APPENDIX E

AIR QUALITY ANALYSIS FOR NON-RADIOLOGICAL POLLUTANTS

E.1 Introduction

Air quality modeling is performed to estimate non-radiological air pollutant concentrations at public receptor locations and Federal Class I areas as a result of air emissions from the proposed action. The Region of Influence (ROI) for the analysis includes public receptor locations and roads as defined for the Idaho National Laboratory (INL) in IDEQ 2011. The ROI also includes the following Federal Class I areas: Craters of the Moon National Monument, Grand Teton National Park, and Yellowstone National Park. The overall objective of the analyses is to demonstrate that National Ambient Air Quality Standard (NAAQS), Toxic Air Pollutants (TAPs), and Prevention of Significant Deterioration (PSD) increments are not exceeded for the various alternatives either separately or cumulatively when added to INL releases. The analyses provide an estimate of impacts based on estimates of facility emissions for the alternatives and emissions from other INL facilities.

Alternatives Analyzed

Three alternatives are analyzed: No Action Alternative, the Overhaul Alternative, and the New Facility Alternative. The following time-frames and durations are used when evaluating air quality impacts in Section 4.6.1 related to these alternatives:

No Action Alternative

The time period evaluated for the No Action Alternative is 45 years.

Overhaul Alternative

- The time period evaluated for the Overhaul Alternative is 45 years.
- The refurbishment period would take place over 33 years in parallel with Expended Core Facility (ECF) operations.
- The post-refurbishment operational period addresses the 12 years after refurbishment when only operational activities would take place in ECF.

New Facility Alternative

- The time period evaluated for the New Facility Alternative is 45 years.
- The construction period (including pre-construction work) would be approximately 5 years and would occur in parallel with ECF operations.
- The transition period would be approximately 5 to 12 years and would overlap with ECF operations.
- The new facility operational period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and examination work continues in ECF.

Emission Estimates for the Proposed Actions

Air pollutant emissions are estimated on an annual basis for the refurbishment period and the post-refurbishment operational period of the Overhaul Alternative, the construction period of the New Facility Alternative, new facility operational period, and INL facilities (which include Naval Reactors Facility (NRF) and ECF) in Section E.2. Air pollutants generated during the transition period and operational period of the New Facility Alternative would be in addition to those described for ECF. The INL baseline emissions include those estimated for all NRF operations (including ECF). Therefore, the transition period is accounted for in the cumulative (new facility operations modeled with other INL facilities) concentration comparisons to air quality standards. This approach provides a reasonable estimate of the pollutant concentrations at receptor locations from all INL activities.

Modeling Methodology

Three computer modeling codes are used to estimate non-radiological air pollutant concentrations at public receptor locations and Federal Class I areas as a result of air emissions from the proposed action: AERMOD, VISCREEN, and CALPUFF. Sections E.3, E.4, and E.5 contain the modeling methodology for AERMOD (EPA 2004a), VISCREEN (EPA 1992a), and CALPUFF Version 5.8, Level 070623 (Scire et al. 2000a and Scire et al. 2000b). The modeling methodology is documented in INL 2013a, INL 2013b, INL 2013c, and K-Spar Inc. 2016. AERMOD is used to model impacts of criteria, toxic, and PSD air pollutants at INL public receptor locations and near field (≤ 50 kilometers (31 miles) from the source) Federal Class I areas. VISCREEN is used to model visibility impacts at near field Federal Class I areas. CALPUFF is used to model PSD at far field (> 50 kilometers (31 miles) from the source) Federal Class I areas. A screening test to evaluate whether visibility, deposition, or ozone impacts would be needed for far field Federal Class I areas (Grand Teton National Park and Yellowstone National Park) is used per recommendations in FLAG 2010, and is included in Section E.4.

E.2 Source Term Development

E.2.1 Source Terms for Emissions From INL Facilities

This section describes the development of source terms for emissions from the INL facilities (including NRF). Primary sources of criteria and toxic pollutants at INL include fuel oil-fired boilers; diesel engines; emergency diesel generators (EDGs); and miscellaneous small gasoline, diesel, and propane combustion sources. The boilers are used to generate steam for heating facilities and are the main source of non-radiological air pollutant emissions at INL. Diesel engines are used at the Advanced Test Reactor (ATR) Complex to generate electricity for reactor operations. EDGs are used at INL facilities as emergency electrical power sources, and periodic testing contributes to criteria and toxic air pollutant emissions. The miscellaneous combustion sources include non-vehicle sources such as small portable generators, air compressors, and welders. These sources for all INL facilities are used to generate current emissions. Air emissions (based on fuel use) from INL facilities for 2005-2009 were reviewed to find the maximum emissions for use in the air dispersion models.

Criteria air pollutants include: sulfur dioxide (SO_2), nitrogen dioxide (NO_2), two size ranges for particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide (CO), lead (Pb), and ozone (O_3). Particulate matter (PM) with an aerodynamic diameter less than or equal to 10 micrometers are referred to as PM_{10} and those that are less than or equal to 2.5 micrometers are referred to as $PM_{2.5}$. Because O_3 is not directly emitted or monitored, volatile organic compounds (VOCs) and nitrogen oxides (NO_x), which are O_3 precursors, are considered. Certain standards apply to long-term (annual average) conditions; other standards are short-term and apply to conditions that persist for periods ranging from 1 hour to 3 months, depending on the toxic properties of the pollutant in question.

PSD pollutants include PM_{10}, $PM_{2.5}$, SO_2, and NO_2. Maximum allowable PSD pollutant concentration increases or increments are specified for the nation as a whole (designated Federal Class II areas), and more stringent increment limits (as well as ceilings) are prescribed for national resources, such as national forests, parks, and monuments (designated Federal Class I areas). Air pollutant standards are presented in Section 3.6.2. Modeling results for INL and NRF are provided in Section 3.6.3 and

Section 3.6.4, respectively. Modeling results for the proposed action are compared to the standards in Section 4.6.

Toxic air pollutants are listed in Table E.2-1. The list of toxic air pollutants in Table E.2-1 is not exhaustive for INL and includes only those that could be emitted as part of the proposed action. Use of various chemical products such as cleaners, lubricants, and adhesives produce small amounts of toxic air pollutants; but the amounts used are small and, therefore, are not included in the analysis. Welding naval spent nuclear fuel canisters at NRF also produces small amounts of toxic air pollutants. These emissions are small based on the maximum number of canisters processed per year in 2005 through 2009 and are intermittent over the course of a year. These emissions are not expected to increase due to the proposed action. Therefore, welding emissions are not included in the analysis.

Table E.2-1: Toxic Air Pollutants

Carcinogens	Non-Carcinogens
Acetaldehyde (C_2H_4O)	Acrolein (C_3H_4O)
As as arsenic trioxide (As_2O_3)	Ammonia (NH_3)
Benzene (C_6H_6)	Chromium (Cr)
Be as beryllium oxide (BeO)	Copper (Cu)
1,3-Butadiene (C_4H_6)	Ethylbenzene (C_8H_{10})
Cd as cadmium oxide (CdO)	Manganese (Mn)
Formaldehyde (HCOH)	Naphthalene ($C_{10}H_8$)
Nickel (Ni)	Selenium (Se)
Polycyclic aromatic compounds (PACs)	Toluene (C_7H_8)
	Xylene (C_8H_{10})
	Zn as zinc oxide (ZnO)

Emission factors and emission calculation methods for fuel combustion sources from Environmental Protection Agency (EPA) 2010 (AP-42, Section 1.3, Fuel Oil Combustion) are used. The general equation for emission estimation is:

$$E = A \times EF \times (1 - ER/100) \qquad \textbf{Equation E-1}$$

Where:

E = emissions
A = activity rate (e.g., gallons of fuel per year or Btu's per year)
EF = emission factor
ER = overall emission reduction efficiency (%)

ER is set to zero based on the conservative assumption that fuel combustion sources at INL do not have stack abatement. The EFs for criteria, PSD, and toxic air pollutants are provided in Table E.2-2.

Annual fuel use (A in Equation E-1) for INL air pollutant sources at each facility is provided in Table E.2-3.

Table E.2-2: Emission Factors for Boilers, EDGs, and Miscellaneous Fuel Combustion Sources

Pollutant Name	Boilers	EDGs and Diesel Engines	EDGs and Miscellaneous Fuel Combustion Sources		
	Grade 1/2 Fuel Oil[1]	Large[2] Diesel Engines	Small[3] Diesel Engines	Gasoline Engines	Propane Combustion
	lb/1000 gal, unless otherwise noted	lb/10^6 Btu, unless otherwise noted	lb/10^6 Btu, unless otherwise noted	lb/10^6 Btu	lb/1000 gal
Sulfur oxides (SOx)	2.16×10^{-1}	1.50×10^{-3}	2.9×10^{-1}	8.4×10^{-2}	1.0×10^{-1}
Sulfur dioxide (SO_2)	2.13×10^{-1}	1.40×10^{-3}	2.755×10^{-1}	7.98×10^{-2}	1.0×10^{-1}
Sulfuric acid (H_2SO_4)	3.73×10^{-3}	1.0×10^{-4}	1.78×10^{-2}	5.1×10^{-3}	
Nitrogen oxides (NOx)	20	3.2	4.41	1.63	1.3×10^{1}
Nitrogen dioxide (NO_2)	1				
Ammonia (NH_3)	8.0×10^{-1}				
Carbon monoxide (CO)	5	8.5×10^{-1}	9.5×10^{-1}	9.9×10^{-1}	7.5
VOCs	2.0×10^{-1}	8.19×10^{-2}	3.276×10^{-2}		8.0×10^{-1}
Benzene (C_6H_6)	2.14×10^{-4}	7.76×10^{-4}	9.33×10^{-4}		
Toluene (C_7H_8)	6.20×10^{-3}	2.81×10^{-4}	4.09×10^{-4}		
Xylenes (C_8H_{10})	1.09×10^{-4}	1.93×10^{-4}	2.85×10^{-4}		
1,3-Butadiene (C_4H_6)		3.91×10^{-5}	3.91×10^{-5}		
Formaldehyde (HCOH)	6.10×10^{-2}	7.89×10^{-5}	1.18×10^{-3}		
Acetaldehyde (C_2H_4O)		2.52×10^{-5}	7.67×10^{-4}		
Acrolein (C_3H_4O)		7.88×10^{-6}	9.25×10^{-5}		
Ethylbenzene (C_8H_{10})	6.36×10^{-5}				
Naphthalene ($C_{10}H_8$)	1.13×10^{-3}	1.30×10^{-4}	8.48×10^{-5}		
Polyaromatic compounds (PACs)	1.65×10^{-5}	8.53×10^{-6}	1.10×10^{-5}		

Note: Gray shaded areas indicate the pollutant is not emitted or an emission factor is not available.
Source: EPA 2010, unless otherwise noted.
[1] Ultra low sulfur fuel containing less than 15 parts per million (ppm) sulfur is used.
[2] Greater than 600 horsepower.
[3] Less than 600 horsepower.
lb=pound; Btu=British thermal unit; gal=gallons

Table E.2-2: Emission Factors for Boilers, EDGs, and Miscellaneous Fuel Combustion Sources (cont.)

Pollutant Name	Boilers	EDGs and Diesel Engines	EDGs and Miscellaneous Fuel Combustion Sources		
	Grade 1/2 Fuel Oil[1]	Large[2] Diesel Engines	Small[3] Diesel Engines	Gasoline Engines	Propane Combustion
	lb/1000 gal, unless otherwise noted	lb/10^6 Btu, unless otherwise noted	lb/10^6 Btu, unless otherwise noted	lb/10^6 Btu	lb/1000 gal
PM_{10}	2.30	5.73×10^{-2}	3.1×10^{-1}	1.0×10^{-1}	7.0×10^{-1}
$PM_{2.5}$	1.55	5.56×10^{-2}	3.1×10^{-1}	1.0×10^{-1}	7.0×10^{-1}
As as arsenic trioxide (As_2O_3)	5.3 (10^{12} Btu)	5.3 (10^{12} Btu)	5.3 (10^{12} Btu)		
Be as beryllium oxide (BeO)	8.3 (10^{12} Btu)	8.3 (10^{12} Btu)	8.3 (10^{12} Btu)		
Cd as cadmium oxide (CdO)	3.4 (10^{12} Btu)	3.4 (10^{12} Btu)	3.4 (10^{12} Btu)		
Chromium (Cr)	3 (10^{12} Btu)	3 (10^{12} Btu)	3 (10^{12} Btu)		
Copper (Cu)	6 (10^{12} Btu)	6 (10^{12} Btu)	6 (10^{12} Btu)		
Pb as lead monoxide (PbO)	9.7 (10^{12} Btu)	9.7 (10^{12} Btu)	9.7 (10^{12} Btu)		
Manganese (Mn)	6 (10^{12} Btu)	6 (10^{12} Btu)	6 (10^{12} Btu)		
Nickel (Ni)	3 (10^{12} Btu)	3 (10^{12} Btu)	3 (10^{12} Btu)		
Selenium (Se)	15 (10^{12} Btu)	15 (10^{12} Btu)	15 (10^{12} Btu)		
Zn as zinc oxide (ZnO)	5.0 (10^{12} Btu)	5.0 (10^{12} Btu)	5.0 (10^{12} Btu)		

Note: Gray shaded areas indicate the pollutant is not emitted or an emission factor is not available.
Source: EPA 2010, unless otherwise noted.
[1] Ultra low sulfur fuel containing less than 15 parts per million (ppm) sulfur is used.
[2] Greater than 600 horsepower.
[3] Less than 600 horsepower.
lb=pound; Btu=British thermal unit; gal=gallons

Table E.2-3: Annual Fuel Use for INL Air Pollutant Sources

Source	INL Facility							
	CFA	INTEC	TAN/SMC	RWMC	NRF	ATR Complex	CITRC	MFC
	liters per year (gallons per year)							
Boilers and Large Diesel Engines[1]	567,810 (150,000)	4,921,020 (1,300,000)	1,362,744 (360,000)	3,028,320 (800,000)	2,281,866 (602,807)	984,204 (260,000)		
Large[2] Engine EDGs		28,141 (7434)	999 (264)		17,439 (4607)	2037 (538)		999 (264)
Small[3] Engine EDGs	4997 (1320)		999 (264)			3997 (1056)	999 (264)	15,990 (4224)
Miscellaneous Fuel Combustion Equipment	40,027 (10,574)	8559 (2261)		947,550 (250,317)	29,583 (7815)	2854 (754)		5580 (1474)

Note: Gray cells indicate absence of source.

ATR = Advanced Test Reactor
CFA = Central Facilities Area
INTEC = Idaho Nuclear Technology and Engineering Center
TAN = Test Area North
SMC = Specific Manufacturing Capability
RWMC = Radioactive Waste Management Complex
NRF = Naval Reactors Facility
CITRC = Critical Infrastructure Test Range Complex
MFC = Materials and Fuels Complex

[1] Large diesel engines are only operated at the ATR Complex.
[2] Greater than 600 horsepower.
[3] Less than 600 horsepower.

Air pollutant release rates in grams per second are determined from estimated emissions and estimated equipment operating hours for each facility. Release rates are used as input for most of the air dispersion modeling and are provided in INL 2013a. Other units are also used depending on the analysis (e.g., tons per year are used for visibility screening). Operating hours for equipment at each facility are provided in Table E.2-4. Annual INL emissions are provided in Table E.2-5 and Table E.2-6.

Table E.2-4: Annual Hours of Operation for INL Air Pollutant Sources

Source	INL Facility							
	CFA	INTEC	TAN/SMC	RWMC	NRF	ATR Complex	CITRC	MFC
	hours per year							
Boilers and Large Diesel Engines[1]	8760	8760	7943	8760	4693	6339		
Large[2] Engine EDGs		63	40		66	8		40
Small[3] Engine EDGs	200		40			160	40	640
Miscellaneous Fuel Combustion Equipment	2600	2600		2600	2340	2600		2600

Note: Gray cells indicate absence of source.

ATR = Advanced Test Reactor
CFA = Central Facilities Area
INTEC = Idaho Nuclear Technology and Engineering Center
TAN = Test Area North
SMC = Specific Manufacturing Capability
RWMC = Radioactive Waste Management Complex
NRF = Naval Reactors Facility
CITRC = Critical Infrastructure Test Range Complex
MFC = Materials and Fuels Complex

[1] Large diesel engines are only operated at the ATR Complex.
[2] Greater than 600 horsepower.
[3] Less than 600 horsepower.

Table E.2-5: Sums of INL Boiler, Large Diesel Engine, and EDG Emissions

Pollutant Name	INL Boilers and Large Diesel Engines			INL EDGs		
	kilograms per year	pounds per year	tons per year	kilograms per year	pounds per year	tons per year
Sulfur oxides (SOx)	3.4×10^{2}	7.5×10^{2}	3.7×10^{-1}	1.3×10^{2}	2.9×10^{2}	1.4×10^{-1}
Sulfur dioxide (SO_2)	3.3×10^{2}	7.4×10^{2}	3.7×10^{-1}	1.2×10^{2}	2.7×10^{2}	1.4×10^{-1}
Sulfuric acid (H_2SO_4)	6.9	1.5×10^{1}	7.6×10^{-3}	7.9	1.8×10^{1}	8.8×10^{-3}
Nitrogen oxides (NOx)	7.8×10^{4}	1.7×10^{5}	8.6×10^{1}	4.5×10^{3}	9.9×10^{3}	5.0
Nitrogen dioxide (NO_2)	1.5×10^{3}	3.2×10^{3}	1.6			
Ammonia (NH_3)	1.2×10^{3}	2.6×10^{3}	1.3			
Carbon monoxide (CO)	2.1×10^{4}	4.6×10^{4}	2.3×10^{1}	1.1×10^{3}	2.5×10^{3}	1.2
VOCs	1.6×10^{3}	3.6×10^{3}	1.8	2.1×10^{2}	4.7×10^{2}	2.3×10^{-1}
Benzene (C_6H_6)	1.3×10^{1}	2.8×10^{1}	1.4×10^{-2}	1.0	2.3	1.2×10^{-3}
Toluene (C_7H_8)	1.4×10^{1}	3.0×10^{1}	1.5×10^{-2}	4.1×10^{-1}	9.0×10^{-1}	4.5×10^{-4}
Xylenes (C_8H_{10})	3.3	7.2	3.6×10^{-3}	2.8×10^{-1}	6.3×10^{-1}	3.1×10^{-4}
1,3-Butadiene (C_4H_6)	6.3×10^{-1}	1.4	7.0×10^{-4}	4.9×10^{-2}	1.1×10^{-1}	5.4×10^{-5}
Formaldehyde (HCOH)	9.0×10^{1}	2.0×10^{2}	9.9×10^{-2}	5.9×10^{-1}	1.3	6.5×10^{-4}
Acetaldehyde (C_2H_4O)	4.1×10^{-1}	9.0×10^{-1}	4.5×10^{-4}	3.6×10^{-1}	7.9×10^{-1}	4.0×10^{-4}
Acrolein (C_3H_4O)	1.3×10^{-1}	2.8×10^{-1}	1.4×10^{-4}	4.7×10^{-2}	1.0×10^{-1}	5.2×10^{-5}
Ethylbenzene (C_8H_{10})	9.3×10^{-2}	2.0×10^{-1}	1.0×10^{-4}			
Naphthalene ($C_{10}H_8$)	3.7	8.3	4.1×10^{-3}	1.4×10^{-1}	3.2×10^{-1}	1.6×10^{-4}
Polycyclic aromatic compounds (PACs)	1.6×10^{-1}	3.6×10^{-1}	1.8×10^{-4}	1.2×10^{-2}	2.6×10^{-2}	1.3×10^{-5}
PM_{10}	3.1×10^{3}	6.9×10^{3}	3.5	1.8×10^{2}	4.1×10^{2}	2.0×10^{-1}
$PM_{2.5}$	2.9×10^{3}	6.5×10^{3}	3.2	1.8×10^{2}	4.0×10^{2}	2.0×10^{-1}
As as arsenic trioxide (As_2O_3)	1.1	2.5	1.3×10^{-3}	6.5×10^{-3}	1.5×10^{-2}	7.5×10^{-6}
Be as beryllium oxide (BeO)	1.8	3.9	2.0×10^{-3}	1.0×10^{-2}	2.3×10^{-2}	1.2×10^{-5}
Cd as cadmium oxide (CdO)	7.3×10^{-1}	1.6	8.0×10^{-4}	4.3×10^{-3}	9.5×10^{-3}	4.8×10^{-6}
Chromium (Cr)	6.4×10^{-1}	1.4	7.0×10^{-4}	3.8×10^{-3}	8.3×10^{-3}	4.2×10^{-6}
Copper (Cu)	1.3	2.8	1.4×10^{-3}	7.5×10^{-3}	1.7×10^{-2}	8.3×10^{-6}
Pb as lead monoxide (PbO)	2.5	5.6	2.8×10^{-3}	1.2×10^{-2}	2.7×10^{-2}	1.3×10^{-5}
Manganese (Mn)	1.3	2.8	1.4×10^{-3}	7.5×10^{-3}	1.7×10^{-2}	8.3×10^{-6}
Nickel (Ni)	6.4×10^{-1}	1.4	7.0×10^{-4}	3.8×10^{-3}	8.3×10^{-3}	4.2×10^{-6}
Selenium (Se)	3.2	7.0	3.5×10^{-3}	1.9×10^{-2}	4.2×10^{-2}	2.1×10^{-5}
Zn as zinc oxide (ZnO)	1.1	2.3	1.2×10^{-3}	6.3×10^{-3}	1.4×10^{-2}	6.9×10^{-6}

Notes: Gray shaded cells indicate pollutant is not emitted or no emission factor is available.

Table E.2-6: Sums of INL Miscellaneous Fuel Combustion Emissions and Sum of All Source Emissions for INL Facilities

Pollutant Name	Sum of INL Miscellaneous Fuel Combustion Emissions			Sum of all Source Emissions for INL Facilities[2]		
	kilograms per year	pounds per year	tons per year[1]	kilograms per year	pounds per year	tons per year[1]
Sulfur oxides (SOx)	4.3×10^{2}	9.4×10^{2}	4.7×10^{-1}	8.9×10^{2}	2.0×10^{3}	9.9×10^{-1}
Sulfur dioxide (SO_2)	4.0×10^{2}	8.9×10^{2}	4.5×10^{-1}	8.6×10^{2}	1.9×10^{3}	9.5×10^{-1}
Sulfuric acid (H_2SO_4)	2.5×10^{1}	5.6×10^{1}	2.8×10^{-2}	4.0×10^{1}	8.9×10^{1}	4.4×10^{-2}
Nitrogen oxides (NOx)	7.8×10^{3}	1.7×10^{4}	8.6	9.0×10^{4}	2.0×10^{5}	9.9×10^{1}
Nitrogen dioxide (NO_2)				1.5×10^{3}	3.2×10^{3}	1.6
Ammonia (NH_3)				1.2×10^{3}	2.6×10^{3}	1.3
Carbon monoxide (CO)	2.3×10^{3}	5.0×10^{3}	2.5	2.4×10^{4}	5.3×10^{4}	2.7×10^{1}
VOCs	5.5×10^{2}	1.2×10^{3}	6.0×10^{-1}	2.4×10^{3}	5.2×10^{3}	2.6
Benzene (C_6H_6)	1.3	2.9	1.4×10^{-3}	1.5×10^{1}	3.4×10^{1}	1.7×10^{-2}
Toluene (C_7H_8)	5.7×10^{-1}	1.3	6.3×10^{-4}	1.5×10^{1}	3.2×10^{1}	1.6×10^{-2}
Xylenes (C_8H_{10})	4.0×10^{-1}	8.8×10^{-1}	4.4×10^{-4}	4.0	8.7	4.4×10^{-3}
1,3-Butadiene (C_4H_6)	5.5×10^{-2}	1.2×10^{-1}	6.0×10^{-5}	7.4×10^{-1}	1.6	8.1×10^{-4}
Formaldehyde (HCOH)	1.6	3.6	1.8×10^{-3}	9.2×10^{1}	2.0×10^{2}	1.0×10^{-1}
Acetaldehyde (C_2H_4O)	1.1	2.4	1.2×10^{-3}	1.8	4.1	2.0×10^{-3}
Acrolein (C_3H_4O)	1.3×10^{-1}	2.8×10^{-1}	1.4×10^{-4}	3.0×10^{-1}	6.7×10^{-1}	3.3×10^{-4}
Ethylbenzene (C_8H_{10})				9.3×10^{-2}	2.0×10^{-1}	1.0×10^{-4}
Naphthalene ($C_{10}H_8$)	1.2×10^{-1}	2.6×10^{-1}	1.3×10^{-4}	4.0	8.8	4.4×10^{-3}
Polycyclic aromatic compounds (PACs)	1.5×10^{-2}	3.4×10^{-2}	1.7×10^{-5}	1.9×10^{-1}	4.2×10^{-1}	2.1×10^{-4}
PM_{10}	5.2×10^{2}	1.2×10^{3}	5.8×10^{-1}	3.8×10^{3}	8.5×10^{3}	4.2
$PM_{2.5}$	5.2×10^{2}	1.2×10^{3}	5.8×10^{-1}	3.6×10^{3}	8.0×10^{3}	4.0
As as arsenic trioxide (As_2O_3)	7.5×10^{-3}	1.6×10^{-2}	8.0×10^{-6}	1.2	2.5	1.3×10^{-3}
Be as beryllium oxide (BeO)	1.2×10^{-2}	2.6×10^{-2}	1.3×10^{-5}	1.8	4.0	2.0×10^{-3}
Cd as cadmium oxide (CdO)	4.8×10^{-3}	1.1×10^{-2}	5.3×10^{-6}	7.4×10^{-1}	1.6	8.1×10^{-4}
Chromium (Cr)	4.2×10^{-3}	9.2×10^{-3}	4.6×10^{-6}	6.5×10^{-1}	1.4	7.1×10^{-4}
Copper (Cu)	8.4×10^{-3}	1.8×10^{-2}	9.2×10^{-6}	1.3	2.9	1.4×10^{-3}
Pb as lead monoxide (PbO)	1.4×10^{-2}	3.0×10^{-2}	1.5×10^{-5}	2.6	5.7	2.8×10^{-3}
Manganese (Mn)	8.4×10^{-3}	1.8×10^{-2}	9.2×10^{-6}	1.3	2.9	1.4×10^{-3}
Nickel (Ni)	4.2×10^{-3}	9.2×10^{-3}	4.6×10^{-6}	6.5×10^{-1}	1.4	7.1×10^{-4}
Selenium (Se)	2.1×10^{-2}	4.6×10^{-2}	2.3×10^{-5}	3.2	7.1	3.6×10^{-3}
Zn as zinc oxide (ZnO)	6.9×10^{-3}	1.5×10^{-2}	7.7×10^{-6}	1.1	2.4	1.2×10^{-3}

Notes: Gray shaded cells indicate either pollutant is not emitted or no emission factor is available.
[1] Tons per year are short tons (2,000 lbs.).
[2] Sums from combined emissions of Tables E.2-5 and E.2-6.

E.2.2 Source Terms for the ECF Baseline and Evaluated Alternatives

Currently, naval spent nuclear fuel handling and examination operations at NRF are conducted in ECF. NRF operates three fuel oil-fired boilers, four large EDGs, and miscellaneous small gasoline, diesel, and propane combustion sources. The boilers are used to generate steam to heat several of the site buildings, including ECF, and are the main source of non-radiological air pollutant emissions at NRF. The four EDGs are used as emergency electrical power sources. Periodic testing of the EDGs also contributes to non-radiological air pollutant emissions at NRF. The miscellaneous combustion sources include non-vehicular sources such as air compressors or heaters used in NRF activities that are not related to ECF operations. None of the fuel combustion sources have stack abatement; therefore, unabated emissions are calculated to establish current ECF conditions.

E.2.2.1 ECF Baseline Source Terms

Criteria, Toxic, and PSD Air Pollutants

Sections 3.6.4.1 and 3.6.4.2 present ECF baseline emissions for criteria and PSD air pollutants, and toxic air pollutants, respectively. This section describes how these emissions are derived from the baseline NRF emissions also presented in Sections 3.6.4.1 and 3.6.4.2. Consistent with development of source terms for emissions from INL facilities, maximum annual emissions based on NRF fuel usage for 2005-2009 are used. Based on NRF boiler operations, about one-third of overall steam demand is dedicated to ECF. NRF boiler emissions are multiplied by 0.333 to get emissions attributable to ECF.

Currently, NRF has four 1000-kilowatt EDGs and is at maximum capacity for emergency power. ECF requires 45 percent of the total 4,000 kilowatts to remain in operation if power is lost. Based on this, ECF would need 1800 kilowatts of EDG power. NRF EDG emissions are multiplied by 0.45 to get emissions attributable to ECF.

Miscellaneous combustion sources are not included since they do not result from naval spent nuclear fuel handling operations.

Emissions for boilers and EDGs for the ECF are provided in Table E.2-7 and Table E.2-8.

Table E.2-7: Estimated Boiler Emissions for ECF

Pollutant Name	Emissions		
	pounds per year	kilograms per year	grams per second
Sulfur oxides (SOx)	4.3×10^{1}	2.0×10^{1}	1.2×10^{-3}
Sulfur dioxide (SO_2)	4.3×10^{1}	1.9×10^{1}	1.1×10^{-3}
Sulfuric acid (H_2SO_4)	7.4×10^{-1}	3.3×10^{-1}	2.0×10^{-5}
Nitrogen oxides (NOx)	4.0×10^{3}	1.8×10^{3}	1.1×10^{-1}
Nitrogen dioxide (NO_2)	2.0×10^{2}	9.1×10^{1}	5.4×10^{-3}
Ammonia (NH_3)	1.6×10^{2}	7.3×10^{1}	4.3×10^{-3}
Carbon monoxide (CO)	1.0×10^{3}	4.6×10^{2}	2.7×10^{-2}
VOCs	4.0×10^{1}	1.8×10^{1}	1.1×10^{-3}
Benzene (C_6H_6)	4.3×10^{-2}	2.0×10^{-2}	1.2×10^{-6}
Toluene (C_7H_8)	1.2	5.7×10^{-1}	3.3×10^{-5}
Xylenes (C_8H_{10})	2.2×10^{-2}	9.9×10^{-3}	5.9×10^{-7}
1,3-Butadiene (C_4H_6)			
Formaldehyde (HCOH)	1.2×10^{1}	5.6	3.3×10^{-4}
Acetaldehyde (C_2H_4O)			
Acrolein (C_3H_4O)			
Ethylbenzene (C_8H_{10})	1.3×10^{-2}	5.8×10^{-3}	3.4×10^{-7}
Naphthalene ($C_{10}H_8$)	2.3×10^{-1}	1.0×10^{-1}	6.1×10^{-6}
Polycyclic aromatic compounds (PACs)	3.3×10^{-3}	1.5×10^{-3}	8.9×10^{-8}
PM_{10}	4.6×10^{2}	2.1×10^{2}	1.2×10^{-2}
$PM_{2.5}$	3.1×10^{2}	1.4×10^{2}	8.4×10^{-3}
As as arsenic trioxide (As_2O_3)	1.5×10^{-1}	6.5×10^{-2}	3.9×10^{-6}
Be as beryllium oxide (BeO)	2.3×10^{-1}	1.0×10^{-1}	6.1×10^{-6}
Cd as cadmium oxide (CdO)	9.3×10^{-2}	4.2×10^{-2}	2.5×10^{-6}
Chromium (Cr)	8.1×10^{-2}	3.7×10^{-2}	2.2×10^{-6}
Copper (Cu)	1.6×10^{-1}	7.4×10^{-2}	4.4×10^{-6}
Pb as lead monoxide (PbO)	2.6×10^{-1}	1.2×10^{-1}	7.1×10^{-6}
Manganese (Mn)	1.6×10^{-1}	7.4×10^{-2}	4.4×10^{-6}
Nickel (Ni)	8.1×10^{-2}	3.7×10^{-2}	2.2×10^{-6}
Selenium (Se)	4.1×10^{-1}	1.8×10^{-1}	1.1×10^{-5}
Zn as zinc oxide (ZnO)	1.4×10^{-1}	6.1×10^{-2}	3.6×10^{-6}

Note: Gray shaded cells indicate pollutant is not emitted or an emission factor is not available.

Table E.2-8: Estimated EDG Emissions for ECF

Pollutant Name	Emissions Overhaul Alternative		
	pounds per year	kilograms per year	grams per second
Sulfur oxides (SOx)	4.3×10^{-1}	2.0×10^{-1}	8.2×10^{-4}
Sulfur dioxide (SO_2)	4.1×10^{-1}	1.9×10^{-1}	7.8×10^{-4}
Sulfuric acid (H_2SO_4)	2.6×10^{-2}	1.2×10^{-2}	5.0×10^{-5}
Nitrogen oxides (NOx)	9.1×10^{2}	4.1×10^{2}	1.7
Nitrogen dioxide (NO_2)			
Ammonia (NH_3)			
Carbon monoxide (CO)	2.4×10^{2}	1.1×10^{2}	4.6×10^{-1}
VOCs	2.3×10^{1}	1.1×10^{1}	4.4×10^{-2}
Benzene (C_6H_6)	2.2×10^{-1}	1.0×10^{-1}	4.2×10^{-4}
Toluene (C_7H_8)	8.0×10^{-2}	3.6×10^{-2}	1.5×10^{-4}
Xylenes (C_8H_{10})	5.5×10^{-2}	2.5×10^{-2}	1.0×10^{-4}
1,3-Butadiene (C_4H_6)	1.1×10^{-2}	5.0×10^{-3}	2.1×10^{-5}
Formaldehyde (HCOH)	2.2×10^{-2}	1.0×10^{-2}	4.3×10^{-5}
Acetaldehyde (C_2H_4O)	7.2×10^{-3}	3.2×10^{-3}	1.4×10^{-5}
Acrolein (C_3H_4O)	2.2×10^{-3}	1.0×10^{-3}	4.3×10^{-6}
Ethylbenzene (C_8H_{10})			
Naphthalene ($C_{10}H_8$)	3.7×10^{-2}	1.7×10^{-2}	7.0×10^{-5}
Polycyclic aromatic compounds (PACs)	2.4×10^{-3}	1.1×10^{-3}	4.6×10^{-6}
PM_{10}	1.6×10^{1}	7.4	3.1×10^{-2}
$PM_{2.5}$	1.6×10^{1}	7.2	3.0×10^{-2}
As as arsenic trioxide (As_2O_3)	1.5×10^{-3}	7.0×10^{-4}	2.9×10^{-6}
Be as beryllium oxide (BeO)	2.4×10^{-3}	1.1×10^{-3}	4.5×10^{-6}
Cd as cadmium oxide (CdO)	9.7×10^{-4}	4.4×10^{-4}	1.9×10^{-6}
Chromium (Cr)	8.5×10^{-4}	3.9×10^{-4}	1.6×10^{-6}
Copper (Cu)	1.7×10^{-3}	7.7×10^{-4}	3.2×10^{-6}
Pb as lead monoxide (PbO)	2.8×10^{-3}	1.2×10^{-3}	5.3×10^{-6}
Manganese (Mn)	1.7×10^{-3}	7.7×10^{-4}	3.2×10^{-6}
Nickel (Ni)	8.5×10^{-4}	3.9×10^{-4}	1.6×10^{-6}
Selenium (Se)	4.3×10^{-3}	1.9×10^{-3}	8.1×10^{-6}
Zn as zinc oxide (ZnO)	1.4×10^{-3}	6.4×10^{-4}	2.7×10^{-6}

Notes: Gray shaded cells indicate pollutant is not emitted or an emission factor is not available.

