Honorable John McCain, United States Senate
The Honorable Howard P. McKeon, U.S. House of Representatives
The Honorable Juanita Millender-McDonald, U.S. House of Representatives
The Honorable Gary G. Miller, U.S. House of Representatives
The Honorable Grace Napolitano, U.S. House of Representatives
The Honorable Bill Nelson, United States Senate

The Honorable Devin Nunes, U.S. House of Representatives
The Honorable David R. Obey, U.S. House of Representatives
The Honorable Ed Pastor, U.S. House of Representatives
The Honorable John E. Peterson, U.S. House of Representatives
The Honorable Jon Porter, U.S. House of Representatives
The Honorable Harry Reid, United States Senate
The Honorable Rick Renzi, U.S. House of Representatives
The Honorable Silvestre Reyes, U.S. House of Representatives
Mr. Bruce Richeson, Office of Senator Robert F. Bennett
The Honorable Dana Rohrabacher, U.S. House of Representatives
The Honorable Lucille Roybal-Allard, U.S. House of Representatives
The Honorable Edward R. Royce, U.S. House of Representatives
The Honorable John Salazar, U.S. House of Representatives
The Honorable Ken Salazar, United States Senate
The Honorable Linda Sanchez, U.S. House of Representatives
The Honorable Loretta Sanchez, U.S. House of Representatives
The Honorable Adam B. Schiff, U.S. House of Representatives
The Honorable Jeff Sessions, United States Senate
The Honorable John Shadegg, U.S. House of Representatives
The Honorable Brad Sherman, U.S. House of Representatives
The Honorable Ike Skelton, U.S. House of Representatives
The Honorable Hilda L. Solis, U.S. House of Representatives
The Honorable William M. Thomas, U.S. House of Representatives
The Honorable Peter J. Visclosky, U.S. House of Representatives
The Honorable John Warner, United State Senate
The Honorable Maxine Waters, U.S. House of Representatives
The Honorable Diane E. Watson, U.S. House of Representatives
The Honorable Henry A. Waxman, U.S. House of Representatives

Tribal

Vice Chairman Smiley Arrowchis, The Ute Tribe
Ms. Elayne Atcitty, White Mesa Ute Indian Tribe
Mr. Neil Cloud, Southern Ute Indian Tribe
Mr. Daniel Eddy, Jr., Colorado River Indian Tribes
Mr. Robert Holden, National Congress of American Indians
Mr. O. Roland McCook, The Ute Tribe
Ms. Nora McDowell, Fort Mojave Indian Tribe
Chairwoman Maxine Natchees, The Ute Tribe
Governor Arlen P. Quetawki, Sr., Pueblo of Zuni
Mr. Tom Rice, Ute Mountain Ute Tribe
Mr. Edward D. "Tito" Smith, Chemehuevi Indian Tribe
Mr. Arvin Trujillo, Navajo Nation Division of Natural Resources
Ms. Mary Jane Yazzie, White Mesa Ute Council

Government Officials—State

Ms. Sheila Brown, Governor's Office of Planning and Research
Ms. LaVonne Garrison, State of Utah School & Institutional Trust Lands Administration
Mr. Hugh Kirkham, Utah Department of Transportation
Mr. Leroy Mead, Utah Division of Wildlife Resources
Mr. Loren Morton, Utah Department of Environmental Quality
Mr. Fred Nelson, Utah State Attorney General's Office
Dr. Dianne Nielson, Utah Department of Environmental Quality
Mr. Stephen A. Owens, Arizona Department of Environmental Quality
Mr. Mark Page, State of Utah, Division of Water Rights
Mr. Daren Rasmussen, Utah Department of Natural Resources Division of Water Rights
Ms. Terry Roberts, Governor's Office of Planning and Research
Mr. Bill Sinclair, Utah Department of Environmental Quality
Mr. Joseph C. Strolin, Nevada Agency for Nuclear Projects
Mr. Reese Tietje, State of Nevada
Mr. William Werner, Arizona Department of Environmental Quality
Ms. Carolyn Wright, Utah Department of Natural Resources Center for Policy and Planning

Elected Officials—State

The Honorable Kenny C. Guinn, Governor of Nevada
The Honorable Jon Huntsman Jr., Governor of Utah
The Honorable Janet Napolitano, Governor of Arizona
The Honorable Bill Owens, Governor of Colorado
The Honorable Arnold Schwarzenegger, Governor of California

Interest Groups

Sierra Club
Greenaction Indigenous Lands Project
Mr. Bradley Angel, GreenAction for Health and Environmental Justice
Ms. Sue Bellagamba, The Nature Conservancy, Moab Project Office
Ms. Ashley Benton, John Burroughs School
Ms. Eleanor Bliss, Grand Canyon Trust, Moab Office
Ms. Danielle Brian, Project on Government Oversight
Mr. Jim Bridgman, Alliance for Nuclear Accountability
Mr. Dan Brook, Univerisity of California at Berkeley
Mr. David Brunner, National Fish and Wildlife Foundation
Mr. Jay Chen, Colorado River Board of California
Mr. Tom Clements, Greenpeace International
Dr. Thomas B. Cochran, Natural Resources Defense Council
Ms. Jana Cranmer, Point Loma Nazarene University
Mr. James H. Davenport, Colorado River Commission of Nevada
Ms. Libby Fayad, National Parks Conservation Association
Ms. Susan Gordon, Alliance for Nuclear Accountability

Ms. Jeannie Gregory, San Diego Natural History Museum
Mr. Jason Groenewold, Healthy Environment Alliance of Utah
Mr. John Hadder, Citizen Alert
Dr. Jack Hamilton, University of Utah
Mr. David Harper, Mohave Cultural Preservation Program
Mr. Bill Hedden, Grand Canyon Trust, Moab Office
Ms. Peggy Maze Johnson, Citizen Alert
Ms. Laura Kamala, Grand Canyon Trust
Mr. Fred Krupp, Environmental Defense
Mr. Lawson LeGate, Sierra Club
Mr. David Livermore, The Nature Conservancy
Mr. Bill Love, Sierra Club
Mr. William B. Mackie, Western Governors' Association
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End of current text

10.0 Glossary

active remediation	The use of active ground water remediation methods such as gradient manipulation, ground water extraction and treatment, or in situ ground water treatment to restore ground water quality to acceptable levels.
acute concentration	The concentration of a contaminant in a medium (air, water, and soil) that would produce an acute exposure. Acute exposure is a single, short-term exposure (usually a day or less) to radiation, a toxic substance, or other stressors that may result in severe biological harm or death.
alluvium	Sediments generally composed of clay, silt, sand, gravel, or similar unconsolidated material deposited by flowing rivers and streams.
ammonia	A nitrogen-based compound that exists in either the un-ionized form (NH_3) or as the ammonium ion (NH_4^+).
aquifer	A geologic unit (rock or sediment) that can store and transmit water at rates sufficient to supply reasonable amounts of water to wells and springs.
aquitard	A layer of low-permeability formation immediately above or below an aquifer that retards but does not prevent the flow of ground water to or from the aquifer. It does not readily yield water to wells and springs but may serve as a storage unit for ground water.
background ground water quality	The composition of ground water in areas near the millsite that are geologically similar to the millsite and were not affected by ore-processing activities.
benchmark	An established criterion, known point, or metric used to compare measured or estimated values of chemicals in the environment. Benchmarks generally represent concentrations for a particular medium (e.g., air, soil, water, food) that are acceptable for given receptors (e.g., humans, animals).
benthos	The plants and animals living on the river bottom.
biota	Living organisms.
borrow material	Rock, soil, or other earth materials that are excavated from one location and transported for use at another location, generally for construction purposes (e.g., as fill material).
brine	The USGS classification of water with a TDS concentration of more than 35,000 mg/L. In the EIS, briny water in the basin fill aquifer beneath the Moab site is salty ground water, which became salty mostly from dissolution of evaporite minerals in the Paradox Formation.

chronic concentration	Concentration of a contaminant in an environmental medium (air, soil, and water) that would produce a chronic exposure. A chronic exposure is a continuous or intermittent exposure of an organism to a stressor (e.g., a toxic substance or ionizing radiation) over an extended period of time or significant fraction (often 10 percent or more) of the life span of the organism. Generally, chronic exposure is considered to produce only effects that can be observed some time following initial exposure. These may include impaired reproduction or growth, genetic effects, and other effects such as cancer, precancerous lesions, benign tumors, cataracts, skin changes, and congenital defects.
cultural resources	Historic properties, archaeological resources, and cultural items, such as (1) archaeological materials (e.g., artifacts) and sites that date to the prehistoric, historic, and ethnohistoric periods that are currently located on, or are buried beneath, the ground surface; (2) standing structures and/or their component parts that are more than 50 years of age or are important because they represent a major historical theme or era (e.g., Manhattan Project, Cold War); (3) structures that have an important technological, architectural, or local significance; (4) cultural and natural places, selected natural resources, and sacred objects that have importance for Native Americans; and (5) American folklife traditions and arts.
decreaser grasses	The grasses most eagerly sought after by grazing animals—they tend to decrease as grazing pressure increases. Most grasses are defined as being pasture increasers or decreasers.
distribution coefficient (K_d and R_d)	A ratio of the concentration of a chemical in soil to the concentration in water under equilibrium conditions (i.e., concentration in soil divided by the concentration in water).
floodplain (including 100 and 500 year)	The surface or strip of relatively smooth land adjacent to a river channel, constructed by the present river, and covered with water when the river overflows its banks. The floodplain is built of alluvium carried by the river during floods and deposited in the sluggish water beyond the influence of the swiftest current. A 100-year floodplain is the area of land that has a 1.0 percent or greater chance of being flooded in any given year. A 500-year floodplain is the area of land that has a 0.2 percent chance of being flooded in any given year.
flow-and-transport modeling	Use of computer software to try to simulate subsurface movement of water and chemicals to predict future conditions in an aquifer.

fresh water	The USGS classification of water based on the following concentration ranges of TDS: fresh water has less than 1,000 mg/L TDS, slightly saline water has 1,000 to 3,000 mg/L TDS, moderately saline water has 3,000 to 10,000 mg/L TDS, very saline water has 10,000 to 35,000 mg/L TDS, and brine has more than 35,000 mg/L TDS. In the EIS, fresh water in the basin fill aquifer beneath the Moab site is referred to as the upper portion of the aquifer that overlies the deeper briny ground water.
fugitive dust	(1) Dust emitted that does not pass through a stack, vent, chimney, or similar opening where it could be captured by a control device. (2) Any dust emitted other than from a stack.
increaser grasses	Grasses that become better established as grazing pressure increases because they are less palatable—they tend to increase as more favored species are grazed out. Most grasses are defined as being pasture increasers or decreasers.
institutional controls	Used to limit or eliminate access to, or uses of, land, facilities, and other real and personal property to prevent inadvertent human and environmental exposure to residual contamination and other hazards. These controls maintain the safety and security of human health and the environment and of the site itself. Institutional controls may include legal controls such as zoning restrictions and deed annotations and physical barriers such as fences and markers. Also included are methods to preserve information and data and to inform current and future generations of the hazards and risks.
kilovolt amperes (kVA)	A unit of electric measurement equal to the product of a kilovolt volt and an ampere. For direct current, it is a measure of power and is the same as a kilowatt; for alternating current, it is a measure of apparent power.
legacy plume	Site-related ground water contamination that is found in the freshwater layer of the ground water system and that would still be present even if no further contamination of the ground water takes place.
long-term surveillance and maintenance	A task performed by the DOE Office of Legacy Management through the DOE in Grand Junction, Colorado. The Office of Legacy Management provides expertise and resources necessary to manage low-level radioactive material disposal and impoundment sites after remedial action is complete.
macrophytes	Large aquatic plants.
maximally exposed individual	A hypothetical individual whose location and habits result in the highest total radiological or chemical exposure (and thus dose) from a particular source for all exposure routes (e.g., inhalation, ingestion, direct exposure).
millirem (mrem)	One thousandth of a rem (0.001 rem); see *rem*.

mixing zone	A limited portion of a body of water, contiguous to a discharge, where dilution is in progress but has not yet resulted in a concentration that will meet certain standards for all pollutants (from State of Utah surface water regulation R317-2-13).
natural flushing	Allowing the natural ground water movement and geochemical processes to decrease contaminant concentrations.
PEIS	*Programmatic Environmental Impact Statement for the Uranium Mill Tailings Remedial Action Ground Water Project*, prepared by DOE in 1996 for the UMTRA Ground Water Project. The PEIS is intended to serve as a programmatic planning document that provides an objective basis for determining site-specific ground water compliance strategies at the UMTRA Project sites.
pH	A measure of the relative acidity or alkalinity of a solution, expressed in a scale of 0 to 14, with a neutral point at 7. Acid solutions have pH values lower than 7, and basic (i.e., alkaline) solutions have pH values higher than 7. Because pH is the negative logarithm of the hydrogen ion (H^+) concentration, each unit increase in pH expresses a change in state of a factor of 10. For example, pH 5 is 10 times more acidic than pH 6, and pH 9 is 10 times more alkaline than pH 8.
plant community	A group of interacting plant species that share a common habitat, including incoming solar radiation, soil water, and nutrients, that recycle nutrients from the soil to living tissue and back again and that alternate with each other in time and space. Plant community is a general term that can be applied to vegetation types of almost any size or longevity. A plant association is a particular type of community that has been described sufficiently and repeatedly in several locations.
PM_{10}	Particulate matter in air small enough to move easily into the lower respiratory tract, defined as particles less than 10 micrometers in aerodynamic diameter.
phytoremediation	Use of plants to remove contaminants from ground water through root uptake. At the Moab site, tamarisk roots take in nitrogen compounds (e.g., ammonia and nitrate) from ground water.
phreatophyte	Deep-rooted plants that obtain water directly from the water table or a permanent ground water source.
picocurie	A unit of radioactivity equal to one trillionth (10^{-12}) of a curie. A curie is a unit of radioactivity equal to 37 billion nuclear disintegrations per second.
plume	The volume of contaminated ground water originating at a contaminant source such as the tailings pile at the Moab site and migrating downgradient.

probable maximum flood	The hypothetical flood that is considered to be the most severe reasonably possible flood, based on the comprehensive application of maximum precipitation and other hydrological factors favorable for maximum flood runoff (e.g., sequential storms and snowmelts). It is usually several times larger than the maximum recorded flood.
radium-226	A radioactive metallic element in the decay chain that begins with uranium-238 and ends with lead-206, a stable isotope. Radium-226 has a half-life of about 1,600 years and decays to radon-222, an inert gas.
radon-222	A radioactive inert gas in the decay chain that begins with uranium-238 and ends with lead-206, a stable isotope. Radon has a half-life of about 3.8 days and decays into polonium-218, a metallic ion.
reasonable maximum exposure	The highest exposure that is reasonably expected to occur at a site (EPA risk assessment guidance) (exposure is defined as the contact of an organism with a chemical or physical agent).
recharge areas	Areas in which water on the ground surface (e.g., precipitation or a water body) infiltrates downward and replenishes an aquifer.
rem	A unit of radioactive dose equivalent, equal to the absorbed dose in tissue multiplied by an appropriate quality factor and possibly other modifying factors. Derived from "roentgen equivalent man," referring to the dose of ionizing radiation that will cause the same biological effect as one roentgen of X-ray or gamma ray exposure.
record of decision (ROD)	A public document that records a federal agency's decisions concerning a proposed action for which the agency has prepared an EIS. The ROD is prepared in accordance with the requirements of the Council on Environmental Quality NEPA regulations (40 CFR 1505.2). A ROD identifies the alternatives considered in reaching the decision, the environmentally preferable alternatives, factors balanced by the agency in making the decision, whether all practicable means to avoid or minimize environmental harm have been adopted, and, if not, why they were not.
rim syncline	A local depression that develops between salt diapirs resulting from movement of underlying salt toward the diapir structure.
river incision	The geologic process by which the Colorado River cuts down through the bedrock sandstone outcroppings located upstream and downstream of the Moab site.
river mile	The distance of a point on a river measured in miles from the river's mouth along the low-water channel.

saline	The USGS classification of water based on the following concentration ranges of TDS: fresh water has less than 1,000 mg/L TDS, slightly saline water has 1,000 to 3,000 mg/L TDS, moderately saline water has 3,000 to 10,000 mg/L TDS, very saline water has 10,000 to 35,000 mg/L TDS, and brine has more than 35,000 mg/L TDS. In the EIS, saline water in the basin fill aquifer beneath the Moab site is referred to as salty ground water, which is salty mostly from dissolution of evaporite minerals in the Paradox Formation.
salt-cored anticline	An anticline in which salt (from evaporating seawater, including other materials such as silt and clay) has flowed upward and formed the core of the anticline.
salt diapir	A dome or elongate anticlinal fold in which the overlying rocks have been ruptured or pierced by the squeezing out of low-density salt deposits and their resulting upward movement.
settling	The gradual compacting and lowering of the height of a tailings pile. It is caused by the weight of the pile squeezing liquids from slimes downward and out of the pile.
slimes	The fine-grained fraction of the mill tailings that consists of clay- and silt-sized grains; defined as material that will pass through a 200-mesh Tyler-equivalent sieve.
steady-state conditions	Conditions that exist when a system is in equilibrium and that do not change significantly over time (e.g., ground water constituent concentrations that remain essentially constant).
subsidence	The geologic process that is lowering the entire tailings pile at the Moab site because of ground water dissolving the Paradox Formation salt deposits that underlie the Moab-Spanish Valley.
supplemental standards	A narrative exemption from remediating ground water to prescriptive numeric standards (background concentrations, maximum concentration limits [MCLs], or alternate concentration limits [ACLs]), if one or more of the eight criteria in 40 CFR 192.21 are met. At the Moab site, the applicable criterion is limited-use ground water, (40 CFR 192.21[g]), which means that ground water has naturally occurring total dissolved solids (TDS) concentrations greater than 10,000 milligrams per liter (mg/L), and widespread TDS contamination is not related to past milling activities at the site. The PEIS (DOE 1996) also discusses supplemental standards within the context of "no ground water remediation." However, guidance in 40 CFR 192.22 directs that where the designation of limited-use ground water applies, remediation shall "assure, at a minimum, protection of human health and the environment."
tailings pore fluids	Water in the pore spaces between the mineral grains that make up the tailings pile at the Moab site. Fluids can be remnants of fluids disposed of in the former tailings ponds or precipitation that seeped into the pile.

total dissolved solids (TDS)	A measurement of the nonvolatile constituents dissolved in water. TDS is measured by filtering a water sample through a glass fiber filter having an average pore size of 1 micrometer, evaporating a measured volume of the filtered water to dryness at 105 degrees Celsius (°C), then drying the residue to a constant weight at 180 °C. The result is expressed in milligrams of residue per liter of water sample. Water with more than 2,000 to 3,000 mg/L TDS is generally too salty to drink. TDS concentration of seawater is about 35,000 mg/L.
traditional cultural property (TCP)	A significant place or object associated with historical and cultural practices or beliefs of a living community that is rooted in that community's history and is important in maintaining the continuing cultural identity of the community.
UMTRA Project	Uranium Mill Tailings Remedial Action Project that was approved by Congress in 1978 and gave DOE authority to clean up inactive uranium-ore processing sites and vicinity properties, including ground water.
uranium	A radioactive, metallic element that is the heaviest of the naturally occurring elements. Uranium has 14 known isotopes, of which uranium-238 (half-life of about 4.5 billion years) is the most abundant. Uranium-235 (half-life of about 700 million years) is used as a fuel for nuclear fission.
vicinity properties	Properties, either public or private in the vicinity of designated uranium-ore processing sites, that are believed to be contaminated with RRM and may be eligible for characterization and cleanup under the UMTRA Project.
wetland	Areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.
working level	A measure of radon daughter concentration, consisting of any combination of short-lived radon-222 decay products in 1 liter of air that result in the ultimate emission of alpha particle energy of 1.5×10^5 million electron volts.
young-of-the-year	Juvenile fish less than 1 year old.
zooplankton	The animal constituent of the small plants and animals that float or drift in fresh water, mainly insects or fish.

