Radiological Release Process

Process for the Release of Land and Facilities for (Radiologically) Unrestricted Use

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Facilities that have been utilized for radiological operations and/or research, are required to be remediated prior to being released for unrestricted use. This release process is implemented to ensure that the facility is restored to a safe, clean status in order to prevent exposing future users to hazards or risks from radiation or radioactivity. Such a process is described in a NRC NUREG report entitled "NMSS Decommissioning Standard Review Plan" (Reference 1). Department of Energy (DOE) facilities generally follow a similar process, and the California Department of Public Health (DPH) generally follow NRC guidance, since California is an Agreement State. This process is outlined below.

- **Radiation Cleanup Standards.** DOE Order 5400.5 (Reference 2) requires DOE contractors to submit for DOE-EM approval, cleanup standards that will be implemented during D&D activities. These cleanup standards cover surface contamination limits for building surfaces, soil radioisotope concentrations and groundwater.

    - Surface contamination limits have been promulgated by NRC (Reference 3), DOE (Reference 2) and DPH (Reference 4). Surface contamination limits for each agency are consistent and Boeing has adopted these limits.

    - In 1994 between EPA and NRC had reached consensus that 15 mrem/y was fully protective of public health. Rockwell developed soil radioisotope concentration limits using the DOE developed RESRAD code, based on a suburban residential scenario and a dose limit of 15 mrem/y. Subsequently, NRC has promulgated a final license termination rule, 10CFR20 Appendix E 20.1402, specifying 25 mrem/y plus ALARA as an appropriate cleanup standard.

    - Boeing adopted, as its groundwater limits, the EPA drinking water MCLs (where they existed) and RESRAD derived limits based on 4 mrem/y (where MCLs did not exist).

    Rockwell (Boeing's predecessor) submitted these cleanup criteria to DOE and DHS for approval in June 1996 by Reference 5. DHS approved the limits in August 1996 with Reference 6 and DOE-EM approved this document in September 1996 with Reference 7. In February 1999 Boeing published its "Approved Site-wide Release Criteria for Remediation of Radiological Facilities at the SSFL" (Reference 8). This document was transmitted to the various agencies and stakeholders involved with SSFL and was placed in three public library repositories in the neighboring community.

- **ALARA and Cost Benefit Analysis.** The NRC has established a mathematical framework to determine if it is cost effective to remediate below the established 10 CFR 20.1402 goal of 25 mrem/y or Reg. Guide 1.86 limits. (Reference 1, Appendix D). This process is used to establish an ALARA goal, that is to say, at what point should one remediate below the established 25 mrem/y goal to achieve ALARA.

  Remedial costs, including excavation, sampling, waste disposal, industrial accidents, worker exposure, traffic accidents and public exposure from waste shipping, are balanced against the benefits of person-rem averted by going to lower residual contamination levels. Generic analyses have been performed for soil excavation at SSFL, which confirm the NRC generic conclusion below (Reference 1, Appendix D, page D12).

  > "Meeting the [25 mrem/y] dose limit would be limiting by a considerable margin. Based on these results, it would rarely be necessary to ship soil to a waste disposal facility to meet the ALARA requirement."
  >
  > "In certain circumstances, the results of an ALARA analysis are known on a generic basis and an analysis is not necessary. For residual radioactivity in soil at sites that will have unrestricted release, generic analyses (See NUREG 1496, the examples in this appendix, and other similar examples) show that shipping soil to a low level waste disposal facility is unlikely to be cost effective for unrestricted release, largely because of the high costs of waste disposal. Therefore shipping soil to a low level waste disposal facility generally does not have to be evaluated for unrestricted release."

- **Soil Cleanup Standards based on Risk Models.** Although much of the NRC, DOE and State regulated radiological cleanups are based on dose-based cleanup standards similar to those described above, the EPA Superfund process requires a risk-based approach whereby preliminary soil remediation goals are based on achieving a residual risk in the range of 10^{-6} to 10^{-4} using 10^{-6} as the point of departure. DOE remediation at SSFL will use the risk framework to establish soil cleanup standards after December 2006.

- **Characterization Survey.** A characterization survey determines the extent and type of contamination. This also includes a review of operating history to determine the likely contaminants of concern and to identify if any spills occurred. Frequently sufficient characterization data exists from routine radiation and contamination surveys performed during the operational phase, to circumvent the requirement for a new stand-alone characterization survey. Data from this phase facilitates planning of the cleanup phase in the next step.