E.2.2.2 No Action Alternative Source Terms

The evaluation for the No Action Alternative covers: (1) ECF operations with preventative and corrective maintenance sufficient to sustain the proper functioning of ECF infrastructure and equipment, and (2) the potential for ECF operations to cease if preventative and corrective maintenance are no longer sufficient to sustain the proper functioning of ECF infrastructure and equipment. The impacts described below would be the same during ECF operations or if ECF operations cease.

There would be no change in unabated air pollutant emissions from boiler and EDG sources. Therefore, air pollutant emissions from the No Action Alternative would not change from current ECF emissions (Table E.2-7 and Table E.2-8). Total NRF emissions are included in those for INL in Table E.2-5 and Table E.2-6.

E.2.2.3 Overhaul Alternative Source Terms

Refurbishment Period

The activities associated with the refurbishment period of the Overhaul Alternative would occur within the ECF with the exception of the construction of the new security boundary system. There would be a small increase in emissions generated from the construction of the new security boundary system. These emissions would be intermittent and would occur over a period of approximately 1 year. Therefore, air pollutant emissions during the refurbishment period would be small enough to eliminate further evaluation and would be similar to current ECF emissions (Table E.2-7 and Table E.2-8).

Post-Refurbishment Operational Period

There would be no change in unabated air pollutant emissions from boiler and EDG sources for the post-refurbishment operational period of the Overhaul Alternative compared to the current ECF since the entire ECF would continue to be heated and would need emergency standby power. Therefore, air pollutant emissions during overhaul post-refurbishment operational period would not change from current ECF emissions (Table E.2-7 and Table E.2-8).

E.2.2.4 New Facility Alternative Source Terms

Construction Period

Emissions for Location 3/4 and Location 6 are estimated for the construction period of the New Facility Alternative. Emissions would be similar for the two locations. Updated design and construction information since the Draft EIS was published resulted in changes to air pollutant emissions for the New Facility Alternative Location 3/4. The updated information prompted changes in how emissions are calculated for the construction period (e.g., use of emission factors with controls for batch plant operations, EPA Tier 4 diesel generators, and non-overlapping construction phases) and use of the current versions of AERMOD/AERMET and MOVES2014. The changes are summarized in Table E.2-9.

Table E.2-9: Summary of Changes Made to New Facility Construction Emissions and Modeling

Change	Draft EIS	Final EIS
Concrete batch plants	One concrete batch plant was used. AP-42 emission factors with no controls were used for concrete batch plant operations, silo filling, and truck loading. AP-42 emission factors for two small diesel generators were used.	Two concrete batch plants are used. AP-42 emission factors with controls are used for concrete batch plant operations, silo filling, and truck loading. AP-42 and EPA emission factors for Tier 4 engines are used for three large diesel generators to power batch plants.

Table E.2-9: Summary of Changes Made to New Facility Construction Emissions and Modeling (cont.)

Change	Draft EIS	Final EIS
Rock crushing plant and facility shell	A rock crushing plant was assumed to be necessary. Diesel generators were assumed to be necessary for heating the facility shell during construction.	A rock crushing plant is not used based on recent geotechnical information (rock is of a suitable size and sandy gravel is adequately stable). An electrical substation will be used for heating the facility shell during construction.
Information on concrete batch plant material throughput and on-road and off-road vehicle travel	Best available information was used for construction activities. MOBILE6.2 was used to estimate on-road emissions. NONROAD2008 was used to estimate off-road emissions.	Batch plant material throughput increased based on design. More accurate description of the extent of on-road and off-road construction activities is available. MOVES2014 is used to estimate on-road and off-road emissions.
Construction phases	All construction operations modeled concurrently.	Only those construction activities that overlap in time are modeled concurrently.

Air pollutant emissions are estimated per construction activity for each construction phase in the construction period of the New Facility Alternative (Table E.2-10). Release rates (in grams per second) for use in modeling are based on the construction phase emissions and the operational time. During construction, fugitive dust would be generated from earth moving activities, wind erosion of bare ground, and two on-site concrete batch plants. Criteria and PSD air pollutants would be generated from on-site operation of construction vehicles and other equipment that burn fossil fuels (e.g., cranes). Criteria and PSD air pollutants would also be generated from delivery vehicles and construction workforce travel to and from the site. Criteria, PSD, and TAP emissions would be generated from operating diesel generators to power concrete batch plant operations, concrete batch plant material handling, and use of diesel engines to heat the water used in concrete batch plant operations during winter months. The preferred option is to use electricity from the NRF substation to concrete power batch plant operations. However, diesel generators and engines are modeled conservatively.

Table E.2-10: Construction Phases and Construction Activities Used to Estimate Air Pollutant Emissions

Construction Phase		Construction Activity		Start	End	Hours per day	Number of work days[2]	Total hours of operation[2]
Phase	Description	Activity	Description					
1	Trenching for Utilities	1	Trenching and installation of Utilities	Oct-17	Apr-18	8	151	1211
		2	Demolition of existing fence and utilities					
2	Clearing/Grading	3	Clearing and grubbing of construction site	Oct-17	Apr-18	8	151	1211
		4	Widening and improving the haul road					
		5	Preparing railroad base					
3	Paving Craft Parking, Roads	6	Grading, installation of road base, and paving of construction roads/parking	Oct-17	Apr-18	8	151	1211
4	Excavation for Building	7	Excavation of building site/ hauling of soil to disposal or stockpile	Mar-18	Oct-18	8	175	1400
		8	Excavation of evaporation ponds					
5	Building & Material Delivery	9	Building and material delivery	Apr-18	Sep-21	8	914	7309
		10	Building steel erection					
6	Batch Plant Phase I	11	Batching concrete with stockpiled aggregate	Oct-18	Nov-19	8/16[1]	304	3302
7	Batch Plant Phase II	12	Batching concrete with aggregate hauled from on-site borrow area	Feb-21	Nov-21	8	217	1738
		13	Installation of pools and floor slabs					
8	Paving Final	14	Grading, placing of road base, paving roads	Apr-22	Sep-22	8	131	1046
9	Final Grading	15	Trenching and installation of final utilities	Apr-22	Sep-22	8	131	1046
		16	Backfilling around building and final grading					

[1]Batch Plant Phase I operates 8 hours/day from Oct 2018 to June 2019 and 16 hours/day from July 2019 to Nov 2019.
[2]Number of work days has been rounded to nearest whole number in table. The product of the unrounded number of work days and the hours per day yields total hours of operation, which is rounded to the nearest whole number in the table.
Source: K-Spar Inc. 2016

Four modeling scenarios are established from the construction phases listed in Table E.2-10 that do not overlap in time. Pollutant concentrations are calculated for each construction phase and then summed per modeling scenario. The modeling scenarios are sequential in time (they are not alternative scenarios). The modeling scenarios are as follows:

- Scenario 1 includes Construction Phases 1, 2, 3, 8, and 9. Phases 8 and 9 do not overlap with Phases 1 through 3, but are conservatively included in this scenario because overall releases for Phases 8 and 9 are relatively low. This simplifies the modeling process by reducing the number of modeling scenarios needed.
- Scenario 2 includes Phases 4 and 5.
- Scenario 3 includes Phases 5 and 6.
- Scenario 4 includes Phases 5 and 7.

Note that Phase 5 (Building and Material Delivery) overlaps the time periods for Phases 4, 6, and 7 and is therefore included in Scenarios 2, 3, and 4.

Standard AP-42 emission factors and methodology are used for all emission estimates with the following exceptions:

- EPA emission factors for Tier 4 engines (generator sets from 40 CFR 1039.101(b)) are used for diesel generators to power the concrete batch plants.
- MOVES2014 is used to estimate on-road and off-road vehicle and equipment emission factors.

Fugitive Dust (PM_{10} and $PM_{2.5}$) Emissions

Impacts from fugitive dust are evaluated using concentrations of particulate matter in ambient air. Fugitive dust modeling uses area source terms versus point (e.g., stacks) or line (e.g., vehicle emissions) source terms.

The majority of fugitive dust during construction would be produced by:

- Wind erosion of bare ground
- Earth moving activities
- Concrete batch plant operations

Haul roads and unpaved roads used on the construction site are assumed to be within the construction area and are not considered as separate sources of fugitive dust.

Wind Erosion of Bare Ground

Areas where wind erosion of bare ground could occur during the construction period include all disturbance areas, including cleared areas, roadways, rail lines, power lines, piping, concrete batch plant footprint, gravel pit, and stockpiles.

Emissions from dust generated by wind erosion are calculated using the model for industrial wind erosion described in AP-42 Section 13.2.5. Emission rates are based on the wind speed exceeding a threshold wind speed.

It is assumed that about 30 percent of the potential 150 acre disturbance footprint would be exposed to wind erosion in a given year. This results in an 18.2 hectare (45 acre) area exposed to wind erosion in a given year. The maximum annual PM_{10} and $PM_{2.5}$ based on the analysis of days with wind speeds exceeding the threshold wind speed are provided in Table E.2-11.

Table E.2-11: Annual PM_{10} and $PM_{2.5}$ Emissions From Wind Erosion of Bare Ground During the Construction Period of the New Facility Alternative

Emissions			
PM_{10}		$PM_{2.5}$	
kilograms per year	pounds per year	kilograms per year	pounds per year
488	1076	73	161

Earth-Moving Activities and Concrete Batch Plant Operations

Earth-moving activities involve operation of heavy construction equipment on exposed soil and are performed during Construction Phases 1, 2, 3, 4, 8, and 9 (see Table E.2-10). Limited earth moving activities are also performed during Construction Phases 6 and 7.

Methods for calculating fugitive dust emissions for earth-moving activities outlined in EPA 2010 are used. Fugitive dust emissions for earth-moving activities are calculated using Equation E-1. Emission Factors are provided in Table E.2-12.

Table E.2-12: Emission Factors for Construction Fugitive Dust for the New Facility Alternative

Equipment or Activity	Pollutant	Emission Factor	Units
Bulldozing	PM_{10}	6.017	pounds per hour
	$PM_{2.5}$	2.370	pounds per hour
Scrapers unloading topsoil	PM_{10}	0.030	pounds per ton
	$PM_{2.5}$	0.004	pounds per ton
Scrapers removing topsoil	PM_{10}	15.2	pounds per vehicle mile
	$PM_{2.5}$	2.1	pounds per vehicle mile
Loading of Trucks	PM_{10}	0.00069	pounds per ton
	$PM_{2.5}$	0.00010	pounds per ton
Truck Dumping of Fill	PM_{10}	0.00069	pounds per ton
	$PM_{2.5}$	0.00010	pounds per ton
Compacting	PM_{10}	3.546	pounds per hour
	$PM_{2.5}$	1.502	pounds per hour
Motor Grading	PM_{10}	1.543	pounds per vehicle mile
	$PM_{2.5}$	0.167	pounds per vehicle mile
Cement Unloading to Storage Silo	PM_{10}	0.00034	pounds per ton
	$PM_{2.5}$	0.0000782	pounds per ton
Cement Supplement Unloading to Storage Silo	PM_{10}	0.0049	pounds per ton
	$PM_{2.5}$	0.001127	pounds per ton

Table E.2-12: Emission Factors for Construction Fugitive Dust for the New Facility Alternative (cont.)

Equipment or Activity	Pollutant	Emission Factor	Units
Sand Transfer	PM_{10}	0.00099	pounds per ton
	$PM_{2.5}$	0.0002277	pounds per ton
Aggregate Transfer	PM_{10}	0.0033	pounds per ton
	$PM_{2.5}$	0.000759	pounds per ton
Weigh Hopper Loading	PM_{10}	0.0028	pounds per ton
	$PM_{2.5}$	0.000644	pounds per ton
Mixer Loading (Central Mix)	PM_{10}	0.0055	pounds per ton
	$PM_{2.5}$	0.001265	pounds per ton

Modeling Scenario 1. For Modeling Scenario 1, examples of fugitive dust generating activities include trenching and installation of utilities; demolition of existing fence and utilities; clearing and grubbing of the construction site; widening and improving haul roads; preparing railroad base; grading, placement of road base; and paving of construction roads/parking (Table E.2-10). As described above, approximately 18.2 hectares (45 acres) of ground are assumed to be subject to wind erosion (see Table E.2-11 for wind erosion emissions). Activity rates (A in Equation E-1) and emissions of PM_{10} and $PM_{2.5}$ are provided in Table E.2-13 for the various equipment and processes associated with this modeling scenario.

Table E.2-13: Activity Parameters With PM_{10} and $PM_{2.5}$ Emissions for Construction Modeling Scenario 1

Construction Phase	Construction Activity	Activity Rates	Units	Emissions PM_{10} (tons)	Emissions $PM_{2.5}$ (tons)	Emissions PM_{10} (kilograms)	Emissions $PM_{2.5}$ (kilograms)
Trenching for Utilities	Loading of Trucks	57,202	tons	2.0×10^{-2}	3.0×10^{-3}	1.8×10^{1}	2.7
	Truck Dumping of Fill	62,203	tons	2.1×10^{-2}	3.0×10^{-3}	1.9×10^{1}	2.9
	Compacting	200	hours	3.6×10^{-1}	1.5×10^{-1}	3.2×10^{2}	1.4×10^{2}
Total				$\mathbf{4.0\times10^{-1}}$	$\mathbf{1.6\times10^{-1}}$	$\mathbf{3.6\times10^{2}}$	$\mathbf{1.4\times10^{2}}$
Clearing/Grading and Paving Craft Parking, Roads	Bulldozing	770	hours	2.3	9.1×10^{-1}	2.1×10^{3}	8.3×10^{2}
	Loading of Trucks	52,435	tons	1.8×10^{-2}	3.0×10^{-3}	1.6×10^{1}	2.5
	Truck Dumping of Fill	57,019	tons	2.0×10^{-2}	3.0×10^{-3}	1.8×10^{1}	2.7
	Compacting	300	hours	5.3×10^{-1}	2.3×10^{-1}	4.8×10^{2}	2.0×10^{2}
	Motor Grading	313	miles	2.4×10^{-1}	2.6×10^{-2}	2.2×10^{2}	2.4×10^{1}
			Total	**3.1**	**1.2**	$\mathbf{2.8\times10^{3}}$	$\mathbf{1.1\times10^{3}}$
Paving Final	Bulldozing	150	hours	4.5×10^{-1}	1.8×10^{-1}	4.1×10^{2}	1.6×10^{2}
	Compacting	100	hours	1.8×10^{-1}	7.5×10^{-2}	1.6×10^{2}	6.8×10^{1}
	Motor Grading	500	miles	3.9×10^{-1}	4.2×10^{-2}	3.5×10^{2}	3.8×10^{1}
			Total	**1.0**	$\mathbf{3.0\times10^{-1}}$	$\mathbf{9.2\times10^{2}}$	$\mathbf{2.7\times10^{2}}$

Table E.2-13: Activity Parameters With PM_{10} and $PM_{2.5}$ Emissions for Construction Modeling Scenario 1 (cont.)

Construction Phase	Construction Activity	Activity Rates	Units	Emissions PM_{10} (tons)	Emissions $PM_{2.5}$ (tons)	Emissions PM_{10} (kilograms)	Emissions $PM_{2.5}$ (kilograms)
Final Grading	Bulldozing	100	hours	3.0×10^{-1}	1.2×10^{-1}	2.7×10^{2}	1.1×10^{2}
	Compacting	80	hours	1.4×10^{-1}	6.0×10^{-2}	1.3×10^{2}	5.5×10^{1}
	Motor Grading	188	miles	1.5×10^{-1}	1.6×10^{-2}	1.3×10^{2}	1.4×10^{1}
			Total	$\mathbf{5.9\times10^{-1}}$	$\mathbf{1.9\times10^{-1}}$	$\mathbf{5.3\times10^{2}}$	$\mathbf{1.8\times10^{2}}$

Modeling Scenario 2. For Modeling Scenario 2, examples of fugitive dust generating activities include excavation of the New Facility Alternative building site; hauling soil to disposal sites or to stockpile sites; and excavation of the lined evaporation ponds for storm water management (Table E.2-10). As described above, approximately 18.2 hectares (45 acres) of ground are assumed to be subject to wind erosion (see Table E.2-11 for wind erosion emissions). Activity rates (A in Equation E-1) and emissions of PM_{10} and $PM_{2.5}$ are provided in Table E.2-14 for the various equipment and processes associated with this modeling scenario.

Table E.2-14: Activity Parameters With PM_{10} and $PM_{2.5}$ Emissions for Construction Modeling Scenario 2

Construction Phase	Equipment Description	Activity Rates	Units	Emissions PM_{10} (tons)	Emissions $PM_{2.5}$ (tons)	Emissions PM_{10} (kilograms)	Emissions $PM_{2.5}$ (kilograms)
Building Excavation	Bulldozing	320	hour	9.6×10^{-1}	3.8×10^{-1}	8.7×10^{2}	3.4×10^{2}
	Scrapers - Unloading Topsoil	396,165	tons	5.9	8.3×10^{-1}	5.4×10^{3}	7.5×10^{2}
	Scrapers - Removing Topsoil	470	miles	3.6	5.0×10^{-1}	3.2×10^{3}	4.5×10^{2}
	Loading of Trucks	23,834	tons	8.0×10^{-3}	1.0×10^{-3}	7.4	1.1
	Truck Dumping of Fill	25,918	tons	9.0×10^{-3}	1.0×10^{-3}	8.1	1.2
			Total	**10.5**	**1.7**	$\mathbf{9.5\times10^{3}}$	$\mathbf{1.6\times10^{3}}$

Modeling Scenario 3. For Modeling Scenario 3, fugitive dust generating activities include batching concrete with stockpiled aggregate (Table E.2-10). As described above, approximately 18.2 hectares (45 acres) of ground are assumed to be subject to wind erosion (see Table E.2-11 for wind erosion emissions). Total material throughput is provided in Table E.2-15. Activity rates (A in Equation E-1) and emissions of PM_{10} and $PM_{2.5}$ are provided in Table E.2-16 for the equipment and processes associated with this modeling scenario.

Table E.2-15: Material Throughput for Batch Plant Phase I

Material	Quantity (metric tons)	Quantity (U.S tons)
Cement	44,421	48,976
Fine Aggregate (Sand)	144,100	158,875
Coarse Aggregate	350,076	385,971
Fly Ash	18,996	20,944
Total	557,593	614,766

Table E.2-16: Activity Parameters With PM_{10} and $PM_{2.5}$ Emissions for Construction Modeling Scenario 3

Construction Phase	Equipment Description	Activity Rates	Units	Emissions PM_{10} (tons)	Emissions $PM_{2.5}$ (tons)	Emissions PM_{10} (kilograms)	Emissions $PM_{2.5}$ (kilograms)
Batch Plant Phase I	Bulldozing	100	hours	3.0×10^{-1}	1.2×10^{-1}	2.7×10^{2}	1.1×10^{2}
			Total	**3.0×10^{-1}**	**1.2×10^{-1}**	**2.7×10^{2}**	**1.1×10^{2}**
Batch Plant Phase I	Cement Unloading to Storage Silo	48,976	tons	8.3×10^{-3}	1.9×10^{-3}	7.6	1.7
	Cement Supplement Unloading to Storage Silo	20,944	tons	5.1×10^{-2}	1.2×10^{-2}	4.7×10^{1}	1.1×10^{1}
	Sand Transfer	158,875	tons	7.9×10^{-2}	1.8×10^{-2}	7.1×10^{1}	1.6×10^{1}
	Aggregate Transfer	385,971	tons	6.4×10^{-1}	1.5×10^{-1}	5.8×10^{2}	1.3×10^{2}
	Weigh Hopper Loading	544,846	tons	7.6×10^{-1}	1.8×10^{-1}	6.9×10^{2}	1.6×10^{2}
	Mixer Loading (Central Mix)	69,920	tons	1.9×10^{-1}	4.4×10^{-2}	1.7×10^{2}	4.0×10^{1}
			Total	**1.7**	**4.0×10^{-1}**	**1.6×10^{3}**	**3.6×10^{2}**

Modeling Scenario 4. For Modeling Scenario 4, fugitive dust generating activities include excavation of aggregate from an on-site borrow area and concrete batch plant operations to support installation of pools and floor slabs (Table E.2-10). In addition, approximately 18.2 hectares (45 acres) of ground are assumed to be subject to wind erosion (see Table E.2-11 for wind erosion emissions). Total material throughput is provided in Table E.2-17. Activity rates (A in Equation E-1) and emissions of PM_{10} and $PM_{2.5}$ are provided in Table E.2-18 for the equipment and processes associated with this modeling scenario.

Table E.2-17: Material Throughput for Batch Plant Phase II

Material	Quantity metric tons	Quantity U.S. tons
Cement	6,939	7,651
Fine Aggregate (Sand)	22,972	25,328
Coarse Aggregate	26,141	28,821
Fly Ash	2,979	3,284
Total	59,031	65,084

Table E.2-18: Activity Parameters With PM_{10} and $PM_{2.5}$ Emissions for Construction Modeling Scenario 4

Construction Phase	Equipment Description	Activity Rates	Units	Emissions		Emissions	
				PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
				tons		kilograms	
Batch Plant Phase II	Bulldozing	200	hours	6.0×10^{-1}	2.4×10^{-1}	5.5×10^{2}	2.1×10^{2}
			Total	**6.0×10^{-1}**	**2.4×10^{-1}**	**5.5×10^{2}**	**2.1×10^{2}**
Batch Plant Phase II	Cement Unloading to Storage Silo	7,651	tons	1.3×10^{-3}	3.0×10^{-4}	1.2	2.7×10^{-1}
	Cement Supplement Unloading to Storage Silo	3,284	tons	8.0×10^{-3}	1.9×10^{-3}	7.3	1.7
	Sand Transfer	25,328	tons	1.3×10^{-2}	2.9×10^{-3}	1.1×10^{1}	2.6
	Aggregate Transfer	28,821	tons	4.8×10^{-2}	1.1×10^{-2}	4.3×10^{1}	9.9
	Weigh Hopper Loading	54,149	tons	7.6×10^{-2}	1.7×10^{-2}	6.9×10^{1}	1.6×10^{1}
	Mixer Loading (Central Mix)	10,935	tons	3.0×10^{-2}	6.9×10^{-3}	2.7×10^{1}	6.3
			Total	**1.8×10^{-1}**	**4.0×10^{-2}**	**1.6×10^{2}**	**3.7×10^{1}**

Vehicle Emissions

The on-road and off-road vehicle and equipment emissions are estimated from emission factors derived with the EPA MOVES2014 model. MOVES2014 is a computer software application that provides emission information associated with fuel combustion and tire wear in on-road vehicles and fuel combustion in off-road vehicles and equipment. These emission factors are applied to the mobile sources and operation information using the following equations:

- On-Road Mobile Sources

$$Emissions\ (grams) = \begin{matrix} Emission \\ Factor \end{matrix} \left(\frac{g}{mi}\right) \times \begin{matrix} Vehicle \\ Miles \end{matrix}\ (mi). \qquad \textbf{Equation E-2}$$

- Off-Road Mobile Sources

$$Emissions\ (grams) = \begin{matrix} Emission \\ Factor \end{matrix} \left(\frac{g}{hp{\cdot}hr}\right) \times \begin{matrix} Horse \\ power \end{matrix}\ (hp) \times \begin{matrix} Load \\ Factor \end{matrix} \times \begin{matrix} Operating \\ Time \end{matrix}\ (hr). \qquad \textbf{Equation E-3}$$

Criteria pollutant emission factors and emissions are estimated for on-road and off-road vehicles and equipment per construction activity and combined per construction phase. Total emissions per pollutant and construction activity are calculated in grams. Construction activities are described in Table E.2-10.

On-Road Vehicles

On-road vehicle emissions from gasoline and diesel fuel combustion are generated for worker, vendor, and haul vehicle traffic during construction. A tire wear component adds to emissions of particulate matter. A summary of the MOVES2014 model run specifications for on-road construction vehicles is listed in Table E.2-19.

Table E.2-19: MOVES2014 Model Run Specification – ONROAD

Setup Category	Parameter	Option Value(s)
Description	-	Butte County, Idaho - Construction OnRoad
Scale	Model	ONROAD
	Domain/Scale	National
	Calculation Type	Emission Rates
Time Span	Years	2017, 2018, 2019, 2020, 2021, 2022 (each year run separately)
	Months	All
	Days	Weekdays and Weekends
	Hours	Start Hour 06:00-06:59 / End Hour 18:00-18:59
Geographic Bounds	State / County	IDAHO – Butte County
Vehicles	Gasoline Fuel	Passenger Car Passenger Truck
	Diesel Fuel	Passenger Truck Light Commercial Truck Single Unit Short-haul Truck Combination Short-haul Truck Combination Long-haul Truck
Pollutants and Processes	-	Running Exhaust Tire wear
Road Types	-	Off-Network Rural Unrestricted Access
Output	General Output	Mass Units = Grams Distance Units = Miles
	Output Emissions Detail	For All Vehicle Categories = Fuel Type

Note – Pre-processing and other model input options/settings are not applicable for this analysis.
Source: North Wind Inc. 2015

Equation E-2 is used to calculate on-road vehicle emissions. Activity data for on-road vehicles per construction phase and construction activity (Table E.2-10) are provided in Table E.2-20. On-road emission factors calculated from MOVES2014 for criteria pollutants are provided in Table E.2-21. On-road vehicle criteria pollutant emissions are in provided in Table E.2-22.

Table E.2-20: On-Road Vehicles - Miles Traveled

MOVES2014 Vehicle Designation	Speed Bin (miles per hour)	Fuel Type	Construction Phase ID							
			1		2			3	4	
			Construction Activity ID							
			1	2	3	4	5	6	7	8
Passenger Car	35	Gasoline	17,153	17,153	17,153	17,153	17,153	17,153	24,098	24,098
Passenger Truck	35	Gasoline	31,856	31,856	31,856	31,856	31,856	31,856	44,754	44,754
Passenger Truck	35	Diesel	100	100	100	100	100	100	200	
Light Commercial Truck	35	Diesel	300	200	400	200		400	1,400	200
Single Unit Short-haul Truck	35	Diesel		500	500	450	300			
Combination Short-haul Truck	35	Diesel	300	100	100	100	100	5,273	500	100
Combination Long-haul Truck	35	Diesel	300					100		
Passenger Car	65	Gasoline	154,380	154,380	154,380	154,380	154,380	154,380	216,885	216,885
Passenger Truck	65	Gasoline	286,706	286,706	286,706	286,706	286,706	286,706	402,787	402,787
Passenger Truck	65	Diesel	900	900	900	900	900	900	1,800	
Light Commercial Truck	65	Diesel	2,700	1,800	3,600	1,800		3,600	12,600	1,800
Single Unit Short-haul Truck	65	Diesel		4,500	4,500	4,050	2,700			
Combination Short-haul Truck	65	Diesel	2,700	900	900	900	900	47,453	4,500	900
Combination Long-haul Truck	65	Diesel	2,700					900		

Note: Gray shaded cells indicate no vehicle miles are traveled during activity.
Total vehicle miles traveled are distributed as 10% @ 35 mph and 90% @ 65 mph.
Source: North Wind Inc. 2015

Table E.2-20: On-Road Vehicles - Miles Traveled (cont.)

MOVES2014 Vehicle Designation	Speed Bin (miles per hour)	Fuel Type	Construction Phase ID							
			5		6	7		8	9	
			Construction Activity ID							
			9	10	11	12	13	14	15	16
Passenger Car	35	Gasoline	332,342	332,342	95,277	64,474	64,474	16,333	16,333	16,333
Passenger Truck	35	Gasoline	617,207	617,207	176,943	119,737	119,737	30,333	30,333	30,333
Passenger Truck	35	Diesel	1,000	500	100		1,000	100	100	
Light Commercial Truck	35	Diesel		500	200	400	500	200	300	200
Single Unit Short-haul Truck	35	Diesel	2,000			5,000				
Combination Short-haul Truck	35	Diesel	15,000		100		21,000	3,426	300	
Combination Long-haul Truck	35	Diesel	7,000	800				100	300	100
Passenger Car	65	Gasoline	2,991,078	2,991,078	857,492	580,263	580,263	147,000	147,000	147,000
Passenger Truck	65	Gasoline	5,554,859	5,554,859	1,592,485	1,077,632	1,077,632	273,000	273,000	273,000
Passenger Truck	65	Diesel	9,000	4,500	900		9,000	900	900	
Light Commercial Truck	65	Diesel		4,500	1,800	3,600	4,500	1,800	2,700	1,800
Single Unit Short-haul Truck	65	Diesel	18,000			45,000				
Combination Short-haul Truck	65	Diesel	135,000		900		189,000	30,838	2,700	
Combination Long-haul Truck	65	Diesel	63,000	7,200				900	2,700	900

Note: Gray shaded cells indicate no vehicle miles are traveled during activity.
Total vehicle miles traveled are distributed as 10% @ 35 mph and 90% @ 65 mph.
Source: North Wind Inc. 2015

Table E.2-21: On-Road Vehicle Emission Factors

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
1	201710	201804	35	Passenger Car	Gasoline	1.970	0.190	0.008	0.010	0.007	0.002	0.002
1	201710	201804	35	Passenger Truck	Gasoline	3.131	0.372	0.009	0.010	0.008	0.002	0.003
1	201710	201804	35	Passenger Truck	Diesel	1.561	1.148	0.041	0.013	0.038	0.002	0.005
1	201710	201804	35	Light Commercial Truck	Diesel	1.784	1.203	0.050	0.012	0.046	0.002	0.005
1	201710	201804	35	Single Unit Short-haul Truck	Diesel	1.134	2.973	0.106	0.020	0.097	0.003	0.009
1	201710	201804	35	Combination Short-haul Truck	Diesel	1.373	5.555	0.199	0.034	0.183	0.005	0.015
1	201710	201804	35	Combination Long-haul Truck	Diesel	1.688	6.839	0.276	0.037	0.254	0.006	0.015
1	201710	201804	65	Passenger Car	Gasoline	1.743	0.203	0.007	0.007	0.007	0.001	0.002
1	201710	201804	65	Passenger Truck	Gasoline	3.137	0.439	0.009	0.007	0.008	0.001	0.002
1	201710	201804	65	Passenger Truck	Diesel	1.354	0.938	0.036	0.008	0.033	0.001	0.005
1	201710	201804	65	Light Commercial Truck	Diesel	1.502	0.983	0.043	0.008	0.039	0.001	0.005
1	201710	201804	65	Single Unit Short-haul Truck	Diesel	0.782	2.045	0.073	0.013	0.067	0.002	0.006
1	201710	201804	65	Combination Short-haul Truck	Diesel	1.012	5.315	0.128	0.021	0.118	0.003	0.014
1	201710	201804	65	Combination Long-haul Truck	Diesel	1.242	6.347	0.170	0.024	0.156	0.004	0.014
2	201710	201804	35	Passenger Car	Gasoline	1.970	0.190	0.008	0.010	0.007	0.002	0.002

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
2	201710	201804	35	Passenger Truck	Gasoline	3.131	0.372	0.009	0.010	0.008	0.002	0.003
2	201710	201804	35	Passenger Truck	Diesel	1.561	1.148	0.041	0.013	0.038	0.002	0.005
2	201710	201804	35	Light Commercial Truck	Diesel	1.784	1.203	0.050	0.012	0.046	0.002	0.005
2	201710	201804	35	Single Unit Short-haul Truck	Diesel	1.134	2.973	0.106	0.020	0.097	0.003	0.009
2	201710	201804	35	Combination Short-haul Truck	Diesel	1.373	5.555	0.199	0.034	0.183	0.005	0.015
2	201710	201804	35	Combination Long-haul Truck	Diesel	1.688	6.839	0.276	0.037	0.254	0.006	0.015
2	201710	201804	65	Passenger Car	Gasoline	1.743	0.203	0.007	0.007	0.007	0.001	0.002
2	201710	201804	65	Passenger Truck	Gasoline	3.137	0.439	0.009	0.007	0.008	0.001	0.002
2	201710	201804	65	Passenger Truck	Diesel	1.354	0.938	0.036	0.008	0.033	0.001	0.005
2	201710	201804	65	Light Commercial Truck	Diesel	1.502	0.983	0.043	0.008	0.039	0.001	0.005
2	201710	201804	65	Single Unit Short-haul Truck	Diesel	0.782	2.045	0.073	0.013	0.067	0.002	0.006
2	201710	201804	65	Combination Short-haul Truck	Diesel	1.012	5.315	0.128	0.021	0.118	0.003	0.014
2	201710	201804	65	Combination Long-haul Truck	Diesel	1.242	6.347	0.170	0.024	0.156	0.004	0.014
3	201710	201804	35	Passenger Car	Gasoline	1.970	0.190	0.008	0.010	0.007	0.002	0.002
3	201710	201804	35	Passenger Truck	Gasoline	3.131	0.372	0.009	0.010	0.008	0.002	0.003

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
3	201710	201804	35	Passenger Truck	Diesel	1.561	1.148	0.041	0.013	0.038	0.002	0.005
3	201710	201804	35	Light Commercial Truck	Diesel	1.784	1.203	0.050	0.012	0.046	0.002	0.005
3	201710	201804	35	Single Unit Short-haul Truck	Diesel	1.134	2.973	0.106	0.020	0.097	0.003	0.009
3	201710	201804	35	Combination Short-haul Truck	Diesel	1.373	5.555	0.199	0.034	0.183	0.005	0.015
3	201710	201804	35	Combination Long-haul Truck	Diesel	1.688	6.839	0.276	0.037	0.254	0.006	0.015
3	201710	201804	65	Passenger Car	Gasoline	1.743	0.203	0.007	0.007	0.007	0.001	0.002
3	201710	201804	65	Passenger Truck	Gasoline	3.137	0.439	0.009	0.007	0.008	0.001	0.002
3	201710	201804	65	Passenger Truck	Diesel	1.354	0.938	0.036	0.008	0.033	0.001	0.005
3	201710	201804	65	Light Commercial Truck	Diesel	1.502	0.983	0.043	0.008	0.039	0.001	0.005
3	201710	201804	65	Single Unit Short-haul Truck	Diesel	0.782	2.045	0.073	0.013	0.067	0.002	0.006
3	201710	201804	65	Combination Short-haul Truck	Diesel	1.012	5.315	0.128	0.021	0.118	0.003	0.014
3	201710	201804	65	Combination Long-haul Truck	Diesel	1.242	6.347	0.170	0.024	0.156	0.004	0.014
4	201710	201804	35	Passenger Car	Gasoline	1.970	0.190	0.008	0.010	0.007	0.002	0.002
4	201710	201804	35	Passenger Truck	Gasoline	3.131	0.372	0.009	0.010	0.008	0.002	0.003
4	201710	201804	35	Passenger Truck	Diesel	1.561	1.148	0.041	0.013	0.038	0.002	0.005