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X, Y, Z

No entries

Cristina Gispert

From: DTSC_SSFL_CEQA <DTSC_SSFL_CEQA@dtsc.ca.gov>
Sent: Monday, December 16, 2013 8:33 AM
To: Jason Ricks
Cc: Hume, Richard@DTSC; Deanna Hansen
Subject: SSFL NOP Comments for Dec 7-14: 4 of 5
Attachments: Mark Malinowski December 10 2013 CR2.pdf; Mark Malinowski December 10 2013 CR3.pdf

4 of 5

From: Christine Rowe [mailto:crwhnc@gmail.com]
Sent: Thursday, December 12, 2013 8:54 AM
To: DTSC_SSFL_CEQA
Subject: Fwd: Christine L. Rowe DTSC SSFL PEIR - Comment 3

---------- Forwarded message ----------
From: **Christine Rowe** <crwhnc@gmail.com>
Date: Wed, Dec 11, 2013 at 6:14 AM
Subject: Christine L. Rowe DTSC SSFL PEIR - Comment 3
To: "Malinowski, Mark@DTSC" <Mark.Malinowski@dtsc.ca.gov>
Cc: "Leclerc, Ray@DTSC" <Ray.Leclerc@dtsc.ca.gov>, Marina Perez <Marina.Perez@dtsc.ca.gov>, "Dassler, David W" <David.W.Dassler@boeing.com>, Kamara Sams <Kamara.Sams@boeing.com>, "James A. Elliott, (MSFC-AS10)" <allen.elliott@nasa.gov>, "Merrilee Fellows, (HQ-NB000)" <mfellows@nasa.gov>, John Jones <john.jones@emcbc.doe.gov>, Stephanie Jennings <stephanie.jennings@emcbc.doe.gov>, "Bell, Jazmin" <jazmin.bell@emcbc.doe.gov>, Cassandra Owens <cowens@waterboards.ca.gov>

Dear Mr. Malinowski.

Please see the attached document (CR2) for my PEIR comments.

The second attachment (CR3), which was incomplete when I left for the meeting, is unsigned. It is what I read as my first comment at the Scoping meeting, but I added additional comments to it based on my notes. It should be included in the record as well.

Thank you.

Christine L. Rowe

Mark Malinowski
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Sacramento, CA 95825
Phone: (916) 255-3717
Fax: (916) 255-3596
Email: Mark.Malinowski@dtsc.ca.gov

December 10, 2013

RE: Santa Susana Field Laboratory Draft Program Environmental Impact Report

Dear Mr. Malinowski,

In May 2013, the Camarillo Springs Fire burned 28,000 acres. Some of this was State parkland. Would DTSC require that area to be cleaned up to Background? Would the State legislature even fund it?

The end use of the Santa Susana Field Laboratory (SFL)site should be parkland based upon its significance in terms of its prehistory, recent history, and its significance as a wildlife corridor. Why should this site be cleaned up to "Background" levels?

It is my opinion that the decision makers for the cleanup of the SSFL site in order to be adequately informed about the SSFL site need to have the following information. These decision makers include not only DTSC, Boeing, NASA, and the Department of Energy. For the NASA and DOE remediations, they also include Congress.

1) **The 2005 fire maps for the SSFL site.**
2) **A GIS overlay of the dioxins found at the SSFL site prior to any remediation.**
3) **Maps which show risk based screening levels and their associated costs.**
4) **The decision makers need to understand the associated risks from the site today for all areas as well as the risks from the site after the remediation has been completed.**
5) **The remediation costs for the soils and groundwater need to be separated due to the fact that under the 2007 Consent Order, the groundwater treatment systems only need to be in place by 2017; the ground water remediation is not scheduled to be completed by that time.**

It is my opinion that the AOCs may be predecisional under NEPA and CEQA.

Mark Malinowski
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December 10, 2013

RE: Santa Susana Field Laboratory Draft Program Environmental Impact Report

Dear Mr. Malinowski,

I believe that there is a tremendous amount of misunderstanding and misinformation in the community regarding the Santa Susana Field Laboratory cleanup goals. For example, remediation was already done under the Los Angeles Regional Water Quality Control Board (LARWQCB) for areas that exceeded the Boeing National Pollutant Discharge Elimination System (NPDES) permit. It is my understanding that there were only five chemicals of concern for the remediation under the LARWQCB Interim Source Removal Action (ISRA) orders. These cleanups were not based on the numbers within the 2007 Consent Order or the 2010 Administrative Orders on Consent. Therefore, these areas that were cleaned up for a small number of contaminants previously will likely need further remediation under the various cleanup agreements in place today.

Furthermore, as a result of the agreements between DTSC and the Department of Energy (DOE), and DTSC with NASA, maps have been created to show what a cleanup to "Background" will look like. <u>What most people do not understand is that a cleanup to "Background" is not risk based</u>. Furthermore, most people who are not technical stakeholders do not understand that for the chemicals and radionuclides that are not found in "Background", it is the ability to detect these chemicals in the laboratory to a level that is replicable in another laboratory that is the Look Up Table value.

On October 12th, 2007, The Boeing Company sent a Letter of Intent to clean up their portion of the Santa Susana Field Laboratory site to Secretary Linda Adams the Director of Cal EPA. They offered to clean up their portion of the site based on risk based approach to a residential standard for both chemicals and radionuclides.

Furthermore, Boeing had offered to donate their property to the State, and they stated that they would try to help to secure the transfer of the NASA portion of the property to the State as well. Both of these transfers were to be at no cost to the State.

I would like to see DTSC work with Boeing, NASA, and the DOE to change the existing cleanup standards to a risk based cleanup that is one standard for all. It is my opinion that a suburban residential standard of cleanup is a compromise between the clean up to the SB 990 standards. SB 990 has been declared unconstitutional and is under appeal by DTSC. The 2010 Administrative Orders on Consent with NASA and DOE, in my opinion, were signed to comply with the 2007 Consent Order and to incorporate SB 990 into that agreement.

It is my opinion based upon the language of the 2010 Administrative Orders on Consent for the DOE that both NASA and the DOE must comply with the 2007 Consent Orders for everything but soil. Therefore, the easiest approach to the full site would be a risk based cleanup to a suburban residential standard under the 2007 Consent Order.

"1.5.1. This Order shall not in any way operate to modify, amend or nullify the obligations of the Parties under the 2007 Consent Order for Corrective Action (Department Docket No. P3-07/08-003, hereinafter "2007 Order"), entered into by DTSC, DOE, the National Aeronautics and Space Administration ("NASA"), and The Boeing Company ("Boeing"). The purpose of this Order is to further define and make more specific DOE's obligations with respect to only the cleanup of soils at the Site. Compliance with and fulfillment of this Order shall, upon completion, satisfy DOE's responsibilities regarding soils at the Site and DOE's obligations and responsibilities in this Order supersede the 2007 Order requirements pertaining to soils cleanup. The 2007 Order requirements pertaining to DOE for soils contamination at the Site shall not be applied to DOE. All other provisions of the 2007 Order remain in effect as to DOE, including provisions relating to ground water contamination and soil vapor emanating from groundwater, and shall remain in full force and effect. All provisions of the 2007 Order applicable to NASA and Boeing are not affected by the provisions of this Order in any way. "

DTSC should create maps to show what has been cleaned up under the Imminent and Substantial Endangerment Order for the Northern Drainage, and what would need to be cleaned up there to the 2007 Consent Order for a suburban residential standard, an industrial standard, and a parkland standard.

DTSC should have maps that show the ISRA cleanup, and what would be necessary to clean up those areas to the same standards based upon risk – the suburban residential standard, industrial standard, and a parkland standard.

Finally, DTSC should produce maps for all four areas, the Northern Buffer Zone (NBZ), and the Southern Buffer Zone (SBZ) that show the risk based cleanup standards to the suburban residential standards, the industrial standard, and to a parkland standard.

By signing the agreement to clean up the areas under NASA's and DOE's responsibility to the 'Background" level, maps have been created that imply that the whole site has widespread chemical and radiological contamination. <u>These maps are not based on human health risk.</u>

DTSC must, in its Draft Programmatic Environmental Impact Report (PEIR) create maps based on risk. I believe that for the decision makers to be adequately informed, they must have an understanding of the risks posed by the contamination at the site now, as well as the risks associated with the site upon remediation as well as the potential risks to the community from remediation at all of these levels.

DTSC has signed the Administrative Orders on Consent based on their authority under CERCLA. CERCLA requires the use of the nine balancing criteria which are:
"Nine Balancing Criteria
1. Overall protection of human health and the

environment
2. Compliance with Applicable, Relevant and Appropriate Requirements
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume
5. Short-term effectiveness
6. Implementability
7. Cost
8. State acceptance
9. Community acceptance"

It is my opinion that since Congress must appropriate the funds for the NASA and DOE cleanups, that both risk and cost must be shown in the Draft PEIR for the elected officials to better understand the risk based levels of cleanup and their associated costs. How can DTSC financially justify a cleanup to the Administrative Order on Consent level without showing the alternative scenarios? DTSC should supply the decision makers with all of the relevant information at all four cleanup standards – the AOC level, suburban residential level, industrial level, and parkland, or they are depriving the community and the decision makers of this information. One of the balancing criteria is community acceptance.

NASA has shown to the community in their Draft Environmental Impact Statement (DEIS) what a cleanup to Background and a No Further Action scenario would be like. It is my opinion, just based on the NASA DEIS alone, that the impact on my community just from the NASA cleanup trucks, that the trucks could pose a greater risk to my community than leaving in place some of the contamination to be cleaned up by alternative methods or having a risk based clean up to a suburban residential standard.

Furthermore, the NASA Office of Inspector General also questioned why NASA committed to this agreement (AOC). At least one member of Congress has questioned where NASA will get the funding for this project.

The information for a complete Environmental Impact Statement from the DOE was sought by the parties, and the lack of information supplied to the parties caused litigation against the DOE. For the same reasons, DTSC must supply all of this information to the community and the decision makers.

Therefore, DTSC must show all four alternatives based upon health risk to human and ecological receptors as well as their associated costs to the community and for the decision makers in their PEIS.

Respectfully submitted,
Christine L. Rowe
West Hills resident of 35 years
*former West Hills Neighborhood Council Board member
*former DTSC Public Participation Group member
*for information purposes only

Cristina Gispert

From: Christine Rowe <crwhnc@gmail.com>
Sent: Friday, December 13, 2013 12:30 PM
To: DTSC_SSFL_CEQA; Malinowski, Mark@DTSC
Subject: Christine L. Rowe DTSC SSFL PEIR - Comment 5

Dear Mr. Malinowski,

I believe that these documents are excellent examples of what we need to discuss in regards to environmental remediation at Santa Susana.

http://www.iaea.org/OurWork/ST/NE/NEFW/_nefw-documents/Environmental_Remediation.pdf

http://www.iaea.org/OurWork/ST/NE/NEFW/documents/IDN/ANL%20Course/Day_5/RiskOverview_revised.pdf

The issues of dose and risk are absolutely necessary to understand the previous cleanup standards in AREA IV, the risk from what is there today, and a remediation goal for radionuclides for the future.

Respectfully submitted.

Christine L. Rowe

Getting to the Core of

Environmental Remediation

Reducing radiation exposure from contaminated areas to protect people

IAEA

International Atomic Energy Agency

Getting to the Core of Environmental Remediation

Taking care of the environment today is a sustainable act for the generations of tomorrow. Avoiding the need for excessive remediation programmes after the end of operations is a fundamental aspect of life cycle thinking of any nuclear facility or industry handling radioactive material.

This brochure provides general information about environmental remediation areas, from planning to the implementation of remediation projects, including stakeholder involvement, which is an important factor for the successful completion of remediation projects.

Content

...after remediation (photo courtesy of Wismut, Germany).

Getting to the Core of Environmental Remediation

Environmental remediation refers to reducing radiation exposure, for example, from contaminated soil, groundwater or surface water. The purpose is more than just eliminating radiation sources; it is about protecting people and the environment against potential harmful effects from exposure to ionizing radiation.

In the past, many nuclear activities were developed without appropriate consideration of their environmental aspects and impacts. Operations were run in situations in which laws and regulations did not exist or if they did, they were neither adequate nor comprehensive enough. As a result, radiologically contaminated sites were created. Such sites have also been created by nuclear and radiological accidents, as well as by non-nuclear industries in which human activities have increased the potential for exposure from naturally occurring radioactive materials compared to the unaltered state.

As contaminated sites can ultimately lead to undesired health effects for local people, appropriate actions must be taken. Remediation of contaminated land areas — or other contaminated media, such as surface or groundwater — is applied in two ways:

(1) By applying actions to the contamination itself. This can lead to isolation, immobilization or removal of the actual source of radiation, for example by means of decontaminating areas, surfaces and environmental media.

(2) Evaluating risks related to radiation exposure to people and thinking of ways of breaking the pathways between the radiation source and people. This approach might lead to evacuation, area isolation or changing land use and the local population's living habits.

The two ways are complementary. When deciding on the actual remediation work, several different factors need to be taken into account. As every site has its own characteristics, there is no simple quick fix.

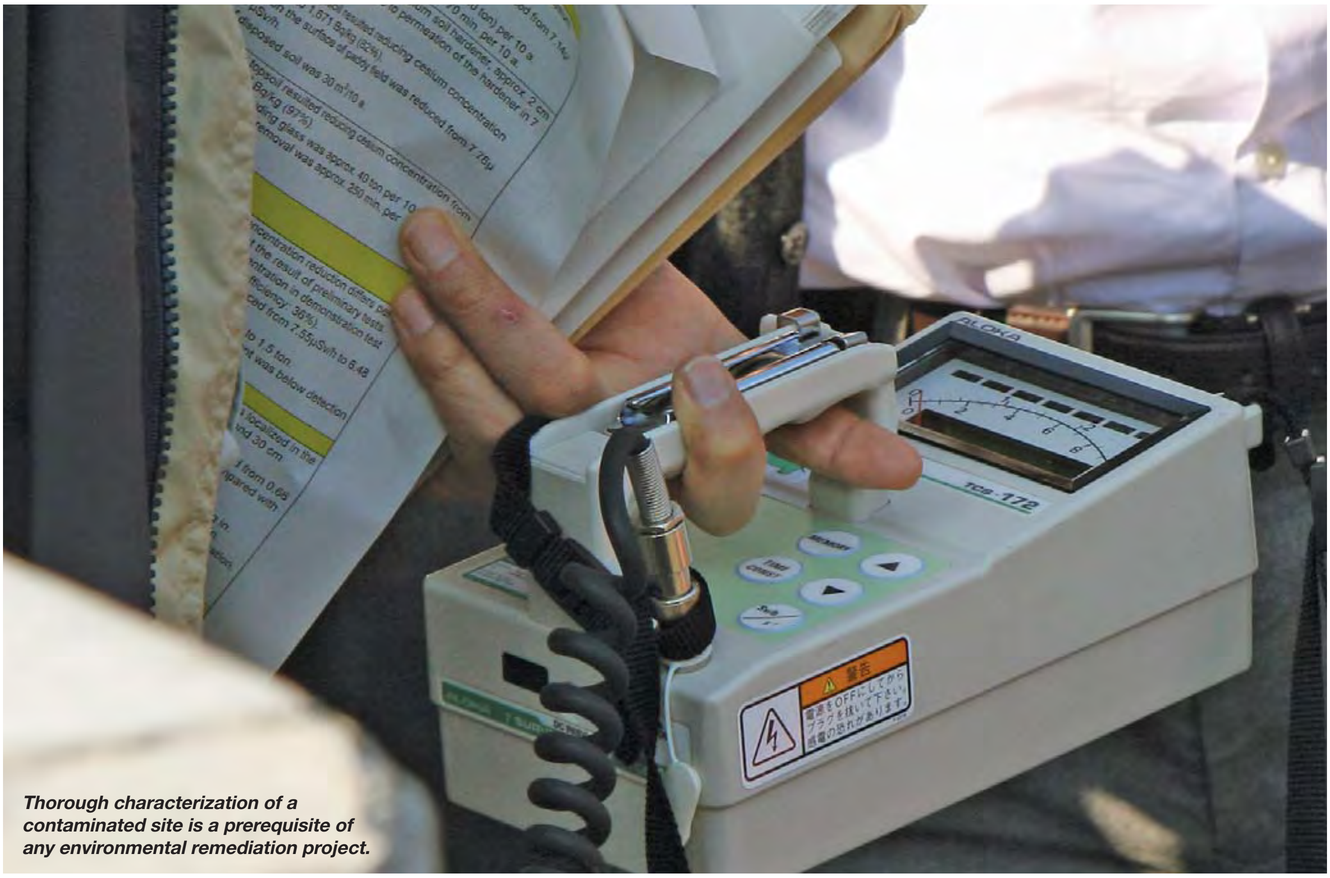
The most important thing is to understand that remediation actions need to be justified and optimized — the adopted actions must do more good than harm. For example, increased radiation levels do not necessarily mean that the increase is harmful; some living environments have inherently high radiation levels. Thus, evacuating or isolating areas without firm scientific grounds for it can needlessly cause distress to the people it concerns.

Returning a contaminated site to its original state is often neither necessary nor possible. While environmental remediation aims to reduce radiation exposure to protect people, remediated sites can still be used for various purposes, for example, industrial operations and even housing.

Environmental remediation is usually not an urgent task, thus enabling proper planning which is an essential aspect of any remediation work.

What to Consider When Defining Remediation Approaches

Remediation should not be confused with an emergency response after an accident, and thus it usually does not require urgent actions. For this reason, thorough evaluation of the situation and formulation of the desired goal is not only possible but a prerequisite. Proper planning is an



Thorough characterization of a contaminated site is a prerequisite of any environmental remediation project.

Getting to the Core of Environmental Remediation

Remediation actions need to be justified and optimized. The end result is always a balance between risks, costs, benefits and remediation viability.

essential aspect of any remediation work in order to reach the justified and optimized end state of the site.

The issues to be taken into account in the decision making process vary from technical to economic and social considerations, such as:

- Radiation risk to the population due to the land use — this is derived from the exposure assessment of people to radioactive materials in the site;
- Occupational exposure due to remediation works — workers will also be exposed during the remediation works;
- Net benefits of the remediation works to the affected community — remediation should do more good than harm;
- Waste generation from remediation — remediation is generally a waste generating activity, and the amounts and properties of generated wastes need to be considered in the decision making process;
- Ethical issues — remediation may affect people's lives and their living environment, including how they live;

Environmental remediation may generate radioactive waste that needs to be managed.

- Financial costs of remediation — remediation work costs are generally high and, therefore, financing mechanisms need to be sought;
- Other non-radiological risks incurred — sites to be remediated may not be contaminated only by radionuclides but also by other non-radioactive substances such as heavy metals and hazardous organic compounds.

As every country is different and every site has its own characteristics, choosing the best possible environmental remediation solution means balancing between risks, costs, benefits and available technologies as well as public acceptance.

How Clean Is ‘Clean’?

The people, whose lives a contaminated site might affect, often have three fundamental questions in their mind: Is it safe for me and my family to live here? Who is responsible for this? Who is going to cover the expenses of the remediation works?

Without national policies, liability issues for the remediation are not addressed and it is unclear which parties are responsible for implementing the remediation works. In addition, the important question of who will pay for the remediation is not unequivocally answered.

National policy and strategies set up societal values regarding the environment and the population. Policy and strategies for implementing remediation need to be complemented by a consistent and well dimensioned regulatory framework. Regulations define in detail ‘how clean clean is’, i.e. the requirements that will need to be met in each given situation; the level of site characterization to be accepted before and after the remediation works; and the acceptable end state of the site. The overall process should be transparent, be communicated to the relevant stakeholders and allow for their participation in the decision making process.