- **Decommissioning Plans.** As its name suggests, the written decommissioning plan lays out the technical requirements, schedule, resources, and goals of cleanup. Depending on the size, scope, complexity and hazards associated with the project, other separate plans may be generated at this time. These may or may not be folded

into the decommissioning plan. These include ...

- **Program Management Plan**
- **Health & Safety Plan**
- **Quality Assurance Plan**

- **Decommissioning & Decontamination (D&D)**. This is the step where all contamination is removed from the facility. Depending on the situation this could involve removal of all fuel and equipment, cleaning of surfaces with surface contamination, removal of material with volumetric neutron activation (e.g. concrete and rebar), removal of tanks and drainlines and removal of contaminated soil. This phase is variously known as D&D, restoration, remediation or simply cleanup.

- **Remedial Action Support Surveys.** During D&D, routine surveys of facility surfaces for surface contamination are performed to determine if indeed, a cleanup operation has been effective. If not, then additional remediation is performed. This process is also performed during soil excavation operations. This step in the process ensures that regulatory cleanup goals are not only met, but are exceeded. This is central to the **"as low as reasonably achievable" (ALARA)** process.

- **Radioactive Waste Disposal.** This is the process of characterizing, packaging, shipping and ultimate disposal and burying of waste generated in the D&D step. Disposal of radioactive waste from SSFL occurs at a variety of DOE-approved or NRC-licensed disposal sites including the Hanford Disposal Site in Washington State, and the Nevada Test Site in Nevada. Two main objectives are key to this process.

    - Compliance with DOT shipping regulations for shipment of radioactive materials on public highways

    - Compliance with disposal site waste acceptance criteria (WAC) which mandates documentation to verifiy the characterization (or pedigree) of the waste

- **Final D&D Report.** Upon completion of D&D, a final report is prepared documenting the D&D process, costs, waste volumes generated, and worker exposure incurred.

- **Final Radiological Status Survey.** This step is the process of surveying a facility to ensure that all contamination has been removed to below limits specified by federal and state regulations. These measurements can include measurements for fixed and removable surface contamination, sampling for volumetric activation, sampling for soil contamination and measurements of radiation exposure rates. Guidance for performing such surveys is provided in the **Multi-Agency Radiation Survey and Site Investigation Manual, MARSSIM** (Reference 9). MARSSIM provides a structured and statistical framework by which to demonstrate compliance with appropriate cleanup standards. MARSSIM defines survey designs using the **Data**

Quality Objectives (DQO) process and utilizes **Data Quality Assessment (DQA)** that includes the Wilcoxon Rank Sum (WRS) test to determine if a sampled area meets established cleanup standards. The MARSSIM manual demonstrates the commonality between the MARSSIM process and the RCRA and CERCLA processes. MARSSIM applies to surface contamination of buildings and facilities and to surface soil contamination. It does not apply to construction debris, subsurface soil contamination, surface or sub-surface water, biota, air or volumetric contamination.

The facility owner or contractor, in this case Boeing, usually performs this survey. Key reports prepared to document these surveys are,

- **Final Status Survey Procedure** (Sampling and Analysis Plan)
- **Final Status Survey Report** (Results)

Procedures and results of these surveys are sent to the appropriate regulatory agencies, namely the Department of Energy and the California Department of Public Health Radiologic Health Branch.

- **Independent Verification Surveys**. Independent verification surveys (IVS) are performed by a third party to confirm or verify the prior Boeing final status survey. The DOE contracts with the Oak Ridge Institute of Science and Education (ORISE) to perform an IVS. ORISE reviews the final status survey procedures and results and provide comments and/or questions to DOE and Boeing. Boeing provides written answers to ORISE and DOE. ORISE utilize information in these reports to prepare a work plan for their IVS which it submits to DOE. ORISE then visits the site in order to perform their IVS.

  A similar process is undertaken with the DHS who visit the site to perform a second IVS at approximately the same time period as ORISE.

  ORISE then prepare a final IVS report and submit to DOE who in turn forwards a copy to Boeing. Boeing then forwards a copy of the ORISE IVS report to the DHS and requests either, that DHS release the facility for unrestricted use (Boeing-owned buildings), or that DHS concur with the release for unrestricted use (DOE-owned buildings).

- **Dose and Risk Analysis.** Although not required by established MARSSIM protocols, it is frequently instructive to perform post-remedial pathways dose assessments and risk analyses. This step in the process can demonstrate the effectiveness of the ALARA process in achieving post-remedial levels far below the established regulatory dose goals. It can also be demonstrated that the ALARA process achieves risk levels within the lower end of the 10^{-6} to 10^{-4} CERCLA target risk range, and in many cases achieves risk levels below 10^{-6}.