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
4	201710	201804	35	Light Commercial Truck	Diesel	1.784	1.203	0.050	0.012	0.046	0.002	0.005
4	201710	201804	35	Single Unit Short-haul Truck	Diesel	1.134	2.973	0.106	0.020	0.097	0.003	0.009
4	201710	201804	35	Combination Short-haul Truck	Diesel	1.373	5.555	0.199	0.034	0.183	0.005	0.015
4	201710	201804	35	Combination Long-haul Truck	Diesel	1.688	6.839	0.276	0.037	0.254	0.006	0.015
4	201710	201804	65	Passenger Car	Gasoline	1.743	0.203	0.007	0.007	0.007	0.001	0.002
4	201710	201804	65	Passenger Truck	Gasoline	3.137	0.439	0.009	0.007	0.008	0.001	0.002
4	201710	201804	65	Passenger Truck	Diesel	1.354	0.938	0.036	0.008	0.033	0.001	0.005
4	201710	201804	65	Light Commercial Truck	Diesel	1.502	0.983	0.043	0.008	0.039	0.001	0.005
4	201710	201804	65	Single Unit Short-haul Truck	Diesel	0.782	2.045	0.073	0.013	0.067	0.002	0.006
4	201710	201804	65	Combination Short-haul Truck	Diesel	1.012	5.315	0.128	0.021	0.118	0.003	0.014
4	201710	201804	65	Combination Long-haul Truck	Diesel	1.242	6.347	0.170	0.024	0.156	0.004	0.014
5	201710	201804	35	Passenger Car	Gasoline	1.970	0.190	0.008	0.010	0.007	0.002	0.002
5	201710	201804	35	Passenger Truck	Gasoline	3.131	0.372	0.009	0.010	0.008	0.002	0.003
5	201710	201804	35	Passenger Truck	Diesel	1.561	1.148	0.041	0.013	0.038	0.002	0.005
5	201710	201804	35	Light Commercial Truck	Diesel	1.784	1.203	0.050	0.012	0.046	0.002	0.005

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
5	201710	201804	35	Single Unit Short-haul Truck	Diesel	1.134	2.973	0.106	0.020	0.097	0.003	0.009
5	201710	201804	35	Combination Short-haul Truck	Diesel	1.373	5.555	0.199	0.034	0.183	0.005	0.015
5	201710	201804	35	Combination Long-haul Truck	Diesel	1.688	6.839	0.276	0.037	0.254	0.006	0.015
5	201710	201804	65	Passenger Car	Gasoline	1.743	0.203	0.007	0.007	0.007	0.001	0.002
5	201710	201804	65	Passenger Truck	Gasoline	3.137	0.439	0.009	0.007	0.008	0.001	0.002
5	201710	201804	65	Passenger Truck	Diesel	1.354	0.938	0.036	0.008	0.033	0.001	0.005
5	201710	201804	65	Light Commercial Truck	Diesel	1.502	0.983	0.043	0.008	0.039	0.001	0.005
5	201710	201804	65	Single Unit Short-haul Truck	Diesel	0.782	2.045	0.073	0.013	0.067	0.002	0.006
5	201710	201804	65	Combination Short-haul Truck	Diesel	1.012	5.315	0.128	0.021	0.118	0.003	0.014
5	201710	201804	65	Combination Long-haul Truck	Diesel	1.242	6.347	0.170	0.024	0.156	0.004	0.014
6	201710	201804	35	Passenger Car	Gasoline	1.970	0.190	0.008	0.010	0.007	0.002	0.002
6	201710	201804	35	Passenger Truck	Gasoline	3.131	0.372	0.009	0.010	0.008	0.002	0.003
6	201710	201804	35	Passenger Truck	Diesel	1.561	1.148	0.041	0.013	0.038	0.002	0.005
6	201710	201804	35	Light Commercial Truck	Diesel	1.784	1.203	0.050	0.012	0.046	0.002	0.005
6	201710	201804	35	Single Unit Short-haul Truck	Diesel	1.134	2.973	0.106	0.020	0.097	0.003	0.009

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
6	201710	201804	35	Combination Short-haul Truck	Diesel	1.373	5.555	0.199	0.034	0.183	0.005	0.015
6	201710	201804	35	Combination Long-haul Truck	Diesel	1.688	6.839	0.276	0.037	0.254	0.006	0.015
6	201710	201804	65	Passenger Car	Gasoline	1.743	0.203	0.007	0.007	0.007	0.001	0.002
6	201710	201804	65	Passenger Truck	Gasoline	3.137	0.439	0.009	0.007	0.008	0.001	0.002
6	201710	201804	65	Passenger Truck	Diesel	1.354	0.938	0.036	0.008	0.033	0.001	0.005
6	201710	201804	65	Light Commercial Truck	Diesel	1.502	0.983	0.043	0.008	0.039	0.001	0.005
6	201710	201804	65	Single Unit Short-haul Truck	Diesel	0.782	2.045	0.073	0.013	0.067	0.002	0.006
6	201710	201804	65	Combination Short-haul Truck	Diesel	1.012	5.315	0.128	0.021	0.118	0.003	0.014
6	201710	201804	65	Combination Long-haul Truck	Diesel	1.242	6.347	0.170	0.024	0.156	0.004	0.014
7	201803	201810	35	Passenger Car	Gasoline	2.077	0.171	0.005	0.010	0.005	0.002	0.002
7	201803	201810	35	Passenger Truck	Gasoline	3.230	0.339	0.006	0.010	0.005	0.002	0.003
7	201803	201810	35	Passenger Truck	Diesel	1.622	1.096	0.038	0.013	0.035	0.002	0.005
7	201803	201810	35	Light Commercial Truck	Diesel	1.867	1.142	0.046	0.012	0.042	0.002	0.005
7	201803	201810	35	Single Unit Short-haul Truck	Diesel	1.062	2.692	0.096	0.020	0.089	0.003	0.009
7	201803	201810	35	Combination Short-haul Truck	Diesel	1.284	5.015	0.181	0.034	0.167	0.005	0.015

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
7	201803	201810	35	Combination Long-haul Truck	Diesel	1.615	6.335	0.262	0.037	0.241	0.006	0.016
7	201803	201810	65	Passenger Car	Gasoline	1.843	0.184	0.005	0.007	0.004	0.001	0.002
7	201803	201810	65	Passenger Truck	Gasoline	3.255	0.403	0.006	0.007	0.005	0.001	0.002
7	201803	201810	65	Passenger Truck	Diesel	1.420	0.890	0.034	0.008	0.031	0.001	0.005
7	201803	201810	65	Light Commercial Truck	Diesel	1.589	0.927	0.040	0.008	0.036	0.001	0.005
7	201803	201810	65	Single Unit Short-haul Truck	Diesel	0.734	1.855	0.067	0.013	0.062	0.002	0.006
7	201803	201810	65	Combination Short-haul Truck	Diesel	0.945	4.789	0.116	0.021	0.106	0.003	0.014
7	201803	201810	65	Combination Long-haul Truck	Diesel	1.187	5.871	0.161	0.024	0.148	0.004	0.015
8	201803	201810	35	Passenger Car	Gasoline	2.077	0.171	0.005	0.010	0.005	0.002	0.002
8	201803	201810	35	Passenger Truck	Gasoline	3.230	0.339	0.006	0.010	0.005	0.002	0.003
8	201803	201810	35	Passenger Truck	Diesel	1.622	1.096	0.038	0.013	0.035	0.002	0.005
8	201803	201810	35	Light Commercial Truck	Diesel	1.867	1.142	0.046	0.012	0.042	0.002	0.005
8	201803	201810	35	Single Unit Short-haul Truck	Diesel	1.062	2.692	0.096	0.020	0.089	0.003	0.009
8	201803	201810	35	Combination Short-haul Truck	Diesel	1.284	5.015	0.181	0.034	0.167	0.005	0.015
8	201803	201810	35	Combination Long-haul Truck	Diesel	1.615	6.335	0.262	0.037	0.241	0.006	0.016

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
8	201803	201810	65	Passenger Car	Gasoline	1.843	0.184	0.005	0.007	0.004	0.001	0.002
8	201803	201810	65	Passenger Truck	Gasoline	3.255	0.403	0.006	0.007	0.005	0.001	0.002
8	201803	201810	65	Passenger Truck	Diesel	1.420	0.890	0.034	0.008	0.031	0.001	0.005
8	201803	201810	65	Light Commercial Truck	Diesel	1.589	0.927	0.040	0.008	0.036	0.001	0.005
8	201803	201810	65	Single Unit Short-haul Truck	Diesel	0.734	1.855	0.067	0.013	0.062	0.002	0.006
8	201803	201810	65	Combination Short-haul Truck	Diesel	0.945	4.789	0.116	0.021	0.106	0.003	0.014
8	201803	201810	65	Combination Long-haul Truck	Diesel	1.187	5.871	0.161	0.024	0.148	0.004	0.015
9	201804	202109	35	Passenger Car	Gasoline	1.878	0.132	0.005	0.010	0.005	0.002	0.002
9	201804	202109	35	Passenger Truck	Gasoline	2.845	0.271	0.006	0.010	0.006	0.002	0.003
9	201804	202109	35	Passenger Truck	Diesel	1.378	0.945	0.031	0.013	0.028	0.002	0.005
9	201804	202109	35	Light Commercial Truck	Diesel	1.593	0.960	0.036	0.012	0.033	0.002	0.005
9	201804	202109	35	Single Unit Short-haul Truck	Diesel	0.877	2.226	0.073	0.020	0.067	0.003	0.009
9	201804	202109	35	Combination Short-haul Truck	Diesel	1.053	4.100	0.139	0.033	0.128	0.005	0.014
9	201804	202109	35	Combination Long-haul Truck	Diesel	1.392	5.512	0.218	0.037	0.201	0.006	0.015
9	201804	202109	65	Passenger Car	Gasoline	1.672	0.145	0.005	0.007	0.004	0.001	0.002

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
9	201804	202109	65	Passenger Truck	Gasoline	2.896	0.327	0.006	0.007	0.006	0.001	0.002
9	201804	202109	65	Passenger Truck	Diesel	1.221	0.761	0.027	0.008	0.025	0.001	0.005
9	201804	202109	65	Light Commercial Truck	Diesel	1.381	0.777	0.031	0.008	0.029	0.001	0.004
9	201804	202109	65	Single Unit Short-haul Truck	Diesel	0.607	1.539	0.051	0.013	0.047	0.002	0.006
9	201804	202109	65	Combination Short-haul Truck	Diesel	0.773	3.893	0.088	0.021	0.081	0.003	0.014
9	201804	202109	65	Combination Long-haul Truck	Diesel	1.020	5.086	0.134	0.024	0.123	0.004	0.014
10	201804	202109	35	Passenger Car	Gasoline	1.878	0.132	0.005	0.010	0.005	0.002	0.002
10	201804	202109	35	Passenger Truck	Gasoline	2.845	0.271	0.006	0.010	0.006	0.002	0.003
10	201804	202109	35	Passenger Truck	Diesel	1.378	0.945	0.031	0.013	0.028	0.002	0.005
10	201804	202109	35	Light Commercial Truck	Diesel	1.593	0.960	0.036	0.012	0.033	0.002	0.005
10	201804	202109	35	Single Unit Short-haul Truck	Diesel	0.877	2.226	0.073	0.020	0.067	0.003	0.009
10	201804	202109	35	Combination Short-haul Truck	Diesel	1.053	4.100	0.139	0.033	0.128	0.005	0.014
10	201804	202109	35	Combination Long-haul Truck	Diesel	1.392	5.512	0.218	0.037	0.201	0.006	0.015
10	201804	202109	65	Passenger Car	Gasoline	1.672	0.145	0.005	0.007	0.004	0.001	0.002
10	201804	202109	65	Passenger Truck	Gasoline	2.896	0.327	0.006	0.007	0.006	0.001	0.002

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
10	201804	202109	65	Passenger Truck	Diesel	1.221	0.761	0.027	0.008	0.025	0.001	0.005
10	201804	202109	65	Light Commercial Truck	Diesel	1.381	0.777	0.031	0.008	0.029	0.001	0.004
10	201804	202109	65	Single Unit Short-haul Truck	Diesel	0.607	1.539	0.051	0.013	0.047	0.002	0.006
10	201804	202109	65	Combination Short-haul Truck	Diesel	0.773	3.893	0.088	0.021	0.081	0.003	0.014
10	201804	202109	65	Combination Long-haul Truck	Diesel	1.020	5.086	0.134	0.024	0.123	0.004	0.014
11	201810	201911	35	Passenger Car	Gasoline	1.917	0.149	0.006	0.010	0.005	0.002	0.002
11	201810	201911	35	Passenger Truck	Gasoline	2.943	0.300	0.007	0.010	0.006	0.002	0.003
11	201810	201911	35	Passenger Truck	Diesel	1.445	1.009	0.034	0.013	0.031	0.002	0.005
11	201810	201911	35	Light Commercial Truck	Diesel	1.657	1.036	0.040	0.012	0.037	0.002	0.005
11	201810	201911	35	Single Unit Short-haul Truck	Diesel	0.953	2.444	0.083	0.020	0.076	0.003	0.009
11	201810	201911	35	Combination Short-haul Truck	Diesel	1.149	4.532	0.156	0.033	0.144	0.005	0.014
11	201810	201911	35	Combination Long-haul Truck	Diesel	1.492	5.943	0.238	0.037	0.219	0.006	0.015
11	201810	201911	65	Passenger Car	Gasoline	1.703	0.162	0.005	0.007	0.005	0.001	0.002
11	201810	201911	65	Passenger Truck	Gasoline	2.982	0.360	0.007	0.007	0.006	0.001	0.002
11	201810	201911	65	Passenger Truck	Diesel	1.273	0.817	0.030	0.008	0.028	0.001	0.005

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
11	201810	201911	65	Light Commercial Truck	Diesel	1.423	0.841	0.035	0.008	0.032	0.001	0.004
11	201810	201911	65	Single Unit Short-haul Truck	Diesel	0.660	1.688	0.058	0.013	0.053	0.002	0.006
11	201810	201911	65	Combination Short-haul Truck	Diesel	0.845	4.315	0.100	0.021	0.092	0.003	0.014
11	201810	201911	65	Combination Long-haul Truck	Diesel	1.095	5.495	0.146	0.024	0.134	0.004	0.014
12	202102	202111	35	Passenger Car	Gasoline	1.718	0.098	0.004	0.010	0.004	0.002	0.002
12	202102	202111	35	Passenger Truck	Gasoline	2.535	0.209	0.006	0.010	0.005	0.002	0.002
12	202102	202111	35	Passenger Truck	Diesel	1.189	0.805	0.024	0.013	0.022	0.002	0.005
12	202102	202111	35	Light Commercial Truck	Diesel	1.396	0.797	0.028	0.012	0.026	0.002	0.005
12	202102	202111	35	Single Unit Short-haul Truck	Diesel	0.717	1.798	0.053	0.020	0.049	0.003	0.009
12	202102	202111	35	Combination Short-haul Truck	Diesel	0.854	3.259	0.102	0.033	0.094	0.005	0.014
12	202102	202111	35	Combination Long-haul Truck	Diesel	1.184	4.675	0.178	0.037	0.164	0.006	0.015
12	202102	202111	65	Passenger Car	Gasoline	1.536	0.111	0.004	0.007	0.003	0.001	0.002
12	202102	202111	65	Passenger Truck	Gasoline	2.605	0.260	0.005	0.007	0.005	0.001	0.002
12	202102	202111	65	Passenger Truck	Diesel	1.067	0.641	0.021	0.008	0.020	0.001	0.005
12	202102	202111	65	Light Commercial Truck	Diesel	1.236	0.642	0.024	0.008	0.022	0.001	0.004

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
12	202102	202111	65	Single Unit Short-haul Truck	Diesel	0.500	1.250	0.037	0.013	0.034	0.002	0.006
12	202102	202111	65	Combination Short-haul Truck	Diesel	0.624	3.071	0.065	0.021	0.060	0.003	0.013
12	202102	202111	65	Combination Long-haul Truck	Diesel	0.865	4.289	0.109	0.024	0.100	0.004	0.014
13	202102	202111	35	Passenger Car	Gasoline	1.718	0.098	0.004	0.010	0.004	0.002	0.002
13	202102	202111	35	Passenger Truck	Gasoline	2.535	0.209	0.006	0.010	0.005	0.002	0.002
13	202102	202111	35	Passenger Truck	Diesel	1.189	0.805	0.024	0.013	0.022	0.002	0.005
13	202102	202111	35	Light Commercial Truck	Diesel	1.396	0.797	0.028	0.012	0.026	0.002	0.005
13	202102	202111	35	Single Unit Short-haul Truck	Diesel	0.717	1.798	0.053	0.020	0.049	0.003	0.009
13	202102	202111	35	Combination Short-haul Truck	Diesel	0.854	3.259	0.102	0.033	0.094	0.005	0.014
13	202102	202111	35	Combination Long-haul Truck	Diesel	1.184	4.675	0.178	0.037	0.164	0.006	0.015
13	202102	202111	65	Passenger Car	Gasoline	1.536	0.111	0.004	0.007	0.003	0.001	0.002
13	202102	202111	65	Passenger Truck	Gasoline	2.605	0.260	0.005	0.007	0.005	0.001	0.002
13	202102	202111	65	Passenger Truck	Diesel	1.067	0.641	0.021	0.008	0.020	0.001	0.005
13	202102	202111	65	Light Commercial Truck	Diesel	1.236	0.642	0.024	0.008	0.022	0.001	0.004
13	202102	202111	65	Single Unit Short-haul Truck	Diesel	0.500	1.250	0.037	0.013	0.034	0.002	0.006

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
13	202102	202111	65	Combination Short-haul Truck	Diesel	0.624	3.071	0.065	0.021	0.060	0.003	0.013
13	202102	202111	65	Combination Long-haul Truck	Diesel	0.865	4.289	0.109	0.024	0.100	0.004	0.014
14	202204	202209	35	Passenger Car	Gasoline	1.707	0.082	0.004	0.010	0.003	0.002	0.002
14	202204	202209	35	Passenger Truck	Gasoline	2.466	0.179	0.005	0.010	0.004	0.002	0.002
14	202204	202209	35	Passenger Truck	Diesel	1.145	0.722	0.021	0.013	0.019	0.002	0.005
14	202204	202209	35	Light Commercial Truck	Diesel	1.351	0.704	0.024	0.012	0.022	0.002	0.005
14	202204	202209	35	Single Unit Short-haul Truck	Diesel	0.643	1.567	0.044	0.020	0.041	0.003	0.009
14	202204	202209	35	Combination Short-haul Truck	Diesel	0.761	2.827	0.086	0.033	0.079	0.005	0.014
14	202204	202209	35	Combination Long-haul Truck	Diesel	1.068	4.141	0.156	0.037	0.144	0.006	0.015
14	202204	202209	65	Passenger Car	Gasoline	1.531	0.095	0.003	0.007	0.003	0.001	0.002
14	202204	202209	65	Passenger Truck	Gasoline	2.548	0.226	0.005	0.007	0.004	0.001	0.002
14	202204	202209	65	Passenger Truck	Diesel	1.036	0.572	0.019	0.008	0.017	0.001	0.004
14	202204	202209	65	Light Commercial Truck	Diesel	1.211	0.565	0.021	0.008	0.019	0.001	0.004
14	202204	202209	65	Single Unit Short-haul Truck	Diesel	0.450	1.091	0.031	0.013	0.029	0.002	0.006
14	202204	202209	65	Combination Short-haul Truck	Diesel	0.554	2.649	0.054	0.021	0.050	0.003	0.013

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
14	202204	202209	65	Combination Long-haul Truck	Diesel	0.778	3.782	0.096	0.024	0.088	0.004	0.014
15	202204	202209	35	Passenger Car	Gasoline	1.707	0.082	0.004	0.010	0.003	0.002	0.002
15	202204	202209	35	Passenger Truck	Gasoline	2.466	0.179	0.005	0.010	0.004	0.002	0.002
15	202204	202209	35	Passenger Truck	Diesel	1.145	0.722	0.021	0.013	0.019	0.002	0.005
15	202204	202209	35	Light Commercial Truck	Diesel	1.351	0.704	0.024	0.012	0.022	0.002	0.005
15	202204	202209	35	Single Unit Short-haul Truck	Diesel	0.643	1.567	0.044	0.020	0.041	0.003	0.009
15	202204	202209	35	Combination Short-haul Truck	Diesel	0.761	2.827	0.086	0.033	0.079	0.005	0.014
15	202204	202209	35	Combination Long-haul Truck	Diesel	1.068	4.141	0.156	0.037	0.144	0.006	0.015
15	202204	202209	65	Passenger Car	Gasoline	1.531	0.095	0.003	0.007	0.003	0.001	0.002
15	202204	202209	65	Passenger Truck	Gasoline	2.548	0.226	0.005	0.007	0.004	0.001	0.002
15	202204	202209	65	Passenger Truck	Diesel	1.036	0.572	0.019	0.008	0.017	0.001	0.004
15	202204	202209	65	Light Commercial Truck	Diesel	1.211	0.565	0.021	0.008	0.019	0.001	0.004
15	202204	202209	65	Single Unit Short-haul Truck	Diesel	0.450	1.091	0.031	0.013	0.029	0.002	0.006
15	202204	202209	65	Combination Short-haul Truck	Diesel	0.554	2.649	0.054	0.021	0.050	0.003	0.013
15	202204	202209	65	Combination Long-haul Truck	Diesel	0.778	3.782	0.096	0.024	0.088	0.004	0.014

Table E.2-21: On-Road Vehicle Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Average Speed (miles per hour)	Vehicle Type	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Tirewear (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Particulate Tirewear ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
						grams per mile						
16	202204	202209	35	Passenger Car	Gasoline	1.707	0.082	0.004	0.010	0.003	0.002	0.002
16	202204	202209	35	Passenger Truck	Gasoline	2.466	0.179	0.005	0.010	0.004	0.002	0.002
16	202204	202209	35	Passenger Truck	Diesel	1.145	0.722	0.021	0.013	0.019	0.002	0.005
16	202204	202209	35	Light Commercial Truck	Diesel	1.351	0.704	0.024	0.012	0.022	0.002	0.005
16	202204	202209	35	Single Unit Short-haul Truck	Diesel	0.643	1.567	0.044	0.020	0.041	0.003	0.009
16	202204	202209	35	Combination Short-haul Truck	Diesel	0.761	2.827	0.086	0.033	0.079	0.005	0.014
16	202204	202209	35	Combination Long-haul Truck	Diesel	1.068	4.141	0.156	0.037	0.144	0.006	0.015
16	202204	202209	65	Passenger Car	Gasoline	1.531	0.095	0.003	0.007	0.003	0.001	0.002
16	202204	202209	65	Passenger Truck	Gasoline	2.548	0.226	0.005	0.007	0.004	0.001	0.002
16	202204	202209	65	Passenger Truck	Diesel	1.036	0.572	0.019	0.008	0.017	0.001	0.004
16	202204	202209	65	Light Commercial Truck	Diesel	1.211	0.565	0.021	0.008	0.019	0.001	0.004
16	202204	202209	65	Single Unit Short-haul Truck	Diesel	0.450	1.091	0.031	0.013	0.029	0.002	0.006
16	202204	202209	65	Combination Short-haul Truck	Diesel	0.554	2.649	0.054	0.021	0.050	0.003	0.013
16	202204	202209	65	Combination Long-haul Truck	Diesel	0.778	3.782	0.096	0.024	0.088	0.004	0.014

Source: North Wind Inc. 2015

Table E.2-22: On-Road Vehicle Emissions Summary

Construction Phase		Activity		MOVES2014 Emissions				
Phase ID	**Phase Description**	**Activity ID**	**Activity Description**	**Carbon Monoxide (CO)**	**Oxides of Nitrogen (NO_x)**	**Particulate (PM_{10})**	**Particulate ($PM_{2.5}$)**	**Sulfur Dioxide (SO_2)**
				grams				
1	Trenching for Utilities	1	Trenching and installation of utilities	1,314,977	211,668	10,212	4,129	1,213
		2	Demolition of existing fence and utilities	1,311,577	191,488	9,307	4,057	1,169
			TOTAL	**2,626,554**	**403,156**	**19,518**	**8,186**	**2,383**
2	Clearing/ Grading	3	Clearing and grubbing of construction site	1,314,637	193,498	9,474	4,077	1,179
		4	Widening and improving haul road	1,311,169	190,419	9,233	4,050	1,166
		5	Preparing railroad base	1,306,882	185,202	8,846	4,007	1,147
			TOTAL	**3,932,688**	**569,119**	**27,553**	**12,134**	**3,492**
3	Paving Craft Parking, Roads	6	Grading, placement of road base, and paving of roads/parking	1,366,028	465,346	22,487	5,376	1,877
			TOTAL	**1,366,028**	**465,346**	**22,487**	**5,376**	**1,877**
4	Building Excavation	7	Excavation of site / hauling of soil to disposal or stockpile	1,935,910	260,641	9,729	5,799	1,705
		8	Excavation of evaporation ponds	1,909,713	228,187	7,732	5,559	1,584
			TOTAL	**3,845,623**	**488,828**	**17,461**	**11,358**	**3,288**
5	Building & Material Delivery	9	Building and material delivery	23,688,095	3,449,997	152,424	82,377	23,771
		10	Building steel erection	23,490,512	2,512,971	106,608	76,368	20,705
			TOTAL	**47,178,607**	**5,962,967**	**259,033**	**158,745**	**44,476**
6	Batch Plant Phase I	11	Batching concrete with stockpiled aggregate	6,917,786	786,078	33,538	21,854	6,025
			TOTAL	**6,917,786**	**786,078**	**33,538**	**21,854**	**6,025**
7	Batch Plant Phase II	12	Batching concrete with aggregate hauled from on-site borrow area	4,144,185	443,474	20,793	15,557	4,139
		13	Installation of pools and floor slabs	4,265,994	1,034,272	45,171	20,354	6,699
			TOTAL	**8,410,179**	**1,477,746**	**65,964**	**35,910**	**10,838**
8	Paving Final	14	Grading, placement of road base, and paving of roads	1,047,384	179,426	7,815	4,684	1,429
			TOTAL	**1,047,384**	**179,426**	**7,815**	**4,684**	**1,429**
9	Final Grading	15	Trenching and installation of final utilities	1,032,259	104,269	4,800	3,941	1,041
		16	Backfilling around building and final grading	1,026,649	87,467	4,003	3,785	964
			TOTAL	**2,058,907**	**191,736**	**8,803**	**7,726**	**2,005**

Source: North Wind Inc. 2015

The criteria pollutant emissions (in total grams) are converted to grams per second for each construction phase based on hours of operation. These values are summed per modeling scenario to get the release rates for use in AERMOD and CALPUFF. The total emission release rates per modeling scenario are provided in Table E.2-23.

Table E.2-23: On-Road Vehicle Emission Rates by Modeling Scenario

Modeling Scenario	Emission Rates				
	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2
	grams per second				
1	2.6	4.3×10^{-1}	2.0×10^{-2}	9.2×10^{-3}	2.7×10^{-3}
2	2.6	3.2×10^{-1}	1.3×10^{-2}	8.3×10^{-3}	2.3×10^{-3}
3	2.4	2.9×10^{-1}	1.3×10^{-2}	7.9×10^{-3}	2.2×10^{-3}
4	3.1	4.6×10^{-1}	2.0×10^{-2}	1.2×10^{-2}	3.4×10^{-3}

Annual emissions in kilogram per year for on-road vehicles are also calculated for inclusion in the construction emission summary table (Table E.2-35).

Off-Road Vehicles

Power equipment used during construction would result in air emissions from combustion of diesel fuel associated with hours of equipment operation at the construction site. The MOVES2014 model run specifications for off-road vehicles and equipment is summarized in Table E.2-24.

Table E.2-24: MOVES2014 Model Run Specification – NONROAD

Setup Category	Parameter	Option Value(s)
Description	-	Butte County, Idaho - Construction NonRoad
Scale	Model	NONROAD
	Domain/Scale	National
	Calculation Type	Inventory
Time Span	Years	2017, 2018, 2019, 2020, 2021, 2022 (each year run separately)
	Months	All
	Days	Weekends and Weekdays
	Hours	(n/a)
Geographic Bounds	State / County	IDAHO – Butte County
Vehicles	Gasoline Fuel	(n/a)
	Diesel Fuel	Construction Commercial Industrial
Pollutants and Processes	-	Running Exhaust

Table E.2-24: MOVES2014 Model Run Specification – NONROAD (cont.)

Setup Category	Parameter	Option Value(s)
Road Types	-	Nonroad
Output	General Output	Mass Units = Grams
	Output Emissions Detail	(Default selections)
Note: Pre-processing and other model input options/settings are not applicable for this analysis. Source: North Wind Inc. 2015		

Off-road vehicle and equipment emissions are dependent on the quantity of fuel combusted in each type of equipment, which is directly related to the engine size, load factor, and hours of operation. The load factor is defined as the ratio of average power demand to maximum power demand during a given time period. It is expressed as either a fraction or percent of full power. Equation E-3 is used to calculate off-road vehicle and equipment emissions from exhaust.

Activity data for off-road vehicles and equipment per construction phase and construction activity (Table E.2-10) are provided in Table E.2-25. Off-road criteria pollutant emission factors calculated from MOVES2014 are provided in Table E.2-26. Off-road equipment criteria pollutant emissions are provided in Table E.2-27.

Table E.2-25: Off-Road Equipment - Operating Hours

MOVES2014 Equipment Designation	Horse-power	Load Factor	Construction Phase ID															
			1		2			3	4		5		6	7		8	9	
			Construction Activity ID															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Cranes	399	0.43										15,000						
Crawler Tractor/Dozers	357	0.59			480	120	120	50	320				100	100	100	150		100
Generator Sets	49	0.74									200							
Graders	174	0.61						50								80		30
Off-highway Trucks (Dump Trucks)	400	0.50	200	80	40	200	200			200				2,200			200	
Off-highway Trucks (Water Trucks)	189	0.50	40	40	100	60	60	40	100	100			800		200	40	40	100
Other General Industrial Equipment	238	0.51							100									
Paving Equipment	104	0.53						40								60		
Rollers Compactor	232	0.50	100			100	100	100						200		100	100	80
Rollers Paving	95	0.56						40								60		
Rough Terrain Forklifts (All Terrain)	145	0.30									4,000	1,000						
Rough Terrain Forklifts (Crane/Forklift)	200	0.40													200			
Scrapers (Engine 1)	500	0.57							1,800									
Scrapers (Engine 2)	283	0.57							1,800									
Tractors/Loaders/ Backhoes	108	0.55	250	80	100	120	120			100			100	100	100		250	100
Welders	45	0.45									400							

Note: Gray shaded cells indicate no vehicle miles are traveled during activity.
Source: North Wind Inc. 2015

Table E.2-26: Off-Road Equipment Emission Factors

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Equipment Description	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
					gallons per horse power-hour				
1	201710	201804	Cranes	Diesel	0.526	1.969	0.092	0.090	0.003
1	201710	201804	Crawler Tractor/Dozers	Diesel	0.730	1.722	0.106	0.102	0.003
1	201710	201804	Generator Sets	Diesel	1.739	4.040	0.292	0.283	0.004
1	201710	201804	Graders	Diesel	0.457	1.221	0.082	0.079	0.003
1	201710	201804	Off-highway Trucks	Diesel	0.601	1.928	0.062	0.060	0.003
1	201710	201804	Other General Industrial Eqp	Diesel	0.737	2.103	0.131	0.127	0.003
1	201710	201804	Paving Equipment	Diesel	1.196	2.328	0.188	0.183	0.003
1	201710	201804	Rollers	Diesel	1.025	2.003	0.159	0.155	0.003
1	201710	201804	Rough Terrain Forklifts	Diesel	1.432	2.182	0.211	0.204	0.003
1	201710	201804	Scrapers	Diesel	0.789	1.695	0.102	0.099	0.003
1	201710	201804	Tractors/Loaders/Backhoes	Diesel	3.459	3.711	0.541	0.525	0.004
1	201710	201804	Welders	Diesel	4.373	4.708	0.642	0.623	0.004
2	201710	201804	Cranes	Diesel	0.526	1.969	0.092	0.090	0.003
2	201710	201804	Crawler Tractor/Dozers	Diesel	0.730	1.722	0.106	0.102	0.003
2	201710	201804	Generator Sets	Diesel	1.739	4.040	0.292	0.283	0.004
2	201710	201804	Graders	Diesel	0.457	1.221	0.082	0.079	0.003
2	201710	201804	Off-highway Trucks	Diesel	0.601	1.928	0.062	0.060	0.003
2	201710	201804	Other General Industrial Eqp	Diesel	0.737	2.103	0.131	0.127	0.003
2	201710	201804	Paving Equipment	Diesel	1.196	2.328	0.188	0.183	0.003
2	201710	201804	Rollers	Diesel	1.025	2.003	0.159	0.155	0.003
2	201710	201804	Rough Terrain Forklifts	Diesel	1.432	2.182	0.211	0.204	0.003
2	201710	201804	Scrapers	Diesel	0.789	1.695	0.102	0.099	0.003
2	201710	201804	Tractors/Loaders/Backhoes	Diesel	3.459	3.711	0.541	0.525	0.004
2	201710	201804	Welders	Diesel	4.373	4.708	0.642	0.623	0.004
3	201710	201804	Cranes	Diesel	0.526	1.969	0.092	0.090	0.003

Table E.2-26: Off-Road Equipment Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Equipment Description	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
					gallons per horse power-hour				
3	201710	201804	Crawler Tractor/Dozers	Diesel	0.730	1.722	0.106	0.102	0.003
3	201710	201804	Generator Sets	Diesel	1.739	4.040	0.292	0.283	0.004
3	201710	201804	Graders	Diesel	0.457	1.221	0.082	0.079	0.003
3	201710	201804	Off-highway Trucks	Diesel	0.601	1.928	0.062	0.060	0.003
3	201710	201804	Other General Industrial Eqp	Diesel	0.737	2.103	0.131	0.127	0.003
3	201710	201804	Paving Equipment	Diesel	1.196	2.328	0.188	0.183	0.003
3	201710	201804	Rollers	Diesel	1.025	2.003	0.159	0.155	0.003
3	201710	201804	Rough Terrain Forklifts	Diesel	1.432	2.182	0.211	0.204	0.003
3	201710	201804	Scrapers	Diesel	0.789	1.695	0.102	0.099	0.003
3	201710	201804	Tractors/Loaders/Backhoes	Diesel	3.459	3.711	0.541	0.525	0.004
3	201710	201804	Welders	Diesel	4.373	4.708	0.642	0.623	0.004
4	201710	201804	Cranes	Diesel	0.526	1.969	0.092	0.090	0.003
4	201710	201804	Crawler Tractor/Dozers	Diesel	0.730	1.722	0.106	0.102	0.003
4	201710	201804	Generator Sets	Diesel	1.739	4.040	0.292	0.283	0.004
4	201710	201804	Graders	Diesel	0.457	1.221	0.082	0.079	0.003
4	201710	201804	Off-highway Trucks	Diesel	0.601	1.928	0.062	0.060	0.003
4	201710	201804	Other General Industrial Eqp	Diesel	0.737	2.103	0.131	0.127	0.003
4	201710	201804	Paving Equipment	Diesel	1.196	2.328	0.188	0.183	0.003
4	201710	201804	Rollers	Diesel	1.025	2.003	0.159	0.155	0.003
4	201710	201804	Rough Terrain Forklifts	Diesel	1.432	2.182	0.211	0.204	0.003
4	201710	201804	Scrapers	Diesel	0.789	1.695	0.102	0.099	0.003
4	201710	201804	Tractors/Loaders/Backhoes	Diesel	3.459	3.711	0.541	0.525	0.004
4	201710	201804	Welders	Diesel	4.373	4.708	0.642	0.623	0.004
5	201710	201804	Cranes	Diesel	0.526	1.969	0.092	0.090	0.003
5	201710	201804	Crawler Tractor/Dozers	Diesel	0.730	1.722	0.106	0.102	0.003
5	201710	201804	Generator Sets	Diesel	1.739	4.040	0.292	0.283	0.004