Stakeholders’ Input Matters

An important factor for a successful remediation project is for those people whose lives are affected by the contaminated site to be involved in and to contribute to the remediation process as they have a stake in the end result. It is not only an ethical matter but a moral obligation to involve various stakeholders in the remediation process. Listening to stakeholders’ opinions, capturing their perspectives and taking them into account from the very beginning of the remediation process assists the decision making process for taking the most appropriate approach.

Typically, a remediation project has a series of stakeholders, including, for example, the immediate affected population and communities, operators, regulators, non-governmental organizations as well as other segments of the society as a whole that may wish to have a say in the project decision making process.

Nuclear activities and operations must be planned in a way that minimizes excessive need for remediation activities at the end of operations.

Key Aspects to Take into Account

To encapsulate the main principles of environmental remediation, four major aspects should be taken into account:

(1) A contaminated site may not necessarily impose significant health risks to people living on it.

(2) The focus should be on radiation doses and risks that the exposure might pose. Reduction of doses — and not necessarily reduction of concentrations — is the ultimate objective of a remediation project.

(3) Returning a site to the conditions before the event that caused the contamination is not necessary and many times not even reasonably achievable.

After remediation, formerly contaminated sites can be utilized for various purposes (photo courtesy of Wismut, Germany).

(4) The major driver for a remediation project will be less the scientific evidence of eventual health risks but rather public perception. Good communication and effective stakeholder involvement are, therefore, essential components for a successful remediation project.

As sites contaminated by artificial and natural radionuclides or even exposures of natural origin may give rise to the need for environmental remediation, remediation can only start after a consensus on the necessity to reduce existing or future exposures to ionizing radiation. In all cases, the actual work, i.e. adopting certain environmental remediation actions, is always a case specific decision.

A range of different remediation technologies exists but regulators often tend to value proven technologies; in some cases, the available technologies are not adequate to achieve the desired goals and further development is needed. For the sustainability of nuclear energy, modern nuclear facilities and operations are designed in a way that also takes into account the end of the operation life cycle. In this way, the need for extensive environmental remediation activities is minimized.

Getting to the Core of Environmental Remediation

The Things to Know about Environmental Remediation

- Environmental remediation refers to actions applied to the source of contamination or to the exposure pathways that may connect people to the source. Removing the source or breaking the pathways reduces exposures.
- A contaminated site does not automatically pose health risks to people. In some cases, natural background radiation is higher than that of contaminated sites.
- The more informal term ‘clean up’ is often used synonymously with environmental remediation. The terms rehabilitation and restoration are also commonly used in the context of environmental remediation.
- Contaminated sites were created in the past because of poor operational practices and lack of appropriate or effective environmental laws and regulations. In some cases, regulators’ inadequate oversight led to contaminated sites. Such sites have also been created by nuclear and radiological accidents, and by non-nuclear industries.
- Environmental remediation is a site specific action that depends on the environmental characteristics of a particular site, the type of contamination and available technologies. Hence, the costs for remediation also vary from site to site.
- Regarding contamination after an accident, there are already over sixty approaches that can be implemented in the remediation of the affected sites.
- There are several environmental remediation programmes in the world, for example, remediation of:
  – Nuclear sites under the environmental management programme of the United States Department of Energy in the United States of America;
  – Uranium mining sites in the former East Germany, i.e. the Wismut project, and the former uranium mining and milling sites in Central Asia;
  – Contaminated sites caused by the Chernobyl and Fukushima accidents;
  – A contaminated site caused by a radiological accident in Goiânia, Brazil.

Before remediation...

Experience has shown that interaction between less and more experienced countries can contribute to better conditions for implementing environmental remediation projects. To resolve environmental liabilities and to avoid the generation of new contaminated sites, the IAEA is helping many countries to adopt appropriate practices. By being the hub of international cooperation, the IAEA provides information and guidance on available remediation strategies and technologies.

...after remediation (photo courtesy of Wismut, Germany)

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Vienna International Centre, PO Box 100
1400 Vienna, Austria
www.iaea.org/NuclearEnergy

12-16881

Overview of Radiological Dose and Risk Assessment

Karen P. Smith
Environmental Science Division
Argonne National Laboratory

IAEA Training Course on Nuclear Facility Decommissioning & Environmental Remediation Skills

Held at Argonne, Illinois

4 – 15 April 2011

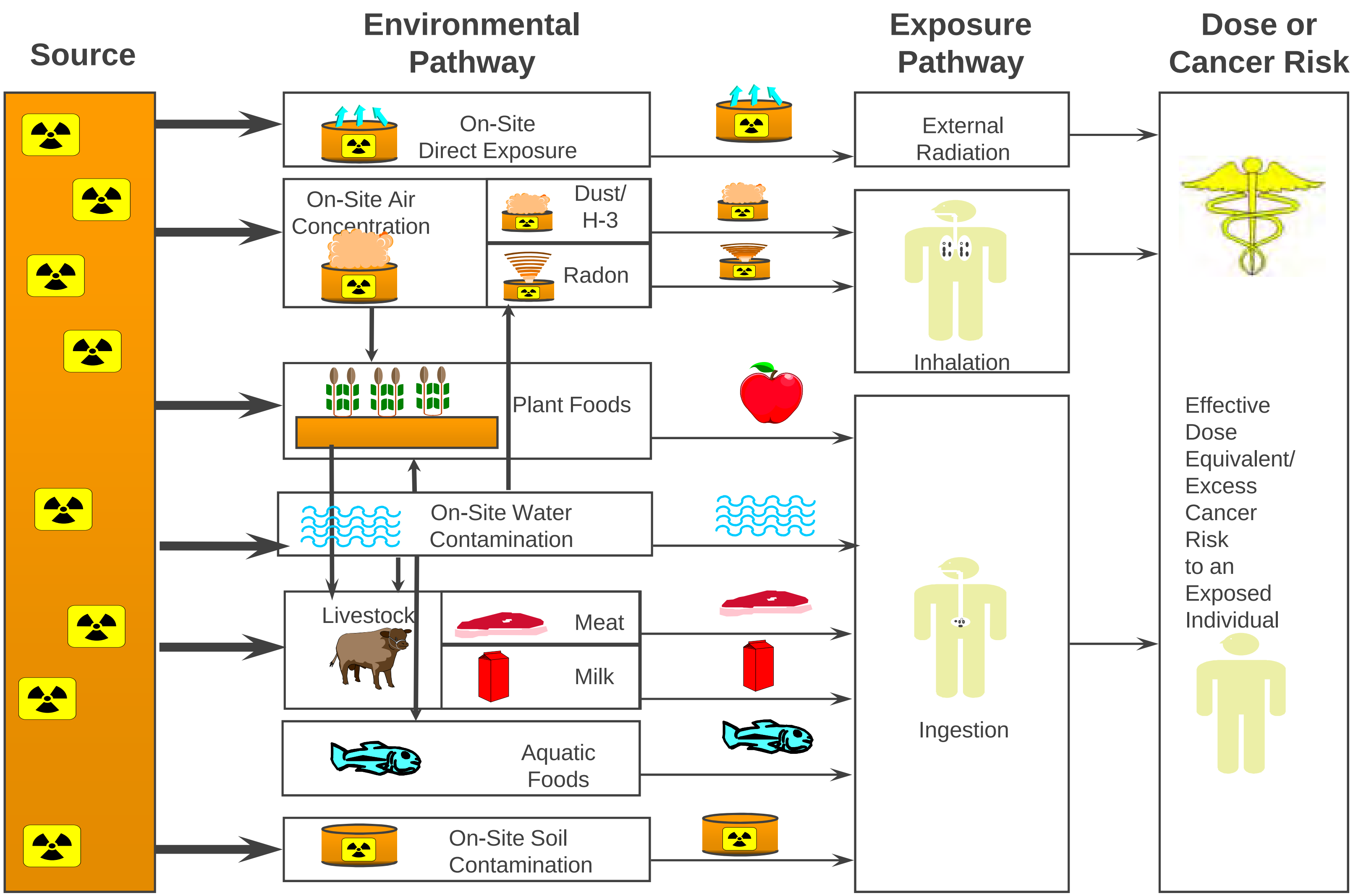
What is Radiological Dose Assessment?

- A radiological dose assessment calculates the amount of radiation energy that might be absorbed by a potentially exposed individual as a result of a specific exposure.
- External doses occur when the body is exposed to radioactive material outside the body; this is primarily a concern for gamma radiation.
- Internal doses occur from exposure to radioactive material taken into the body by inhalation or ingestion; this is a concern for alpha and beta radiation, as well as gamma radiation.
- Depending on the radionuclide, the dose can be localized to specific organs, or distributed across the whole body.

Radiological Dose Assessment Terminology

- Absorbed dose is measured in amount of energy absorbed per unit mass:
  - 1 rad = 100 erg/g
  - 1 gray (Gy) = 1 J/kg
  - 1 Gy= 100 rad
- Equivalent dose is a measure of the biological damage to living tissue resulting from exposure:
  - Expressed in units of rem or Sievert (Sv) (1 Sv = 100 rems)
  - For gamma and beta radiation: 1 rad = 1 rem = 0.01 Sv
  - For alpha radiation: 1 rad = 20 rems = 0.2 Sv
  - 1 mrem = 0.001 rem; 1 mSv = 0.001 Sv
- Effective dose is:
  - A measure of the whole body dose
  - The sum of the doses from both external and internal exposures

Pathway Analysis is Used to Calculate Radiological Dose



What Health Effects Can Result from Radiation Exposure?

- Detrimental effects of ionizing radiation include:
  - Carcinogenesis (can cause cancer)
  - Mutagenesis (can cause mutations in cells)
  - Teratogenesis (can cause birth defects)
  - Acute toxicity (can kill you)
- Large doses of radiation (600,000 – 1,000,000 mrem [6 – 10 Sv]) can cause severe health effects, including death.
- At normal environmental and occupational levels, the most important effect is the increase in the *potential* for developing a latent fatal cancer. (Latent means the cancer manifests itself later in life, long [often years] after the exposure to radiation occurs.)

Radiological Dose Limits

- International agencies have established recommended dose limits for both workers and the general public for different types of activities.
- National regulations have been adopted in many countries based on these recommendations.
- It is commonly accepted that efforts should be undertaken at all times to keep radiological doses "as low as reasonably achievable," which is referred to as the ALARA principle or requirement.
- Average exposure to natural sources of radiation in the U.S. is 3 mSv/yr (300 mrem/yr) – mostly from cosmic radiation and radon.
- Additional exposure can result from medical procedures (exposure from a chest x-ray is 0.1 mSv [~10 mrem]; a CT scan is 15 mSv [~1,500 mrem]).

Worker and Public Effective Dose Limits under Normal Operations (Planned Activities or Practices)

	IAEA	ICRP	EU
General Public	≤ 1 mSv/yr	≤ 1 mSv/yr	≤ 1 mSv/yr
Licensed Workers (over 18 yrs)	≤ 20 mSv/yr	≤ 20 mSv/yr	≤ 100 mSv over 5 consecutive yrs
Reference	Basic Safety Standards (Safety Series No. 15)	ICRP Pub. 60 & Pub. 103	96/29/Euratom Basic Safety Standards

For perspective: background in the U.S. is ~3 mSv/yr; an x-ray is ~0.1mSv, a CT scan is ~15 mSv.

U.S. Nuclear Regulatory Commission established a dose limit for license termination of 25 mrem/yr (0.25 mSv/yr) from residual radioactivity.

The general public dose limits are for exposures in addition to background exposures. ICRP recommends ≤ 0.3 mSv/yr from a single activity.

The IAEA and ICRP worker limit is for dose averaged over a defined 5-year period.

In all standards, the worker dose should not exceed 50 mSv in any single year. The limit for workers age 16-18 is 6 mSv/yr.

EU has established more stringent requirements for workers who might receive an effective dose over 6 mSv/yr (e.g., training, monitoring, recordkeeping).

EU proposes public limit of 0.3 mSv/yr for exposures from NORM industries (2009).

What is Radiological Risk Assessment?

- A radiological risk assessment is an estimate of the probability of a fatal cancer over the lifetime of an exposed individual.
- Radiation cancer health risks are expressed in terms of mortality (death) and morbidity (incidence).
- A risk of 1×10^{-4} means the potential for an exposed individual to have a fatal cancer is one in 10,000 or 0.0001.
- Some considerations:
  - The relationship between dose and development of cancer is well characterized for high doses of most types of radiation.
  - For lower doses, it is not well defined.
  - Risks from low levels of radiological exposure are estimated by extrapolating from data available for high dose exposures.
  - Risk estimates are typically based on a linear/no-threshold model (LNT) that assumes there is no level below which radiological doses are safe.

Dose to Risk Conversion

- Radiological dose can be converted to carcinogenic risk using radionuclide-specific risk coefficients (also called slope factors) developed by the U.S. EPA.
- Often the risk is calculated by applying a dose-to-risk conversion factor to the effective dose (the whole body dose).
- Dose-to-risk conversion factors are identified by organizations such as the International Commission on Radiological Protection (ICRP) and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).
- Sample calculation:
  - Dose = 2.2×10^{-4} Sv
  - Dose-to-Risk Conversion Factor for Cancer Mortality = 5×10^{-2} per person-Sv
  - Risk of Cancer Mortality = $(2.2 \times 10^{-4}\ \text{Sv}) \times (5 \times 10^{-2}\ /\text{Sv}) = 1 \times 10^{-5}$

Many Different Types of Decisions Are Supported by Radiological Dose and Risk Assessment

What needs to be done to manage risk?

- Operational controls
  - What operational controls are needed to ensure radiation exposures are safe and acceptable?
  - Time limitations
  - Access controls
  - Personal protective equipment
  - Storage requirements

Many Different Types of Decisions Are Supported by Radiological Dose and Risk Assessment (cont.)

What needs to be done to manage risk?

- Remediation / decontamination objectives
  - How clean is clean?
  - What are the likely future uses of the site?
  - Can these be controlled?
  - How much remediation / decontamination is needed to ensure doses to future site users are low enough?

Many Different Types of Decisions Are Supported by Radiological Dose and Risk Assessment (cont.)

What needs to be done to manage risk?

- Remediation / decontamination actions
  - How do we get the site clean enough?
  - How effective will different remediation actions be in terms of limiting future radiation exposures?
    - Do nothing
    - Capping in place
    - Excavation
    - Burial
    - Entombment
    - Landfill
    - Groundwater pump and treat

Many Different Types of Decisions Are Supported by Radiological Dose and Risk Assessment (cont.)

What needs to be done to manage risk?

- Treatment, storage, and disposal facility design and operation
  - What are the necessary design and operation features for a facility
    - Protection of workers
    - Protection of the general public
    - During operations
    - Post facility closure

Many Different Types of Decisions Are Supported by Radiological Dose and Risk Assessment (cont.)

What needs to be done to manage risk?

- Addressing uncertainty (sensitivity analyses)
  - What is the uncertainty associated with key site and/or waste parameters?
  - What do we not know enough about in order to make reliable decisions?
- Risk-based standards and regulations
  - What are the appropriate management and cleanup requirements based on potential risk?

What Information is Needed to Conduct These Assessments?

- Characteristics of the source material
  - Specific radionuclides
  - Chemical and physical form
  - Concentration
  - Volume
  - Containment
- Physical setting and location
  - Distribution of the contamination
  - Hydrologic and geologic setting
  - Meteorological setting
  - What is the population density around the site?

What Information is Needed to Conduct These Assessments? (cont.)

- **Exposure Scenarios**
  - Which workers might be exposed?
  - What is the nature of the workers' activities?
  - How might members of the general public be exposed?
    - During remediation or D&D
    - Following closure of the site
  - What are the potential future uses of the site?
    - No future use
    - Agricultural
    - Recreational
    - Industrial
    - Residential
  - Intruder scenarios

What Information is Needed to Conduct These Assessments? (cont.)

- **Exposure Scenarios (cont.)**
  - What are the possible environmental pathways?
    - Onsite direct exposure
    - Surface water or groundwater contamination
    - Soil contamination
    - Plant uptake or ingestion by animals
  - What are the possible exposure pathways?
    - External radiation
    - Inhalation
    - Ingestion

Examples of Available Radiological Dose and Risk Assessment Tools

- RESRAD (RESidual RADioactivity) – Argonne
- TSD-DOSE (Treatment, Storage, Disposal) – Argonne
- RISKIND and RADTRAN (transportation) – Argonne and Sandia National Laboratories
- SimER (Simulation of Environmental Risks) – UK National Nuclear Laboratory
- ReCLAIM – UK National Nuclear Laboratory
- U.S. EPA models: CAP88, COMPLY, PRESTO, GENII-NESHAPs, DCAL
- SAFRAN (Safety Assessment Framework) – Facilia

Dale Till

From: Christine Rowe <crwhnc@gmail.com>
Sent: Thursday, December 19, 2013 2:46 PM
To: DTSC_SSFL_CEQA
Cc: Malinowski, Mark@DTSC; Leclerc, Ray@DTSC; Perez, Marina@DTSC; Dassler, David W; paul. j. costa@boeing. com; Kamara Sams; James A. Elliott, (MSFC-AS10); Merrilee Fellows, (HQ-NB000); John Jones; Stephanie Jennings; Bell, Jazmin; wondolleckjt@cdm.com; Owens, Cassandra@Waterboards
Subject: Christine L. Rowe DTSC SSFL PEIR - Comment 6

Dear Mr. Malinowski,

Last night a member of the Santa Susana community referenced research done by USC relative to the impact of transportation and air quality on children. This research has been done by many researchers in the Los Angeles area. Below is a link to a study done by Dr. Beate Ritz of UCLA.

http://www.environment.ucla.edu/reportcard/article.asp?parentid=1700

This is a story related to diesel trucks from the UCLA website:
http://today.ucla.edu/portal/ut/PRN-project-educates-residents-breathing-232942.aspx

And this story states that nearly 10% of schools are sited near a freeway:
http://www.healthdatabytes.org/nearly-10-of-la-schools-sit-next-to-a-freeway

"Nearly 10% of LA schools sit next to a freeway"

The roads through West Hills, Chatsworth, Canoga Park, and Woodland Hills that these trucks will travel are classified as highways. But they will also take you past schools, preschools, churches where there are programs, parks, and senior facilities.

For the cleanup of the Santa Susana, DTSC must consider the impact of the proposed trucks on the public health in our community. They must also consider the impact of the greenhouse gases on the environment.

NASA's DEIS mentions the ability to pay for carbon credits to offset greenhouse gases. Carbon credits will not protect those in my community who already have lifetimes of being exposed to some of the worst air quality in the nation. These trucks will add to our community health burden.

Respectfully submitted,

Christine L. Rowe
West Hills

Dale Till

From:	Malinowski, Mark@DTSC
Sent:	Thursday, December 12, 2013 8:26 AM
To:	DTSC_SSFL_CEQA
Cc:	Jason Ricks (JRicks@esassoc.com); Deanna Hansen (DHansen@esassoc.com); Hume, Richard@DTSC
Subject:	FW: Christine L. Rowe DTSC SSFL PEIR - Comment 4
Attachments:	Dr. Thomas Mack WestHillsSlides.pdf

From: Christine Rowe [mailto:crwhnc@gmail.com]
Sent: Wednesday, December 11, 2013 7:54 AM
To: Malinowski, Mark@DTSC
Cc: Leclerc, Ray@DTSC; Perez, Marina@DTSC; Owens, Cassandra@Waterboards; James A. Elliott, (MSFC-AS10); peter.d.zorba@nasa.gov; Merrilee Fellows, (HQ-NB000); John Jones; Stephanie Jennings; Bell, Jazmin; Dassler, David W; Arthur.J.Lenox@boeing.com; Kamara Sams; wondolleckjt@cdm.com; Tom Eisenhauer; Seckington, Tom@DTSC; Jason Glasgow
Subject: Christine L. Rowe DTSC SSFL PEIR - Comment 4

Dear Mr. Malinowski,

Attached are Dr. Thomas Mack of USCs West Hills slides. I have a rough videotape of Dr. Mack's presentation. He did speak about the SSFL at our meeting, but it is not referenced in his slides. He mentioned the previous worker and community studies done related to the SSFL site. He explained levels of significance. He spoke about cancer clusters as well. - how you determine a true cluster.