  For example building surface contamination limits were developed in a 1974 Atomic

Energy Commission Regulatory Guide (Reference 3). It is natural to wonder how these surface contamination limits (in units of disintegrations per minute per 100 cm^2) translate into dose and risk. Such calculations can be performed using RESRAD-Build; a DOE developed computer code. Calculations using post-remedial survey data have shown that facilities released for unrestricted use pose an insignificant dose to an occupant. Similar calculations, using RESRAD-Recycle and IMPACTS, have been performed for building debris shipped to landfills (prior to 2002) and scrap metal sent for recycling (prior to 2000). Again, doses are insignificant.

The recent ANSI/HPS N13.12-1999, Surface and Volume Radioactivity Standards for Clearance (Reference 10) has proposed new isotope specific standards for surface and volumetric contamination based on a 1 mrem/y standards. Comparing the Regulatory Guide 1.86 limits with these new proposed limits shows that RG 1.86 limits are equal or less than 1 mrem/y, thus confirming the Boeing analyses.

- **Certification Docket.** At the completion of the D&D and survey process for a DOE building, a Certification Docket is prepared by Boeing, which includes all key documentation. This includes the approved site release criteria (Reference 8), the DOE approval of these criteria (Reference 7), the final D&D report, the final status survey report, the ORISE IVS report, and the release concurrence letter from DHS (if available). This Docket is submitted to DOE for approval.

- **Federal Register Publication.** For DOE-owned buildings, DOE publishes in the Federal Register, its intent to release the building for unrestricted use. DOE then transmits a letter to Boeing releasing the building for unrestricted use.

- **Removal of Facility from Radioactive Materials License 0015-19.** For Boeing-owned buildings, the DHS transmits a letter to Boeing releasing the building for unrestricted use and issues an amendment to Radioactive Materials License 0015-19, removing the facility from the license.

- **Release for Unrestricted Use.** The legal and regulatory process of "releasing a building for unrestricted use" means that,

    - Approved cleanup standards have been met.
    - DOE and DHS impose no further radiological controls or regulatory oversight for the building or land.
    - DHS removes the building from the Radioactive Material License.
    - The building can be safely used for any other purposes without any further radiological controls.
    - Prior to September 2002, the building could be safely demolished and disposed of at municipal landfills without any further radiological controls. Subsequent to California Executive Order D-62-02 of September 2002 (a.k.a.

Governor's Moratorium) all such decommissioned material is required to be sent instead to a Class 1 hazardous waste landfill.

- Prior to July 2000, any other material from the building, including metal, can be safely reused or recycled without any further radiological controls. Subsequent to July 2000, there is a suspension on recycling of metal from DOE radiological facilities.

References

1. US Nuclear Regulatory Commission, NUREG-1727, "NMSS Decommissioning Standard Review Plan". September 2000.

2. DOE Order 5400.5, "Radiation Protection of the Public and Environment", Chapter 4. January 7, 1993

3. US Nuclear Regulatory Commission, Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors." June 1974.

4. California Department of Health Services, DECON-1, "State of California Guidelines for Decontamination of Facilities and Equipment prior to Release for Unrestricted Use." June 1977.

5. Rocketdyne Document, N001SRR140127, "Proposed Site-wide Release Criteria for Remediation of Facilities at the SSFL." March 11, 1996.