Table E.2-26: Off-Road Equipment Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Equipment Description	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
					gallons per horse power-hour				
5	201710	201804	Graders	Diesel	0.457	1.221	0.082	0.079	0.003
5	201710	201804	Off-highway Trucks	Diesel	0.601	1.928	0.062	0.060	0.003
5	201710	201804	Other General Industrial Eqp	Diesel	0.737	2.103	0.131	0.127	0.003
5	201710	201804	Paving Equipment	Diesel	1.196	2.328	0.188	0.183	0.003
5	201710	201804	Rollers	Diesel	1.025	2.003	0.159	0.155	0.003
5	201710	201804	Rough Terrain Forklifts	Diesel	1.432	2.182	0.211	0.204	0.003
5	201710	201804	Scrapers	Diesel	0.789	1.695	0.102	0.099	0.003
5	201710	201804	Tractors/Loaders/Backhoes	Diesel	3.459	3.711	0.541	0.525	0.004
5	201710	201804	Welders	Diesel	4.373	4.708	0.642	0.623	0.004
6	201710	201804	Cranes	Diesel	0.526	1.969	0.092	0.090	0.003
6	201710	201804	Crawler Tractor/Dozers	Diesel	0.730	1.722	0.106	0.102	0.003
6	201710	201804	Generator Sets	Diesel	1.739	4.040	0.292	0.283	0.004
6	201710	201804	Graders	Diesel	0.457	1.221	0.082	0.079	0.003
6	201710	201804	Off-highway Trucks	Diesel	0.601	1.928	0.062	0.060	0.003
6	201710	201804	Other General Industrial Eqp	Diesel	0.737	2.103	0.131	0.127	0.003
6	201710	201804	Paving Equipment	Diesel	1.196	2.328	0.188	0.183	0.003
6	201710	201804	Rollers	Diesel	1.025	2.003	0.159	0.155	0.003
6	201710	201804	Rough Terrain Forklifts	Diesel	1.432	2.182	0.211	0.204	0.003
6	201710	201804	Scrapers	Diesel	0.789	1.695	0.102	0.099	0.003
6	201710	201804	Tractors/Loaders/Backhoes	Diesel	3.459	3.711	0.541	0.525	0.004
6	201710	201804	Welders	Diesel	4.373	4.708	0.642	0.623	0.004
7	201803	201810	Cranes	Diesel	0.498	1.857	0.087	0.084	0.003
7	201803	201810	Crawler Tractor/Dozers	Diesel	0.678	1.613	0.097	0.094	0.003
7	201803	201810	Generator Sets	Diesel	1.690	3.952	0.283	0.274	0.003
7	201803	201810	Graders	Diesel	0.412	1.114	0.072	0.070	0.003
7	201803	201810	Off-highway Trucks	Diesel	0.547	1.852	0.056	0.054	0.003

Table E.2-26: Off-Road Equipment Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Equipment Description	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
					gallons per horse power-hour				
7	201803	201810	Other General Industrial Eqp	Diesel	0.700	1.984	0.124	0.120	0.003
7	201803	201810	Paving Equipment	Diesel	1.140	2.224	0.179	0.174	0.003
7	201803	201810	Rollers	Diesel	0.960	1.896	0.148	0.144	0.003
7	201803	201810	Rough Terrain Forklifts	Diesel	1.353	2.061	0.199	0.193	0.003
7	201803	201810	Scrapers	Diesel	0.742	1.584	0.096	0.093	0.003
7	201803	201810	Tractors/Loaders/Backhoes	Diesel	3.346	3.583	0.521	0.506	0.004
7	201803	201810	Welders	Diesel	4.219	4.629	0.618	0.599	0.004
8	201803	201810	Cranes	Diesel	0.498	1.857	0.087	0.084	0.003
8	201803	201810	Crawler Tractor/Dozers	Diesel	0.678	1.613	0.097	0.094	0.003
8	201803	201810	Generator Sets	Diesel	1.690	3.952	0.283	0.274	0.003
8	201803	201810	Graders	Diesel	0.412	1.114	0.072	0.070	0.003
8	201803	201810	Off-highway Trucks	Diesel	0.547	1.852	0.056	0.054	0.003
8	201803	201810	Other General Industrial Eqp	Diesel	0.700	1.984	0.124	0.120	0.003
8	201803	201810	Paving Equipment	Diesel	1.140	2.224	0.179	0.174	0.003
8	201803	201810	Rollers	Diesel	0.960	1.896	0.148	0.144	0.003
8	201803	201810	Rough Terrain Forklifts	Diesel	1.353	2.061	0.199	0.193	0.003
8	201803	201810	Scrapers	Diesel	0.742	1.584	0.096	0.093	0.003
8	201803	201810	Tractors/Loaders/Backhoes	Diesel	3.346	3.583	0.521	0.506	0.004
8	201803	201810	Welders	Diesel	4.219	4.629	0.618	0.599	0.004
9	201804	202109	Cranes	Diesel	0.407	1.521	0.069	0.067	0.003
9	201804	202109	Crawler Tractor/Dozers	Diesel	0.531	1.317	0.071	0.069	0.003
9	201804	202109	Generator Sets	Diesel	1.537	3.667	0.254	0.246	0.003
9	201804	202109	Graders	Diesel	0.302	0.833	0.047	0.046	0.003
9	201804	202109	Off-highway Trucks	Diesel	0.411	1.725	0.044	0.043	0.003
9	201804	202109	Other General Industrial Eqp	Diesel	0.581	1.638	0.101	0.098	0.003
9	201804	202109	Paving Equipment	Diesel	0.968	1.918	0.149	0.144	0.003

Table E.2-26: Off-Road Equipment Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Equipment Description	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
					gallons per horse power-hour				
9	201804	202109	Rollers	Diesel	0.767	1.597	0.112	0.109	0.003
9	201804	202109	Rough Terrain Forklifts	Diesel	1.103	1.709	0.159	0.154	0.003
9	201804	202109	Scrapers	Diesel	0.598	1.276	0.075	0.073	0.003
9	201804	202109	Tractors/Loaders/Backhoes	Diesel	2.986	3.168	0.457	0.444	0.004
9	201804	202109	Welders	Diesel	3.751	4.381	0.544	0.528	0.004
10	201804	202109	Cranes	Diesel	0.407	1.521	0.069	0.067	0.003
10	201804	202109	Crawler Tractor/Dozers	Diesel	0.531	1.317	0.071	0.069	0.003
10	201804	202109	Generator Sets	Diesel	1.537	3.667	0.254	0.246	0.003
10	201804	202109	Graders	Diesel	0.302	0.833	0.047	0.046	0.003
10	201804	202109	Off-highway Trucks	Diesel	0.411	1.725	0.044	0.043	0.003
10	201804	202109	Other General Industrial Eqp	Diesel	0.581	1.638	0.101	0.098	0.003
10	201804	202109	Paving Equipment	Diesel	0.968	1.918	0.149	0.144	0.003
10	201804	202109	Rollers	Diesel	0.767	1.597	0.112	0.109	0.003
10	201804	202109	Rough Terrain Forklifts	Diesel	1.103	1.709	0.159	0.154	0.003
10	201804	202109	Scrapers	Diesel	0.598	1.276	0.075	0.073	0.003
10	201804	202109	Tractors/Loaders/Backhoes	Diesel	2.986	3.168	0.457	0.444	0.004
10	201804	202109	Welders	Diesel	3.751	4.381	0.544	0.528	0.004
11	201810	201911	Cranes	Diesel	0.449	1.670	0.077	0.075	0.003
11	201810	201911	Crawler Tractor/Dozers	Diesel	0.591	1.442	0.081	0.079	0.003
11	201810	201911	Generator Sets	Diesel	1.607	3.798	0.267	0.259	0.003
11	201810	201911	Graders	Diesel	0.338	0.945	0.055	0.054	0.003
11	201810	201911	Off-highway Trucks	Diesel	0.471	1.775	0.049	0.047	0.003
11	201810	201911	Other General Industrial Eqp	Diesel	0.635	1.787	0.112	0.108	0.003
11	201810	201911	Paving Equipment	Diesel	1.045	2.050	0.163	0.158	0.003
11	201810	201911	Rollers	Diesel	0.855	1.728	0.129	0.125	0.003
11	201810	201911	Rough Terrain Forklifts	Diesel	1.217	1.861	0.178	0.173	0.003

Table E.2-26: Off-Road Equipment Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Equipment Description	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
					gallons per horse power-hour				
11	201810	201911	Scrapers	Diesel	0.660	1.407	0.084	0.082	0.003
11	201810	201911	Tractors/Loaders/Backhoes	Diesel	3.151	3.359	0.487	0.473	0.004
11	201810	201911	Welders	Diesel	3.963	4.495	0.578	0.560	0.004
12	202102	202111	Cranes	Diesel	0.321	1.208	0.053	0.051	0.003
12	202102	202111	Crawler Tractor/Dozers	Diesel	0.408	1.059	0.050	0.048	0.003
12	202102	202111	Generator Sets	Diesel	1.391	3.394	0.226	0.219	0.003
12	202102	202111	Graders	Diesel	0.225	0.599	0.030	0.029	0.003
12	202102	202111	Off-highway Trucks	Diesel	0.286	1.623	0.034	0.033	0.003
12	202102	202111	Other General Industrial Eqp	Diesel	0.467	1.326	0.078	0.075	0.003
12	202102	202111	Paving Equipment	Diesel	0.806	1.642	0.119	0.115	0.003
12	202102	202111	Rollers	Diesel	0.585	1.322	0.078	0.075	0.003
12	202102	202111	Rough Terrain Forklifts	Diesel	0.866	1.390	0.118	0.114	0.003
12	202102	202111	Scrapers	Diesel	0.467	1.000	0.056	0.054	0.003
12	202102	202111	Tractors/Loaders/Backhoes	Diesel	2.640	2.767	0.395	0.383	0.004
12	202102	202111	Welders	Diesel	3.307	4.144	0.473	0.459	0.004
13	202102	202111	Cranes	Diesel	0.321	1.208	0.053	0.051	0.003
13	202102	202111	Crawler Tractor/Dozers	Diesel	0.408	1.059	0.050	0.048	0.003
13	202102	202111	Generator Sets	Diesel	1.391	3.394	0.226	0.219	0.003
13	202102	202111	Graders	Diesel	0.225	0.599	0.030	0.029	0.003
13	202102	202111	Off-highway Trucks	Diesel	0.286	1.623	0.034	0.033	0.003
13	202102	202111	Other General Industrial Eqp	Diesel	0.467	1.326	0.078	0.075	0.003
13	202102	202111	Paving Equipment	Diesel	0.806	1.642	0.119	0.115	0.003
13	202102	202111	Rollers	Diesel	0.585	1.322	0.078	0.075	0.003
13	202102	202111	Rough Terrain Forklifts	Diesel	0.866	1.390	0.118	0.114	0.003
13	202102	202111	Scrapers	Diesel	0.467	1.000	0.056	0.054	0.003
13	202102	202111	Tractors/Loaders/Backhoes	Diesel	2.640	2.767	0.395	0.383	0.004

Table E.2-26: Off-Road Equipment Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Equipment Description	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
					gallons per horse power-hour				
13	202102	202111	Welders	Diesel	3.307	4.144	0.473	0.459	0.004
14	202204	202209	Cranes	Diesel	0.275	1.037	0.044	0.042	0.003
14	202204	202209	Crawler Tractor/Dozers	Diesel	0.349	0.928	0.041	0.039	0.003
14	202204	202209	Generator Sets	Diesel	1.306	3.230	0.209	0.203	0.003
14	202204	202209	Graders	Diesel	0.197	0.489	0.024	0.023	0.003
14	202204	202209	Off-highway Trucks	Diesel	0.222	1.594	0.030	0.029	0.003
14	202204	202209	Other General Industrial Eqp	Diesel	0.398	1.157	0.063	0.061	0.003
14	202204	202209	Paving Equipment	Diesel	0.712	1.492	0.100	0.097	0.003
14	202204	202209	Rollers	Diesel	0.488	1.178	0.059	0.057	0.003
14	202204	202209	Rough Terrain Forklifts	Diesel	0.723	1.213	0.092	0.089	0.003
14	202204	202209	Scrapers	Diesel	0.393	0.849	0.045	0.044	0.003
14	202204	202209	Tractors/Loaders/Backhoes	Diesel	2.426	2.521	0.356	0.345	0.004
14	202204	202209	Welders	Diesel	3.039	3.999	0.429	0.416	0.004
15	202204	202209	Cranes	Diesel	0.275	1.037	0.044	0.042	0.003
15	202204	202209	Crawler Tractor/Dozers	Diesel	0.349	0.928	0.041	0.039	0.003
15	202204	202209	Generator Sets	Diesel	1.306	3.230	0.209	0.203	0.003
15	202204	202209	Graders	Diesel	0.197	0.489	0.024	0.023	0.003
15	202204	202209	Off-highway Trucks	Diesel	0.222	1.594	0.030	0.029	0.003
15	202204	202209	Other General Industrial Eqp	Diesel	0.398	1.157	0.063	0.061	0.003
15	202204	202209	Paving Equipment	Diesel	0.712	1.492	0.100	0.097	0.003
15	202204	202209	Rollers	Diesel	0.488	1.178	0.059	0.057	0.003
15	202204	202209	Rough Terrain Forklifts	Diesel	0.723	1.213	0.092	0.089	0.003
15	202204	202209	Scrapers	Diesel	0.393	0.849	0.045	0.044	0.003
15	202204	202209	Tractors/Loaders/Backhoes	Diesel	2.426	2.521	0.356	0.345	0.004
15	202204	202209	Welders	Diesel	3.039	3.999	0.429	0.416	0.004
16	202204	202209	Cranes	Diesel	0.275	1.037	0.044	0.042	0.003

Table E.2-26: Off-Road Equipment Emission Factors (cont.)

Activity ID	Period Start (yyyymm)	Period End (yyyymm)	Equipment Description	Fuel	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate Exhaust (PM_{10})	Particulate Exhaust ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
					gallons per horse power-hour				
16	202204	202209	Crawler Tractor/Dozers	Diesel	0.349	0.928	0.041	0.039	0.003
16	202204	202209	Generator Sets	Diesel	1.306	3.230	0.209	0.203	0.003
16	202204	202209	Graders	Diesel	0.197	0.489	0.024	0.023	0.003
16	202204	202209	Off-highway Trucks	Diesel	0.222	1.594	0.030	0.029	0.003
16	202204	202209	Other General Industrial Eqp	Diesel	0.398	1.157	0.063	0.061	0.003
16	202204	202209	Paving Equipment	Diesel	0.712	1.492	0.100	0.097	0.003
16	202204	202209	Rollers	Diesel	0.488	1.178	0.059	0.057	0.003
16	202204	202209	Rough Terrain Forklifts	Diesel	0.723	1.213	0.092	0.089	0.003
16	202204	202209	Scrapers	Diesel	0.393	0.849	0.045	0.044	0.003
16	202204	202209	Tractors/Loaders/Backhoes	Diesel	2.426	2.521	0.356	0.345	0.004
16	202204	202209	Welders	Diesel	3.039	3.999	0.429	0.416	0.004

Source: North Wind Inc. 2015

Table E.2-27: Off-Road Equipment Emissions Summary

Construction Phase		Construction Activity		MOVES2014 Emissions				
Phase ID	Phase Description	Activity ID	Activity Description	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)	Particulate (PM_{10})	Particulate ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
				grams				
1	Trenching for Utilities	1	Trenching and installation of utilities	89,577	162,740	12,606	12,228	215
		2	Demolition of existing fence and utilities	28,330	55,766	3,801	3,687	73
			TOTAL	**117,907**	**218,506**	**16,407**	**15,915**	**287**
2	Clearing/Grading	3	Clearing and grubbing of construction site	104,832	229,776	14,982	14,532	369
		4	Widening and improving haul road	82,451	181,252	11,215	10,878	263
		5	Preparing railroad base	82,451	181,252	11,215	10,878	263
			TOTAL	**269,735**	**592,280**	**37,411**	**36,289**	**896**
3	Paving Craft Parking, Roads	6	Grading, placement of road base, and paving of roads/parking	29,092	64,532	4,384	4,253	106
			TOTAL	**29,092**	**64,532**	**4,384**	**4,253**	**106**
4	Building Excavation	7	Excavation of site / hauling of soil to disposal or stockpile	655,301	1,422,880	85,523	82,957	2,630
		8	Excavation of evaporation ponds	46,915	112,866	5,843	5,668	156
			TOTAL	**702,216**	**1,535,746**	**91,366**	**88,625**	**2,786**
5	Building & Material Delivery	9	Building and material delivery	233,482	359,397	33,853	32,838	599
		10	Building steel erection	1,096,224	3,988,502	185,563	179,996	7,579
			TOTAL	**1,329,706**	**4,347,899**	**219,416**	**212,833**	**8,178**
6	Batch Plant Phase I	11	Batching concrete with stockpiled aggregate	66,788	184,501	8,299	8,050	284
			TOTAL	**66,788**	**184,501**	**8,299**	**8,050**	**284**
7	Batch Plant Phase II	12	Batching concrete with aggregate hauled from on-site borrow area	163,730	783,447	20,327	19,717	1,297
		13	Installation of pools and floor slabs	43,528	91,660	5,934	5,756	178
			TOTAL	**207,258**	**875,107**	**26,260**	**25,472**	**1,474**
8	Paving Final	14	Grading, placement of road base, and paving of roads	23,113	61,843	2,799	2,715	169
			TOTAL	**23,113**	**61,843**	**2,799**	**2,715**	**169**
9	Final Grading	15	Trenching and installation of final utilities	51,423	120,867	7,274	7,056	203
		16	Backfilling around building and final grading	29,020	62,059	3,873	3,756	139
			TOTAL	**80,443**	**182,926**	**11,147**	**10,813**	**341**

Source: North Wind Inc. 2015

The criteria pollutant emissions (in total grams) provided by North Wind Inc. are converted to grams per second for each construction phase based on hours of operation. These values are summed per modeling scenario to get the release rates for use in AERMOD and CALPUFF. The total emission release rates for off-road vehicles and equipment per modeling scenario are provided in Table E.2-28.

Table E.2-28: Off-Road Equipment Emission Rates by Construction Modeling Scenario

Modeling Scenario	Emission Rates				
	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2
	grams per second				
1	$1.2{\times}10^{-1}$	$2.7{\times}10^{-1}$	$1.7{\times}10^{-2}$	$1.7{\times}10^{-2}$	$4.3{\times}10^{-4}$
2	$1.9{\times}10^{-1}$	$4.7{\times}10^{-1}$	$2.6{\times}10^{-2}$	$2.6{\times}10^{-2}$	$8.6{\times}10^{-4}$
3	$5.6{\times}10^{-2}$	$1.8{\times}10^{-1}$	$9.0{\times}10^{-3}$	$8.8{\times}10^{-3}$	$3.3{\times}10^{-4}$
4	$8.4{\times}10^{-2}$	$3.1{\times}10^{-1}$	$1.3{\times}10^{-2}$	$1.2{\times}10^{-2}$	$5.5{\times}10^{-4}$

Annual emissions in kilograms per year for off-road vehicles and equipment are also calculated for inclusion in the construction emissions summary table (Table E.2-35).

Diesel Generators and Concrete Batch Plant Operations

Power for concrete batch plant operations would either be supplied by three large diesel generators or by connecting into the existing electrical grid. Connecting into the existing electrical grid is preferred. For conservatism, the use of three large diesel generators is assumed. Two water heaters powered by either diesel-fired engines or by connecting into the existing electrical grid would be needed for the batch plants during winter months. Connecting into the existing electrical grid is preferred. For conservatism, the use of diesel fuel is assumed. Emission factors for NO_x, CO, PM (used for PM_{10}, $PM_{2.5}$), and VOCs for EPA Tier 4 diesel engines from 40 CFR 1039.101(b) are used for the three diesel generators and are presented in Table E.2-29. For the remaining pollutants, emission factors from Table E.2-2 for large diesel engines are used for the three diesel generators. Emission factors from Table E.2-2 for boilers are used for the two water heaters. Annual operating hours and fuel use for Batch Plant Phases I and II are provided in Table E.2-30. Batch Plant Phase I and Batch Plant Phase II emissions for are provided in Table E.2-31 and Table E.2-32, respectively.

Table E.2-29: Emission Factors for Tier 4 Large Diesel Engines

Pollutant Name	Emission Factor
	$lb/10^6$ Btu
Nitrogen oxides (NOx)	0.4329
Carbon monoxide (CO)	2.2614
PM_{10}	0.0194
$PM_{2.5}$	0.0194
VOCs	0.1228
Source: 40 CFR 1039.101(b) Btu = British Thermal Units lb = pound	

Table E.2-30: Annual Hours of Operation and Fuel Use for Water Heaters and Diesel Generators for the Construction Period of the New Facility Alternative

Source	Run Time	Fuel Use	Fuel Use
	hours per year	liters per year	gallons per year
Batch Plant Phase I			
Water Heaters	2607	394,723	104,286
Batch Plant Diesel Generators	3302	2,148,665	567,679
Batch Plant Phase II			
Water Heaters	1043	157,887	41,714
Batch Plant Diesel Generators	1738	1,130,879	298,779

Table E.2-31: Estimated Emissions for Concrete Batch Plant Phase I

Pollutant Name	Emissions					
	Batch Plant Water Heaters			Batch Plant Diesel Generators		
	pounds per year	kilograms per year	grams per second	pounds per year	kilograms per year	grams per second
Sulfur oxides (SO_x)	2.3×10^{1}	1.0×10^{1}	1.1×10^{-3}	1.2×10^{2}	5.3×10^{1}	4.5×10^{-3}
Sulfur dioxide (SO_2)	2.2×10^{1}	1.0×10^{1}	1.1×10^{-3}	1.1×10^{2}	5.1×10^{1}	4.3×10^{-3}
Sulfuric acid (H_2SO_4)	3.8×10^{-1}	1.7×10^{-1}	1.9×10^{-5}	7.2	3.3	2.8×10^{-4}
Nitrogen oxides (NO_x)	2.1×10^{3}	9.5×10^{2}	1.0×10^{-1}	3.4×10^{4}	1.5×10^{4}	1.3
Nitrogen dioxide (NO_2)	1.0×10^{2}	4.7×10^{1}	5.0×10^{-3}			
Ammonia (NH_3)	8.3×10^{1}	3.8×10^{1}	4.0×10^{-3}			
Carbon monoxide (CO)	5.2×10^{2}	2.4×10^{2}	2.5×10^{-2}	1.8×10^{5}	8.0×10^{4}	6.7
Volatile organic compounds (VOC)	2.1×10^{1}	9.5	1.0×10^{-3}	9.5×10^{3}	4.3×10^{3}	3.6×10^{-1}
Benzene (C_6H_6)	2.2×10^{-2}	1.0×10^{-2}	1.1×10^{-6}	6.0×10^{1}	2.7×10^{1}	2.3×10^{-3}
Toluene (C_7H_8)	6.5×10^{-1}	2.9×10^{-1}	3.1×10^{-5}	2.2×10^{1}	9.9	8.3×10^{-4}
Xylenes (C_8H_{10})	1.1×10^{-2}	5.2×10^{-3}	5.5×10^{-7}	1.5×10^{1}	6.8	5.7×10^{-4}
Propylene (C_3H_6)	1.9×10^{-4}	8.5×10^{-5}	9.1×10^{-9}	2.2×10^{2}	9.8×10^{1}	8.3×10^{-3}
1,3-Butadiene (C_4H_6)				3.0	1.4	1.2×10^{-4}
Formaldehyde (HCOH)	6.4	2.9	3.1×10^{-4}	6.1	2.8	2.3×10^{-4}
Acetaldehyde (C_2H_4O)				2.0	8.9×10^{-1}	7.5×10^{-5}
Acrolein (C_3H_4O)				6.1×10^{-1}	2.8×10^{-1}	2.3×10^{-5}

Table E.2-31: Estimated Emissions for Concrete Batch Plant Phase I (cont.)

Pollutant Name	Emissions					
	Batch Plant Water Heaters			Batch Plant Diesel Generators		
	pounds per year	kilograms per year	grams per second	pounds per year	kilograms per year	grams per second
Ethylbenzene (C_8H_{10})	6.6×10^{-3}	3.0×10^{-3}	3.2×10^{-7}			
1,1,1-Trichloroethane ($C_2H_3Cl_3$)	2.5×10^{-2}	1.1×10^{-2}	1.2×10^{-6}			
Naphthalene ($C_{10}H_8$)	1.2×10^{-1}	5.3×10^{-2}	5.7×10^{-6}	1.0×10^{1}	4.6	3.9×10^{-4}
Polycyclic aromatic compounds (PACs)	1.7×10^{-3}	7.8×10^{-4}	8.3×10^{-8}	6.6×10^{-1}	3.0×10^{-1}	2.5×10^{-5}
PM_{10}	2.4×10^{2}	1.1×10^{2}	1.2×10^{-2}	1.5×10^{3}	6.8×10^{2}	5.8×10^{-2}
$PM_{2.5}$	1.6×10^{2}	7.3×10^{1}	7.8×10^{-3}	1.5×10^{3}	6.8×10^{2}	5.8×10^{-2}
Chromium (Cr)	4.3×10^{-2}	2.0×10^{-2}	2.1×10^{-6}	2.3×10^{-1}	1.1×10^{-1}	8.9×10^{-6}
Copper (Cu)	8.6×10^{-2}	3.9×10^{-2}	4.2×10^{-6}	4.7×10^{-1}	2.1×10^{-1}	1.8×10^{-5}
Mercury (Hg) as Hg	4.3×10^{-2}	2.0×10^{-2}	2.1×10^{-6}	2.3×10^{-1}	1.1×10^{-1}	8.9×10^{-6}
Manganese (Mn)	8.6×10^{-2}	3.9×10^{-2}	4.2×10^{-6}	4.7×10^{-1}	2.1×10^{-1}	1.8×10^{-5}
Nickel (Ni)	4.3×10^{-2}	2.0×10^{-2}	2.1×10^{-6}	2.3×10^{-1}	1.1×10^{-1}	8.9×10^{-6}
Selenium (Se)	2.2×10^{-1}	9.8×10^{-2}	1.0×10^{-5}	1.2	5.3×10^{-1}	4.5×10^{-5}
As as arsenic trioxide (As_2O_3)	7.6×10^{-2}	3.4×10^{-2}	3.7×10^{-6}	4.1×10^{-1}	1.9×10^{-1}	1.6×10^{-5}
Be as beryllium oxide (BeO)	1.2×10^{-1}	5.4×10^{-2}	5.8×10^{-6}	6.5×10^{-1}	2.9×10^{-1}	2.5×10^{-5}
Cd as cadmium oxide (CdO)	4.9×10^{-2}	2.2×10^{-2}	2.4×10^{-6}	2.7×10^{-1}	1.2×10^{-1}	1.0×10^{-5}
Pb as lead monoxide (PbO)	1.4×10^{-1}	6.3×10^{-2}	6.7×10^{-6}	7.5×10^{-1}	3.4×10^{-1}	2.9×10^{-5}
Zn as zinc oxide (ZnO)	7.2×10^{-2}	3.3×10^{-2}	3.5×10^{-6}	3.9×10^{-1}	1.8×10^{-1}	1.5×10^{-5}

Notes: Gray shaded cells indicate pollutant is not emitted or an emission factor is not available

Table E.2-32: Estimated Emissions for Concrete Batch Plant Phase II

Pollutant Name	Emissions					
	Batch Plant Water Heaters			Batch Plant Diesel Generators		
	pounds per year	kilograms per year	grams per second	pounds per year	kilograms per year	grams per second
Sulfur oxides (SO_x)	9.0	4.1	1.1×10^{-3}	6.2×10^{1}	2.8×10^{1}	4.5×10^{-3}
Sulfur dioxide (SO_2)	8.9	4.0	1.1×10^{-3}	5.9×10^{1}	2.7×10^{1}	4.3×10^{-3}
Sulfuric acid (H_2SO_4)	1.5×10^{-1}	7.0×10^{-2}	1.9×10^{-5}	3.8	1.7	2.8×10^{-4}
Nitrogen oxides (NO_x)	8.3×10^{2}	3.8×10^{2}	1.0×10^{-1}	1.8×10^{4}	8.0×10^{3}	1.3
Nitrogen dioxide (NO_2)	4.2×10^{1}	1.9×10^{1}	5.0×10^{-3}			
Ammonia (NH_3)	3.3×10^{1}	1.5×10^{1}	4.0×10^{-3}			
Carbon monoxide (CO)	2.1×10^{2}	9.5×10^{1}	2.5×10^{-2}	9.3×10^{4}	4.2×10^{4}	6.7
Volatile organic compounds (VOCs)	8.3	3.8	1.0×10^{-3}	5.0×10^{3}	2.3×10^{3}	3.6×10^{-1}
Benzene (C_6H_6)	8.9×10^{-3}	4.0×10^{-3}	1.1×10^{-6}	3.2×10^{1}	1.4×10^{1}	2.3×10^{-3}
Toluene (C_7H_8)	2.6×10^{-1}	1.2×10^{-1}	3.1×10^{-5}	1.2×10^{1}	5.2	8.3×10^{-4}
Xylenes (C_8H_{10})	4.5×10^{-3}	2.1×10^{-3}	5.5×10^{-7}	7.9	3.6	5.7×10^{-4}
Propylene (C_3H_6)	7.5×10^{-5}	3.4×10^{-5}	9.1×10^{-9}	1.1×10^{2}	5.2×10^{1}	8.3×10^{-3}
1,3-Butadiene (C_4H_6)				1.6	7.3×10^{-1}	1.2×10^{-4}
Formaldehyde (HCOH)	2.5	1.2	3.1×10^{-4}	3.2	1.5	2.3×10^{-4}
Acetaldehyde (C_2H_4O)				1.0	4.7×10^{-1}	7.5×10^{-5}
Acrolein (C_3H_4O)				3.2×10^{-1}	1.5×10^{-1}	2.3×10^{-5}
Ethylbenzene (C_8H_{10})	2.7×10^{-3}	1.2×10^{-3}	3.2×10^{-7}			
1,1,1-Trichloroethane ($C_2H_3Cl_3$)	9.8×10^{-3}	4.5×10^{-3}	1.2×10^{-6}			
Naphthalene ($C_{10}H_8$)	4.7×10^{-2}	2.1×10^{-2}	5.7×10^{-6}	5.3	2.4	3.9×10^{-4}
Polycyclic aromatic compounds (PACs)	6.9×10^{-4}	3.1×10^{-4}	8.3×10^{-8}	3.5×10^{-1}	1.6×10^{-1}	2.5×10^{-5}
PM_{10}	9.6×10^{1}	4.4×10^{1}	1.2×10^{-2}	7.9×10^{2}	3.6×10^{2}	5.8×10^{-2}
$PM_{2.5}$	6.5×10^{1}	2.9×10^{1}	7.8×10^{-3}	7.9×10^{2}	3.6×10^{2}	5.8×10^{-2}
Chromium (Cr)	1.7×10^{-2}	7.8×10^{-3}	2.1×10^{-6}	1.2×10^{-1}	5.6×10^{-2}	8.9×10^{-6}
Copper (Cu)	3.5×10^{-2}	1.6×10^{-2}	4.2×10^{-6}	2.5×10^{-1}	1.1×10^{-1}	1.8×10^{-5}
Mercury (Hg) as Hg	1.7×10^{-2}	7.8×10^{-3}	2.1×10^{-6}	1.2×10^{-1}	5.6×10^{-2}	8.9×10^{-6}
Manganese (Mn)	3.5×10^{-2}	1.6×10^{-2}	4.2×10^{-6}	2.5×10^{-1}	1.1×10^{-1}	1.8×10^{-5}
Nickel (Ni)	1.7×10^{-2}	7.8×10^{-3}	2.1×10^{-6}	1.2×10^{-1}	5.6×10^{-2}	8.9×10^{-6}
Selenium (Se)	8.6×10^{-2}	3.9×10^{-2}	1.0×10^{-5}	6.1×10^{-1}	2.8×10^{-1}	4.5×10^{-5}
As as arsenic trioxide (As_2O_3)	3.0×10^{-2}	1.4×10^{-2}	3.7×10^{-6}	2.2×10^{-1}	9.8×10^{-2}	1.6×10^{-5}
Be as beryllium oxide (BeO)	4.8×10^{-2}	2.2×10^{-2}	5.8×10^{-6}	3.4×10^{-1}	1.5×10^{-1}	2.5×10^{-5}
Cd as cadmium oxide (CdO)	2.0×10^{-2}	8.9×10^{-3}	2.4×10^{-6}	1.4×10^{-1}	6.4×10^{-2}	1.0×10^{-5}
Pb as lead monoxide (PbO)	5.6×10^{-2}	2.5×10^{-2}	6.7×10^{-6}	4.0×10^{-1}	1.8×10^{-1}	2.9×10^{-5}
Zn as zinc oxide (ZnO)	2.9×10^{-2}	1.3×10^{-2}	3.5×10^{-6}	2.0×10^{-1}	9.2×10^{-2}	1.5×10^{-5}

Notes: Gray shaded cells indicate pollutant is not emitted or an emission factor is not available.

Certain TAPs would be emitted from concrete batch plant processes. These emissions are calculated using the controlled emission factors presented in Table E.2-33, total material throughputs in Table E.2-15, with throughput partitioned per concrete batch plant process in Table E.2-16. Emissions are provided in Table E.2-34 for Concrete Batch Plant Phase I and Concrete Batch Plant Phase II.

Table E.2-33: Toxic Pollutant Emission Factors for Concrete Batch Plant Material Handling

Pollutant Name	Unloading Cement to Storage Silo	Unloading Cement Supplement to Storage Silo	Mixer Loading (Central Mix)
	pounds per ton		
Arsenic	4.24×10^{-9}	1.00×10^{-6}	2.96×10^{-7}
Beryllium	4.86×10^{-10}	9.04×10^{-8}	
Cadmium	4.68×10^{-9}	1.98×10^{-10}	7.10×10^{-10}
Total Chromium	2.90×10^{-8}	1.22×10^{-6}	1.27×10^{-7}
Lead	1.09×10^{-8}	5.20×10^{-7}	3.66×10^{-8}
Manganese	1.17×10^{-7}	2.56×10^{-7}	3.78×10^{-6}
Nickel	4.18×10^{-8}	2.28×10^{-6}	2.48×10^{-7}
Total Phosphorus	2.36×10^{-7}	3.54×10^{-6}	1.20×10^{-6}
Selenium		7.24×10^{-8}	
Note: Gray shaded cells indicate pollutant is not emitted or an emission factor is not available.			