Dr. Mack's book - "Cancers in the Urban Environment" does not make any reference, to the best of my memory, to cancers caused by Santa Susana. He does not mention Santa Susana in his book, to the best of my memory, at all. He does explain potential causes of cancers.

http://www.sciencedirect.com/science/book/9780124643512

It is true that we have an elevated incidence of breast cancer in Eastern Ventura County, and in Western Los Angeles County.

However, that incidence is correlated with an upper socioeconomic status and hormones.

Please see Dr. Mack's and Dr. Bate's comments on that in the Ventura County Star:
http://www.vcstar.com/news/2012/sep/30/ventura-countys-breast-cancer-rate-looms-as-one/?print=1

"**"We know that breast cancer is related to the cumulative exposure to hormones," said Dr. Thomas Mack, Cozen's husband and an epidemiologist who wrote a book that tracked the highest cancer rates in Los Angeles County."**

""For breast cancer, those census tracts are Bel Air, Beverly Hills and Encino," Mack said. "They are strictly high social class."

"**The $71,418 median income in Ventura County ranked as the fifth highest among California counties, according to 2010 census estimates. California's three wealthiest counties — Santa Clara, San Mateo and Marin — have breast cancer rates far above the state's.**

"It's well-established in California that rates are highest in non-Hispanic white women in higher socioeconomic classes," Bates said. "We know in general that rates are higher in non-Hispanic white women than in Hispanic women. That's true in Ventura County, and that's true across the country."

""High incidence and low mortality may mean that what is happening is exactly what you want to happen," said Dr. Janet Bates, chief of the cancer surveillance program at the California Department of Public Health. "Cancers are (being diagnosed) early, and women are not dying from them."

This is the link to the American Cancer Society 2013 cancer incidence rates:

http://www.cancer.org/research/cancerfactsstatistics/cancerfactsfigures2013/index

"This annual report provides the estimated numbers of new cancer cases and deaths in 2013 as well as current cancer incidence, mortality, and survival statistics and information on cancer symptoms, risk factors, early detection, and treatment. About 1,660,290 new cancer cases are expected to be diagnosed in 2013, and in 2013 about 580,350 Americans are projected to die of cancer, almost 1,600 people a day. Cancer remains the second most common cause of death in the US, accounting for nearly 1 of every 4 deaths.

The topic of this year's special section is pancreatic cancer."

DOWNLOAD CANCER FACTS & FIGURES 2013

I would like to point out that there is a difference between incidence of cancer and mortality from cancer.

Furthermore, you cannot extrapolate the former employee exposures to the community populations. While some community members may cite the number of claims made by former DOE employees at four DOE sites (all considered by NIOSH as AREA IV of the SSFL), NIOSH could not prove exposures (internal or external) in many cases, but it is obligated to be worker friendly in its compensation if there is any doubt. A surrogate is used for NIOSH potential exposures in these cases.

It was very apparent at last night's meeting that the people who want a strict adherence to the AOCs believe that there is an off site risk from the Santa Susana site. Therefore, it is important that you discuss possible exposure pathways in your DEIS. You need to discuss dose.

Furthermore, DTSC has released some areas such as Dayton Canyon and Runkle Canyon as safe for development. Other locations that were discussed included perchlorates in Simi Valley's groundwater. I do understand that there has been a correlation with the SSFL for perchlorates in Simi groundwater made by one geologist, but I do not believe that the Boeing Expert Groundwater Panel or Tom Seckington ever made the comment that we know the perchlorates in Simi are sourced at the SSFL? Furthermore, we need to know at what locations they were found, at what depths. It should also be pointed out that Simi Valley does not get their drinking water from Simi Valley aquifers.

An explanation of risk is very obviously necessary. One commenter made the statement that there is no safe levels of radiation. However, the more that you dig, the more that you will potentially be releasing larger amounts of naturally occurring radionuclides to the air.

This needs to be discussed. There should be a map that specifically just shows the "NORM" radionuclides found in AREA IV. Maybe some reference points could point out that the features are rock outcrops containing natural sources of uranium, etc.

It is my opinion that for more than half of the community - particularly those who live near Calabasas, Agoura Hills, and Oak Park, you need to make it clear what, if any, exposure pathways that there are to those areas. Both the EPA and DTSC Background Studies were done closer to the SSFL site than some of these communities.

We cannot know what burned in 2005 from a natural fire at the SSFL and blew in various directions. Furthermore, we can't tell what is in the air from any of these natural burns which are frequent in our community including the Camarillo Springs fire of 2013.

I do not know if we can assess what would have been released from engine tests to the air when this was an active site?

It is my understanding that only Xenon and Krypton gases were released at the SRE under a controlled release. That information is in the DOE documents on the SRE.

In the videos that I have given to DTSC, the Senior Engineer at the SRE, Jim Owens, stated that the only time the hand and foot monitors went off at the SRE were during a Russian test. The Junior Engineer that I gave DTSC a video of, Jack Hornor, stated that their alarms at the UCLA reactor went off during a Chinese test I believe. I am not sure if that is in the video or not.

Dr. Beyea's comments related to his original estimates of cancer in 2006, are mentioned on the Enviroreporter here: http://www.enviroreporter.com/2009/07/meltdown-denier/

It is the first comment.

Off site risk is the driver of the fear in my community. Answers to the community's questions related to off site risk, risk from the site now, and potential risk after the soil is remediated need to be answered in the DEIR.

Finally, can you please find out why residents of the San Fernando Valley must disclose their proximity to the Santa Susana site when they sell. I received a notice that I have to notice a future buyer that I am in the "prevailing winds" of the SSFL site - and I am within about 5 miles from the SSFL site; I got this notice more than twenty years ago. I am not sure of the source of that information. Therefore, we need to know if there is any offsite risk for future purchasers of our homes.

Respectfully submitted.

Christine L. Rowe

Cancer by Neighborhood

Thomas Mack, M.D., M.P.H.
Keck School of Medicine
University of Southern California

Neighborhood Cancer Problems

- Worry about a local "cancer cluster"

AND/OR

- Worry about a local hazard that could cause cancer cases

The necessary questions

- How frequently does cancer normally occur?
- What factors predict local cancer frequency?
- How do we identify causes of cancer?
- What are the known causes of cancer?
- What causes are in the residential environment?
- What environmental clusters have occurred?
- What are the problems in assessing clusters?
- What specifics relate to this local concern?

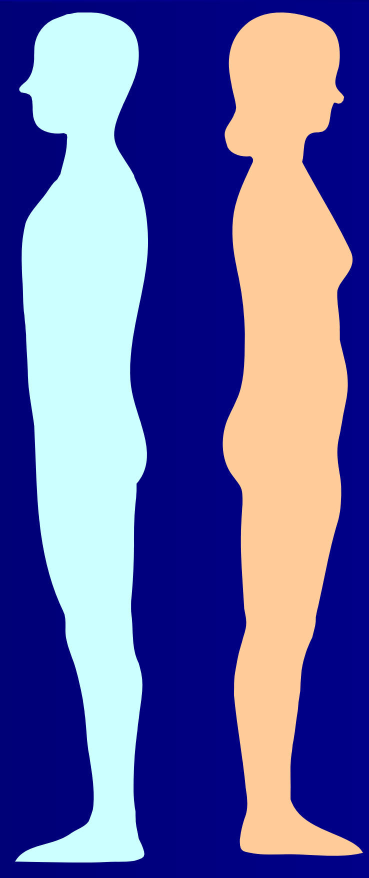
How frequently does cancer normally occur?

- From place to place
- From cancer site to cancer site
- By sex, race, and especially age

Estimated Lifetime US Cancer Risk*

Men 45%

Of Total	
Prostate	15%
Lung & bronchus	6%
Colon & rectum	4%
Urinary bladder	3%
Melanoma of skin	2%
Non-Hodg lymphoma	2%
Kidney & renal pelvis	1%
Leukemia	1%
Oral cavity	1%
Pancreas	1%
Stomach	1%
Any Other Site	8%



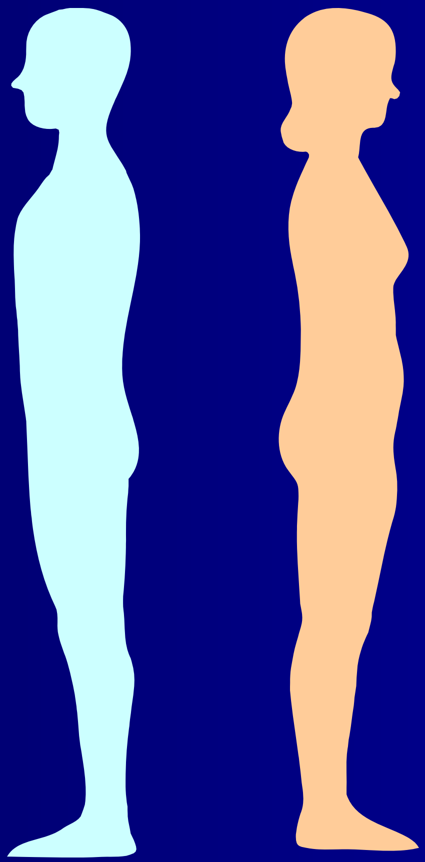
Women 36%

Of Total	
12%	Breast
5%	Lung & bronchus
3%	Colon & rectum
3%	Uterine corpus
2%	Ovary
1%	Melanoma of skin
1%	Thyroid
1%	Kidney & renal pelvis
1%	Non-Hodg. lymphoma
1%	Pancreas
1%	Uterine cervix
1%	Leukemia
4%	Any Other Site

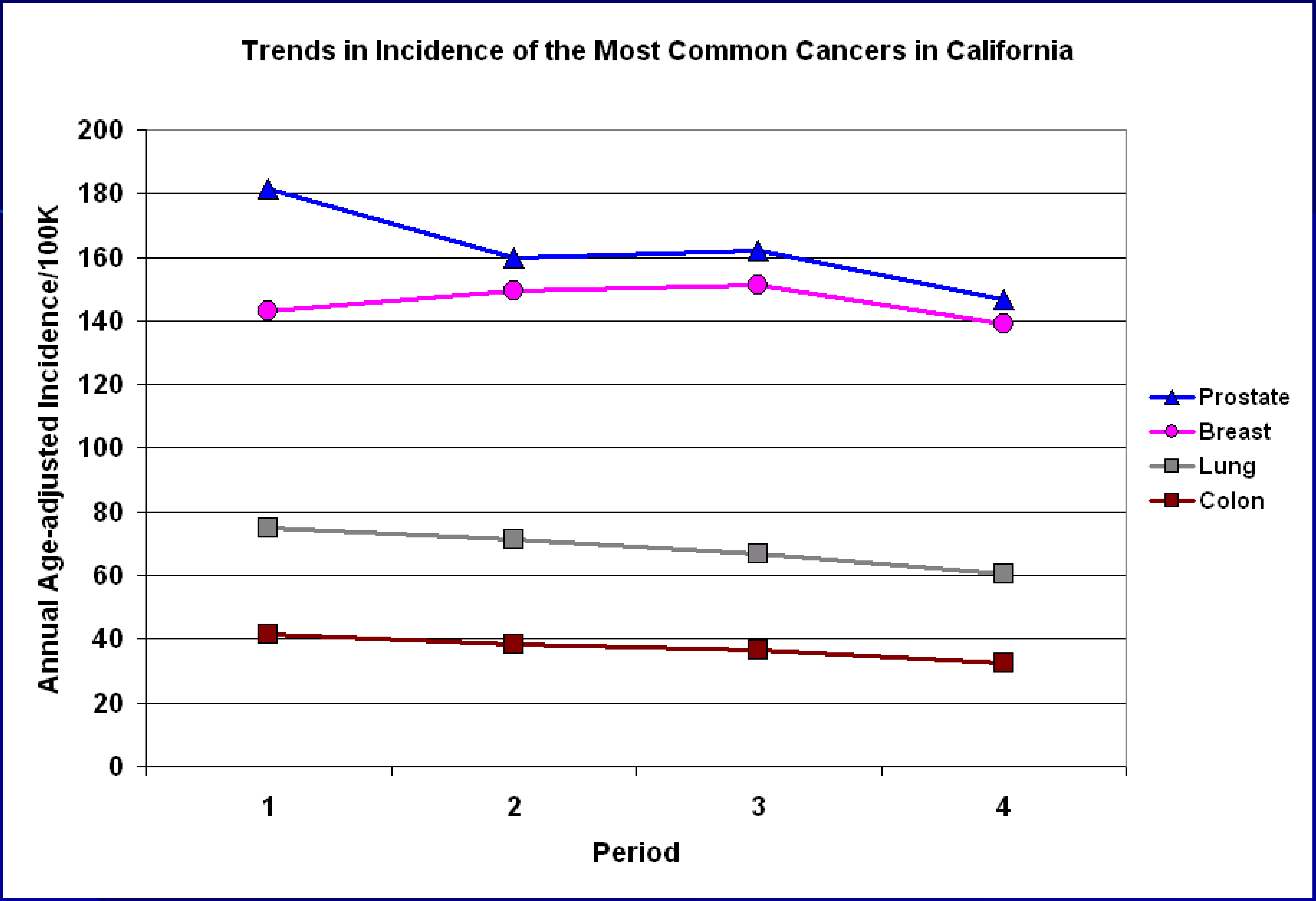
***Excludes basal and squamous cell skin cancers and in situ carcinomas except urinary bladder.**
Source: American Cancer Society, 2009.

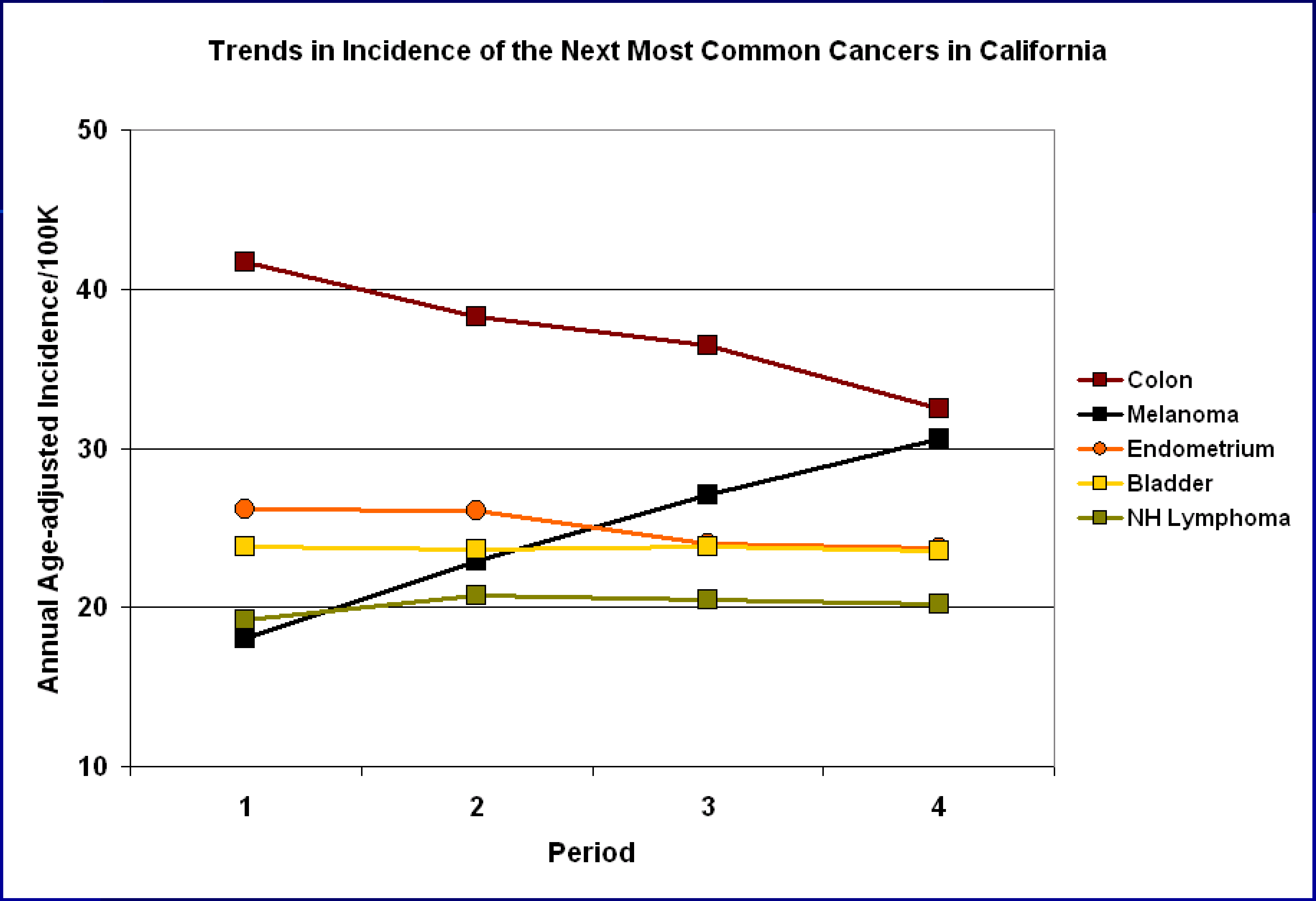
2009 Estimated US Cancer Deaths*

Of Total (Men)		Men 292,540	Women 269,800	*Of Total* (Women)	
Lung & bronchus	30%			26%	Lung & bronchus
Prostate	9%			15%	Breast
Colon & rectum	9%			9%	Colon & rectum
Pancreas	6%			6%	Pancreas
Leukemia	4%			5%	Ovary
Liver & bile duct	**4%**			4%	Non-Hodg. lymphoma
Esophagus	4%			3%	Leukemia
Urinary bladder	3%			**2%**	**Uterine cervix**
Non-Hodg. lymphoma	3%			**2%**	**Liver & bile duct**
Kidney & renal pelvis	3%			2%	Brain/ONS
All other sites	25%			1%	Uterine corpus
				25%	All other sites