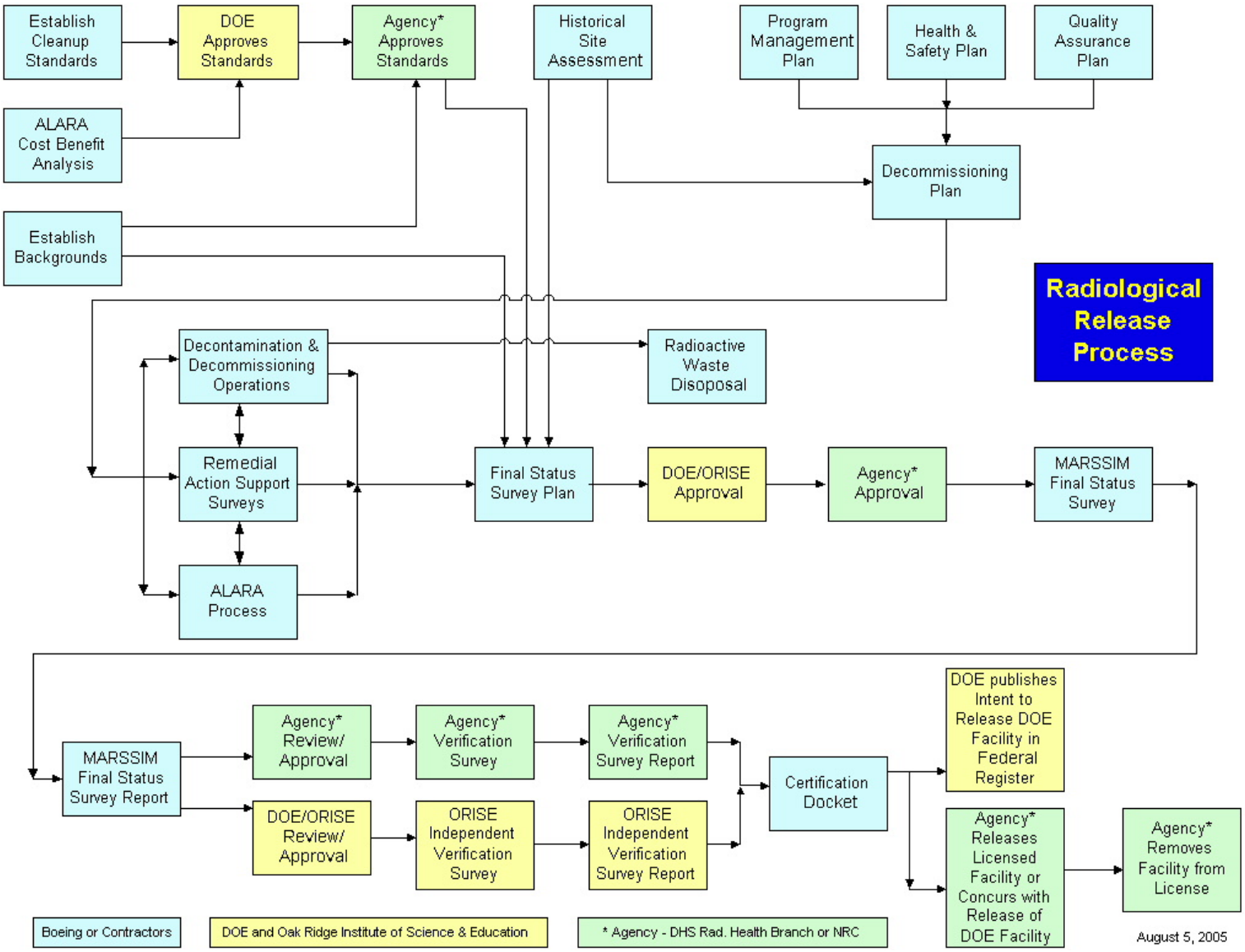
6. Department of Health Services, Letter from Gerard Wong (DHS) to Majelle Lee, "Authorized Statewide radiological Guidelines for Release for Unrestricted Use." August 9, 1996.

7. Department of Energy, Sally Robison (DOE-EM-44) to Roger Liddle (DOE-OAK), "Site-wide Limits for Release of Facilities without Radiological Restriction." September 17, 1996.

8. Rocketdyne Document. N001SRR140131, "Approved Site-wide Release Criteria for Remediation of Radiological Facilities at the SSFL." February 18, 1999.

9. Nuclear Regulatory Commission NUREG-1575. Environmental Protection Agency EPA 402-R97-016. "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)." December 1997.

10. American National Standards Institute, ANSI/HPS 13.12-1999, "Surface and Volume Radioactivity Standards for Clearance." August 31, 1999.


Establish Cleanup Standards
DOE Approves Standards
Agency* Approves Standards
Historical Site Assessment
Program Management Plan
Health & Safety Plan
Quality Assurance Plan
ALARA Cost Benefit Analysis
Decommissioning Plan
Establish Backgrounds
Radiological Release Process
Decontamination & Decommissioning Operations
Radioactive Waste Disoposal
Remedial Action Support Surveys
Final Status Survey Plan
DOE/ORISE Approval
Agency* Approval
MARSSIM Final Status Survey
ALARA Process
MARSSIM Final Status Survey Report
Agency* Review/ Approval
Agency* Verification Survey
Agency* Verification Survey Report
DOE/ORISE Review/ Approval
ORISE Independent Verification Survey
ORISE Independent Verification Survey Report
Certification Docket
DOE publishes Intent to Release DOE Facility in Federal Register
Agency* Releases Licensed Facility or Concurs with Release of DOE Facility
Agency* Removes Facility from License
Boeing or Contractors
DOE and Oak Ridge Institute of Science & Education
* Agency - DHS Rad. Health Branch or NRC
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