Table E.2-34: Toxic Pollutant Emissions for Concrete Batch Plant Material Handling

Pollutant Name	Emissions	
	kilograms per year	pounds per year
Batch Plant Phase I		
Arsenic	1.9×10^{-2}	4.2×10^{-2}
Beryllium	8.7×10^{-4}	1.9×10^{-3}
Cadmium	1.3×10^{-4}	2.8×10^{-4}
Total Chromium	1.6×10^{-2}	3.6×10^{-2}
Lead	6.3×10^{-3}	1.4×10^{-2}
Manganese	1.2×10^{-1}	2.8×10^{-1}
Nickel	3.0×10^{-2}	6.7×10^{-2}
Total Phosphorus	7.7×10^{-2}	1.7×10^{-1}
Selenium	6.9×10^{-4}	1.5×10^{-3}
Batch Plant Phase II		
Arsenic	3.0×10^{-3}	6.6×10^{-3}
Beryllium	1.4×10^{-4}	3.0×10^{-4}
Cadmium	2.0×10^{-5}	4.4×10^{-5}
Total Chromium	2.5×10^{-3}	5.6×10^{-3}
Lead	9.9×10^{-4}	2.2×10^{-3}
Manganese	2.0×10^{-2}	4.3×10^{-2}
Nickel	4.8×10^{-3}	1.1×10^{-2}
Total Phosphorus	1.2×10^{-2}	2.7×10^{-2}
Selenium	1.1×10^{-4}	2.4×10^{-4}

Construction Emissions Summary

A summary of annual construction emissions for the four modeling scenarios is provided in Table E.2-35. All sources are included in the annual emissions estimates.

Table E.2-35: Summary of Annual Emission Inventories by Construction Modeling Scenario

Pollutant Name	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	kilograms per year			
Criteria Pollutants				
CO	1.21×10^{4}	1.38×10^{4}	1.09×10^{5}	6.22×10^{4}
NO_X	3.03×10^{3}	4.00×10^{3}	2.18×10^{4}	1.32×10^{4}
PbO	0.00	0.00	4.12×10^{-1}	2.06×10^{-1}
PM_{10}[1]	5.30×10^{3}	1.02×10^{4}	3.38×10^{3}	1.80×10^{3}
$PM_{2.5}$[1]	1.83×10^{3}	1.80×10^{3}	1.50×10^{3}	8.65×10^{2}
SO_2	1.36×10^{1}	1.62×10^{1}	9.38×10^{1}	5.71×10^{1}
Toxic Air Pollutants				
Carcinogens				
Acetaldehyde			8.89×10^{-1}	4.68×10^{-1}
Arsenic (As_2O_3)			2.40×10^{-1}	1.15×10^{-1}
Benzene			2.74×10^{1}	1.44×10^{1}
Beryllium (BeO)			3.49×10^{-1}	1.77×10^{-1}
1,3-Butadiene			1.38	7.26×10^{-1}
Cadmium (CdO)			1.43×10^{-1}	7.26×10^{-2}
Formaldehyde			5.67	2.62
Nickel (Ni)			1.56×10^{-1}	6.83×10^{-2}
PACs			3.02×10^{-1}	1.58×10^{-1}
Non-Carcinogens				
Acrolein			2.78×10^{-1}	1.46×10^{-1}
Ammonia			3.78×10^{1}	1.51×10^{1}
Chromium (Cr)			1.42×10^{-1}	6.61×10^{-2}
Copper (Cu)			2.51×10^{-1}	1.27×10^{-1}
Ethylbenzene			3.01×10^{-3}	1.20×10^{-3}
Manganese (Mn)			3.76×10^{-1}	1.46×10^{-1}
Mercury			1.26×10^{-1}	6.35×10^{-2}
Naphthalene			4.64	2.43
Phosphorus			7.69×10^{-2}	1.20×10^{-2}
Propylene			9.84×10^{1}	5.18×10^{1}
Selenium (Se)			6.28×10^{-1}	3.18×10^{-1}
Toluene			1.02×10^{1}	5.34
1,1,1-Trichloroethane			1.12×10^{-2}	4.47×10^{-3}
Xylene			6.82	3.58
Zinc (ZnO)			2.09×10^{-1}	1.06×10^{-1}

Note: Gray shaded cells indicate absence of source
[1]Includes the maximum annual wind erosion release of 488 kilograms per year of PM_{10} and 73.2 kilograms per year of $PM_{2.5}$ for Scenario 1 through 4
Source: K-Spar Inc. 2016

Transition Period

Impacts during the transition period of the New Facility Alternative are analyzed by modeling the new facility operations emissions with INL emissions to get cumulative concentrations of pollutants at receptor locations. Source terms for new facility operations emissions are generated from the 5-year maximum criteria and toxic emissions from fuel combustion for heating ECF (fuel oil-fired boilers) and from testing EDGs that would power ECF should a site-wide power failure occur. These maximum emissions are scaled for new facility operations for use in the dispersion modeling. Information on facility size, operations, and power requirements is used to establish reasonable scaling factors for emissions. Conservatisms (e.g., extra kilowatts for EDGs) are built in to account for uncertainties.

It is assumed that emissions for new facility operations would not change based on the location at NRF (i.e., Location 3/4 or Location 6). The conceptual facility designs are similar enough at each location that differences in air pollutant emissions would be small and not likely to influence concentrations at receptor locations.

Scaling factors for pollutant emissions are developed by considering area, air volumes, and EDG energy requirements of ECF currently being used for naval spent nuclear fuel handling activities along with conservative estimates of the area, air volumes, and EDG energy requirements of a new facility. Naval spent nuclear fuel handling operations are estimated to take place in about 92 percent of the ECF area, with the remaining 8 percent dedicated to examination operations. The following assumptions are made:

- Change in the volume of air to be heated is proportional to the amount of pollutants emitted by the boilers
- Change in emergency power requirements is proportional to the amount of pollutants emitted by the EDGs

Scaling factors for the New Facility Alternative boilers and EDGs are provided in Table E.2-36.

Table E.2-36: Emission Scaling Factors for Boilers and EDGs From New Facility Operations

Source	Emission Scaling Factors
Boilers	2.392[1]
EDGs	1.50[2]
[1] Scaling factors are multiplied by ECF emissions. [2] Scaling factors are multiplied by NRF emissions.	

Based on NRF boiler operations, about one-third of overall steam demand is dedicated to ECF.

Based on engineering and design calculations, the ratio of air volume of the conceptual new facility to the volume of air in the ECF would be about 2.6. As mentioned above, naval spent nuclear fuel handling operations take place in about 92 percent of the ECF area. The scaling factor for new facility emissions in Table E.2-36 is determined by multiplying the volume ratio by 0.92 (2.6 x 0.92 = 2.392). The scaling factor is multiplied by boiler emissions for heating ECF (per individual pollutant) to get an estimate of emissions from new facility operations.

Based on the conceptual design information for the new facility, two EDGs totaling 4000 kilowatts of capacity would be needed to supply standby emergency power. EDGs could also be needed for fire water pumps or other systems not yet identified. Therefore, EDG emissions for a new facility are based on a 6,000-kilowatt need; the scaling factor is provided in Table E.2-36.

Source terms for boilers and EDGs for the transition period of the New Facility Alternative are provided in Table E.2-37 and Table E.2-38.

Table E.2-37: Boiler Emissions for the Transition Period of the New Facility Alternative

Pollutant Name	Emissions		
	pounds per year	kilograms per year	grams per second
Sulfur oxides (SOx)	1.0×10^{2}	4.7×10^{1}	2.8×10^{-3}
Sulfur dioxide (SO_2)	1.0×10^{2}	4.6×10^{1}	2.7×10^{-3}
Sulfuric acid (H_2SO_4)	1.8	8.0×10^{-1}	4.7×10^{-5}
Nitrogen oxides (NOx)	9.6×10^{3}	4.4×10^{3}	2.6×10^{-1}
Nitrogen dioxide (NO_2)	4.8×10^{2}	2.2×10^{2}	1.3×10^{-2}
Ammonia (NH_3)	3.8×10^{2}	1.7×10^{2}	1.0×10^{-2}
Carbon monoxide (CO)	2.4×10^{3}	1.1×10^{3}	6.5×10^{-2}
VOCs	9.6×10^{1}	4.4×10^{1}	2.6×10^{-3}
Benzene (C_6H_6)	1.0×10^{-1}	4.7×10^{-2}	2.8×10^{-6}
Toluene (C_7H_8)	3.0	1.4	8.0×10^{-5}
Xylenes (C_8H_{10})	5.2×10^{-2}	2.4×10^{-2}	1.4×10^{-6}
1,3-Butadiene (C_4H_6)			
Formaldehyde (HCOH)	2.9×10^{1}	1.3×10^{1}	7.9×10^{-4}
Acetaldehyde (C_2H_4O)			
Acrolein (C_3H_4O)			
Ethylbenzene (C_8H_{10})	3.1×10^{-2}	1.4×10^{-2}	8.2×10^{-7}
Naphthalene ($C_{10}H_8$)	5.4×10^{-1}	2.5×10^{-1}	1.5×10^{-5}
Polycyclic aromatic compounds (PACs)	7.9×10^{-3}	3.6×10^{-3}	2.1×10^{-7}
PM_{10}	1.1×10^{3}	5.0×10^{2}	3.0×10^{-2}
$PM_{2.5}$	7.4×10^{2}	3.4×10^{2}	2.0×10^{-2}
As as arsenic trioxide (As_2O_3)	3.5×10^{-1}	1.6×10^{-1}	9.0×10^{-6}
Be as beryllium oxide (BeO)	5.4×10^{-1}	2.5×10^{-1}	1.5×10^{-5}
Cd as cadmium oxide (CdO)	2.2×10^{-1}	1.0×10^{-1}	6.0×10^{-6}
Chromium (Cr)	1.9×10^{-1}	8.8×10^{-2}	5.2×10^{-6}
Copper (Cu)	3.9×10^{-1}	1.8×10^{-1}	1.0×10^{-5}
Pb as lead monoxide (PbO)	6.3×10^{-1}	2.9×10^{-1}	1.7×10^{-5}
Manganese (Mn)	3.9×10^{-1}	1.8×10^{-1}	1.0×10^{-5}
Nickel (Ni)	1.9×10^{-1}	8.8×10^{-2}	5.2×10^{-6}
Selenium (Se)	9.7×10^{-1}	4.4×10^{-1}	2.6×10^{-5}
Zn as zinc oxide (ZnO)	3.2×10^{-1}	1.5×10^{-1}	8.7×10^{-6}

Note: Gray shaded cells indicate pollutant is not emitted or an emission factor is not available.

Table E.2-38: EDG Emissions for the Transition Period of the New Facility Alternative

Pollutant Name	Emissions		
	pounds per year	kilograms per year	grams per second
Sulfur oxides (SO_x)	1.4	6.5×10^{-1}	2.7×10^{-3}
Sulfur dioxide (SO_2)	1.4	6.2×10^{-1}	2.6×10^{-3}
Sulfuric acid (H_2SO_4)	8.8×10^{-2}	4.0×10^{-2}	1.7×10^{-4}
Nitrogen oxides (NO_x)	3.0×10^{3}	1.4×10^{3}	5.8
Nitrogen dioxide (NO_2)			
Ammonia (NH_3)			
Carbon monoxide (CO)	8.0×10^{2}	3.7×10^{2}	1.5
VOCs	7.8×10^{1}	3.5×10^{1}	1.5×10^{-1}
Benzene (C_6H_6)	7.3×10^{-1}	3.3×10^{-1}	1.4×10^{-3}
Toluene (C_7H_8)	2.7×10^{-1}	1.2×10^{-1}	5.1×10^{-4}
Xylenes (C_8H_{10})	1.8×10^{-1}	8.3×10^{-2}	3.5×10^{-4}
1,3-Butadiene (C_4H_6)	3.7×10^{-2}	1.7×10^{-2}	7.1×10^{-5}
Formaldehyde (HCOH)	7.5×10^{-2}	3.4×10^{-2}	1.4×10^{-4}
Acetaldehyde (C_2H_4O)	2.4×10^{-2}	1.1×10^{-2}	4.5×10^{-5}
Acrolein (C_3H_4O)	7.5×10^{-3}	3.4×10^{-3}	1.4×10^{-5}
Ethylbenzene (C_8H_{10})			
Naphthalene ($C_{10}H_8$)	1.2×10^{-1}	5.6×10^{-2}	2.3×10^{-4}
Polycyclic aromatic compounds (PACs)	8.1×10^{-3}	3.7×10^{-3}	1.5×10^{-5}
PM_{10}	5.4×10^{1}	2.5×10^{1}	1.0×10^{-1}
$PM_{2.5}$	5.3×10^{1}	2.4×10^{1}	1.0×10^{-1}
As as arsenic trioxide (As_2O_3)	5.0×10^{-3}	2.3×10^{-3}	9.5×10^{-6}
Be as beryllium oxide (BeO)	7.9×10^{-3}	3.6×10^{-3}	1.5×10^{-5}
Cd as cadmium oxide (CdO)	3.2×10^{-3}	1.5×10^{-3}	6.2×10^{-6}
Chromium (Cr)	2.8×10^{-3}	1.3×10^{-3}	5.4×10^{-6}
Copper (Cu)	5.7×10^{-3}	2.6×10^{-3}	1.1×10^{-5}
Pb as lead monoxide (PbO)	9.2×10^{-3}	4.2×10^{-3}	1.8×10^{-5}
Manganese (Mn)	5.7×10^{-3}	2.6×10^{-3}	1.1×10^{-5}
Nickel (Ni)	2.8×10^{-3}	1.3×10^{-3}	5.4×10^{-6}
Selenium (Se)	1.4×10^{-2}	6.4×10^{-3}	2.7×10^{-5}
Zn as zinc oxide (ZnO)	4.7×10^{-3}	2.1×10^{-3}	9.0×10^{-6}

Note: Gray shaded cells indicate pollutant is not emitted or an emission factor is not available.

New Facility Operational Period

The new facility operational period represents the time when all naval spent nuclear fuel handling operations have moved to a new facility and only examination work continues in the ECF. ECF would continue to be heated and require EDG testing to support the examination work. Since portions of the water pool in the high bay would still be needed to support examination work, a conservative assumption is made that air pollutant emissions during the new facility operational period would be the same as the boiler and EDG emissions described for the transition period.

E.3 AERMOD Protocol

Proposed action emissions and INL emissions are evaluated using AERMOD, Version 11103, with meteorological data processed through the AERMET (EPA 2004b) preprocessor, Version 06341. During consultation with IDEQ on the AERMOD protocol used in the Draft EIS, IDEQ requested that a sensitivity study be performed between the AERMOD/AERMET Versions 11103/06341 and the current AERMOD/AERMET Version 15181 (see Appendix B). This study is provided in Section E.6. As identified in Appendix B, IDEQ agreed that the sensitivity study is sufficient to show that the air quality impacts using versions 11103/06341 are adequately represented and that there would be no change in the overall air quality impacts conclusions based on use of the older model versions in the Draft EIS. In addition, AERMOD/AERMET Version 15181 is used to model the pollutant concentrations at receptor locations for the revised construction analysis.

During consultation with IDEQ on the AERMOD protocol used in the Draft EIS, IDEQ also requested that a sensitivity analysis be performed between the PM_{10} and $PM_{2.5}$ concentrations at receptor locations with and without deposition to determine if impacts would change (see Appendix B). This analysis is also provided in Section E.6. As identified in Appendix B, IDEQ agreed that the sensitivity analysis is sufficient to show that running AERMOD without deposition would not cause PM_{10} and $PM_{2.5}$ to increase beyond the regulatory standards, and that there would be no change in the overall air quality impact conclusions described in the DEIS.

Criteria and toxic air pollutant concentrations are modeled for public receptor locations for comparison with regulatory standards, and the results are presented in Section 4.6. PSD air pollutant concentrations at public receptor locations on Federal Class II areas and near field Federal Class I areas (Craters of the Moon National Monument) are also modeled; the results are presented in Section 4.6.

E.3.1 Meteorological Data

A 5-year meteorological data set for the Idaho Falls area was provided by the IDEQ in AERMOD format for 2000-2004 (Geomatrix 2008). Five years of continuous meteorological data from a nearby airport or 1-year of site-specific data are considered by the state of Idaho to be sufficient to perform air quality assessments (IDEQ 2002). These data include (1) surface data from the Idaho Falls airport, (2) upper-air data from Boise International Airport, and (3) on-site data from the National Oceanic and Atmospheric Administration (NOAA) 15-meter (50-feet) tower located along the greenbelt in downtown Idaho Falls. The IDEQ provided not only the AERMOD data file, but the raw meteorological data and AERMET input files for processing the data. The meteorological data from the on-site Idaho Falls greenbelt station is not representative of INL facilities. Therefore, meteorological data from the INL mesonet network (NOAA 2011) are substituted for use in AERMOD (Table E.3-1 and Figure E.3-1). The INL mesonet network data were provided by NOAA (Idaho Falls office). The surface data (Idaho Falls Airport) and upper air data (Boise International Airport) that were provided in the IDEQ data set are used in the AERMET processing of INL on-site data. The surface data at the Idaho Falls Airport provides cloud cover data that are used by AERMET to compute turbulence statistics. The upper air data from the Boise International Airport provide the vertical atmospheric structure in the morning and afternoon. The INL mesonet data are used for surface wind directions and speed.

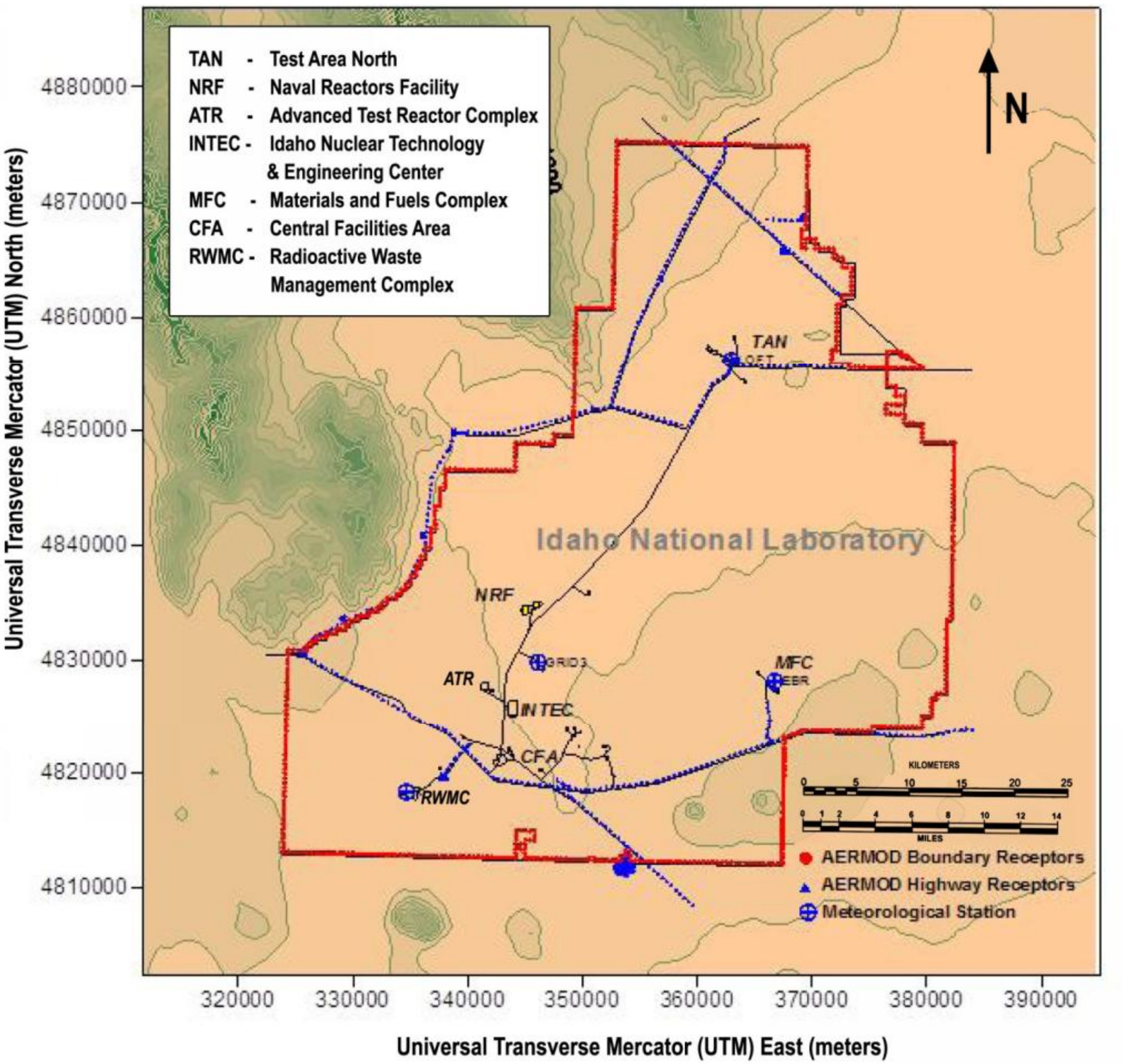
For the revised construction modeling and the sensitivity analyses, the surface data (Idaho Falls Airport) provided by IDEQ was not in a format acceptable to AERMET Version 15181. Thus, the Idaho Falls airport data was downloaded from the National Climatic Data Center web site for the years 2000-2004 in the TD 3505 format for use in AERMET Version 15181.

Table E.3-1: INL Mesonet Meteorological Station Locations and Storage Files

Facility	NOAA Meteorological Station[1]	Meteorological File	Location (latitude, longitude)
INTEC, ATR, CFA, NRF	GRID3	GRI2000.MET GRI2001.MET GRI2002.MET GRI2003.MET GRI2004.MET	43.6049˚N, 112.9067˚W
TAN	LOFT	LOF2000.MET LOF2001.MET LOF2002.MET LOF2003.MET LOF2004.MET	43.846˚N, 112.705˚W
MFC	EBR	EBR2000.MET EBR2001.MET EBR2002.MET EBR2003.MET EBR2004.MET	43.594˚N, 112.651˚W
RWMC	RWMC	RWM2000.MET RWM2001.MET RWM2002.MET RWM2003.MET RWM2004.MET	43.499˚N, 113.0453˚W

[1] Measurement height at each station is 15 meters (50 feet).

ATR = Advanced Test Reactor
CFA = Central Facilities Area
INTEC = Idaho Nuclear Technology and Engineering Center
TAN = Test Area North
RWMC = Radioactive Waste Management Complex
NRF = Naval Reactors Facility
MFC = Materials and Fuels Complex
EBR = Experimental Breeder Reactor



Source: INL 2013a

Figure E.3-1: INL Facilities, Meteorological Stations, and Public Receptor Locations Along Boundaries and Highways

Surface data (roughness height, albedo, terrain, etc.) are processed for each individual meteorological station using the AERSURFACE utility and National Land Cover Data (NLCD) data file, idaho_NLCD92.tif. The NLCD data are derived from the early to mid-1990s Landsat Thematic Mapper satellite data and is a 21-class land cover classification scheme applied consistently over the United States (U.S). The spatial resolution of the data is 30 meters and mapped in the Albers Conic Equal Area projection, NAD 83. The NLCD are provided on a state-by-state basis at WebGIS 2009. The input parameters for AERSURFACE are presented in Table E.3-2.

Table E.3-2: AERSURFACE Input Parameters

Parameter	Value	Units and Comments
Coordinate type	Latitude Longitude	Decimal degrees, see Table E.3-1 for coordinates
Datum	NAD83	
Study radius	1.0	kilometers
Vary by sector?	Yes	
Number of sectors	12	30-degree sectors
Temporal resolution	Seasonal	
Continuous snow cover	Yes	Continuous snow cover is assumed during the winter months
Airport	No	
Surface moisture	Average	

AERMET Processing

The surface data provided by IDEQ are processed with AERMET Version 06341. AERMET processing used the same parameter values that were used in the IDEQ processing. These parameters include the threshold wind speed (0.447 meters per second), and the range of acceptable values for on-site data. These ranges are provided in Table E.3-3.

Table E.3-3: AERMET Processing Parameters

Parameter (units)	Range (missing data designation)
Wind speed (meters per second)	RANGE WS 0 <= 50 (99999)
Wind direction range (degrees)	RANGE WD 0 <= 360 (99999)
Temperature range (Celsius)	RANGE TT -30 < 49 (99999)
Delta temperature range (Celsius)	RANGE DT01 -2 < 5 (99999)
Standard deviation wind angle (degrees)	RANGE SA 0 <= 90 (99999)
Solar radiation (watts per square meters)	RANGE INSO -1 < 1250 (99999)
Relative humidity (percent)	RANGE RH 0 <= 100 (999)
Pressure (millibars)	RANGE PRES 8500 < 10999 (9999)

E.3.2 AERMOD Modeling

The 5-year site-specific meteorological data set for each facility as specified in Table E.3-1, and the receptors as illustrated in Figure E.3-1, are used in AERMOD. Individual emission sources at each of the named facilities in Table E.3-1 are modeled. The model is run for individual pollutants and averaging times assuming unit release rates, and then scaled to actual release rates. See INL 2013a Appendix A for INL release rates per facility and source.

E.3.2.1 Receptor Locations

Receptor locations for INL were obtained from IDEQ in the file "U S DEPT OF ENERGY-INL-DEFAULT AMBIENT AIR RECEPTORS - DEQ May 2011.zip" (IDEQ 2011). The receptors are shown in Figure E.3-1. The receptors are divided into two types: (1) site boundary receptors, and (2) public highway receptors. Site boundary and public highway receptors total 1374. These hypothetical receptors provide a conservative bound for all actual off-INL public receptor locations.

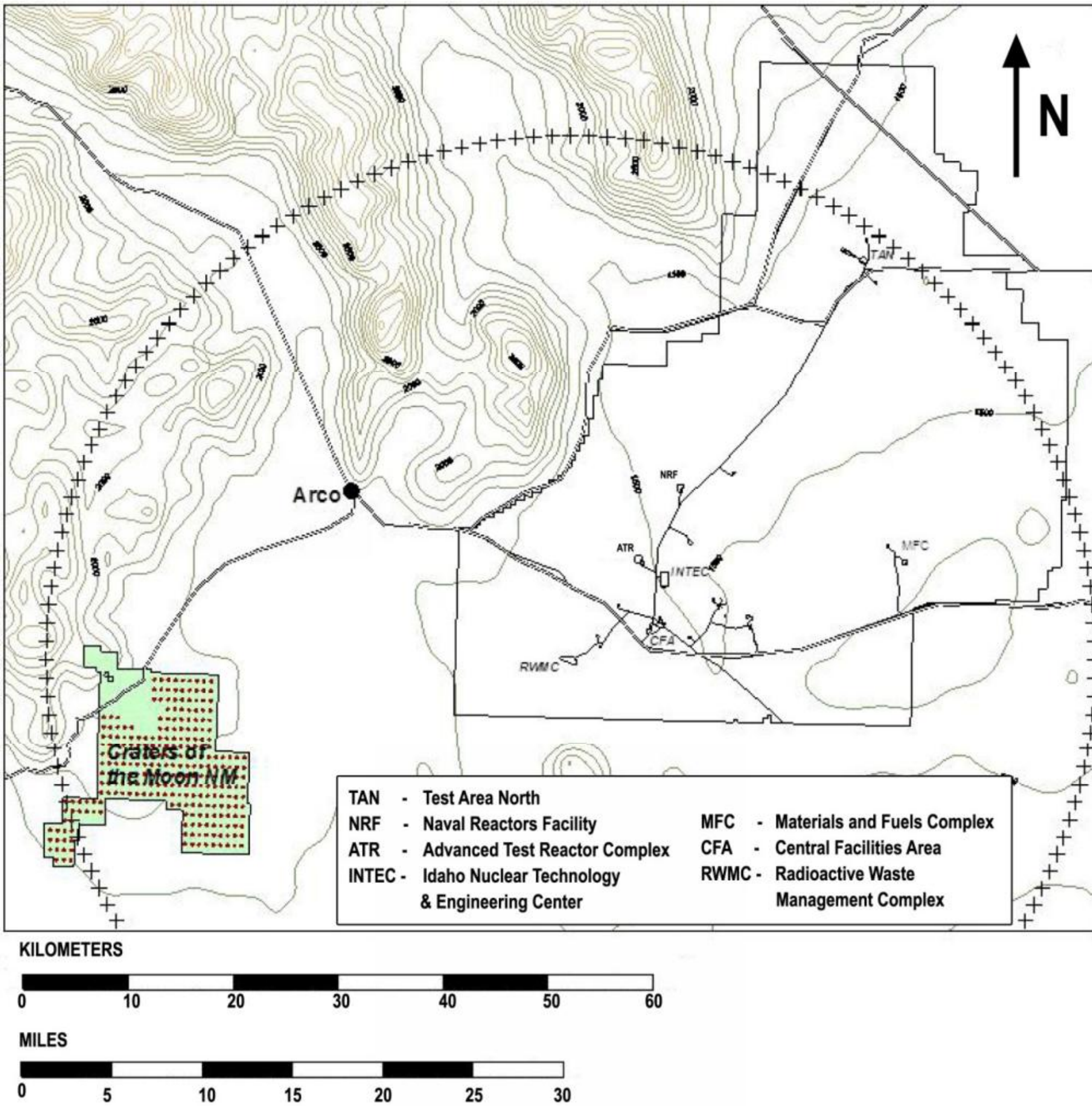
PSD impacts at the near field Federal Class I area are evaluated using the same AERMOD meteorological data for each facility described earlier and a receptor network provided by the National Park Service (NPS) (NPS 2012) . These Federal Class I area receptors are illustrated in Figure E.3-2.

E.3.2.2 Source Characterization

Source terms for the proposed action emissions and INL emissions are presented in Section E.2. See Appendix A of INL 2013a for individual facility source release rates used for the INL modeling and Appendix A of K-Spar Inc. 2016 for individual source release rates used for the revised construction analysis. For all facilities and the proposed action, boilers are assumed to operate 24 hours per day, 365 days per year. Actual stack parameters and estimated emissions are used in the INL AERMOD runs. NRF stack parameters and projected emissions are used for the proposed action.

EDGs are routinely tested during normal working hours and releases from these sources are modeled using the actual release parameters. Testing typically involves starting the generator during normal working daylight hours and running the generator for 15 to 30 minutes. If the exhaust stack is horizontal, then a small exit velocity is assumed and an effective stack diameter is calculated based on the total flow rate (exit velocity × actual stack diameter). Horizontal stacks or stacks with rain caps are assumed to have zero vertical momentum plume rise. These sources are assumed to be tested only during working hours (Monday through Friday, 8 a.m. to 4 p.m.). If more than one generator is present at a given facility and the stack parameters differed between generators, then the average of the two stacks is used. Hourly release rates are used for these sources. For longer averaging times (i.e. 24-hour, annual), the same maximum hourly release rate is conservatively assumed.

Miscellaneous combustion sources are modeled assuming all emissions emanated from a 1-meter (3.3-foot) high point source located at the center of the facility. Zero vertical momentum plume rise is assumed, and the release temperature is conservatively assumed to be 200 Fahrenheit (366 Kelvin), which is relatively cool for a combustion source. Miscellaneous combustion sources are assumed to operate during working hours. Hourly release rates are used for these sources. For longer averaging times (i.e. 24-hour, annual), the same maximum hourly release rate is conservatively assumed.

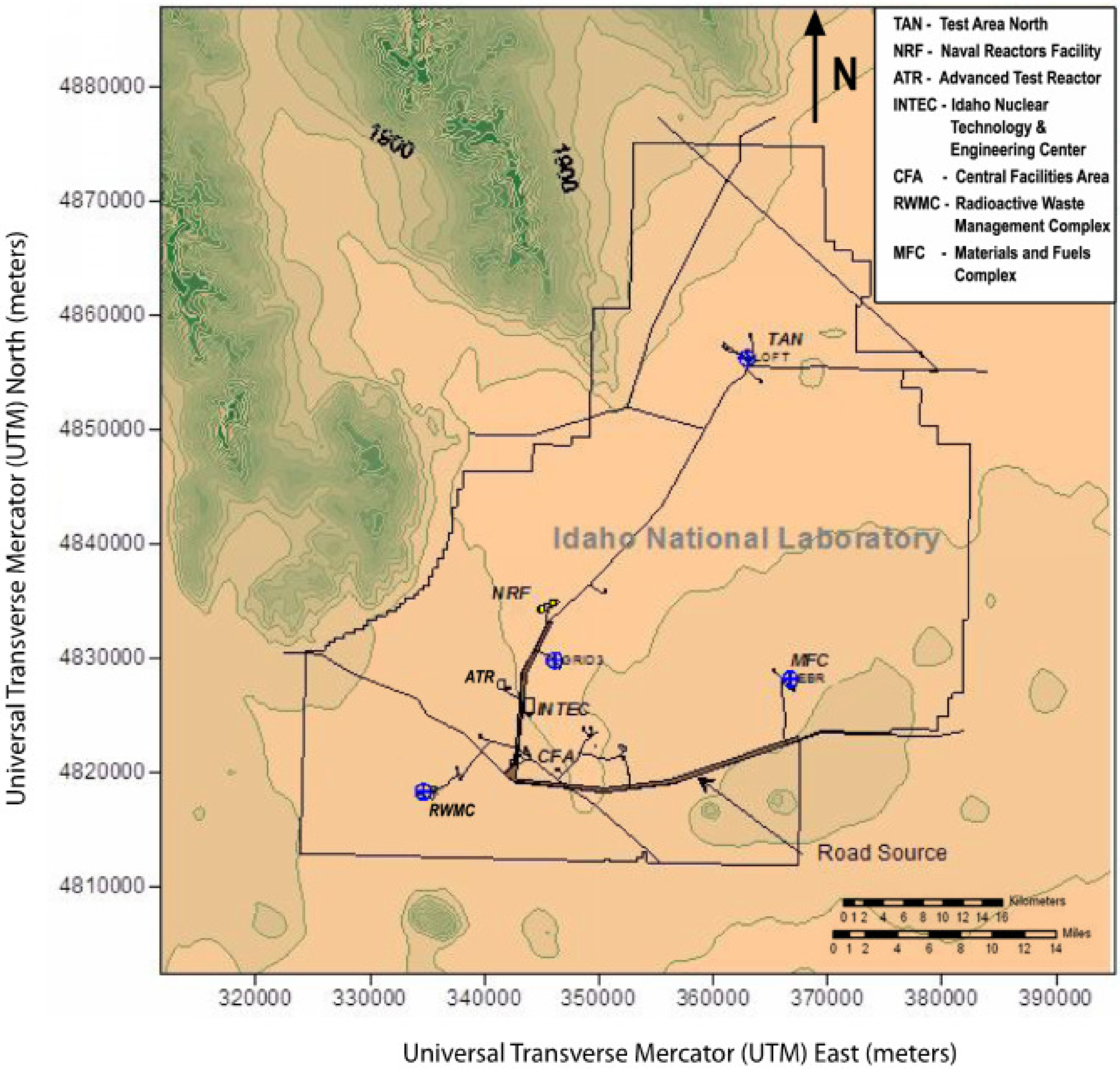


Source: INL 2013a
Note: The delineated circular area represents a 50-kilometer (31-mile) radius around Radioactive Waste Management Complex (RWMC).