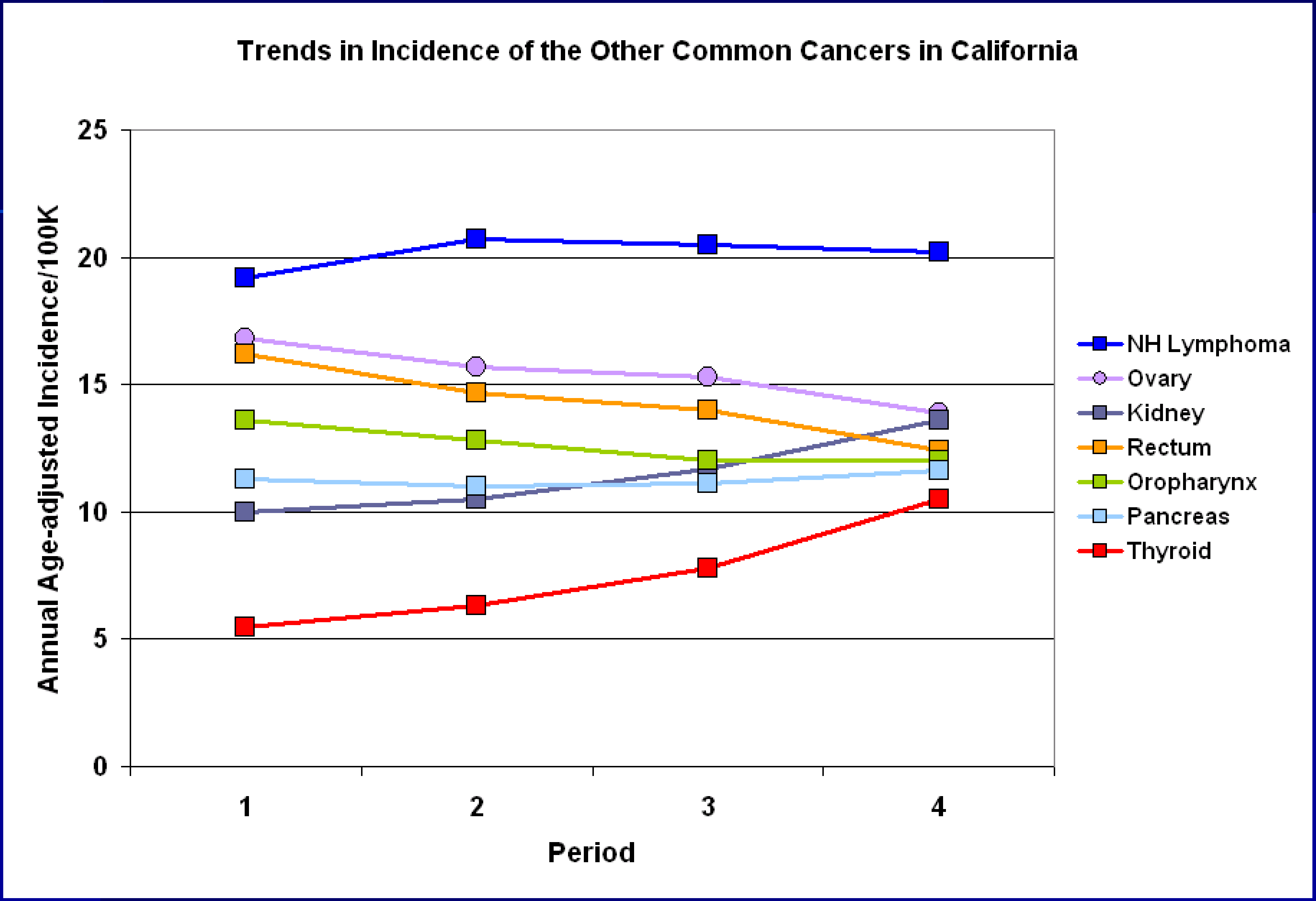


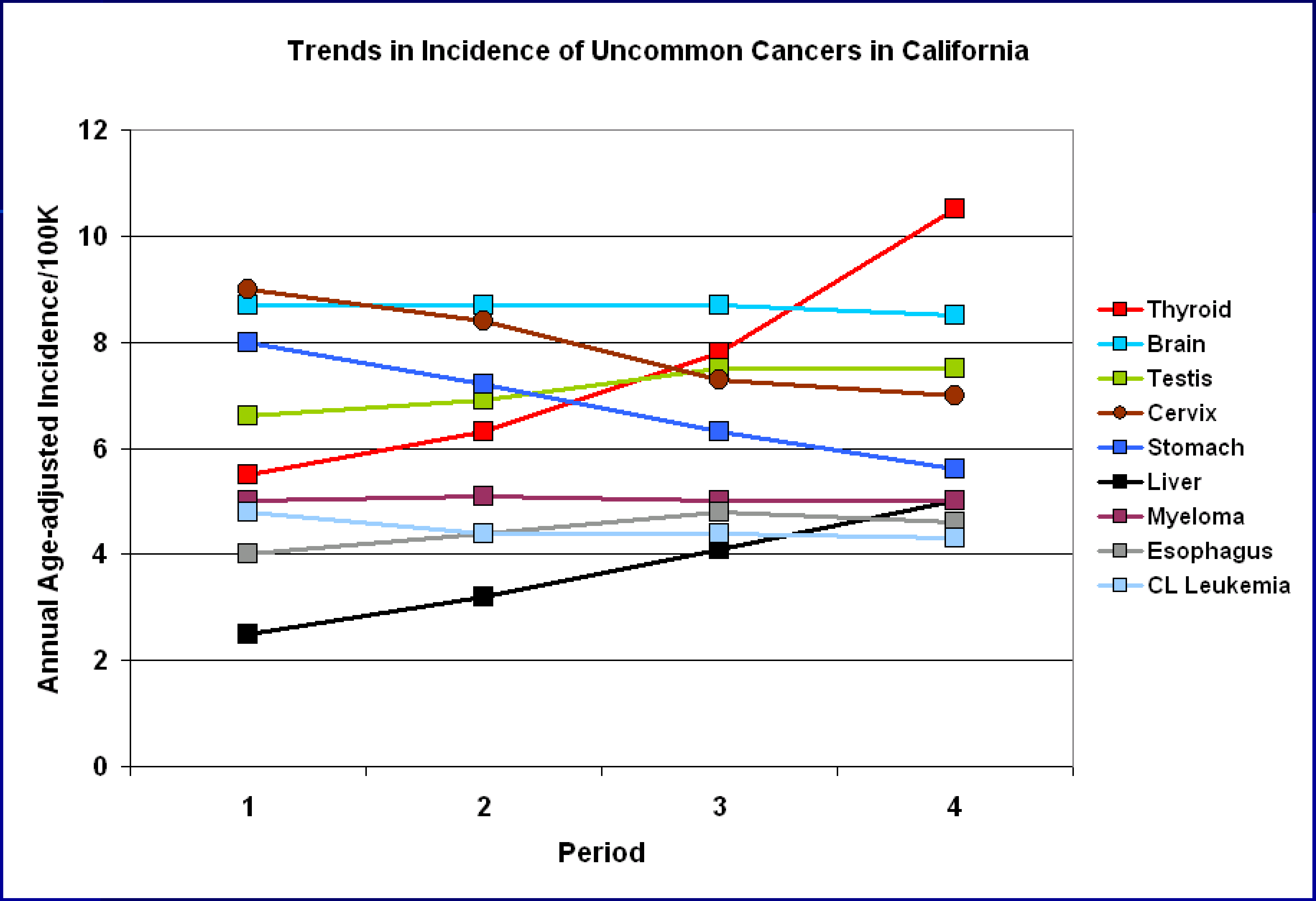
ONS=Other nervous system.
Source: American Cancer Society, 2009.

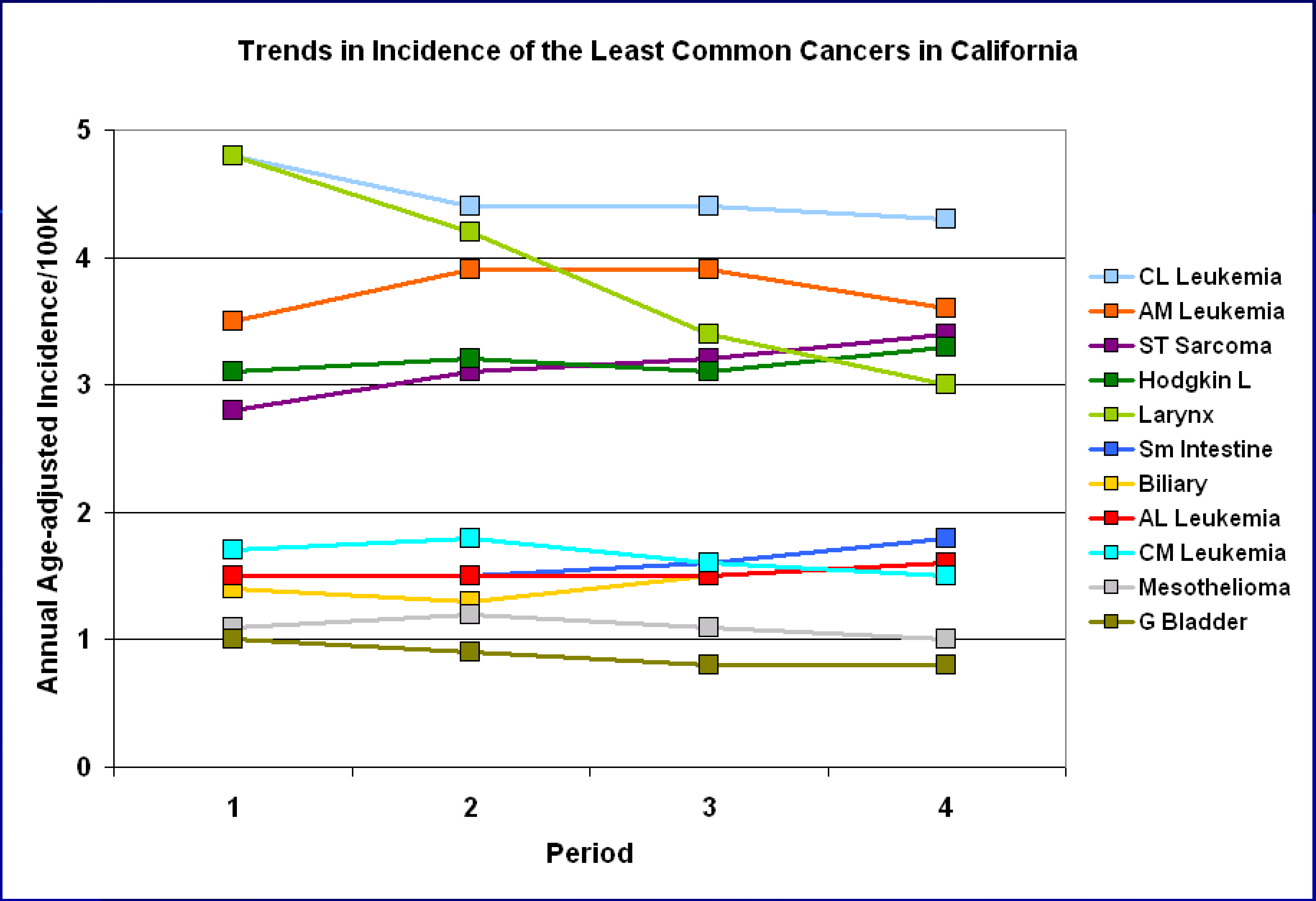

Trends in Incidence of the Most Common Cancers in California
Annual Age-adjusted Incidence/100K
0
20
40
60
80
100
120
140
160
180
200
1
2
3
4
Period
Prostate
Breast
Lung
Colon



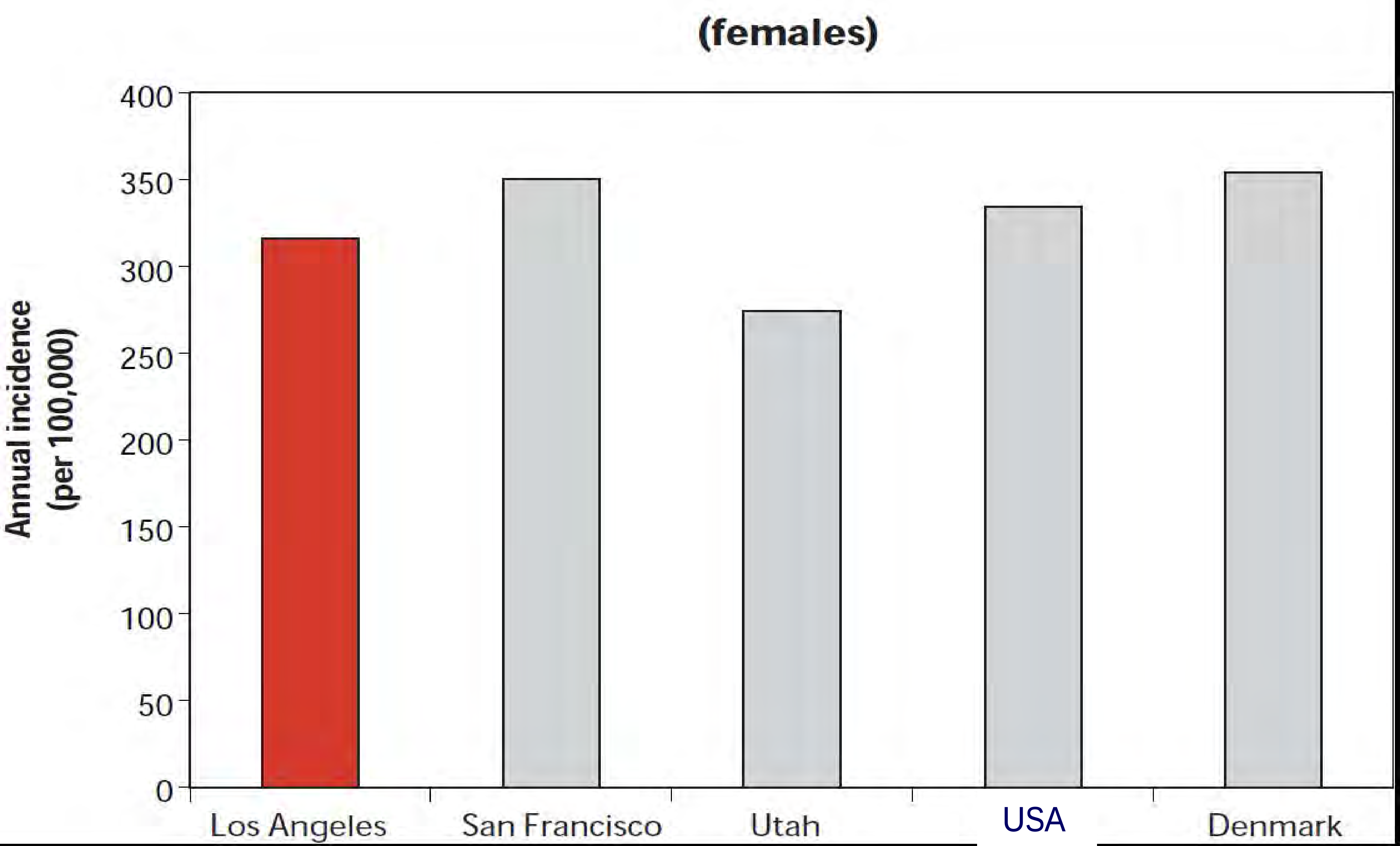
Trends in Incidence of the Next Most Common Cancers in California
Annual Age-adjusted Incidence/100K
50
40
30
20
10
1
2
3
4
Period
Colon
Melanoma
Endometrium
Bladder
NH Lymphoma


Trends in Incidence of the Other Common Cancers in California
Annual Age-adjusted Incidence/100K
25
20
15
10
5
0
1
2
3
4
Period
NH Lymphoma
Ovary
Kidney
Rectum
Oropharynx
Pancreas
Thyroid

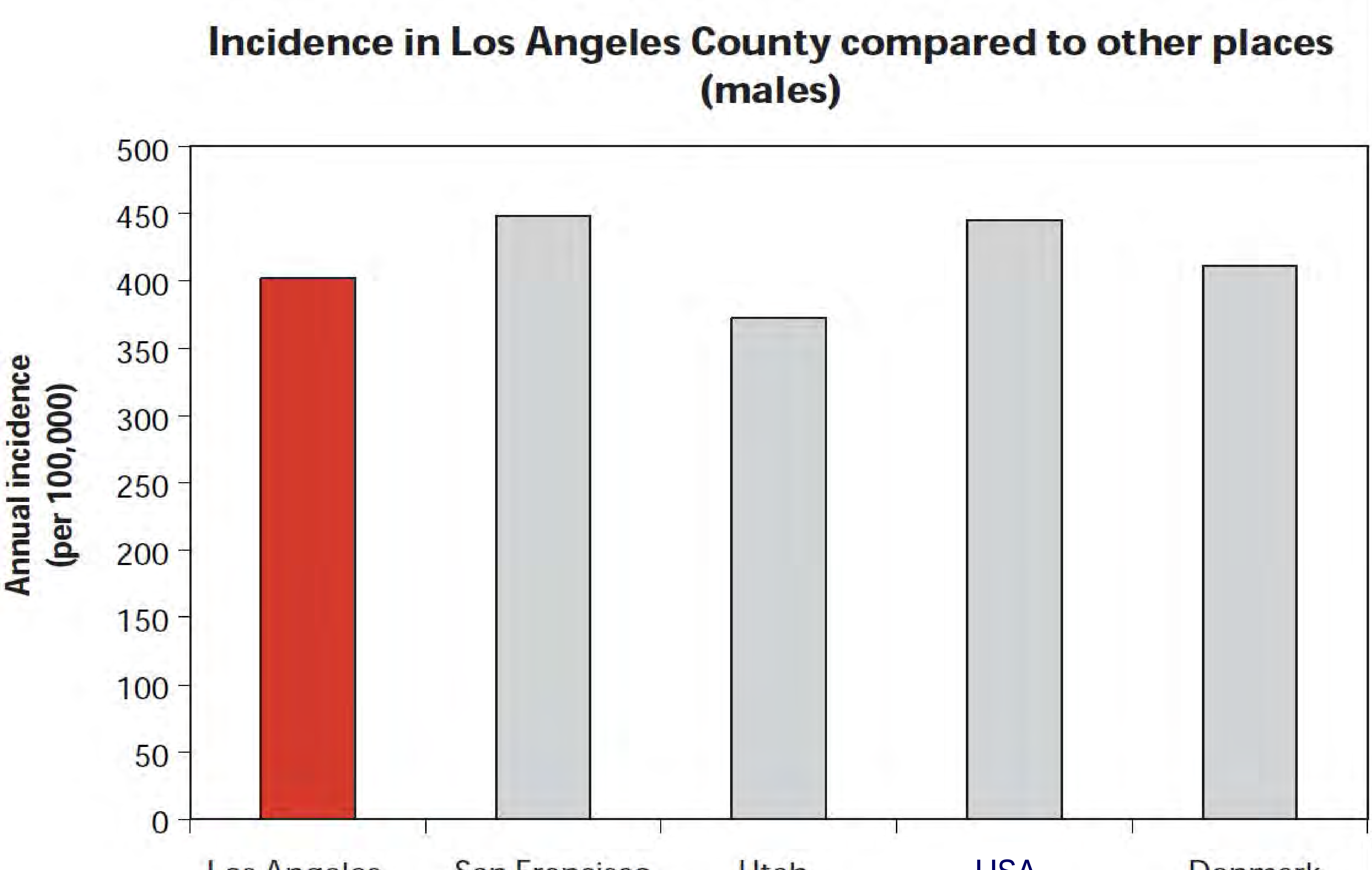

Trends in Incidence of Uncommon Cancers in California
Annual Age-adjusted Incidence/100K
12
10
8
6
4
2
0
1
2
3
4
Period
Thyroid
Brain
Testis
Cervix
Stomach
Liver
Myeloma
Esophagus
CL Leukemia


Trends in Incidence of the Least Common Cancers in California
Annual Age-adjusted Incidence/100K
0
1
2
3
4
5
1
2
3
4
Period
CL Leukemia
AM Leukemia
ST Sarcoma
Hodgkin L
Larynx
Sm Intestine
Biliary
AL Leukemia
CM Leukemia
Mesothelioma
G Bladder

Cancer at All Sites
Los Angeles v. Other Places



Cancer at All Sites
Los Angeles v. Other Places

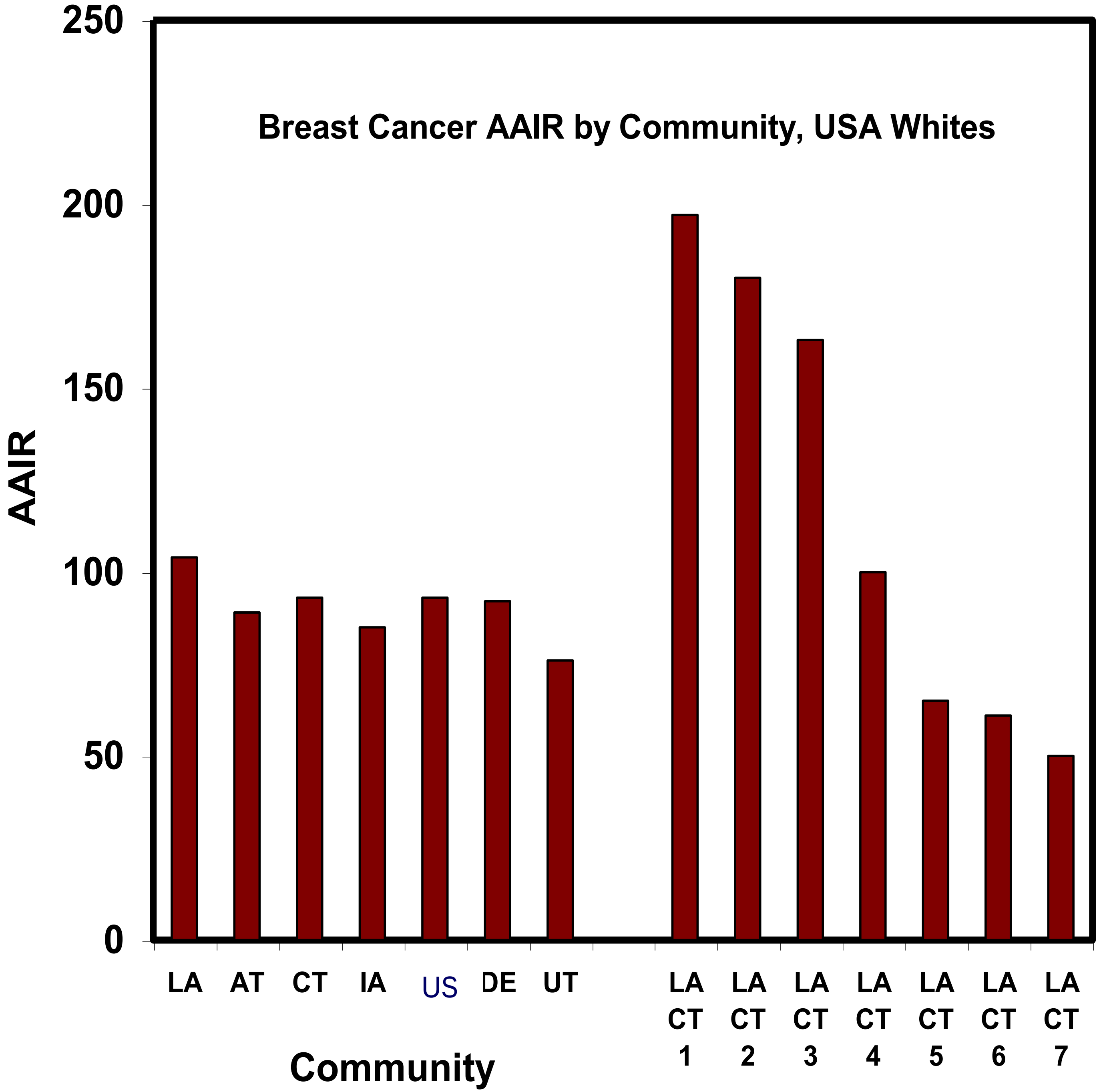


What factors predict local cancer frequency?