Figure E.3-2: Craters of the Moon National Monument Near Field and Far Field Receptors

Construction period emissions are modeled as four non-overlapping scenarios as described in Section E.2. Construction period emissions that are not combustion sources (e.g., wind erosion, concrete batch plant, and off-road vehicle emissions) are modeled as several area sources that represent different disturbed regions of the proposed construction footprint. It is assumed that about 18.2 hectares (45 acres) of the entire construction footprint would be open to wind erosion in a given year (see Table E.2-10 for construction phases). This source is placed within the construction footprint.

On-road vehicle emissions are modeled as a segmented line source using an aspect ratio of 60:1 and a road width of 16 meters which results in 37 line segments (Figure E.3-3). Release height is 1-meter (3.3-foot). On-road vehicle emissions are limited to 5 a.m. to 7 p.m. to represent main transport to and from the work site and hauling material from Idaho Falls. It is assumed material would be hauled from Idaho Falls because U.S. Highway 20 is the main route to INL. Because on-road vehicle impacts are based on an estimate of the number of commuters and material loads that would be needed, pollutant concentrations would be the same regardless of the route.



Source: INL 2013a

Note: The source conservatively terminates at the INL site boundary south of the Materials and Fuels Complex (MFC) facility.

Figure E.3-3: Location of the On-Road Vehicle Emission Source

Building wake effects are not modeled explicitly for any of the sources, but are analyzed separately to confirm that the overall impact of including building wake effects would not result in a regulatory limit being exceeded (INL 2013a). It is concluded that including building wake effects would not result in predicted concentrations exceeding NAAQS limits. Additionally, other model uncertainties and conservatisms far outweigh small increases in concentrations that could occur due to building wake effects.

E.3.2.3 Dispersion Modeling

Individual sources, stack parameters, and construction areas associated with the different sources that are used in dispersion modeling are presented in Table E.3-4. Multiple model runs of the same source are necessary to get the different averaging times (i.e., 1-hour, 8-hour, 24-hour, etc.), deposition characteristics, and ranking (1st highest, 6th highest, 8th highest, etc.) for comparison of each air pollutant to regulation standards.

Table E.3-4: Parameters for Air Pollutant Emission Sources at INL

Source Name	Stack Height	Diameter	Temperature	Velocity	UTM East	UTM North	Area
	meters	meters	degrees Kelvin	meters per second	meters	meters	square meters
CFA Boilers	10.4	0.305	436	6.94	343500	4821930	N/A
INTEC Boilers	15.2	0.61	464	22.9	343810	4826080	N/A
TAN Boilers	9.14	0.61	466	6.31	363150	4856160	N/A
RWMC Boilers	15.5	0.56	450	9.39	335214	4817838	N/A
NRF Boilers	9.14	1.07	644	18.7	345400	4834600	N/A
ATR Generators	9.14	0.43	489	23.3	341390	4827820	N/A
ATR EDGs	4.64	0.15	810	67.8	341270	4827896	N/A
CFA EDGs	3.58	0.126	841	53.2	343113	4821377	N/A
CITRIC EDGs	3.58	0.126	841	53.2	343113	4821377	N/A
INTEC EDGs	6.10	0.457	785	43.5	343787	4825844	N/A
MFC EDGs[1]	1	1	366	0	365913	4828301	N/A
SMC EDGs	4.42	0.2	791	71.8	360911	4857538	N/A
NRF EDGs[2]	7.32	14.1	749	0.025	345400	4834600	N/A
ATR Misc. Sources	1	1	366	0	341270	4827896	N/A
CFA Misc. Sources	1	1	366	0	343113	4821377	N/A
INTEC Misc. Sources	1	1	366	0	343787	4825844	N/A
MFC Misc. Sources	1	1	366	0	365913	4828301	N/A
RWMC Misc. Sources	1	1	366	0	335299	4818098	N/A
NRF Misc. Sources	1	1	366	0	345400	4834600	N/A
New Facility Boilers	9.14	1.07	644	18.7	345400	4834600	N/A
TAN Misc. Sources	1	1	366	0	362930	4856320	N/A
New Facility EDGs	7.32	14.1	749	0.025	345400	4834600	N/A
Overhaul, Boilers	9.14	1.07	644	18.7	345400	4834600	N/A
Overhaul, EDGs	7.32	14.1	749	0.025	345400	4834600	N/A

Table E.3-4: Parameters for Air Pollutant Emission Sources at INL (cont.)

Source Name	Stack Height	Diameter	Temperature	Velocity	UTM East	UTM North	Area
	meters	meters	degrees Kelvin	meters per second	meters	meters	square meters
New Facility Construction Disturbed Area[3]	NA	NA	NA	NA	345792	4834602	60,014
New Facility Construction Wind Erosion Area[3]	NA	NA	NA	NA	345949	4834353	182,108
New Facility Construction Concrete Batch Plant, Phase I[3]	NA	NA	NA	NA	346494	4834223	4,045
New Facility Construction Concrete Batch Plant, Phase II[3]	NA	NA	NA	NA	346494	4834223	4,045
New Facility Construction Concrete Batch Plant Diesel Generators, Phase I	1.524	0.2032	784.4	87.4	346526	4834254	NA
New Facility Construction Concrete Batch Plant Diesel Generators, Phase II	1.524	0.2032	784.4	87.4	346526	4834254	NA
New Facility Construction Concrete Batch Plant Water Heaters, Phase I	0.3048	0.254	561	9.32	346526	4834254	NA
New Facility Construction Concrete Batch Plant Water Heaters, Phase II	0.3048	0.254	561	9.32	346526	4834254	NA
New Facility Construction On-Road Emissions[4]	NA	NA	NA	NA	NA	NA	614,104

[1] Uses the miscellaneous source release parameters for MFC EDGs.
[2] Horizontal exhaust pipe. Effective diameter calculated assuming a 0.025 meters per second release velocity.
[3] Area source, UTM coordinates represent the southwest corner of construction footprint.
[4] Roads modeled as a segmented line source (Figure E.3-3). Coordinates and area calculated with the Perl script mklineseg.pl.
ATR = Advanced Test Reactor; CFA = Central Facilities Area; INTEC = Idaho Nuclear Technology and Engineering Center; TAN = Test Area North; SMC = Specific Manufacturing Capability; RWMC = Radioactive Waste Management Complex; NRF = Naval Reactors Facility; CITRC = Critical Infrastructure Test Range Complex; MFC = Materials and Fuels Complex

For each source modeled, seven separate “simulated pollutants” are run in AERMOD, having either different averaging times or deposition characteristics (Table E.3-5). The criteria pollutants, NO_2, PM_{10}, and $PM_{2.5}$, required specific runs to incorporate pollutant-specific characteristics for deposition and chemical transformation. Parameter specifics for these pollutants are discussed in the following sections.

Table E.3-5: Air Pollutants and Averaging Times Used in AERMOD

Pollutant Type ID	Pollutants Included	Averaging Times	Notes
SO2	SO_2, TAPs (non-carcinogens)	1-hour, 24-hour, 3-hour	The 1-hour average is the 4th highest value representing the 99th percentile. The 3-hour and 24-hour averages are the maximum concentrations and are also used to model non-carcinogenic TAPs.
NOX	NO_2	1-hour	8th highest 1-hour average concentration representing the 98th percentile of the maximum 1-hour average concentration in a 24-hour period. Assumes a NO_X to NO_2 conversion ratio of 0.8 based on EPA 2011b.
NOXSOX	NO_2, SO_2, TAPs (carcinogens)	Annual	Annual average concentration across 5-year data set. Also used to estimate carcinogenic TAPs.
CO	CO	1-hour, 8-hour	Maximum 1-hour and 8-hour concentration.
PB	PB	Month	Maximum monthly average concentration used to compare with the rolling 3-month average limit.
PM10	PM_{10}	24-hour, Annual	Maximum 24-hour and annual concentration. Includes deposition and plume depletion. Assume the particle size distribution given in Appendix B of Wesley et al. 2002. Fine particle mass fraction = 0.80. Mass mean particle diameter = 0.4 micrometer.
PM25	$PM_{2.5}$	24-hour, Annual	Maximum 24-hour and annual concentration. Includes deposition and plume depletion. Assume the particle size distribution given in Appendix B of Wesley et al. 2002. Fine particle mass fraction = 0.80. Mass mean particle diameter = 0.4 micrometer. Revised construction analysis only: Average of the maximum 24-hour concentration over five years per special processing invoked by AERMOD when $PM_{2.5}$ pollutant is designated.

NO_2 Modeling

For NO_2 modeling, the tiered approach recommended by EPA 2011b is used. Tier 1 assumes 100 percent conversion of NO_x to NO_2, while Tier 2 assumes a NO_x to NO_2 ambient ratio of 0.8. Tier 3 uses NO_x chemistry models, Plume Volume Molar Ratio Method and the Ozone Limiting Method (OLM) within AERMOD, along with background ozone concentrations and in-stack NO_x/NO_2 ratios to estimate ambient NO_2 concentrations. The Tier 2 approach is primarily used in this assessment.

For demonstrating compliance with the 1-hour NO_2 standard, the Tier 2 methodology allows comparison of the 8th highest 1-hour average value of NO_2/NO_x (98th highest 1-hour average concentration in a 24-hour period) to the standard. For the annual average standard, 100 percent conversion from NO_2 to NO_x is modeled.

Because the 1-hour average NO_2 concentration is close to exceeding the standard for INL emissions, a second AERMOD run is performed using the Tier 3 methodology. In this assessment, all NO_2 sources with their actual release rates are included in a single AERMOD simulation. Output from this simulation also included gridded receptors so that the spatial distribution of NO_2 across INL could be visualized.

Sources for NO_2 modeling included all INL facilities and the road source limited to hours of 6 to 8 a.m. and 4 to 6 p.m. (to simulate commuter traffic to and from INL). The Tier 3 methodology used the OLM NO_2 atmospheric chemistry model (an option in AERMOD) and all sources are run simultaneously. Other parameters include an in-stack NO_2/NO_X ratio of 0.5 (EPA 2011b), and a background ozone concentration of 30 parts per billion. The background ozone concentration is the average value from a study on ozone in Treasure Valley, Idaho and is the approximate average taken from Table 3-1 in Kavouras et al. 2008.

Particulate Matter Less Than 10 Micrometers and 2.5 Micrometers

With the exception of the revised modeling for the construction period, deposition is not considered for any of the pollutants except PM_{10} and $PM_{2.5}$. Based on guidance in AERMOD user documentation and EPA 2012, the particle size distribution selected for fugitive dust as provided by Wesley et al. 2002 is used in this assessment. Method 2 is used to determine the particle size distribution from a fine mass fraction and representative mass mean particle diameter. Wesley et al. 2002 provides a fine particle mass fraction of 0.8 and a representative mass mean particle diameter of 0.4 micrometers.

Other Pollutants

Dispersion factor (χ/Q, or concentration divided by source term in units of second per cubic meters) values for some modeled pollutants are used to model other pollutants. For example, the NOXSOX annual average χ/Q values are used to model annual average concentrations of SO_2, NO_2, and carcinogenic TAPs because the averaging criteria and the dispersion characteristic for these pollutants are essentially the same. For non-carcinogens, the 24-hour SO_2 χ/Q is used. Ambient air concentrations of lead are based on a 3-month rolling average. The monthly average air concentration is used as a conservative bounding estimate of this value. The CO 8-hour average χ/Q is used for these pollutants.

Post-Processing

Output from AERMOD is summarized in terms of the dispersion factor for each source, averaging time, pollutant type, and receptor location. The dispersion factors are entered into a Microsoft Access database by source, averaging time, pollutant type, and receptor location.

The concentration from a single source is computed by

$$\chi_{i,j,k,l} = \chi / Q_{i,j,k,l} \times Q_{i,j,l} \qquad \textbf{Equation E-4}$$

Where:

$\chi_{i,j,k,l}$ = the concentration (grams per cubic meters) for source *i*, averaging time *j*, receptor *k*, and pollutant *l*

$\chi/Q_{i,j,k,l}$ = the dispersion factor (seconds per meter) for source *i*, averaging time *j*, receptor *k* , and pollutant *l*, and

$Q_{i,j,l}$ = the source term (grams per cubic meters) for source *i,* averaging time *j*, and pollutant *l*.

The concentration from all sources ($\chi_{T\,j,k,l}$) is calculated by summing across all sources by receptor and averaging time.

$$\chi_{T\,j,k,l} = \sum_{i=1}^{n} \chi_{i,j,k,l} \qquad \textbf{Equation E-5}$$

Where:

n = the number of sources

The maximum concentration across receptors is determined from the distribution of $\chi_{Tj,k,l}$ values. Total concentrations as given in Equation E-5 are coincident in space but not time. This is a conservative approach because the highest concentration from a source at a given receptor location does not necessarily coincide in time with the maximum concentration from another source at the same receptor location. For carcinogenic toxic air pollutants, maximum concentrations are reported regardless of whether the receptor is located on a highway where no person is expected to reside. This is a conservative assumption because the carcinogenic TAP limits are based on annual average lifetime exposure.

Concentrations of criteria pollutants, non-carcinogenic toxic air pollutants, and carcinogenic toxic air pollutants are calculated using the AERMOD χ/Q values at each of the IDEQ receptors (Figure E.3-1), the emission rates, and Equations E-4 and E-5.

E.4 Far Field Federal Class I Screening Assessment and VISCREEN Modeling Protocol

Under the Clean Air Act, the Federal Land Manager (FLM) and federal officials with direct responsibility for management of Federal Class I areas (e.g., national parks, monuments, and wilderness areas) have an affirmative responsibility to protect the Air Quality Related Values (AQRVs) (including visibility) of such lands. This includes the evaluation of impacts on visibility, ozone concentrations, and deposition from the construction and operations of a proposed major emitting facility. The FLM's decision regarding whether there is an adverse impact on AQRVs from air pollutants emitted from the proposed facility is considered by the permitting authority in the decision making process.

Visibility, ozone, and deposition impacts from the Overhaul and New Facility Alternatives in Federal Class I areas are evaluated using the methodology outlined by the FLM's AQRV Work Group (FLAG 2010).

E.4.1 FLAG Methodology

An initial screening assessment for far field Federal Class I areas is developed in FLAG 2010. The screening assessment is a first step used to determine whether modeling will be needed to adequately evaluate air pollution impacts. The screening assessment uses the ratio of pollutant emissions (Q) to distance (D) between the new source and Federal Class I areas. If Q/D is less than 10, then additional modeling is not usually required by the FLM; the FLM consider that there would be no impact on AQRVs at the Federal Class I area from the proposed source. Emissions of SO_2, NO_x, PM_{10}, and H_2SO_4 are summed to determine Q. If Q/D is greater than 10, then modeling is needed to evaluate air pollution impacts on AQRVs at far field Federal Class I areas. There is no simple screening test for near field Federal Class I areas. For these areas, initial screening for visibility impacts is performed using VISCREEN (EPA 1992a). The National Park Service waived the need for a near field acid deposition analysis due to the very low emissions of SO_x, H_2SO_4, and NO_x and the very low annual concentration impacts at Craters of the Moon National Monument (Appendix B).

For visibility assessments, the general procedure recommended by the Federal Land Managers Air Quality Work Group (FLAG) is as follows:

- Apply the Q/D screening test for far field Federal Class I areas. If Q/D is greater than 10, consult with the appropriate regulatory agency and with the FLM for the affected Federal Class I area(s) or other affected area for confirmation of preferred analysis or modeling procedures.
- For near field Federal Class 1 areas, obtain FLM recommendations for the specified reference levels and if applicable, FLM recommended plume/observed geometries and model receptor locations.
- Apply the applicable EPA steady-state models (e.g., VISCREEN) for regions within the Federal Class I area that are affected by plumes (source to receptor distance <50 kilometers (31 miles)) or layers that are viewed against a background.
- For regions of the Federal Class I area where visibility impairment from the source would cause a general alteration of the appearance of the scene (e.g., regional haze, generally > 50 kilometers (31 miles)), apply a non-steady-state air quality model (e.g., CALPUFF) with chemical transformation capabilities which yield ambient concentrations of visibility-impairing pollutants.
- If the modeling results are above levels of concern, continue to consult with the regulatory agencies to discuss other considerations.

For near field Federal Class I area visibility assessment the simplest model to apply is VISCREEN. If critical values for VISCREEN are not met, further analysis using PLUVUE II (EPA 1992b) would be required. Two phases of assessment are recommended for application of VISCREEN. Level I screening is designed to provide a conservative estimate of plume visual impacts and is achieved by using the worst-case meteorological conditions (stability class F and 1 meter per second wind speed) coupled with the wind blowing in the direction of the Federal Class I area. The screening level estimates of the change in the color difference index (ΔE) and contrast value (C) are compared to screening criteria. If the modeled ΔE value and the absolute value of the contrast ($|C|$) are less than 2.0 and 0.5 respectively, then the FLM is not likely to request further near field visibility analyses.

Failure of VISCREEN Level I screening leads to Level II screening, which requires site-specific meteorology coupled with actual emission characteristics of the facility. Failure to meet the criteria of Level II screening would lead to a Level III analysis using PLUVUE II. A Level III analysis represents a more realistic assessment of visibility impacts. Levels I, II, and III screening apply only to near field Federal Class I areas.

E.4.2 Q/D Screening Assessment for Far Field Federal Class I Areas

Visibility-impacting pollutants from operations include NO_x, SO_x, PM_{10}, and H_2SO_4. New facility construction sources that could impair visibility include fugitive dust, on-road and off-road vehicles, and batch plant/stone crushing operations. Construction emissions that could impair visibility would be short-term and variable over the four modeling scenarios. Source terms calculated as the sums of all pollutants that could impact visibility for each alternative, INL, and alternatives plus INL are provided in Table E.4-1. The sums include boiler, EDG, and construction (where appropriate) emissions for the proposed action. Boilers, EDGs, and miscellaneous combustion sources are included for the INL model.

Minimum distance from the eastern site boundary to the western boarders of either Grand Teton National Park or Yellowstone National Park is 110 kilometers (68 miles). A portion of Craters of the Moon National Monument lies outside the 50-kilometer (31-mile) radius of the nearest INL facility (RWMC) (Figure E.3-2). The distances,110 kilometers (68 miles) and 50 kilometers (31 miles), are used as conservative distances to far field Federal Class I areas for all alternatives and INL in the Q/D assessment (Table E.4-1).

Q/D values are less than 10 for the proposed action and cumulative scenarios with INL (Table E.4-1), indicating that AQRVs would not be impacted at far field Federal Class I areas and further visibility and deposition analyses are not necessary.

Table E.4-1: Total NO_x, SO_x, PM_{10}, and H_2SO_4 Source Term and Q/D Analysis

Description	NO_x		PM_{10}		SO_x		H_2SO_4		Total[1]	Q/D at 110 kilometers (68 miles)	Q/D at 50 kilometers (31 miles)
	kilograms per year	pounds per year	kilograms per year	pounds per year	kilograms per year	pounds per year	kilograms per year	pounds per year	tons per year		
INL Emissions	8.99×10^4	1.98×10^5	3.84×10^3	8.47×10^3	8.94×10^2	1.97×10^3	4.02×10^1	8.86×10^1	1.04×10^2	0.95	2.09
New Facility Operations Only	5.73×10^3	1.26×10^4	5.26×10^2	1.16×10^3	4.77×10^1	1.05×10^2	8.41×10^{-1}	1.85	6.95	0.06	0.14
Overhaul Operations Only	2.24×10^3	1.98×10^5	2.17×10^2	4.78×10^2	1.99×10^1	4.39×10^1	3.47×10^{-1}	7.65×10^{-1}	2.73	0.02	0.05
New Facility Operations at NRF[2] Plus INL	9.56×10^4	2.11×10^5	4.37×10^3	9.63×10^3	9.42×10^2	2.09×10^3	4.10×10^1	9.04×10^1	1.11×10^2	1.01	2.23
Overhaul Operations[3] Plus INL	8.99×10^4	1.98×10^5	3.84×10^3	8.47×10^3	8.94×10^2	1.97×10^3	4.02×10^1	8.86×10^1	1.04×10^2	0.95	2.09
New Facility Construction Scenario 1[4]	2.93×10^3	6.46×10^3	4.81×10^3	1.06×10^4	1.30×10^1	2.87×10^1	0.00	0.00	8.54	0.078	0.171
New Facility Construction Scenario 2[5]	1.23×10^4	2.71×10^4	1.01×10^4	2.23×10^4	5.87×10^1	1.29×10^2	0.00	0.00	2.48×10^1	0.225	0.496
New Facility Construction Scenario 3[6]	2.75×10^4	6.06×10^4	3.16×10^3	6.97×10^3	1.23×10^2	2.71×10^2	3.45	7.61	3.39×10^1	0.308	0.679
New Facility Construction Scenario 4[7]	2.11×10^4	4.65×10^4	1.68×10^3	3.70×10^3	9.72×10^1	2.14×10^2	1.79	3.95	2.52×10^1	0.229	0.504
New Facility Construction Scenario 1 Plus INL	9.28×10^4	2.05×10^5	8.65×10^3	1.91×10^4	9.07×10^2	2.00×10^3	4.02×10^1	8.86×10^1	1.13×10^2	1.027	2.258
New Facility Construction Scenario 2 Plus INL	1.02×10^5	2.25×10^5	1.39×10^4	3.06×10^4	9.53×10^2	2.10×10^3	4.02×10^1	8.86×10^1	1.29×10^2	1.174	2.583

Table E.4-1: Total NO_x, SO_x, PM_{10}, and H_2SO_4 Source Term and Q/D Analysis (cont.)

Description	NO_x		PM_{10}		SO_x		H_2SO_4		Total[1]	Q/D at 110 kilometers (68 miles)	Q/D at 50 kilometers (31 miles)
	kilograms per year	pounds per year	kilograms per year	pounds per year	kilograms per year	pounds per year	kilograms per year	pounds per year	tons per year		
New Facility Construction Scenario 3 Plus INL	1.17×10^5	2.58×10^5	6.99×10^3	1.54×10^4	1.02×10^3	2.25×10^3	4.36×10^1	9.61×10^1	1.38×10^2	1.257	2.766
New Facility Construction Scenario 4 Plus INL	1.11×10^5	2.45×10^5	5.52×10^3	1.22×10^4	9.92×10^2	2.19×10^3	4.20×10^1	9.26×10^1	1.30×10^2	1.178	2.591

[1] Total of NO_x, PM_{10}, SO_x, and H_2SO_4 source term converted to tons per year.
[2] Transition period.
[3] Refurbishment and post-refurbishment operational period.
[4] Includes construction phases 1, 2, 3, 8, 9
[5] Includes construction phases 4 and 5
[6] Includes construction phases 5 and 6
[7] Includes construction phases 5 and 7

E.4.3 VISCREEN Modeling Protocol

For Level 1 visibility screening, the default VISCREEN parameters are used along with user-specified values where appropriate. User-specified parameters included the source-to-observer distance, the minimum distance from the source to the Federal Class I area, background visibility range, and NO_x, primary NO_2, PM_{10}, SO_4, and soot release rates from diesel construction equipment. SO_4 is considered equal to the sulfuric acid (H_2SO_4) source terms in Section E.2. Soot release rates are estimated as 42 percent of the $PM_{2.5}$ release rates, based on guidance in EPA 2002. The soot component is subtracted from the total PM_{10} release rate to avoid double counting the releases. User-specified parameter and default parameters are presented in Table E.4-2 and source terms are presented in Table E.4-3. Distances from each source to the nearest Craters of the Moon National Monument boundary are presented in Table E.4-4. The source term for the VISCREEN Level 1 analysis included boilers for operations and diesel construction equipment for new facility construction. As recommended by the NPS, release rates are converted to maximum 24-hour releases in units of grams per second, and intermittent sources are not included in the source term. These sources operate infrequently and intermittently; and, therefore, do not represent long-term plume impacts.

For simplicity and conservatism, emissions from all sources in the VISCREEN simulations are summed across all facilities and placed at the facility (RWMC) nearest to Craters of the Moon National Monument. As stated earlier, Level 1 screening threshold values stipulated in the FLAG document are $\Delta E < 2.0$ (background extinction) and $|C| < 0.05$ (color contrast). Color contrast values vary between negative and positive depending on the situation. If C is negative, then blue light is removed due to scattering from particles present in the atmosphere. If C is positive, then blue light is added due to scattering from particles present in the atmosphere. The addition or subtraction of blue light results in a diminished contrast between objects and the sky and therefore causes visibility impairment. ΔE is always positive and represents light extinction (absorption) caused mainly by the presence of NO_2 in the atmosphere. A detailed discussion of the mathematical models for light extinction is provided in EPA 1980.

Table E.4-2: Default and User-Specified Input Parameters for the VISCREEN Level 1 Analysis

Parameter	Input	Comments
Minimum distance from source to Federal Class I boundary	32 kilometers (20 miles)	All sources are conservatively assumed to be at the INL facility nearest to the Craters of the Moon National Monument eastern boundary. The proposed new facility sources would be farther from the Federal Class I boundary.
Source-observer distance	32 kilometers (20 miles)	The observer is placed at the Craters of the Moon National Monument eastern boundary.
Distance from the source to most distant Federal Class I boundary	50 kilometers (31 miles)	Maximum distance calculated for plume impacts.
Background visual range	253.3 kilometers (157.5 miles)	Average of monthly average visual range for Craters of the Moon National Monument as provided in the FLAG 2010, Table 10.
Primary soot values	43% of $PM_{2.5}$ grams per second	EPA 2002, Table 6.
Background ozone	0.04 parts per million	VISCREEN default value.
Plume-source-observer angle	11.25 degrees	VISCREEN default value.
Stability class	F	VISCREEN default value.
Wind speed	1 meter per second (3.28 feet per second)	VISCREEN default value.
[1] For Construction Scenarios 1 and 2, a Level 2 screening distance of 48.4 kilometers (30.1 miles) was used because the construction emissions originate from NRF.		

Table E.4-3: VISCREEN Source Terms

Scenario Description	PM_{10}	NO_x	Primary NO_2	Soot[1]	SO_4[2]
	grams per second				
INL emissions	7.82×10^{-2}	3.18	5.43×10^{-2}	4.98×10^{-2}	2.65×10^{-4}
New facility operations plus INL	9.93×10^{-2}	3.42	6.72×10^{-2}	5.84×10^{-2}	3.13×10^{-4}
Overhaul operations plus INL	7.82×10^{-2}	3.18	5.43×10^{-2}	4.98×10^{-2}	2.65×10^{-4}
New facility operations only	2.11×10^{-2}	2.45×10^{-1}	1.29×10^{-2}	8.60×10^{-3}	4.74×10^{-5}
Overhaul operations only	8.81×10^{-3}	1.02×10^{-1}	5.39×10^{-3}	3.60×10^{-3}	1.98×10^{-5}
New Facility Construction Scenario 1 + baseline	1.22	3.87	5.43×10^{-2}	6.09×10^{-2}	2.65×10^{-4}
New Facility Construction Scenario 2 +baseline	1.99	3.97	5.43×10^{-2}	6.44×10^{-2}	2.65×10^{-4}
New Facility Construction Scenario 3 + baseline	2.89×10^{-1}	5.03	5.93×10^{-2}	8.51×10^{-2}	5.59×10^{-4}
New Facility Construction Scenario 4 +baseline	2.55×10^{-1}	5.32	5.93×10^{-2}	8.82×10^{-2}	5.59×10^{-4}
New Facility Construction Scenario 1	1.14	6.94×10^{-1}	0.00	1.11×10^{-2}	0.00
New Facility Construction Scenario 2	1.91	7.94×10^{-1}	0.00	1.46×10^{-2}	0.00
New Facility Construction Scenario 3	2.11×10^{-1}	1.85	5.04×10^{-3}	3.53×10^{-2}	2.94×10^{-4}
New Facility Construction Scenario 4	1.77×10^{-1}	2.15	5.04×10^{-3}	3.84×10^{-2}	2.94×10^{-4}

[1] The soot source term is estimated as 43 percent of the $PM_{2.5}$ releases. The soot mass release rate is subtracted from the PM_{10} release rate to avoid double counting.
[2] SO_4 source term is considered equal to the sulfuric acid (H_2SO_4) source term.

Table E.4-4: Distance From Craters of the Moon National Monument to INL Facilities

Location	UTM East	UTM North	Distance to Eastern Boundary	
	meters		kilometers	miles
Craters of the Moon National Monument, Eastern Boundary	304,378	4,809,098	0	0
RWMC	335,033	4,818,101	32.0	19.9
CFA	343,143	4,821,300	40.6	25.2
ATR	341,506	4,827,625	41.5	25.8
NRF	345,598	4,834,470	48.4	30.1
INTEC	343,961	4,825,690	42.9	26.7
MFC	366,952	4,827,327	65.2	40.5

ATR = Advanced Test Reactor; CFA = Central Facilities Area; INTEC = Idaho Nuclear Technology and Engineering Center; RWMC = Radioactive Waste Management Complex; NRF = Naval Reactors Facility MFC= Materials and Fuels Complex

Failure of VISCREEN Level 1 screening leads to Level 2 screening. Level 2 screening uses the VISCREEN model with site-specific meteorology coupled with actual emission characteristics of the facility. For Level 2 screening, site-specific meteorology is incorporated. Level 2 screening is required for the new facility construction sources for Modeling Scenarios 1 and 2 construction only and construction plus INL baseline sources. All other alternatives meet Level 1 screening thresholds when evaluated alone or cumulatively with INL emissions.

The worst-case dispersion conditions are ranked in order of decreasing severity, and the frequency of occurrence of these conditions is used for Level 2 screening (Table E.4-5). The frequency of the meteorological conditions is associated with the wind direction that could transport emissions toward the Federal Class I area and the time period during which excavation is assumed to occur. It is assumed for modeling purposes that excavation will occur between the hours of 7 A.M. and 5 P.M. The largest emission source for construction Modeling Scenarios 1 and 2 is PM_{10} from fugitive dust emissions during excavation.

The wind direction angle from the nearest Federal Class I Area boundary to NRF is 58.4 degrees. Visibility impacts are assumed to be possible for a sector width (22.5 degree sectors) on either side of the center line. Therefore the minimum wind direction angle is 58.4-22.5 = 35.9 degrees and the maximum wind direction angle is 58.4+22.5 = 80.9 degrees.

A 5-year meteorological data set from 1997 to 2001 taken at the Grid 3 meteorological tower (10-meter (32.8-feet) height) which is located south of NRF is used in the analysis. As stated in the VISCREEN guidance, acceptable results are achieved when the Level 1 screening thresholds for ΔE and |C| are not exceeded using Level 2 screening meteorology that does not exceed a cumulative frequency of occurrence greater than 0.01 or 1 percent. Stability class E with a wind speed of 2 meters (6.6 feet) per second is the most conservative conditions that met the screening thresholds, and is used in the analysis. Stability class E with a wind speed of 3 meters (9.8 feet) per second also had a cumulative frequency less than 0.01. However, the more conservative conditions are selected. Screening Level 2 meteorology is presented in Table E.4-5.

Table E.4-5: Screening Level 2 Meteorology Used for New Facility Construction

Stability	Wind speed meters per second	Hours	Frequency[1]	Cumulative Frequency	Transport Time hours
F	1	91	0.0021	0.0021	13.44
F	2	35	0.0008	0.0029	6.72
F	3	0	0.0000	0.0029	4.48
E	1	82	0.0019	0.0047	13.44
E	2	55	0.0013	0.0060	6.72
E	3	61	0.0014	0.0074	4.48
D	1	154	0.0035	0.0109	13.44

[1] Frequency is based on 43,824 hours of data.

E.5 CALPUFF Protocol

PSD air pollutant concentrations at far field Federal Class I areas are modeled using CALPUFF Version 5.8, as recommended by the NPS (INL 2013c). CALMET Version 5.8 is used to model meteorological parameters and post processing is done with CALPOST. Model parameters are specified by the NPS and the EPA.

For construction, the CALPUFF analysis in the Draft EIS was redone using the revised construction emissions. The CALPUFF model version and protocol did not change for this analysis. Construction Modeling Scenario 4 and Construction Modeling Scenario 4 plus INL emissions are modeled as bounding. The bounding scenarios are determined from the AERMOD results for the 1-hour NO_2 concentration (see Section 4.6 for the AERMOD results).

The model domain encompassed the boundaries of Craters of the Moon National Monument, Grand Teton National Park, and Yellowstone National Park. The domain is sufficiently large (approximately 100 kilometers (62 miles)) such that the Lambert Conformal Conic (LCC) coordinate system is selected to account for distortion due to the curvature of the earth, and to match the units in the gridded meteorological data (see below). Parameters for the LCC system and the grid parameters are presented in Table E.5-1. The EPA recommended 4-kilometer (2.5-mile) grid spacing for CALPUFF long-range transport is used.

The domain is illustrated in Figure E.5-1. For plotting purposes, coordinates are transformed from LCC to UTM coordinates using the CALPUFF utility program, Coords.exe.

Terrain data were obtained from the U.S. Geological Survey in the form of 1-degree (90-meter resolution) digital elevation model files. Thirty digital elevation model files are needed to cover the domain. These files are processed through the CALPUFF terrain preprocessor, TERREL, which produced a gridded terrain data file in the LCC coordinate system. Elevation contours are plotted in Figure E.5-1. DEM files that are used are listed in INL 2013c.

The NPS provided 3 years (2004-2006) of surface, upper air, and extracted Meteorological Mesoscale Model 5 (MM5) data that are used in the CALMET simulation. The MM5 data provide gridded, three-dimensional wind fields across the entire model domain. The gridded three-dimensional wind field has a much larger impact on long-range plume transport compared to surface meteorological stations.

Surface meteorological data provided by the NPS were obtained from airports in the SAMSON format and processed through the SMERGE data processor to produce a surface meteorological data file. Those stations in the domain are illustrated in Figure E.5-1.

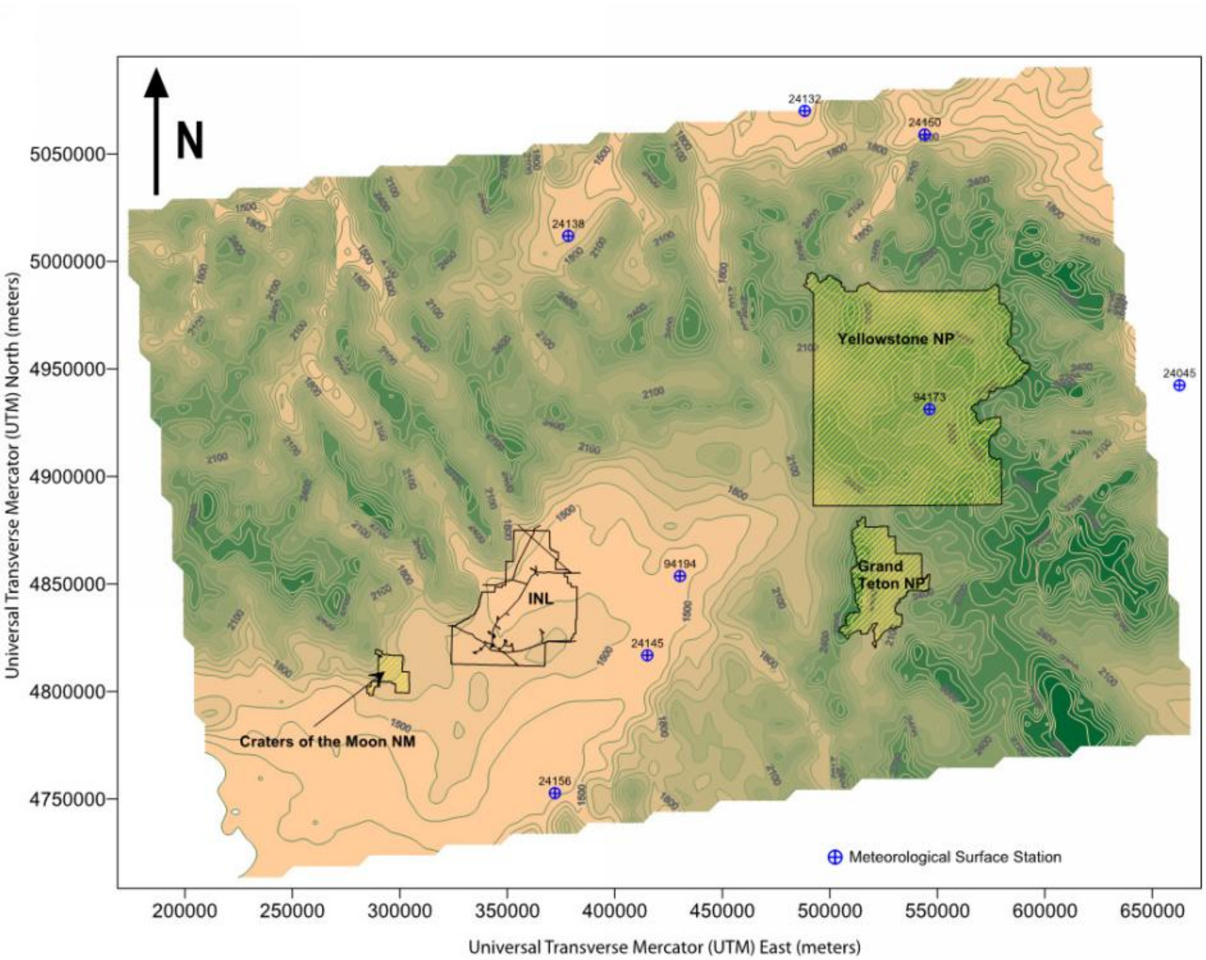
The receptor network for Federal Class I areas was provided by the NPS (NPS 2012). A total of 1692 receptors are identified; 271 receptors are identified within the Craters of the Moon National Monument, 506 receptors are identified for Grand Teton National Park, and 915 receptors are identified for Yellowstone National Park. Grid spacing is 2.6 kilometers (1.6 miles) for Yellowstone National Park, and 0.67 kilometers (0.4 miles) for Grand Teton National Park and Craters of the Moon National Monument. Receptor coordinates are provided in the Geodetic (latitude to longitude) coordinate system and are converted to LCC and UTM using the Coords.exe utility in CALPUFF.

Source terms (construction and operations), stack data, and facility locations described above are used in the CALPUFF model. Chemical transformation mechanisms are included in the simulation using the EPA default MESOPUFF II scheme. The MESOPUFF II scheme takes the concentrations of NOx, and SO_2 and converts these compounds to HNO_3, NO_3, and SO_4. The pollutants NO_x, SO_2, and HNO_3 are modeled as gases while NO_3 and SO_4 are modeled as particulates. $PM_{2.5}$ and PM_{10} (listed as fine and course particulate matter respectively) are also modeled. Deposition and plume depletion processes are included in the simulation. Physical properties for pollutants are in Table E.5-2.

CALPOST files for criteria pollutants were provided by the NPS. Separate files were provided for NO_X/NO_2, SO_2, $PM_{2.5}$, and PM_{10}. Concentrations for the different averaging times are output at each of the Federal Class I receptors defined by the NPS. The maximum concentration in each Federal Class I area is extracted for each of the model scenarios. The CALPOST input files are available in INL 2013c.

Table E.5-1: Coordinate System and Domain Parameters Used in CALPUFF

Parameter	Value (units)	Comments
Coordinate system	Lambert Conformal Conic (LLC)	
Matching parallels	33 N, 45 N	Provided by NPS
Latitude and longitude of projection origin	40 N, 97 W	Provided by NPS
Datum region	World Geodetic System-84	
Southwest Corner coordinate	-1422.59 kilometers West, 408.6 kilometers North	LCC coordinates, UTM coordinates 166.7759 kilometers, 4706.502 kilometers (Zone 12)
Grid spacing	4 kilometers (2.5 mile)	EPA 2009b
Number of X nodes	116	Site-specific based on grid spacing and domain extent
Number of Y nodes	81	Site-specific based on grid spacing and domain extent
Number of vertical layers	10	EPA 2009b
Vertical levels	20.0, 40.0, 80.0, 160.0, 320.0, 640.0, 1200.0, 2000.0, 3000.0, 4000.0 meters	EPA 2009b



Source: INL 2013c

Figure E.5-1: CALPUFF Model Domain for PSD Analysis of Federal Class I Areas

Table E.5-2: Physical Properties of Pollutants Modeled in CALPUFF Used for Deposition and Plume Depletion Calculations

Pollutant	Diffusivity[1] square centimeters per second	α*[1]	Reactivity[1]	Mesophyll Resistance[1] seconds per centimeter	Henry's Law Constant[1,2]	Geometric Mass Median Diameter[3] micrometers	SC[4], Liquid per second	SC[4], Frozen per second
SO_2	0.1509	1000	8.0	0.0	0.04		3.0×10^{-5}	0.0
SO_4						0.48	1.0×10^{-4}	3.0×10^{-5}
HNO_3	0.1628	1.0	18.0	0.0	0.0000001		6.0×10^{-5}	0.0
NO_X	0.1656	1.0	8.0	5.0	3.5		1.0×10^{-4}	3.0×10^{-5}
NO_3						0.48	1.0×10^{-4}	3.0×10^{-5}
PM_{10}						3.0	1.0×10^{-4}	3.0×10^{-5}
$PM_{2.5}$						0.48	1.0×10^{-5}	3.0×10^{-5}

Source: INL 2013c
Note: Gray cells indicate property does not apply.
[1] Applies only to dry deposition of gases.
[2] Dimensionless.
[3] Applies only to dry deposition of particles. The geometric standard deviation is 2.0 in all cases.
[4] Scavenging coefficient for particles and gases.

E.6 Sensitivity Analyses Requested by IDEQ

During consultation with IDEQ on the AERMOD protocol used in the Draft EIS (Appendix B), IDEQ requested that three sensitivity studies be performed to ensure that the results of the AERMOD analysis adequately represented air quality impacts. They also requested that a statement on the completeness of meteorological data used in the AERMOD analysis be included in the Final EIS. The sensitivity studies include:

1. A comparison between the results of AERMOD/AERMET Versions 11103/06341 used in the Draft EIS and the current AERMOD/AERMET Version 15181
2. A comparison between the PM_{10} and $PM_{2.5}$ concentrations at receptor locations with and without deposition
3. A comparison between on-road emissions calculated with MOBILE6.2 and MOVES2010b

The technical memorandum inserted below provides the detailed sensitivity studies for items 1 and 2 and the information about the completeness of meteorological data used in the AERMOD analysis. Based on the technical memorandum, IDEQ agreed that the sensitivity study for item 1 is sufficient to show that the air quality impacts using AERMOD versions 11103/06341 are adequately represented and that there would be no change in the overall conclusions on air quality impacts based on use of the older model versions in the Draft EIS. In addition, IDEQ agreed that the sensitivity analysis for item 2 is sufficient to show that running AERMOD without deposition would not cause PM_{10} and $PM_{2.5}$ to increase beyond the regulatory standards, and that there would be no change in the overall air quality described in the Draft EIS. IDEQ agreement is documented in Appendix B.

MOVES2014 is used for calculating on-road emissions in the revised construction analysis for the New Facility Alternative; therefore, the sensitivity study between on-road emissions calculated with MOBILE6.2 and MOVES2010b is not needed.

E.6.1 Technical Memorandum: Additional Information Requested by the State of Idaho on Air Quality Monitoring

TECHNICAL MEMORANDUM

ADDITIONAL INFORMATION REQUESTED BY THE STATE OF IDAHO ON AIR QUALITY MODELING FOR THE EXPENDED CORE FACILITY RECAPITALIZATION PROJECT ENVIRONMENTAL IMPACT STATEMENT

Arthur S. Rood
K-Spar Inc.
September 30, 2015
Revised November 6, 2015

INTRODUCTION

The Naval Nuclear Propulsion Program (NNPP) is preparing an Environmental Impact Statement (EIS) for recapitalization of the spent fuel handling capabilities of the Expended Core Facility (ECF) at the Naval Reactors Facility (NRF). Air quality impacts were evaluated by Battelle Energy Alliance (BEA) and documented in three reports:

- Rood (2013a) documents near-field (<50 km from the source) impacts for Prevention of Significant Deterioration (PSD) and National Ambient Air Quality Standards (NAAQS) criteria air pollutants, and toxic air pollutants (TAPs)
- Rood (2013b) documents PSD increment levels in far-field (>50 km from the source) Class I areas
- Rood (2013c) documents near-field (<50 km) visibility impacts.

These documents describe the modeling protocol, assessment objectives, and other background information for construction and operations of the Spent Fuel Handling Project (SFHP) facility and the Examination Project (EP) facility. The construction of the EP facility has since been dropped from the analysis, but its operation is included in the cumulative impacts as a potential future source. The air modeling results were presented in the Draft Environmental Impact Statement (DEIS) for the project (DOE 2015).

The Idaho Department of Environmental Quality (IDEQ) reviewed Rood 2013a and provided comments on August 2, 2013[1]. A follow up discussion was had with IDEQ to ensure that their comments were understood and to agree upon changes that would be needed to the Final EIS (FEIS). These communications are documented in pages B-75 through B-91 in the DEIS (DOE 2015). Action items are summarized below:

1) Comparison of the maximum 8th highest NO_2 concentration for Scenario 6 reported in the DEIS with the 8th highest NO_2 concentration for Scenario 6 calculated using the latest version of AERMOD/AERMET and the χ/Q method as described in the DEIS. Scenario 6 represents the cumulative impacts of operation of SFHP located at Area 3/4, operation of the EP facility at NRF, and all INL baseline sources.
2) PM_{10} and $PM_{2.5}$ concentrations were modeled using the deposition algorithm provided in AERMOD. IDEQ stated that for permit modeling, taking credit for deposition was not

[1] Letter from Cheryl Robinson, IDEQ to R.E. Ramsey, Naval Reactors, August 2, 2013, Naval Nuclear Propulsion Program (NNPP) EIS for Recapitalizing Naval Spent Nuclear Fuel Handling Capabilities of the Expended Core Facility (ECF) at INL: DEQ Review of Non-radiological Air Quality Modeling (AERMOD only)

allowed. Although the EIS is not permit modeling, it would be useful to know what impact deposition has on PM_{10} and $PM_{2.5}$ modeled concentrations.

3) The modeling report should discuss whether hourly or subhourly data was obtained for the four INL met towers (GRID3, LOFT, EBR, and RWMC) used as “onsite” met for project dispersion modeling, and identify whether these data meet minimum 90% completeness requirements. If subhourly data were obtained, the report should discuss how these data were handled, and whether/how the bugs identified in AERMET Version 06341 (v06341) for processing subhourly ONSITE data may have affected the dispersion modeling results.
4) Road emissions were calculated with MOBILE 6.2. The current EPA approved software for performing road emissions estimates is MOVES2010b. A comparison of the emission rates from the two models would be of interest.

For the Final Environmental Impact Statement (FEIS), MOVES2014 (the updated version of MOVES2010b) will be used to estimate mobile source vehicle emissions, and thus item 4 above is no longer applicable. This technical memorandum addresses the NO_2 concentration for Scenario 6 using AERMOD/AERMET Version 15181 (v15181) (the current version of AERMOD), PM_{10} and $PM_{2.5}$ concentrations for Scenario 6 without deposition using AERMOD/AERMET v15181, and a meteorological data completeness report for the onsite data. AERMOD input files for runs performed with v15181 are provided in the files, *noxfiles.txt* for NOx 1-hour files, *pm10files.txt* for PM_{10} 24-hour and annual average files, and *pm25files.txt* for $PM_{2.5}$ 24-hour and annual average files.

This technical memorandum was originally issued September 30, 2015. Review of the AERMET files for a separate project by IDEQ revealed an error for the year 2001 where the onsite data for GRD3 tower was given the incorrect date. This error was corrected, AERMOD was rerun, and the revised concentrations are presented in this version of the technical memorandum. Predicted concentrations did not change appreciably and conclusions remain the same from the September 30th version.

SOURCES AND RECEPTORS

Onsite Idaho National Laboratory (INL) emission sources originate from seven primary facilities illustrated in Figure 1. Sources of criteria and toxic air pollutants from these facilities include oil-fired boilers, diesel engine generators, emergency diesel generators (EDGs), and miscellaneous small gasoline, diesel, and propane combustion sources. For modeling purposes, these sources are grouped into oil-fired boilers and diesel generators, EDGs, and miscellaneous sources. Criteria pollutants include nitrogen oxides (NO_2,) carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter less than 10 µm (PM_{10}) and less than 2.5 µm ($PM_{2.5}$) diameter, and lead (Pb). For this technical memorandum, only the 1-hr average NO_2, and 24-hr average and annual average PM_{10} and $PM_{2.5}$ concentrations are evaluated. Pollutant (NO_2 and particulate matter) concentrations are calculated for Class II public receptors located on the boundary and within the INL as provided by IDEQ and illustrated in Figure 1. Public receptors in Federal Class I areas (Craters of the Moon National Monument [COM]) that are less than 50 km from the INL sources are illustrated in Figure 2. These receptors were provided by the National Park Service (NPS).

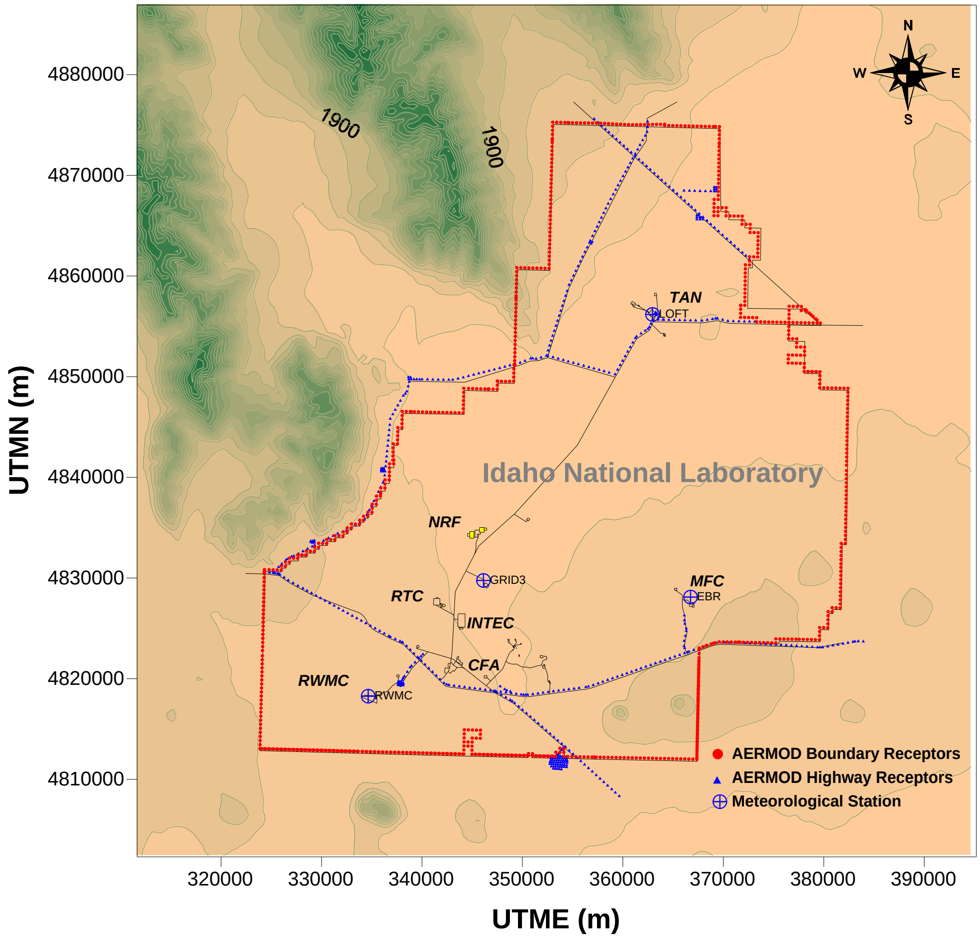


Figure 1. Idaho National Laboratory facilities showing the locations of meteorological stations and AERMOD Class II receptors that were provided by IDEQ.

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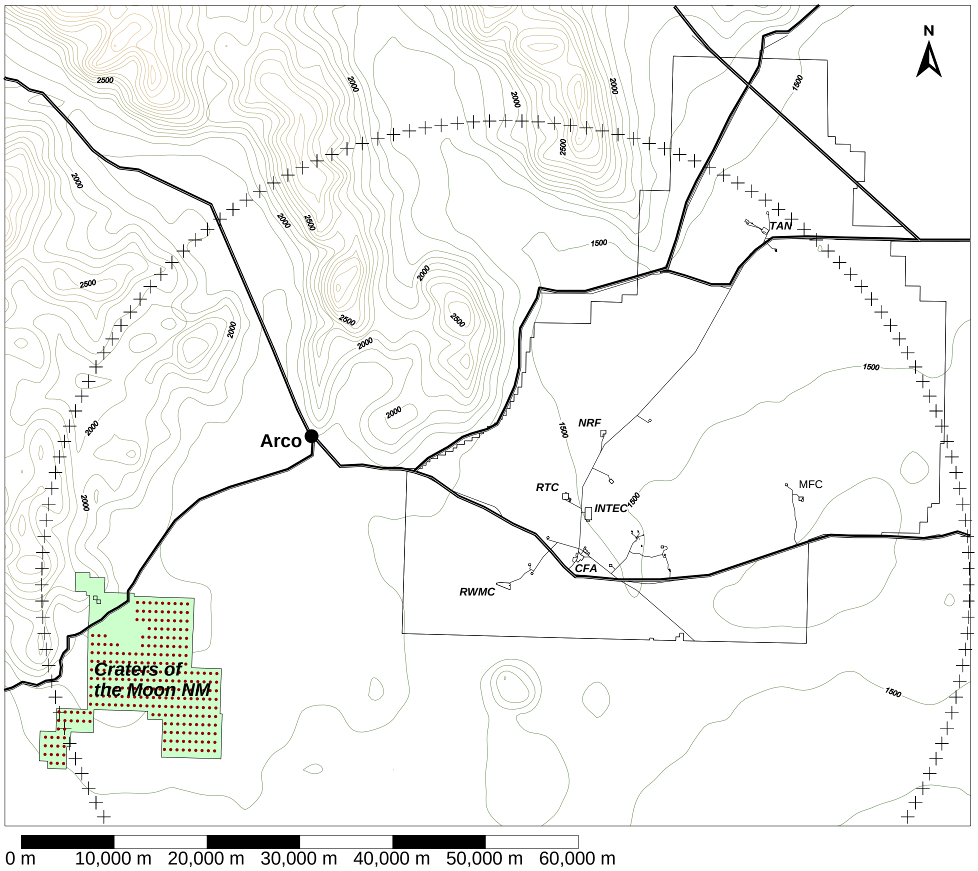

Figure 2. Map showing location of the Craters of the Moon Class I receptors (residing in the Craters of the Moon boundary) as provided by the National Park Service. The circular area with the plus signs represents the 50-km distance from the Radioactive Waste Management Complex.

NO_2 CONCENTRATIONS FOR SCENARIO 6

Pollutant concentrations in the DEIS are calculated as the product of the χ/Q value (concentration (χ) divided by the source term (Q)) and the actual pollutant source term. The DEIS used AERMOD Version 11103 and AERMET Version 06341 (AERMOD/AERMET v11103/06341) to calculate χ/Q values. The χ/Q values for all sources that contributed to the 8th highest NO_2 concentration for Scenario 6 were recalculated using AERMET and AERMOD Version 15181 (AERMOD/AERMET v15181). Sources included those at Naval Reactors Facility (NRF), Central Facilities Area (CFA), Idaho Nuclear Technology Engineering Center (INTEC), Test Reactor Area (TRA), Radioactive Waste Management Complex (RWMC), Materials Fuel Complex (MFC), and Test Area North (TAN). Meteorological data from the GRID3, RWMC, MFC and TAN meteorological towers were obtained from the onsite data provided in Rood (2013a) and processed with AERMET v15181. Sources at NRF, TRA, INTEC, and CFA were modeled using the GRID3 meteorological data, those at RWMC were modeled using RWMC meteorological data, those at MFC were modeled using MFC meteorological data, and those at TAN were modeled using TAN meteorological data. For some sources, existing source χ/Q values were used. For example, the Spent Fuel Handling Project (SFHP) boilers used χ/Q values from the existing NRF boilers.

A total of 18 χ/Q values representing the 8th highest 1-hr average NO_2 concentration at all the 1,374 Class II public receptors were calculated (24,732 values) with AERMOD v15181 and compared with the same values calculated with AERMOD/AERMET v11103/06341. The mean 8th highest NO_2 1-hr χ/Q ratio (v15181 to v11103/06341) was 0.834 with a minimum and maximum of 0.137 and 3.24 respectively, and a standard deviation of 0.236 (Figure 3). Thus, on average, v15181 will produce lower 8th highest 1-hr NO_2 concentrations compared to v11103/06341. However, 15% of the χ/Q ratios were greater than 1.0 indicating that 15% of the receptors calculated with v15181 would have higher 1-hr NO_2 concentrations compared to v11103/06341.

Table 1 presents the AERMOD/AERMET v11103/06341 χ/Q values, NO_2 source term, and 8th highest 1-hr NO_2 concentration at the maximum location (receptor 179). These are the values that are reported in Rood 2013a. The 8th highest 1-hr average NO_2 concentration was 97.9 µg m^{-3}. Table 2 presents the AERMOD/AERMET v15181 χ/Q values, NO_2 source term, and 8th highest 1-hr NO_2 concentration at the maximum location (receptor 179). The 8th highest 1-hr average NO_2 concentration was 85.9 µg m^{-3}. The NO_2 source term used in the calculations for both AERMOD versions was the same as reported in Rood 2013a. The maximum 8th highest 1-hr average NO_2 concentration using AERMOD/AERMET v15181 of 85.9 µg/m^3 is below the NAAQS limit of 190 µg/m^3.

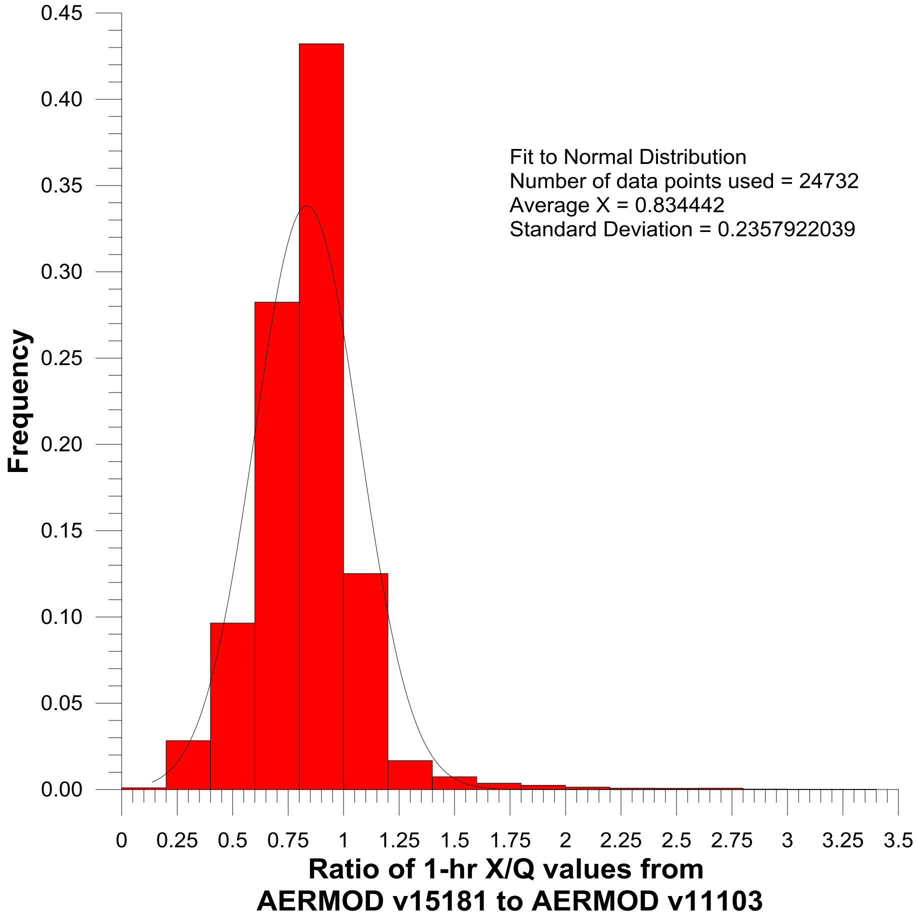

Figure 3. Distribution of the ratio of 1-hr χ/Q values from AERMOD/AERMET v15181 to AERMOD/AERMET v11103/06341.

Table 1. χ/Q Values, Source Term (Q), and 8th Highest 1-hr Average NO_2 Concentration at Receptor 179 using AERMOD/AERMET v 11103/06341 and Scenario 6

χ/Q ID	χ/Q (s/m^3)	Q (g/s)	Concentration (µg/m^3)	Source ID
TRAEDG	2.70E-06	2.36E+00	6.36E+00	ATR EDGs
TRABOIL	3.42E-06	2.21E+00	7.55E+00	ATR Generators
TRAMISC	1.16E-05	1.91E-02	2.21E-01	ATR Misc
CFABOIL	1.89E-05	3.94E-02	7.47E-01	CFA Boiler
CFAEDG	1.36E-05	5.03E-01	6.84E+00	CFA EDGs
CFAMISC	7.36E-05	3.07E-01	2.26E+01	CFA Misc
CFAEDG	1.36E-05	5.03E-01	6.84E+00	CITRIC EDGs
NRFBOIL	3.34E-06	1.90E-02	6.34E-02	EPBoil
NRFEDG	1.70E-06	9.63E-02	1.64E-01	EPEDG
INTECBOIL	2.58E-06	3.43E-01	8.86E-01	INTEC Boiler
INTECEDG	1.96E-06	6.52E+00	1.28E+01	INTEC EDGs
INTECMISC	1.44E-05	5.79E-02	8.33E-01	INTEC Misc
ANLMISC	4.05E-06	8.67E-01	3.51E+00	MFC EDGs
ANLMISC	4.05E-06	4.26E-02	1.72E-01	MFC Misc
NRFBOIL	3.34E-06	3.24E-01	1.08E+00	NRF Boiler
NRFEDG	1.70E-06	3.85E+00	6.56E+00	NRF EDGs
NRFMISC	5.53E-06	2.21E-01	1.22E+00	NRF Misc
RWMCBOIL	2.60E-06	2.12E-01	5.51E-01	RWMC Boiler
RWMCMISC	3.54E-05	2.08E-01	7.38E+00	RWMC Misc
NRFBOIL	3.34E-06	2.58E-01	8.61E-01	SFHPBoil
NRFEDG	1.70E-06	5.78E+00	9.84E+00	SFHPEDG
TANEDG	7.70E-07	8.67E-01	6.68E-01	SMC EDGs
TANBOIL	1.51E-06	1.05E-01	1.58E-01	TAN Boiler
TANMISC	1.67E-06	0.00E+00	0.00E+00	TAN Misc
TOTAL			9.79E+01	

Table 2. χ/Q Values, Source Term (Q), and 8th Highest 1-hr Average NO_2 Concentration at Receptor 179 using AERMOD/AERMET v 15181 and Scenario 6

χ/Q ID	χ/Q (s/m^3)	Q (g/s)	Concentration ($\mu g/m^3$)	Source ID
TRAEDG	2.65E-06	2.36E+00	6.24E+00	ATR EDGs
TRABOIL	4.40E-06	2.21E+00	9.71E+00	ATR Generators
TRAMISC	5.13E-06	1.91E-02	9.78E-02	ATR Misc
CFABOIL	2.40E-05	3.94E-02	9.44E-01	CFA Boiler
CFAEDG	1.35E-05	5.03E-01	6.78E+00	CFA EDGs
CFAMISC	6.76E-05	3.07E-01	2.08E+01	CFA Misc
CFAEDG	1.35E-05	5.03E-01	6.78E+00	CITRIC EDGs
NRFBOIL	2.81E-06	1.90E-02	5.33E-02	EPBoil
NRFEDG	1.51E-06	9.63E-02	1.45E-01	EPEDG
INTECBOIL	2.64E-06	3.43E-01	9.08E-01	INTEC Boiler
INTECEDG	1.73E-06	6.52E+00	1.12E+01	INTEC EDGs
INTECMISC	1.01E-05	5.79E-02	5.84E-01	INTEC Misc
ANLMISC	1.21E-06	8.67E-01	1.05E+00	MFC EDGs
ANLMISC	1.21E-06	4.26E-02	5.15E-02	MFC Misc
NRFBOIL	2.81E-06	3.24E-01	9.09E-01	NRF Boiler
NRFEDG	1.51E-06	3.85E+00	5.81E+00	NRF EDGs
NRFMISC	3.27E-06	2.21E-01	7.23E-01	NRF Misc
RWMCBOIL	2.52E-06	2.12E-01	5.36E-01	RWMC Boiler
RWMCMISC	1.09E-05	2.08E-01	2.27E+00	RWMC Misc
NRFBOIL	2.81E-06	2.58E-01	7.25E-01	SFHPBoil
NRFEDG	1.51E-06	5.78E+00	8.72E+00	SFHPEDG
TANEDG	7.55E-07	8.67E-01	6.55E-01	SMC EDGs
TANBOIL	1.46E-06	1.05E-01	1.54E-01	TAN Boiler
TANMISC	1.86E-06	0.00E+00	0.00E+00	TAN Misc
TOTAL			8.59E+01	

COMPARISON OF PM_{10} AND $PM_{2.5}$ WITH AND WITHOUT DEPOSITION

PM_{10} and $PM_{2.5}$ are subject to deposition processes that can deplete the plume and reduce ambient air concentrations. AERMOD includes algorithms to compute deposition fluxes and deplete the plume. For permitting however, IDEQ requires that deposition not be considered. In this exercise, the 24-hour and annual average PM_{10} and $PM_{2.5}$ concentrations for Scenario 6 were calculated assuming no deposition and compared to the concentrations from the DEIS with deposition. Prevention of Significant Deterioration (PSD) and National Ambient Air Quality Standards (NAAQS) limits for Class II (INL and surrounding area) and Class I (National Parks) regions are provided in Table 3. In addition to differences related to deposition, variations related to different AERMOD/AERMET versions would also impact the PM_{10} and $PM_{2.5}$ concentrations.

The IDEQ Impact Analysis Report Template (IDEQ 2014) states that the 24-hr PM_{10} concentration is evaluated using the 6th highest 24-hr concentration at any receptor based on 5-years of meteorological data. For the DEIS, the 1st highest 24-hr PM_{10} concentration was conservatively used. For $PM_{2.5}$ modeling, the 5-year mean of the 8th highest modeled 24-hour concentration at the modeled receptor for each year of meteorological data modeled is used, and for Significant Impact Level (SIL) analysis, the 5-year mean of the 1st highest modeled 24-hour concentration at the modeled receptor is used. When the pollutant is identified in AERMOD as "PM25" as was done in the DEIS, special processing is used to calculate the 5-year mean of the nth highest modeled 24-hour $PM_{2.5}$ concentration at the modeled receptor. In the DEIS, the 1st highest concentration using $PM_{2.5}$ modeling was conservatively used.

Table 3. Prevention of Significant Deterioration (PSD) and National Ambient Air Quality Standards (NAAQS) for PM_{10} and $PM_{2.5}$

Pollutant	Averaging time	NAAQS Limit (μg m^{-3})	PSD Class II Limit (μg m^{-3})[a]	PSD Class I Limit (μg m^{-3})[a]
PM_{10}	24-hour	150	30	8
$PM_{2.5}$	24-hour	35	9	2
PM_{10}	Annual	N/A	17	4
$PM_{2.5}$	Annual	12	4	1

a. Maximum allowable increase from a new or modified source [40 CFR 51.166(c)(1)]

Maximum twenty-four-hour average PM_{10} and $PM_{2.5}$ concentrations calculated with AERMOD v11103/06341 with deposition and AERMOD/AERMET v15181 without deposition are summarized in Table 4. Maximum annual average PM_{10} and $PM_{2.5}$ concentrations calculated with AERMOD v11103/06341 with deposition and AERMOD/AERMET v15181 without deposition are summarized in Table 5. Detailed results are presented in Tables 6 through 21. Figure 4 shows the ratio of the 24-hr PM_{10} χ/Q at 1,374 receptors and 18 sources for AERMOD v15181 without deposition to AERMOD v11103 with deposition. The mean ratio was 1.32 indicating that on average, ignoring deposition and using AERMOD v15181 will result higher χ/Q values. Seventy percent of the PM_{10} χ/Q values calculated with v15181 without deposition were higher than v11103 with deposition. Only three percent of the v15181 χ/Q values were lower than v11103 by a factor of two or more. For χ/Q values that are close to a source, little plume depletion occurs, and the observed decrease in the χ/Q values using v15181 is due to differences in the AERMOD versions and not deposition.

For the maximum 24-hour concentrations, AERMOD v15181 concentrations at Class II receptors are lower without deposition compared to AERMOD/AERMET v11103/06341 with deposition. In general, higher concentrations would be expected when deposition and plume depletion are ignored because deposition will deplete the plume resulting in lower air concentrations. However, the expected higher concentrations without deposition are compensated for by changes made in v15181 of AERMOD, which calculates a lower maximum 24-hour concentration at the Class II receptor relative to AERMOD/AERMET v11103/06341. Note also that the receptor with the maximum 24-hour concentration for v15181 differs from that for the receptor with the maximum 24-hour concentration using v11103/06341. Receptor 176 and 180 are located along the highway south of CFA. Receptor 113 lies at the furthest northern extent of public access to the MFC facility. As shown in Table 6, the CFA miscellaneous source is the highest contributor to the maximum 24-hour PM_{10} concentration for AERMOD/AERMET v11103/06341, whereas MFC EDGs is the highest contributor to the maximum 24-hour PM_{10} concentration for AERMOD/AERMET v15181 (Table 14).