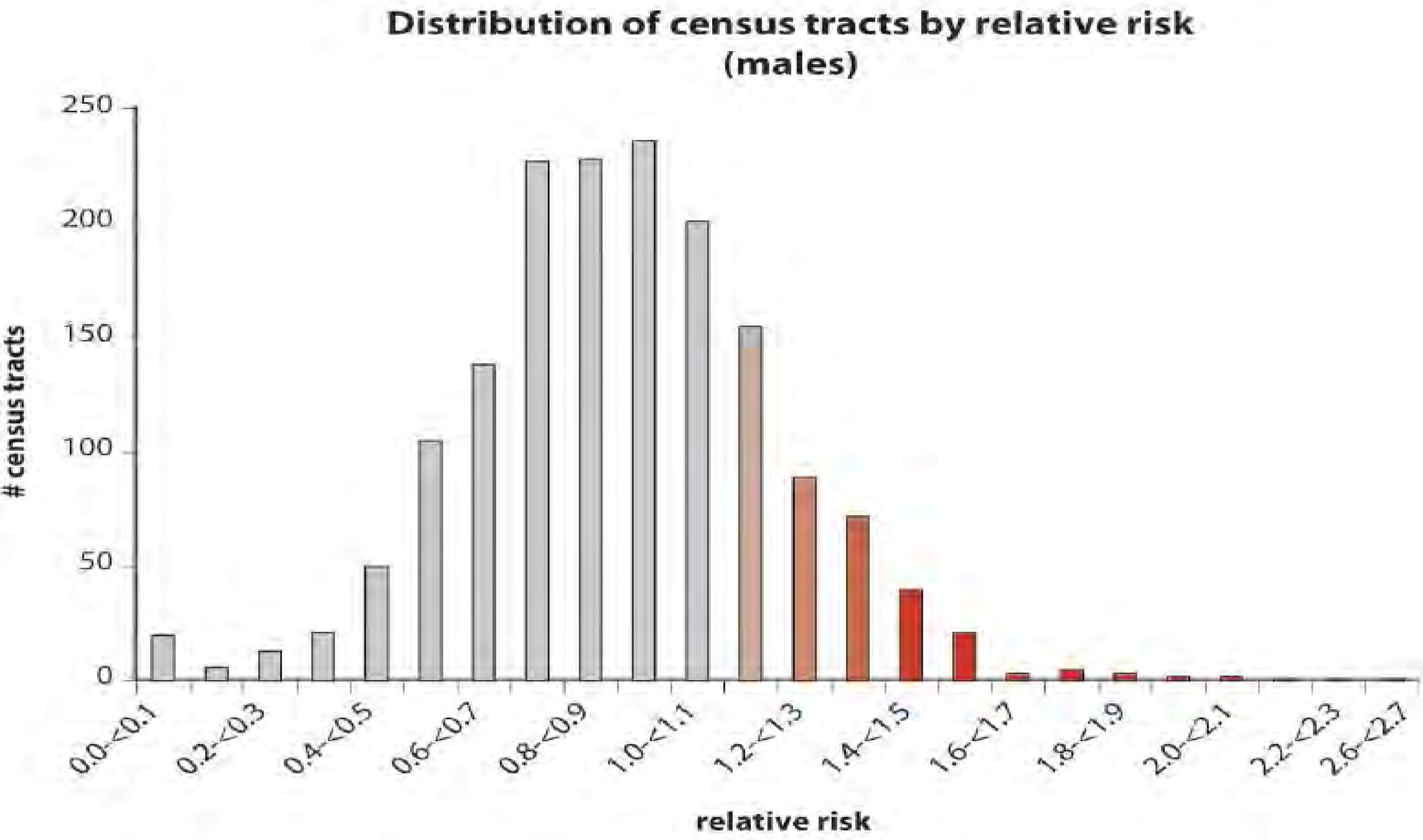
- Los Angeles County

Risk to Neighborhoods is more variable

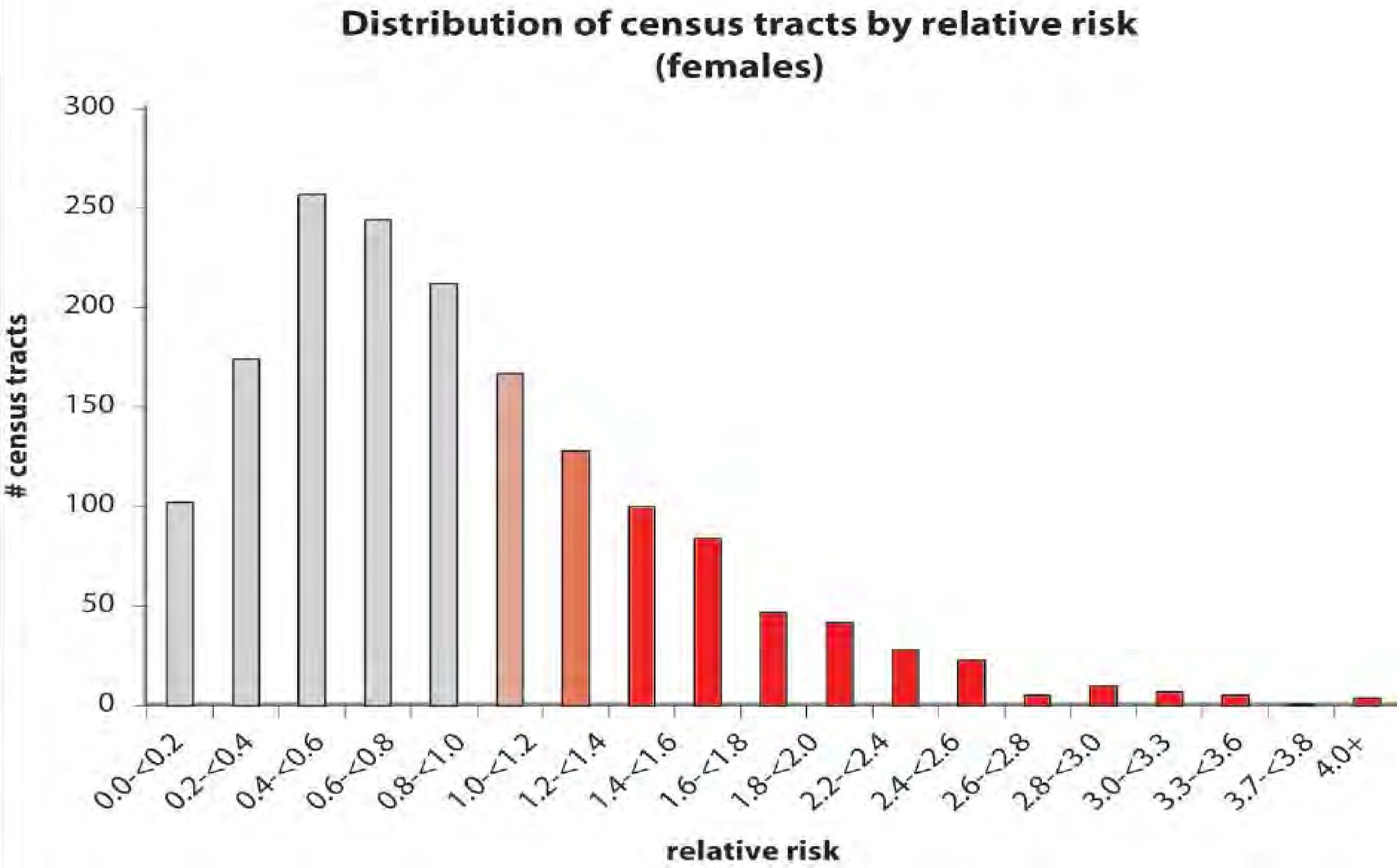
- Residents tend to be similar
- Smaller frequencies make less stable estimates


Breast Cancer AAIR by Community, USA Whites
AAIR
250
200
150
100
50
0
LA
AT
CT
IA
US
DE
UT
LA CT 1
LA CT 2
LA CT 3
LA CT 4
LA CT 5
LA CT 6
LA CT 7
Community

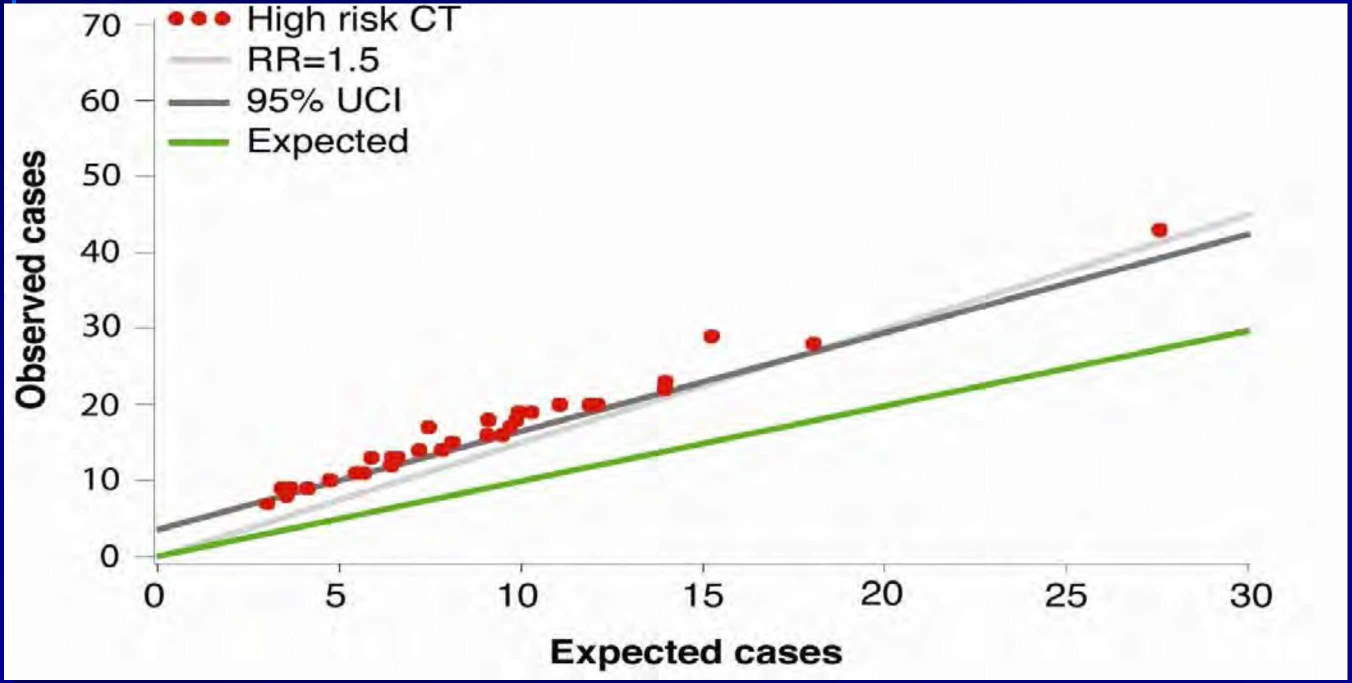
Colon Carcinoma in LA (common)



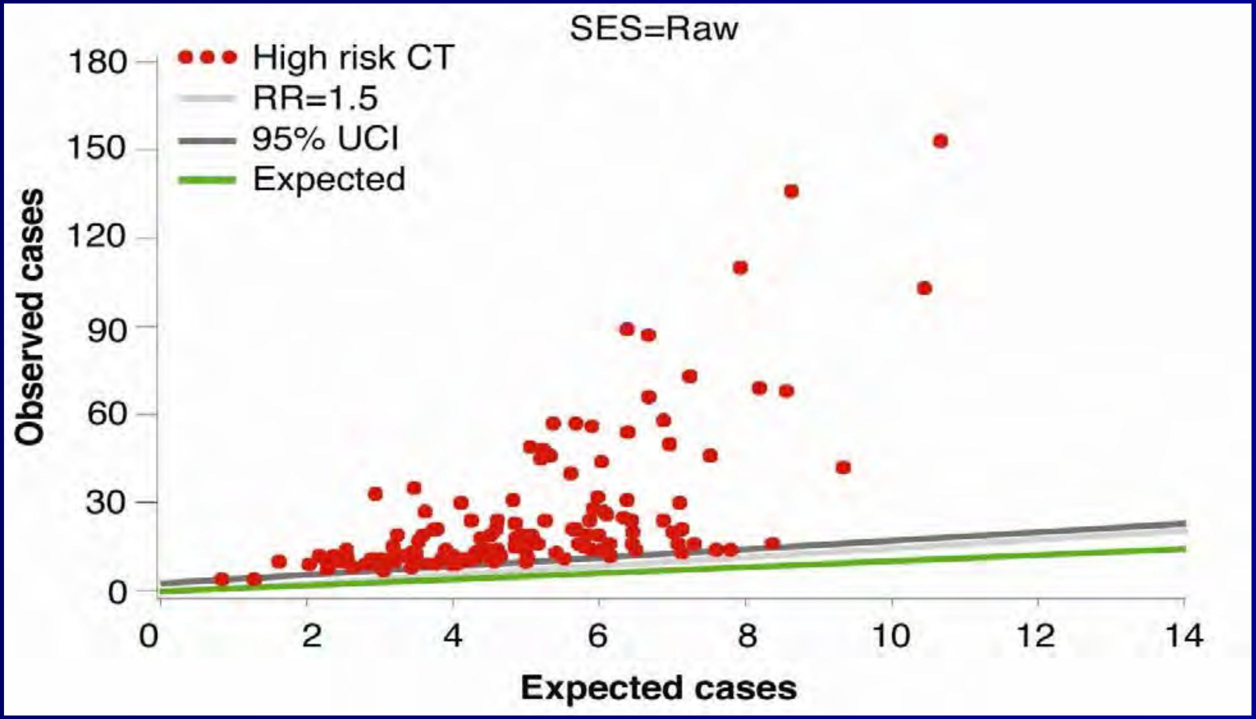
Cervix Carcinoma in LA (rare)



Carcinoma of the Sigmoid Colon, Males



Kaposi Sarcoma, Males

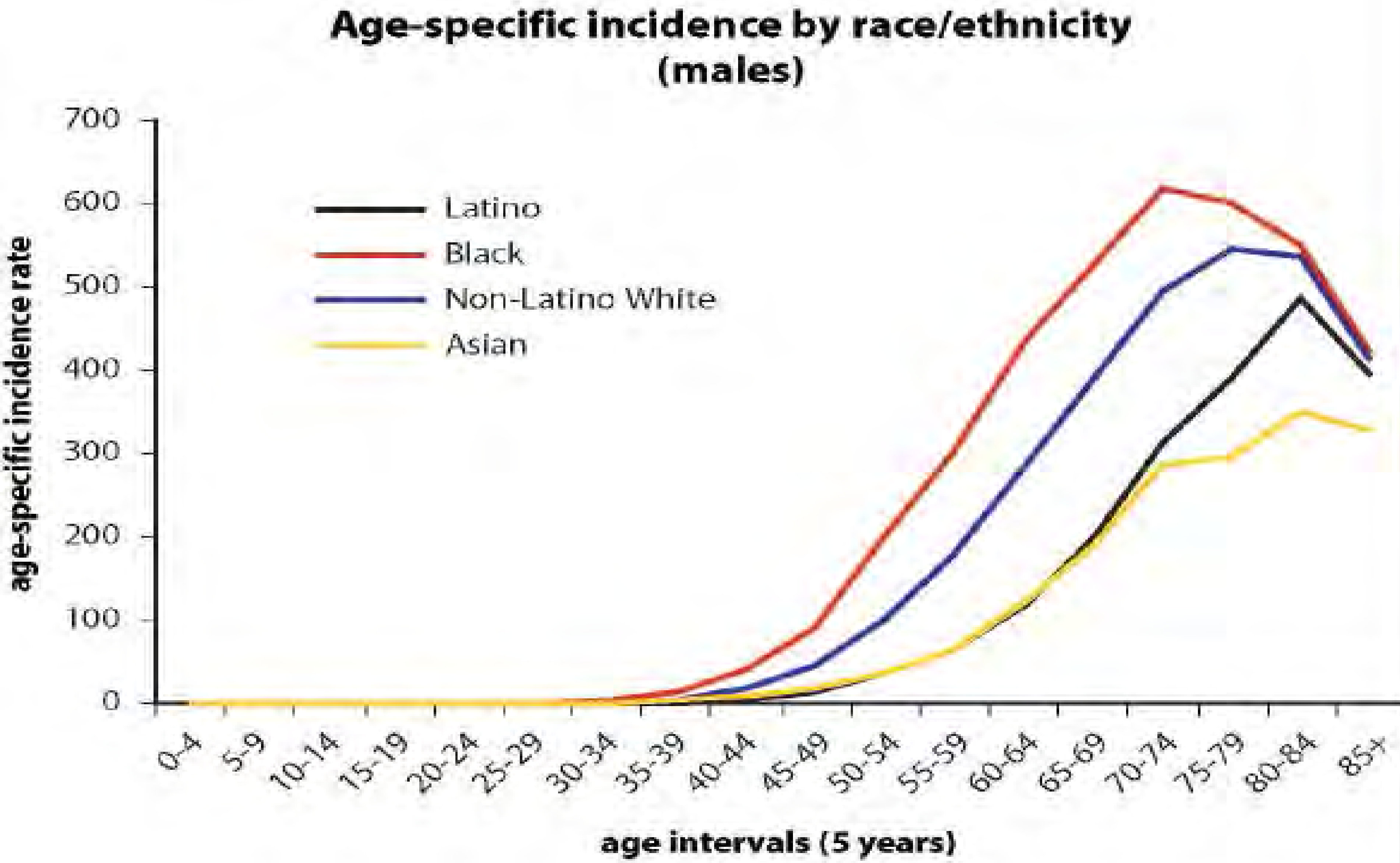


Geographic Variation in Cancer Occurrence

- Chance (especially among small places)
- Demographic gradients
  - Age, Race and Gender
  - Ethnicity and culture
  - Education and income
  - Lifestyle and Occupation
  - Medical care
- Rarely from geographic environment

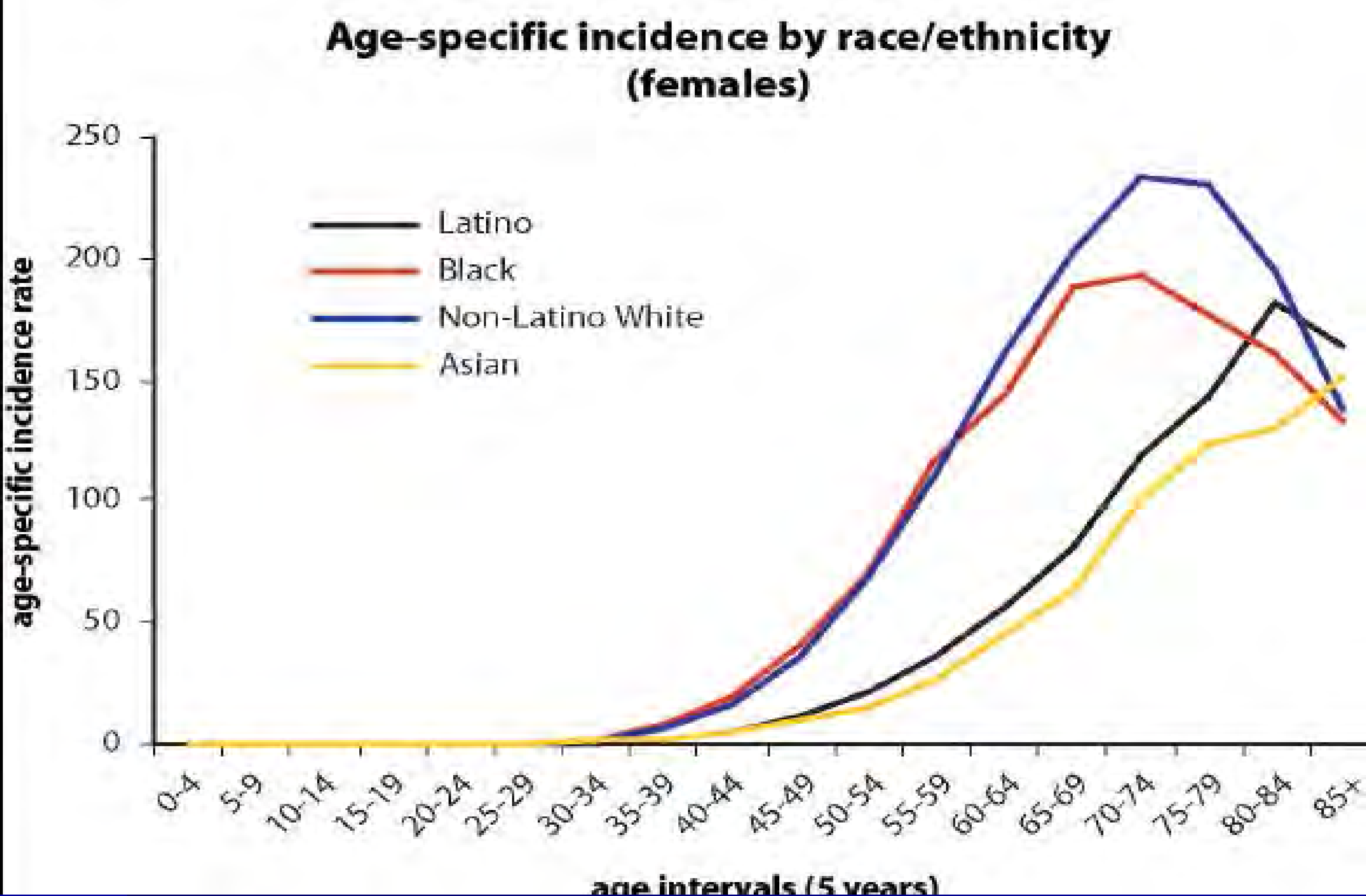
Age, Race and Gender

Lung Cancer

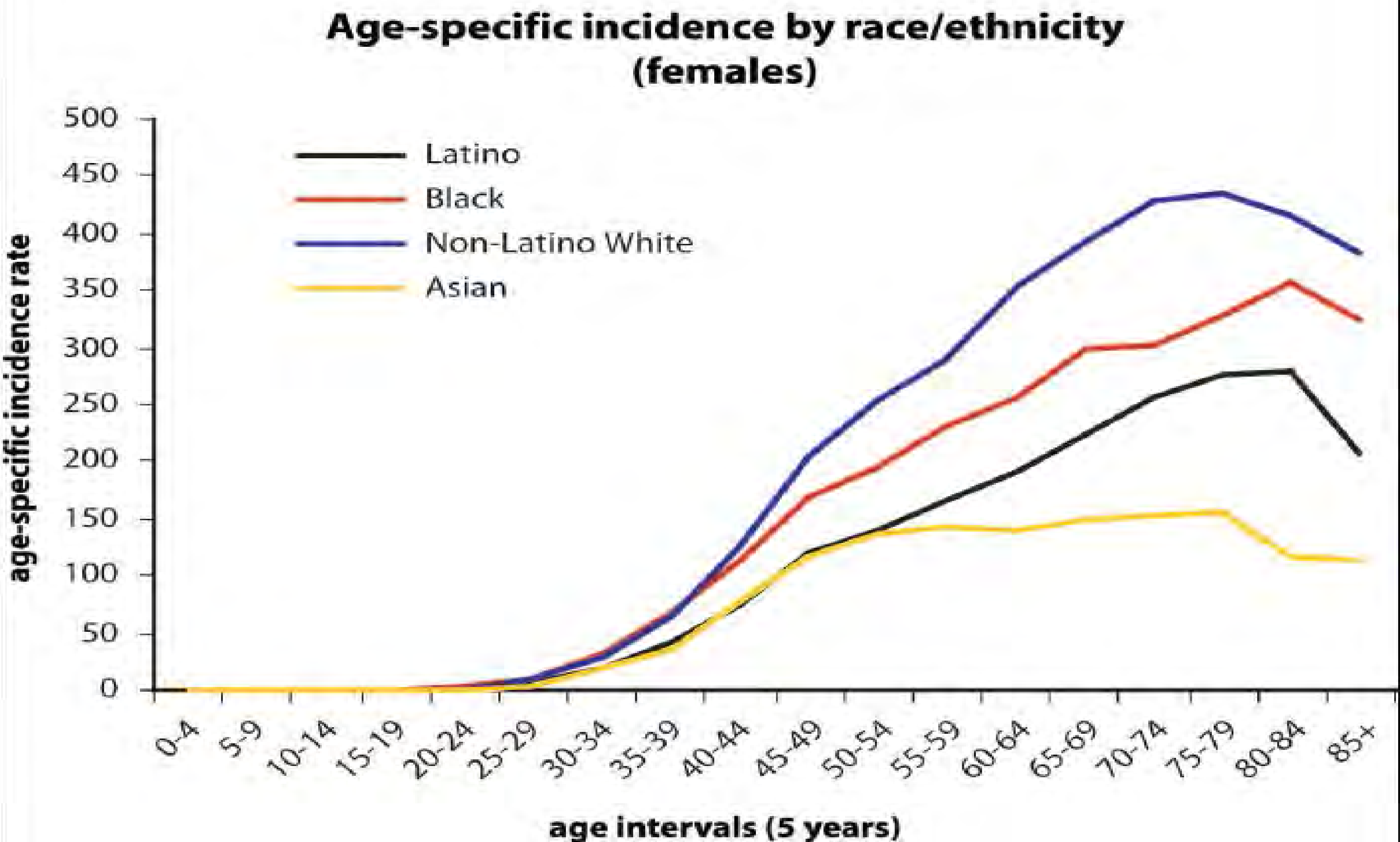


Age-specific incidence by race/ethnicity
(males)
700
600
500
400
300
200
100
0
Latino
Black
Non-Latino White
Asian
age-specific incidence rate
0-4
5-9
10-14
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85+
age intervals (5 years)

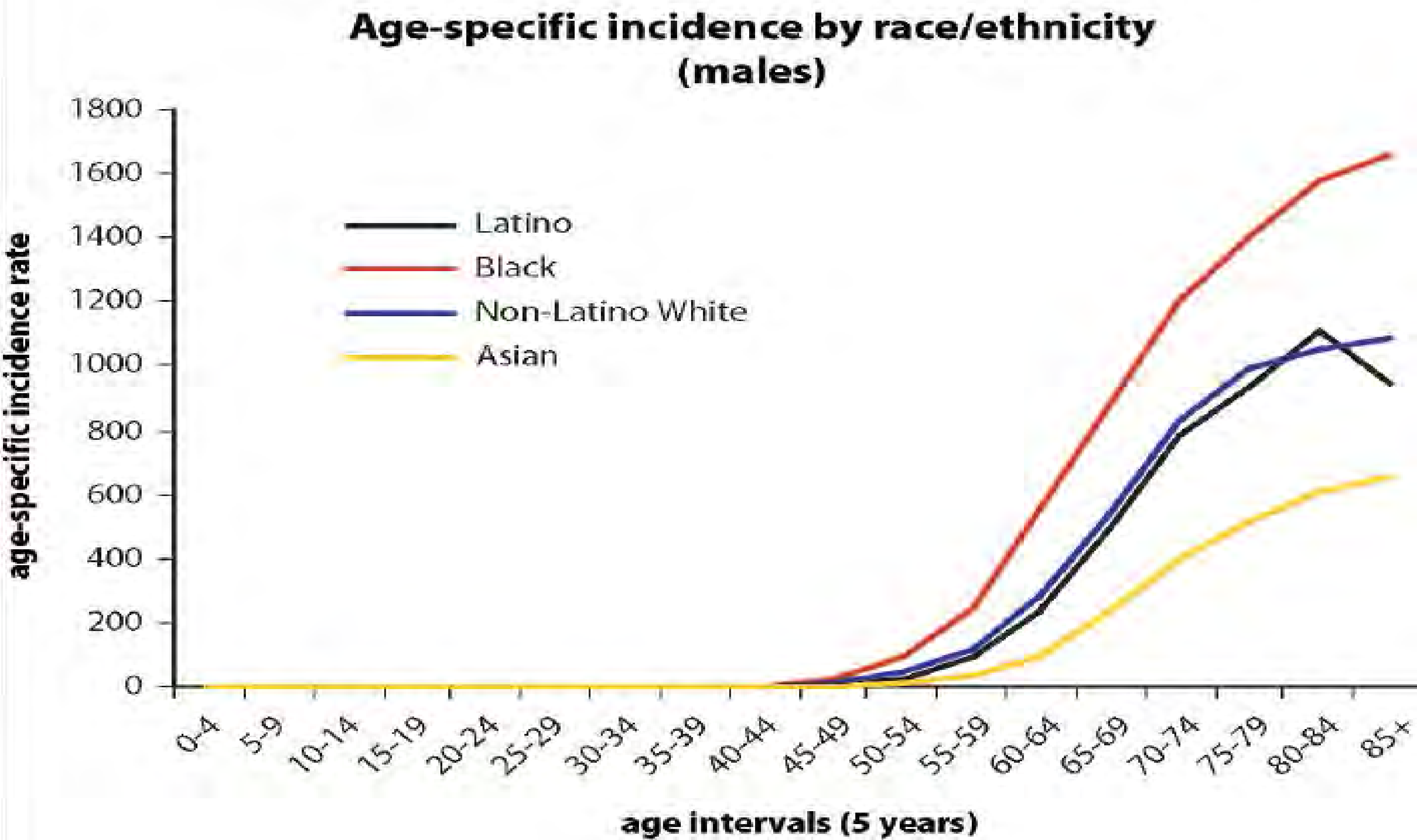
Lung Cancer


Age-specific incidence by race/ethnicity
(females)
Latino
Black
Non-Latino White
Asian
250
200
150
100
50
0
age-specific incidence rate
0-4
5-9
10-14
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85+
age intervals (5 years)

Breast Carcinoma



Prostate Cancer



Ethnicity and Culture

Specific variation in Los Angeles

- Race/Ethnicity
  - Gall Bladder Cancer in Latinas
- Birthplace
  - Liver Cancer in East Asian-Born

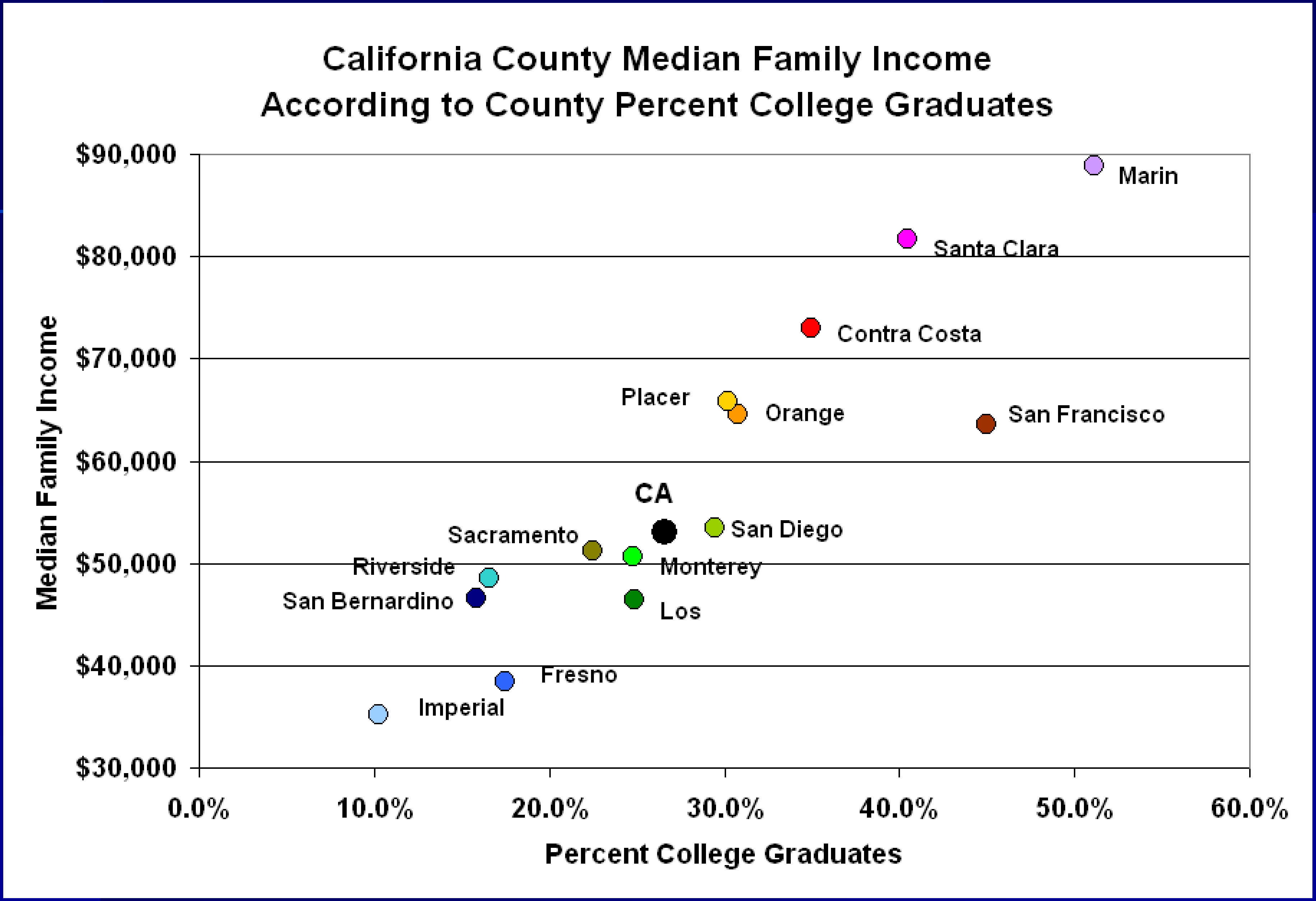
Education and Income

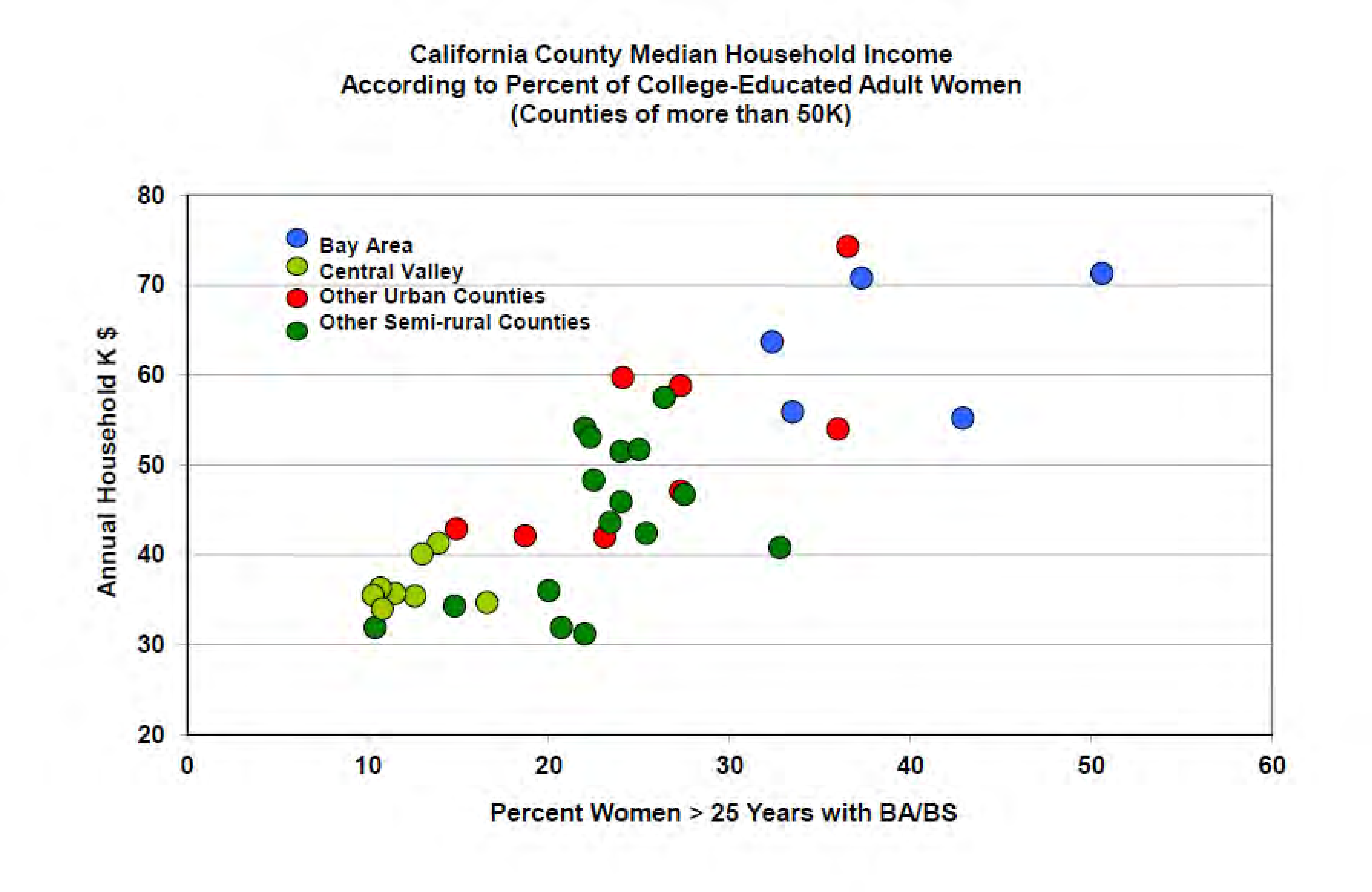
- Variations linked to both extremes
  - High income, much education
    - Unrestricted consumption
    - Abundant medical care, medications
    - Late reproduction
  - Low income, little education
    - Ignorance of risk (tobacco, infections, etc)
    - Paucity of medical care, advice
    - Early Reproduction

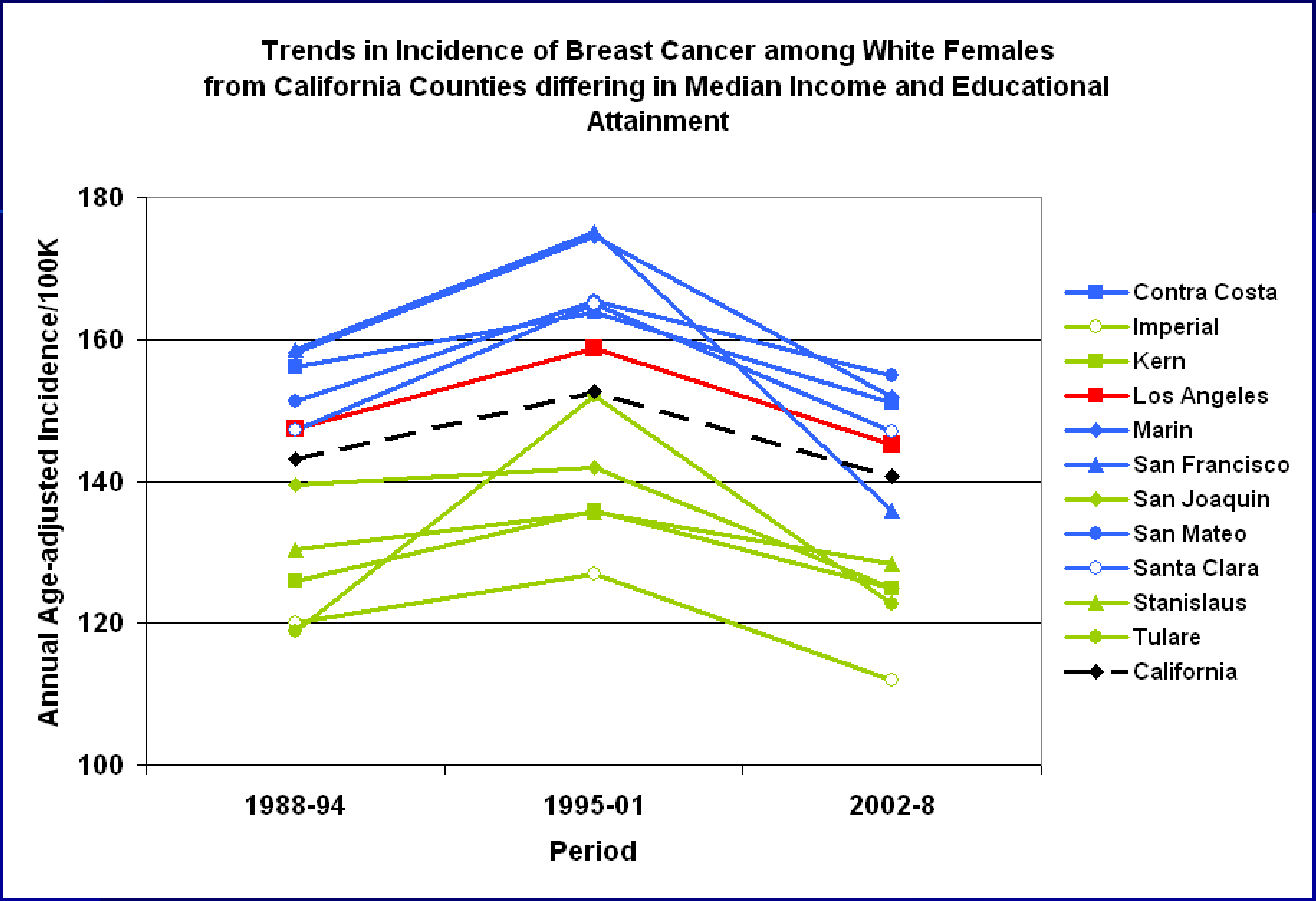
SOCIAL CLASS AND CANCER

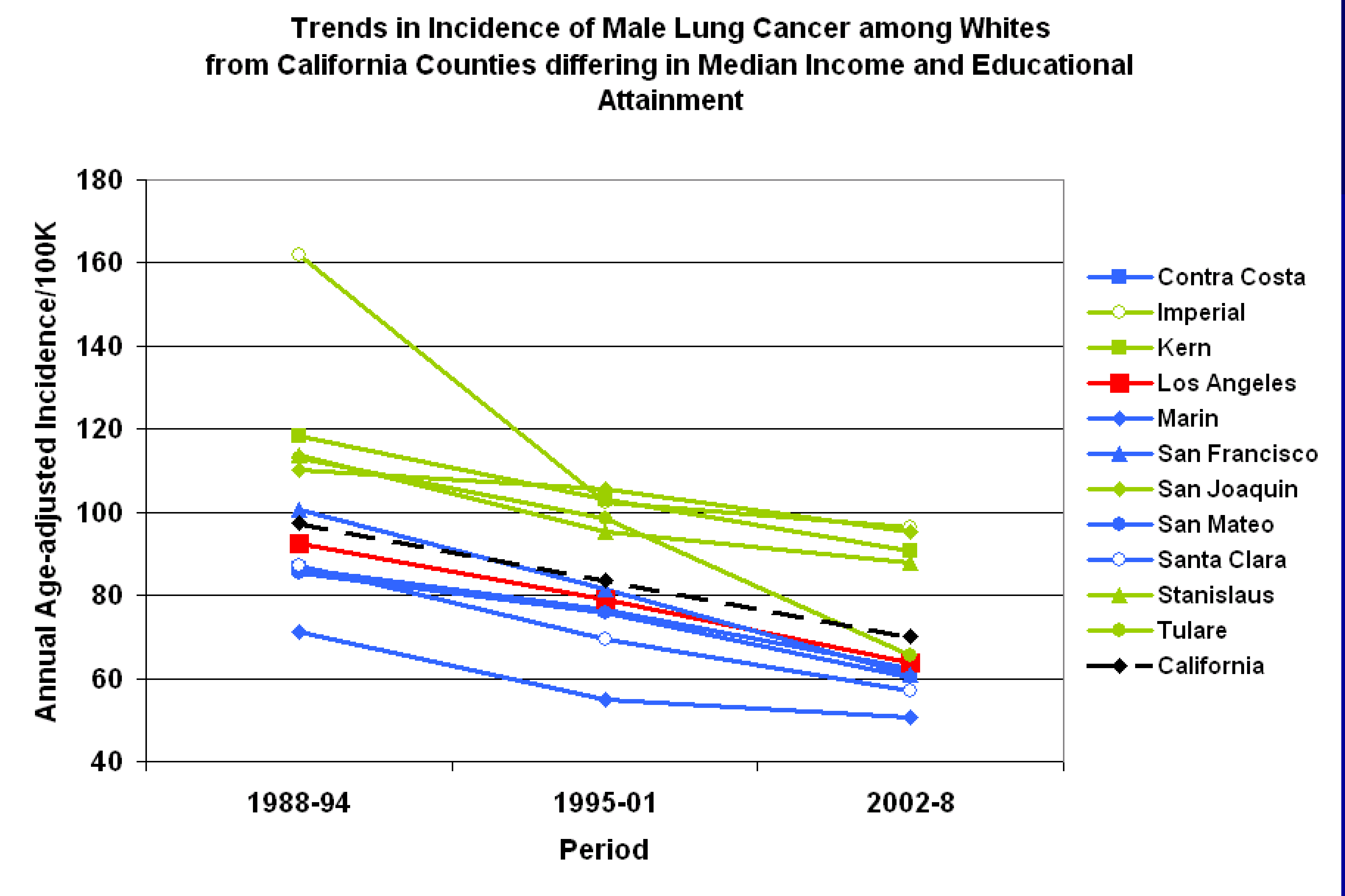
Breast Cancer: High educated tracts, strictly because of social class

Cervical Cancer: Low income tracts, strictly because of social class


California County Median Family Income
According to County Percent College Graduates
Median Family Income
$90,000
$80,000
$70,000
$60,000
$50,000
$40,000
$30,000
Marin
Santa Clara
Contra Costa
Placer
Orange
San Francisco
CA
San Diego
Sacramento
Monterey
Riverside
San Bernardino
Los
Fresno
Imperial
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
Percent College Graduates


California County Median Household Income
According to Percent of College-Educated Adult Women
(Counties of more than 50K)
Bay Area
Central Valley
Other Urban Counties
Other Semi-rural Counties
Annual Household K $
80
70
60
50
40
30
20
0
10
20
30
40
50
60
Percent Women > 25 Years with BA/BS


Trends in Incidence of Breast Cancer among White Females
from California Counties differing in Median Income and Educational Attainment
180
160
140
120
100
Annual Age-adjusted Incidence/100K
1988-94
1995-01
2002-8
Period
Contra Costa
Imperial
Kern
Los Angeles
Marin
San Francisco
San Joaquin
San Mateo
Santa Clara
Stanislaus
Tulare
California



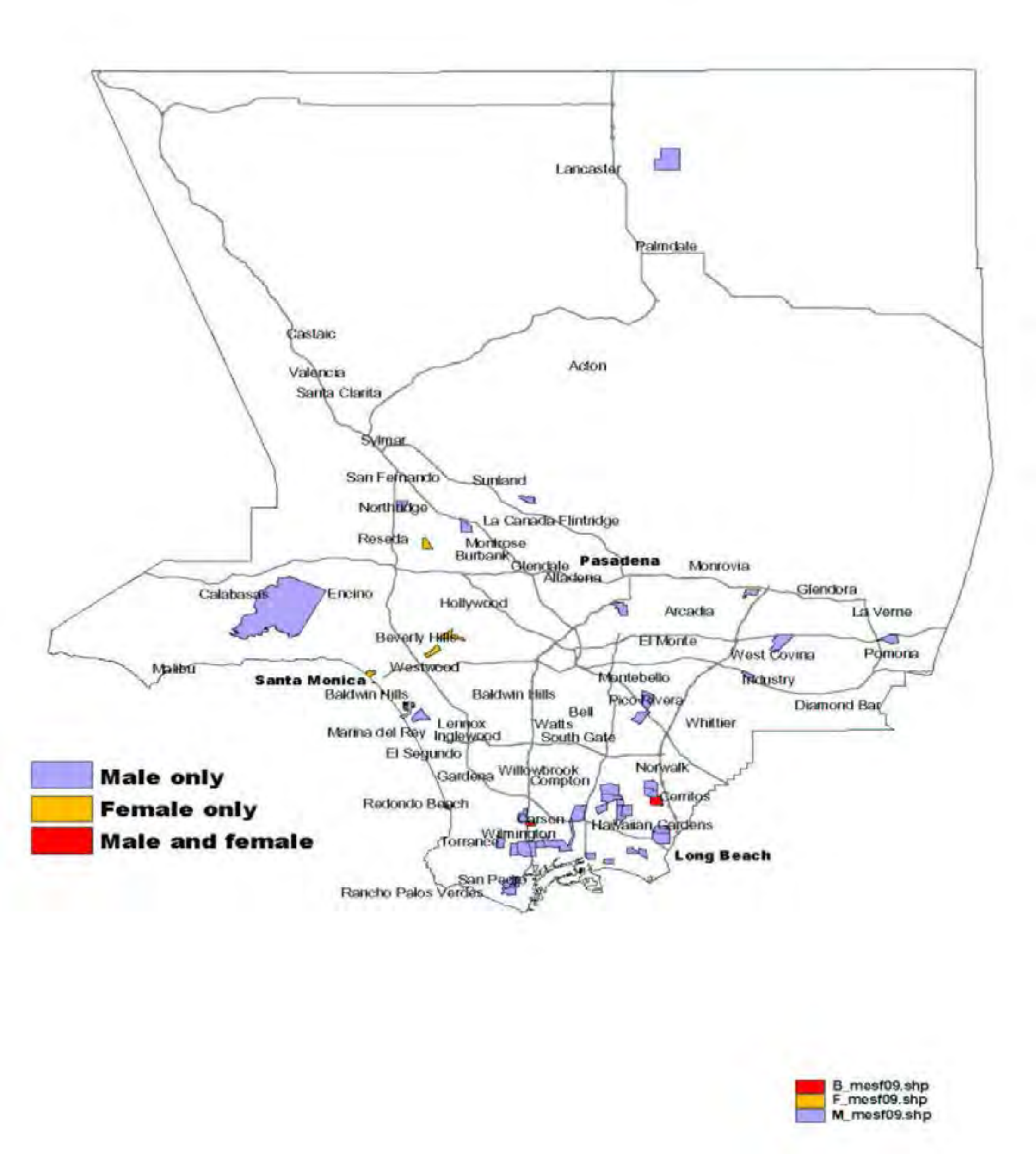
Trends in Incidence of Male Lung Cancer among Whites
from California Counties differing in Median Income and Educational
Attainment
Annual Age-adjusted Incidence/100K
180
160
140
120
100
80
60
40
1988-94
1995-01
2002-8
Period
Contra Costa
Imperial
Kern
Los Angeles
Marin
San Francisco
San Joaquin
San Mateo
Santa Clara
Stanislaus
Tulare
California

Lifestyle and Occupation

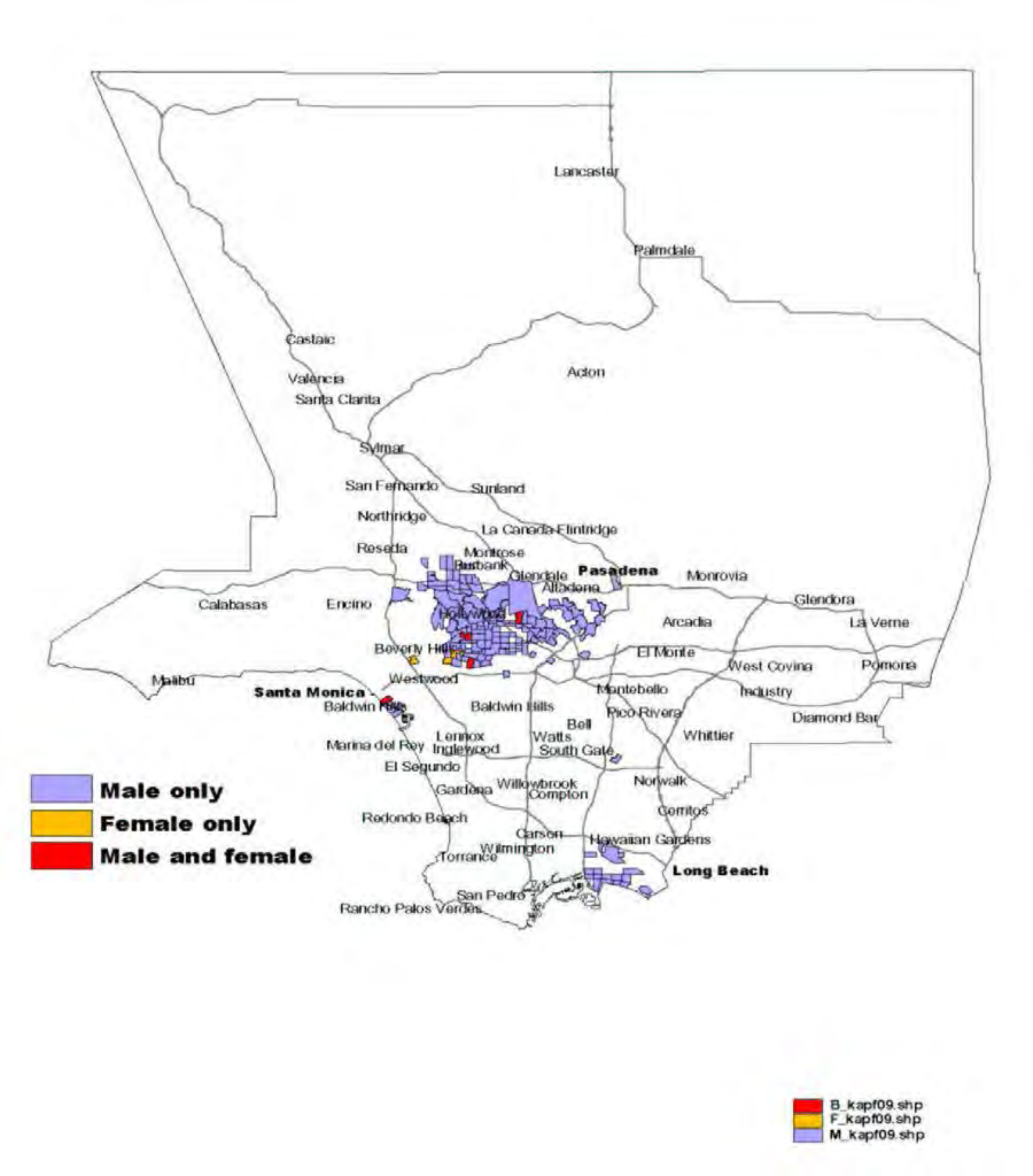
Workplace Exposures

Habits and Recreational Exposures

MESOTHELIOMA



KAPOSI SARCOMA



Medical Care

Selective access to therapy ad libitum
Endometrial Cancer

Selective access to diagnostic facilities, testing
Papillary thyroid cancer, prostate cancer

Selective motivation for screening from media
Breast cancer in a celebrity

WITH CHARACTERISTIC PATTERN

- Oropharynx CA
- Sq Esophagus
- Adenoca Stomach
- Upper Colon
- Hepatoma
- Gallbladder
- Larynx
- Squamous Lung
- Small Cell Lung
- Large Cell Lung
- Adenoca Lung
- Mesothelioma
- Kaposi Sarcoma
- NS Hodgkin's Dis
- Melanoma
- Breast Cancer
- Cervix Cancer
- Endometrial CA
- Prostate CA
- Anogenital Sq CA
- Squamous Bladder
- Papill. Thyroid CA
- Large B-cell NHL
- Immature C. NHL
- Sm.B/Mixed NHL
- Mult. Myeloma

NO CHARACTERISTIC PATTERN

- Mixed Salivary
- Stomach Cardia
- Small Bowel
- Sigmoid Colon
- Rectum
- Cholangiocarcinoma
- Biliary Tract
- Pancreas
- Nose/Sinuses
- Soft Tissue Sarcoma
- Angiosarcoma
- Osteosarcoma
- Ovarian CA
- Germ Cell Carcinoma
- Acute Myelocytic Leukemia
- Bladder
- Kidney
- Wilms Tumor
- Brain
- Retinoblastoma
- Neuroblastoma
- Follicular Thyroid
- Multiple Endocrine Neoplasm
- Mixed Cell Hodgkin's Lymphoma
- Follicular Non-Hodgkin lymphoma
- T-cell Non-Hodgkin Lymphoma
- Acute Lymphoblastic Leukemia
- Chronic Lymphocytic Leukemia
- Chronic Myelocytic Leukemia
- Mixed Cell Genital Neoplasm

How do we identify causes of cancer?

- Cause:
  - Something that if eliminated, prevents cancer
- Genes ~~or~~ and Environment
- Environment or ***Environment***
  - ***Every cause that is not inherited***
- Workplace or Residence
- Factors may predict cancer but not cause it

Genetic Factors (Causal Genes)

- Play a role in all forms of cancer
- Usually create susceptibility to environment
- Usually only a small proportion from any gene
- The most important cause of a few rare cancers