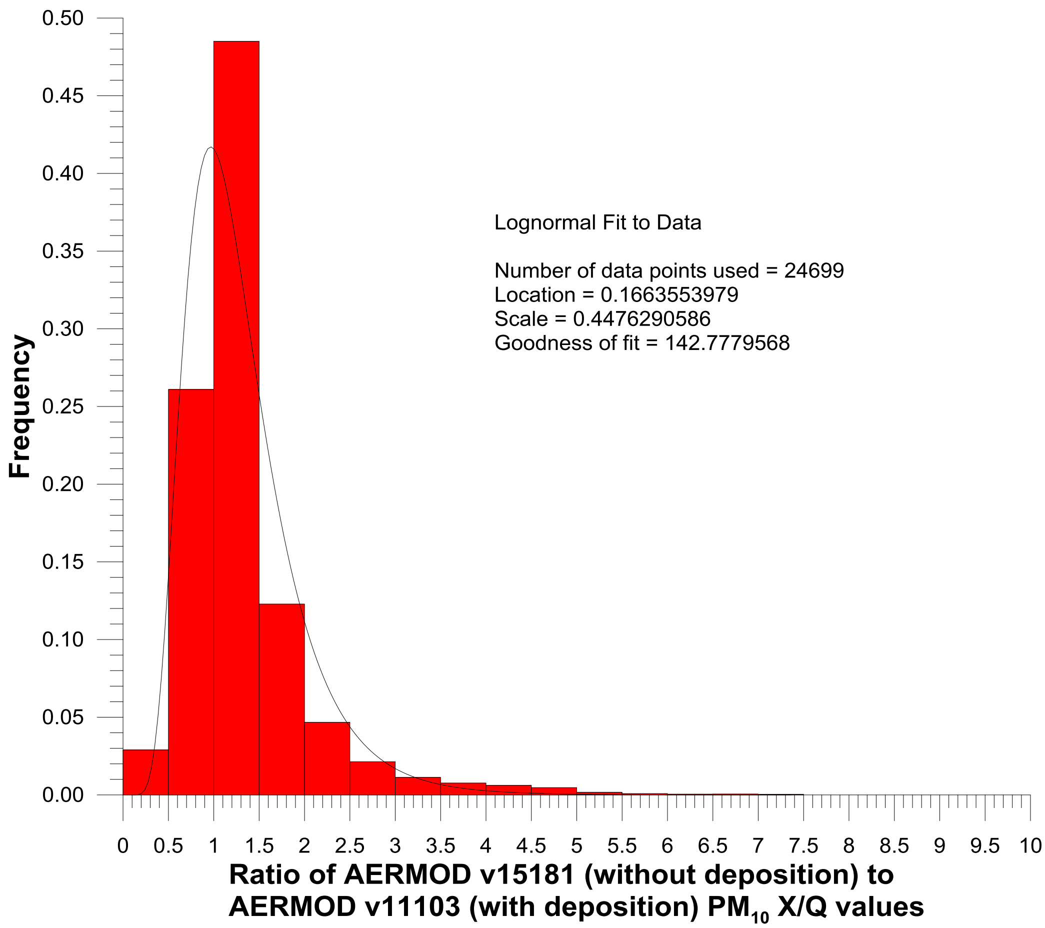

Figure 4. Distribution of the ratio of 24-hr χ/Q values for PM_{10} from AERMOD/AERMET v15181 without deposition to AERMOD/AERMET v11103/06341 with deposition.

For the Class I receptors, maximum 24-hour PM_{10} and $PM_{2.5}$ concentrations increase in v15181 without deposition relative to v11103/06341 with deposition. These receptors are farther way (~40-50 km) from INL sources than the Class II receptors, and deposition and plume depletion have a much larger effect on distant receptors compared to Class II receptors along the highway.

For the maximum annual average PM_{10} and $PM_{2.5}$ concentrations, AERMOD/AERMET v15181 without deposition produces slightly higher concentrations compared to AERMOD/AERMET v11103/06341 with deposition at both the Class I and Class II receptors, and the receptor with the maximum concentration remains the same between the different

AERMOD versions. This is what would be expected because deposition and depletion would generally result in lower air concentrations. Note that the receptor with the highest annual average concentration differs from the receptor with with the maximum 24-hour concentration. In general, annual average concentrations are more stable from year to year and are less sensitive to modeling assumptions (and thus changes made in code versions) compared to short-term averages.

All 24-hour and annual average PM_{10} and $PM_{2.5}$ concentrations were below NAAQS and PSD limits.

Table 4. Summary of PM_{10} and $PM_{2.5}$ 24-hour Average Maximum Concentration for Scenario 6 and AERMOD/AERMET v11103/06341 With Deposition and AERMOD/AERMET v15181 Without Deposition

Region	Pollutant	Receptor for AERMOD/AERMET v11103/06341	AERMOD/AERMET v11103/06341 24-hr concentration ($\mu g/m^3$)	Receptor for AERMOD/AERMET v15181	AERMOD/AERMET v15181 24-hr concentration ($\mu g/m^3$)
Class II (INL)	PM_{10}	176	2.00E+00	113	8.88E-01
Class II (INL)	$PM_{2.5}$	176	6.76E-01	180	4.70E-01
Class I (COM)	PM_{10}	20	1.69E-02	20	2.54E-02
Class I (COM)	$PM_{2.5}$	20	1.08E-02	20	1.69E-02

Table 5. Summary of PM_{10} and $PM_{2.5}$ Maximum Annual Average Concentration for Scenario 6 and AERMOD/AERMET v11103/06341 With Deposition and AERMOD/AERMET v15181 Without Deposition

Region	Pollutant	Receptor for AERMOD/AERMET v11103/06341	AERMOD/AERMET v11103/06341 annual concentration ($\mu g/m^3$)	Receptor for AERMOD/AERMET v15181	AERMOD/AERMET v15181 annual concentration ($\mu g/m^3$)
Class II (INL)	PM_{10}	97	3.60E-02	97	4.47E-02
Class II (INL)	$PM_{2.5}$	97	3.58E-02	97	4.44E-02
Class I (COM)	PM_{10}	20	4.94E-04	20	7.56E-04
Class I (COM)	$PM_{2.5}$	20	4.58E-04	20	7.10E-04

Table 6. χ/Q Values, Source Term (Q), and Scenario 6 24-hour PM_{10} Concentrations with Deposition in Class II Regions using AERMOD/AERMET v11106/06341

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m³)	Q (g/s)	Concentration (μg/m³)	Source ID
176	TRAEDG	24-HR	7.73E-07	1.02E-01	7.87E-02	ATR EDGs
176	TRABOIL	24-HR	1.53E-06	3.94E-02	6.03E-02	ATR Generators
176	TRAMISC	24-HR	2.07E-06	1.33E-03	2.76E-03	ATR Misc
176	CFABOIL	24-HR	3.05E-06	1.73E-03	5.26E-03	CFA Boiler
176	CFAEDG	24-HR	1.33E-06	3.53E-02	4.68E-02	CFA EDGs
176	CFAMISC	24-HR	7.16E-05	2.16E-02	1.55E+00	CFA Misc
176	CFAEDG	24-HR	1.33E-06	3.53E-02	4.68E-02	CITRIC EDGs
176	NRFBOIL	24-HR	4.91E-07	2.18E-03	1.07E-03	EPBoil
176	NRFEDG	24-HR	2.51E-07	1.72E-03	4.32E-04	EPEDG
176	INTECBOIL	24-HR	4.57E-07	2.70E-02	1.24E-02	INTEC Boiler
176	INTECEDG	24-HR	2.42E-07	1.17E-01	2.83E-02	INTEC EDGs
176	INTECMISC	24-HR	3.77E-06	4.03E-03	1.52E-02	INTEC Misc
176	ANLMISC	24-HR	2.15E-07	4.19E-02	9.01E-03	MFC EDGs
176	ANLMISC	24-HR	2.15E-07	3.00E-03	6.44E-04	MFC Misc
176	NRFBOIL	24-HR	4.91E-07	3.72E-02	1.83E-02	NRF Boiler
176	NRFEDG	24-HR	2.51E-07	6.90E-02	1.73E-02	NRF EDGs
176	NRFMISC	24-HR	8.66E-07	1.54E-02	1.33E-02	NRF Misc
176	RWMCBOIL	24-HR	4.17E-07	1.70E-02	7.08E-03	RWMC Boiler
176	RWMCMISC	24-HR	3.68E-06	1.21E-02	4.43E-02	RWMC Misc
176	NRFBOIL	24-HR	4.91E-07	2.97E-02	1.46E-02	SFHPBoil
176	NRFEDG	24-HR	2.51E-07	1.03E-01	2.59E-02	SFHPEDG
176	TANEDG	24-HR	1.21E-07	4.19E-02	5.07E-03	SMC EDGs
176	TANBOIL	24-HR	1.22E-07	5.70E-03	6.94E-04	TAN Boiler
176	TANMISC	24-HR	1.26E-07	0.00E+00	0.00E+00	TAN Misc
	TOTAL				2.00E+00	

Table 7. χ/Q Values, Source Term (Q), and Scenario 6 24-hour $PM_{2.5}$ Concentrations with Deposition in Class II Regions using AERMOD/AERMET v11106/06341

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m^3)	Q (g/s)	Concentration ($\mu g/m^3$)	Source ID
176	TRAEDG	24-HR	3.52E-07	9.99E-02	3.52E-02	ATR EDGs
176	TRABOIL	24-HR	9.54E-07	3.94E-02	3.76E-02	ATR Generators
176	TRAMISC	24-HR	6.69E-07	1.33E-03	8.92E-04	ATR Misc
176	CFABOIL	24-HR	2.42E-06	1.73E-03	4.17E-03	CFA Boiler
176	CFAEDG	24-HR	1.13E-06	3.53E-02	3.98E-02	CFA EDGs
176	CFAMISC	24-HR	1.83E-05	2.16E-02	3.95E-01	CFA Misc
176	CFAEDG	24-HR	1.13E-06	3.53E-02	3.98E-02	CITRIC EDGs
176	NRFBOIL	24-HR	3.69E-07	1.47E-03	5.43E-04	EPBoil
176	NRFEDG	24-HR	1.46E-07	1.67E-03	2.45E-04	EPEDG
176	INTECBOIL	24-HR	4.00E-07	2.70E-02	1.08E-02	INTEC Boiler
176	INTECEDG	24-HR	1.93E-07	1.13E-01	2.19E-02	INTEC EDGs
176	INTECMISC	24-HR	1.31E-06	4.03E-03	5.29E-03	INTEC Misc
176	ANLMISC	24-HR	1.33E-07	4.17E-02	5.54E-03	MFC EDGs
176	ANLMISC	24-HR	1.33E-07	3.00E-03	3.98E-04	MFC Misc
176	NRFBOIL	24-HR	3.69E-07	2.51E-02	9.25E-03	NRF Boiler
176	NRFEDG	24-HR	1.46E-07	6.69E-02	9.80E-03	NRF EDGs
176	NRFMISC	24-HR	3.61E-07	1.54E-02	5.56E-03	NRF Misc
176	RWMCBOIL	24-HR	3.25E-07	1.70E-02	5.51E-03	RWMC Boiler
176	RWMCMISC	24-HR	1.93E-06	1.21E-02	2.33E-02	RWMC Misc
176	NRFBOIL	24-HR	3.69E-07	2.00E-02	7.38E-03	SFHPBoil
176	NRFEDG	24-HR	1.46E-07	1.00E-01	1.47E-02	SFHPEDG
176	TANEDG	24-HR	6.00E-08	4.17E-02	2.50E-03	SMC EDGs
176	TANBOIL	24-HR	1.11E-07	5.70E-03	6.33E-04	TAN Boiler
176	TANMISC	24-HR	5.91E-08	0.00E+00	0.00E+00	TAN Misc
	TOTAL				6.76E-01	

Table 8. χ/Q Values, Source Term (Q), and Scenario 6 24-hour PM_{10} Concentrations with Deposition in Class I Regions using AERMOD/AERMET v11106/06341

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m³)	Q (g/s)	Concentration (μg/m³)	Source ID
20	TRAEDG	24-HR	1.94E-08	1.02E-01	1.97E-03	ATR EDGs
20	TRABOIL	24-HR	2.59E-08	3.94E-02	1.02E-03	ATR Generators
20	TRAMISC	24-HR	2.62E-08	1.33E-03	3.49E-05	ATR Misc
20	CFABOIL	24-HR	2.85E-08	1.73E-03	4.92E-05	CFA Boiler
20	CFAEDG	24-HR	2.41E-08	3.53E-02	8.51E-04	CFA EDGs
20	CFAMISC	24-HR	3.20E-08	2.16E-02	6.91E-04	CFA Misc
20	CFAEDG	24-HR	2.41E-08	3.53E-02	8.51E-04	CITRIC EDGs
20	NRFBOIL	24-HR	2.25E-08	2.18E-03	4.92E-05	EPBoil
20	NRFEDG	24-HR	1.43E-08	1.72E-03	2.47E-05	EPEDG
20	INTECBOIL	24-HR	2.38E-08	2.70E-02	6.43E-04	INTEC Boiler
20	INTECEDG	24-HR	2.18E-08	1.17E-01	2.55E-03	INTEC EDGs
20	INTECMISC	24-HR	5.40E-08	4.03E-03	2.18E-04	INTEC Misc
20	ANLMISC	24-HR	3.35E-08	4.19E-02	1.40E-03	MFC EDGs
20	ANLMISC	24-HR	3.35E-08	3.00E-03	1.00E-04	MFC Misc
20	NRFBOIL	24-HR	2.25E-08	3.72E-02	8.38E-04	NRF Boiler
20	NRFEDG	24-HR	1.43E-08	6.90E-02	9.86E-04	NRF EDGs
20	NRFMISC	24-HR	2.46E-08	1.54E-02	3.79E-04	NRF Misc
20	RWMCBOIL	24-HR	7.83E-08	1.70E-02	1.33E-03	RWMC Boiler
20	RWMCMISC	24-HR	6.43E-08	1.21E-02	7.76E-04	RWMC Misc
20	NRFBOIL	24-HR	2.25E-08	2.97E-02	6.68E-04	SFHPBoil
20	NRFEDG	24-HR	1.43E-08	1.03E-01	1.48E-03	SFHPEDG
20	TANEDG	24-HR	0.00E+00	4.19E-02	0.00E+00	SMC EDGs
20	TANBOIL	24-HR	0.00E+00	5.70E-03	0.00E+00	TAN Boiler
20	TANMISC	24-HR	0.00E+00	0.00E+00	0.00E+00	TAN Misc
	TOTAL				1.69E-02	

Table 9. χ/Q Values, Source Term (Q), and Scenario 6 24-hour $PM_{2.5}$ Concentrations with Deposition in Class I Regions using AERMOD/AERMET v11106/06341

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m^3)	Q (g/s)	Concentration ($\mu g/m^3$)	Source ID
20	TRAEDG	24-HR	1.39E-08	9.99E-02	1.39E-03	ATR EDGs
20	TRABOIL	24-HR	2.06E-08	3.94E-02	8.10E-04	ATR Generators
20	TRAMISC	24-HR	1.94E-08	1.33E-03	2.58E-05	ATR Misc
20	CFABOIL	24-HR	1.83E-08	1.73E-03	3.15E-05	CFA Boiler
20	CFAEDG	24-HR	1.51E-08	3.53E-02	5.32E-04	CFA EDGs
20	CFAMISC	24-HR	1.86E-08	2.16E-02	4.01E-04	CFA Misc
20	CFAEDG	24-HR	1.51E-08	3.53E-02	5.32E-04	CITRIC EDGs
20	NRFBOIL	24-HR	1.46E-08	1.47E-03	2.15E-05	EPBoil
20	NRFEDG	24-HR	1.08E-08	1.67E-03	1.80E-05	EPEDG
20	INTECBOIL	24-HR	1.92E-08	2.70E-02	5.19E-04	INTEC Boiler
20	INTECEDG	24-HR	1.37E-08	1.13E-01	1.55E-03	INTEC EDGs
20	INTECMISC	24-HR	2.60E-08	4.03E-03	1.05E-04	INTEC Misc
20	ANLMISC	24-HR	1.77E-08	4.17E-02	7.37E-04	MFC EDGs
20	ANLMISC	24-HR	1.77E-08	3.00E-03	5.30E-05	MFC Misc
20	NRFBOIL	24-HR	1.46E-08	2.51E-02	3.66E-04	NRF Boiler
20	NRFEDG	24-HR	1.08E-08	6.69E-02	7.21E-04	NRF EDGs
20	NRFMISC	24-HR	1.72E-08	1.54E-02	2.65E-04	NRF Misc
20	RWMCBOIL	24-HR	4.67E-08	1.70E-02	7.93E-04	RWMC Boiler
20	RWMCMISC	24-HR	4.37E-08	1.21E-02	5.27E-04	RWMC Misc
20	NRFBOIL	24-HR	1.46E-08	2.00E-02	2.92E-04	SFHPBoil
20	NRFEDG	24-HR	1.08E-08	1.00E-01	1.08E-03	SFHPEDG
20	TANEDG	24-HR	0.00E+00	4.17E-02	0.00E+00	SMC EDGs
20	TANBOIL	24-HR	0.00E+00	5.70E-03	0.00E+00	TAN Boiler
20	TANMISC	24-HR	0.00E+00	0.00E+00	0.00E+00	TAN Misc
	TOTAL				1.08E-02	

Table 10. χ/Q Values, Source Term (Q), and Scenario 6 Annual PM_{10} Concentrations with Deposition in Class II Regions using AERMOD/AERMET v11106/06341

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m³)	Q (g/s)	Concentration (μg/m³)	Source ID
97	TRAEDG	ANNUAL	1.12E-09	1.02E-01	1.14E-04	ATR EDGs
97	TRABOIL	ANNUAL	1.05E-08	3.94E-02	4.11E-04	ATR Generators
97	TRAMISC	ANNUAL	1.10E-09	1.33E-03	1.47E-06	ATR Misc
97	CFABOIL	ANNUAL	1.23E-08	1.73E-03	2.12E-05	CFA Boiler
97	CFAEDG	ANNUAL	9.40E-10	3.53E-02	3.32E-05	CFA EDGs
97	CFAMISC	ANNUAL	8.50E-10	2.16E-02	1.83E-05	CFA Misc
97	CFAEDG	ANNUAL	9.40E-10	3.53E-02	3.32E-05	CITRIC EDGs
97	NRFBOIL	ANNUAL	8.37E-09	2.18E-03	1.83E-05	EPBoil
97	NRFEDG	ANNUAL	1.49E-09	1.72E-03	2.57E-06	EPEDG
97	INTECBOIL	ANNUAL	6.34E-09	2.70E-02	1.71E-04	INTEC Boiler
97	INTECEDG	ANNUAL	8.50E-10	1.17E-01	9.92E-05	INTEC EDGs
97	INTECMISC	ANNUAL	1.04E-09	4.03E-03	4.19E-06	INTEC Misc
97	ANLMISC	ANNUAL	8.90E-10	4.19E-02	3.73E-05	MFC EDGs
97	ANLMISC	ANNUAL	8.90E-10	3.00E-03	2.67E-06	MFC Misc
97	NRFBOIL	ANNUAL	8.37E-09	3.72E-02	3.12E-04	NRF Boiler
97	NRFEDG	ANNUAL	1.49E-09	6.90E-02	1.03E-04	NRF EDGs
97	NRFMISC	ANNUAL	1.80E-09	1.54E-02	2.77E-05	NRF Misc
97	RWMCBOIL	ANNUAL	6.51E-09	1.70E-02	1.10E-04	RWMC Boiler
97	RWMCMISC	ANNUAL	7.10E-10	1.21E-02	8.57E-06	RWMC Misc
97	NRFBOIL	ANNUAL	8.37E-09	2.97E-02	2.48E-04	SFHPBoil
97	NRFEDG	ANNUAL	1.49E-09	1.03E-01	1.54E-04	SFHPEDG
97	TANEDG	ANNUAL	6.31E-09	4.19E-02	2.64E-04	SMC EDGs
97	TANBOIL	ANNUAL	5.94E-06	5.70E-03	3.39E-02	TAN Boiler
97	TANMISC	ANNUAL	2.87E-06	0.00E+00	0.00E+00	TAN Misc
	TOTAL				3.60E-02	

Table 11. χ/Q Values, Source Term (Q), and Scenario 6 Annual $PM_{2.5}$ Concentrations with Deposition in Class II Regions using AERMOD/AERMET v11106/06341

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m^3)	Q (g/s)	Concentration (μg/m^3)	Source ID
97	TRAEDG	ANNUAL	1.12E-09	9.99E-02	1.12E-04	ATR EDGs
97	TRABOIL	ANNUAL	1.05E-08	3.94E-02	4.11E-04	ATR Generators
97	TRAMISC	ANNUAL	1.10E-09	1.33E-03	1.47E-06	ATR Misc
97	CFABOIL	ANNUAL	1.23E-08	1.73E-03	2.12E-05	CFA Boiler
97	CFAEDG	ANNUAL	9.40E-10	3.53E-02	3.32E-05	CFA EDGs
97	CFAMISC	ANNUAL	8.50E-10	2.16E-02	1.83E-05	CFA Misc
97	CFAEDG	ANNUAL	9.40E-10	3.53E-02	3.32E-05	CITRIC EDGs
97	NRFBOIL	ANNUAL	8.37E-09	1.47E-03	1.23E-05	EPBoil
97	NRFEDG	ANNUAL	1.49E-09	1.67E-03	2.49E-06	EPEDG
97	INTECBOIL	ANNUAL	6.34E-09	2.70E-02	1.71E-04	INTEC Boiler
97	INTECEDG	ANNUAL	8.50E-10	1.13E-01	9.63E-05	INTEC EDGs
97	INTECMISC	ANNUAL	1.04E-09	4.03E-03	4.19E-06	INTEC Misc
97	ANLMISC	ANNUAL	8.90E-10	4.17E-02	3.71E-05	MFC EDGs
97	ANLMISC	ANNUAL	8.90E-10	3.00E-03	2.67E-06	MFC Misc
97	NRFBOIL	ANNUAL	8.37E-09	2.51E-02	2.10E-04	NRF Boiler
97	NRFEDG	ANNUAL	1.49E-09	6.69E-02	9.97E-05	NRF EDGs
97	NRFMISC	ANNUAL	1.80E-09	1.54E-02	2.77E-05	NRF Misc
97	RWMCBOIL	ANNUAL	6.51E-09	1.70E-02	1.10E-04	RWMC Boiler
97	RWMCMISC	ANNUAL	7.10E-10	1.21E-02	8.57E-06	RWMC Misc
97	NRFBOIL	ANNUAL	8.37E-09	2.00E-02	1.67E-04	SFHPBoil
97	NRFEDG	ANNUAL	1.49E-09	1.00E-01	1.50E-04	SFHPEDG
97	TANEDG	ANNUAL	6.31E-09	4.17E-02	2.63E-04	SMC EDGs
97	TANBOIL	ANNUAL	5.94E-06	5.70E-03	3.39E-02	TAN Boiler
97	TANMISC	ANNUAL	2.87E-06	0.00E+00	0.00E+00	TAN Misc
	TOTAL				3.58E-02	

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Table 12. χ/Q Values, Source Term (Q), and Scenario 6 Annual PM_{10} Concentrations with Deposition in Class I Regions using AERMOD/AERMET v11106/06341

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m³)	Q (g/s)	Concentration (μg/m³)	Source ID
20	TRAEDG	ANNUAL	5.50E-10	1.02E-01	5.60E-05	ATR EDGs
20	TRABOIL	ANNUAL	1.43E-09	3.94E-02	5.63E-05	ATR Generators
20	TRAMISC	ANNUAL	5.00E-10	1.33E-03	6.67E-07	ATR Misc
20	CFABOIL	ANNUAL	1.00E-09	1.73E-03	1.73E-06	CFA Boiler
20	CFAEDG	ANNUAL	3.90E-10	3.53E-02	1.38E-05	CFA EDGs
20	CFAMISC	ANNUAL	3.30E-10	2.16E-02	7.12E-06	CFA Misc
20	CFAEDG	ANNUAL	3.90E-10	3.53E-02	1.38E-05	CITRIC EDGs
20	NRFBOIL	ANNUAL	1.34E-09	2.18E-03	2.93E-06	EPBoil
20	NRFEDG	ANNUAL	5.60E-10	1.72E-03	9.65E-07	EPEDG
20	INTECBOIL	ANNUAL	1.24E-09	2.70E-02	3.35E-05	INTEC Boiler
20	INTECEDG	ANNUAL	4.70E-10	1.17E-01	5.49E-05	INTEC EDGs
20	INTECMISC	ANNUAL	4.40E-10	4.03E-03	1.77E-06	INTEC Misc
20	ANLMISC	ANNUAL	2.20E-10	4.19E-02	9.21E-06	MFC EDGs
20	ANLMISC	ANNUAL	2.20E-10	3.00E-03	6.59E-07	MFC Misc
20	NRFBOIL	ANNUAL	1.34E-09	3.72E-02	4.99E-05	NRF Boiler
20	NRFEDG	ANNUAL	5.60E-10	6.90E-02	3.86E-05	NRF EDGs
20	NRFMISC	ANNUAL	5.20E-10	1.54E-02	8.00E-06	NRF Misc
20	RWMCBOIL	ANNUAL	2.21E-09	1.70E-02	3.75E-05	RWMC Boiler
20	RWMCMISC	ANNUAL	7.60E-10	1.21E-02	9.17E-06	RWMC Misc
20	NRFBOIL	ANNUAL	1.34E-09	2.97E-02	3.98E-05	SFHPBoil
20	NRFEDG	ANNUAL	5.60E-10	1.03E-01	5.79E-05	SFHPEDG
20	TANEDG	ANNUAL	0.00E+00	4.19E-02	0.00E+00	SMC EDGs
20	TANBOIL	ANNUAL	0.00E+00	5.70E-03	0.00E+00	TAN Boiler
20	TANMISC	ANNUAL	0.00E+00	0.00E+00	0.00E+00	TAN Misc
	TOTAL				4.94E-04	

Table 13. χ/Q Values, Source Term (Q), and Scenario 6 Annual $PM_{2.5}$ Concentrations with Deposition in Class I Regions using AERMOD/AERMET v11106/06341

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m^3)	Q (g/s)	Concentration (μg/m^3)	Source ID
20	TRAEDG	ANNUAL	5.50E-10	9.99E-02	5.50E-05	ATR EDGs
20	TRABOIL	ANNUAL	1.43E-09	3.94E-02	5.63E-05	ATR Generators
20	TRAMISC	ANNUAL	5.00E-10	1.33E-03	6.67E-07	ATR Misc
20	CFABOIL	ANNUAL	1.00E-09	1.73E-03	1.73E-06	CFA Boiler
20	CFAEDG	ANNUAL	3.90E-10	3.53E-02	1.38E-05	CFA EDGs
20	CFAMISC	ANNUAL	3.30E-10	2.16E-02	7.12E-06	CFA Misc
20	CFAEDG	ANNUAL	3.90E-10	3.53E-02	1.38E-05	CITRIC EDGs
20	NRFBOIL	ANNUAL	1.34E-09	1.47E-03	1.97E-06	EPBoil
20	NRFEDG	ANNUAL	5.60E-10	1.67E-03	9.37E-07	EPEDG
20	INTECBOIL	ANNUAL	1.24E-09	2.70E-02	3.35E-05	INTEC Boiler
20	INTECEDG	ANNUAL	4.70E-10	1.13E-01	5.32E-05	INTEC EDGs
20	INTECMISC	ANNUAL	4.40E-10	4.03E-03	1.77E-06	INTEC Misc
20	ANLMISC	ANNUAL	2.20E-10	4.17E-02	9.17E-06	MFC EDGs
20	ANLMISC	ANNUAL	2.20E-10	3.00E-03	6.59E-07	MFC Misc
20	NRFBOIL	ANNUAL	1.34E-09	2.51E-02	3.36E-05	NRF Boiler
20	NRFEDG	ANNUAL	5.60E-10	6.69E-02	3.75E-05	NRF EDGs
20	NRFMISC	ANNUAL	5.20E-10	1.54E-02	8.00E-06	NRF Misc
20	RWMCBOIL	ANNUAL	2.21E-09	1.70E-02	3.75E-05	RWMC Boiler
20	RWMCMISC	ANNUAL	7.60E-10	1.21E-02	9.17E-06	RWMC Misc
20	NRFBOIL	ANNUAL	1.34E-09	2.00E-02	2.68E-05	SFHPBoil
20	NRFEDG	ANNUAL	5.60E-10	1.00E-01	5.62E-05	SFHPEDG
20	TANEDG	ANNUAL	0.00E+00	4.17E-02	0.00E+00	SMC EDGs
20	TANBOIL	ANNUAL	0.00E+00	5.70E-03	0.00E+00	TAN Boiler
20	TANMISC	ANNUAL	0.00E+00	0.00E+00	0.00E+00	TAN Misc
	TOTAL				4.58E-04	

Table 14. χ/Q Values, Source Term (Q), and Scenario 6 24-hour PM_{10} Concentrations without Deposition in Class II Regions using AERMOD/AERMET v15181

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m³)	Q (g/s)	Concentration (μg/m³)	Source ID
113	TRAEDG	24-HR	5.15E-08	1.02E-01	5.25E-03	ATR EDGs
113	TRABOIL	24-HR	1.29E-07	3.94E-02	5.06E-03	ATR Generators
113	TRAMISC	24-HR	7.99E-08	1.33E-03	1.07E-04	ATR Misc
113	CFABOIL	24-HR	1.36E-07	1.73E-03	2.34E-04	CFA Boiler
113	CFAEDG	24-HR	1.05E-07	3.53E-02	3.72E-03	CFA EDGs
113	CFAMISC	24-HR	3.05E-07	2.16E-02	6.59E-03	CFA Misc
113	CFAEDG	24-HR	1.05E-07	3.53E-02	3.72E-03	CITRIC EDGs
113	NRFBOIL	24-HR	1.72E-07	2.18E-03	3.76E-04	EPBoil
113	NRFEDG	24-HR	4.28E-08	1.72E-03	7.38E-05	EPEDG
113	INTECBOIL	24-HR	1.90E-07	2.70E-02	5.13E-03	INTEC Boiler
113	INTECEDG	24-HR	3.12E-08	1.17E-01	3.64E-03	INTEC EDGs
113	INTECMISC	24-HR	1.59E-07	4.03E-03	6.41E-04	INTEC Misc
113	ANLMISC	24-HR	1.83E-05	4.19E-02	7.64E-01	MFC EDGs
113	ANLMISC	24-HR	1.83E-05	3.00E-03	5.47E-02	MFC Misc
113	NRFBOIL	24-HR	1.72E-07	3.72E-02	6.41E-03	NRF Boiler
113	NRFEDG	24-HR	4.28E-08	6.90E-02	2.95E-03	NRF EDGs
113	NRFMISC	24-HR	9.45E-08	1.54E-02	1.45E-03	NRF Misc
113	RWMCBOIL	24-HR	3.60E-07	1.70E-02	6.11E-03	RWMC Boiler
113	RWMCMISC	24-HR	3.87E-07	1.21E-02	4.67E-03	RWMC Misc
113	NRFBOIL	24-HR	1.72E-07	2.97E-02	5.11E-03	SFHPBoil
113	NRFEDG	24-HR	4.28E-08	1.03E-01	4.43E-03	SFHPEDG
113	TANEDG	24-HR	6.59E-08	4.19E-02	2.76E-03	SMC EDGs
113	TANBOIL	24-HR	7.41E-08	5.70E-03	4.23E-04	TAN Boiler
113	TANMISC	24-HR	1.34E-07	0.00E+00	0.00E+00	TAN Misc
	TOTAL				8.88E-01	

Table 15. χ/Q Values, Source Term (Q), and Scenario 6 24-hour $PM_{2.5}$ Concentrations without Deposition in Class II Regions using AERMOD/AERMET v15181

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m^3)	Q (g/s)	Concentration (µg/m^3)	Source ID
180	TRAEDG	24-HR	2.24E-07	9.99E-02	2.24E-02	ATR EDGs
180	TRABOIL	24-HR	3.99E-07	3.94E-02	1.57E-02	ATR Generators
180	TRAMISC	24-HR	4.58E-07	1.33E-03	6.11E-04	ATR Misc
180	CFABOIL	24-HR	3.99E-06	1.73E-03	6.89E-03	CFA Boiler
180	CFAEDG	24-HR	1.86E-06	3.53E-02	6.57E-02	CFA EDGs
180	CFAMISC	24-HR	8.31E-06	2.16E-02	1.79E-01	CFA Misc
180	CFAEDG	24-HR	1.86E-06	3.53E-02	6.57E-02	CITRIC EDGs
180	NRFBOIL	24-HR	3.66E-07	1.47E-03	5.39E-04	EPBoil
180	NRFEDG	24-HR	1.77E-07	1.67E-03	2.96E-04	EPEDG
180	INTECBOIL	24-HR	3.21E-07	2.70E-02	8.68E-03	INTEC Boiler
180	INTECEDG	24-HR	1.84E-07	1.13E-01	2.08E-02	INTEC EDGs
180	INTECMISC	24-HR	1.08E-06	4.03E-03	4.36E-03	INTEC Misc
180	ANLMISC	24-HR	1.15E-07	4.17E-02	4.79E-03	MFC EDGs
180	ANLMISC	24-HR	1.15E-07	3.00E-03	3.44E-04	MFC Misc
180	NRFBOIL	24-HR	3.66E-07	2.51E-02	9.19E-03	NRF Boiler
180	NRFEDG	24-HR	1.77E-07	6.69E-02	1.18E-02	NRF EDGs
180	NRFMISC	24-HR	4.14E-07	1.54E-02	6.38E-03	NRF Misc
180	RWMCBOIL	24-HR	2.89E-07	1.70E-02	4.90E-03	RWMC Boiler
180	RWMCMISC	24-HR	9.83E-07	1.21E-02	1.19E-02	RWMC Misc
180	NRFBOIL	24-HR	3.66E-07	2.00E-02	7.33E-03	SFHPBoil
180	NRFEDG	24-HR	1.77E-07	1.00E-01	1.77E-02	SFHPEDG
180	TANEDG	24-HR	9.48E-08	4.17E-02	3.95E-03	SMC EDGs
180	TANBOIL	24-HR	1.66E-07	5.70E-03	9.49E-04	TAN Boiler
180	TANMISC	24-HR	1.74E-07	0.00E+00	0.00E+00	TAN Misc
	TOTAL				4.70E-01	

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Table 16. χ/Q Values, Source Term (Q), and Scenario 6 Annual Average PM_{10} Concentrations without Deposition in Class II Regions using AERMOD/AERMET v15181

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m^3)	Q (g/s)	Concentration (μg/m^3)	Source ID
97	TRAEDG	ANNUAL	1.62E-09	1.02E-01	1.65E-04	ATR EDGs
97	TRABOIL	ANNUAL	1.27E-08	3.94E-02	4.98E-04	ATR Generators
97	TRAMISC	ANNUAL	1.92E-09	1.33E-03	2.56E-06	ATR Misc
97	CFABOIL	ANNUAL	1.44E-08	1.73E-03	2.49E-05	CFA Boiler
97	CFAEDG	ANNUAL	1.33E-09	3.53E-02	4.70E-05	CFA EDGs
97	CFAMISC	ANNUAL	1.46E-09	2.16E-02	3.15E-05	CFA Misc
97	CFAEDG	ANNUAL	1.33E-09	3.53E-02	4.70E-05	CITRIC EDGs
97	NRFBOIL	ANNUAL	9.69E-09	2.18E-03	2.12E-05	EPBoil
97	NRFEDG	ANNUAL	2.03E-09	1.72E-03	3.50E-06	EPEDG
97	INTECBOIL	ANNUAL	7.78E-09	2.70E-02	2.10E-04	INTEC Boiler
97	INTECEDG	ANNUAL	1.17E-09	1.17E-01	1.37E-04	INTEC EDGs
97	INTECMISC	ANNUAL	1.80E-09	4.03E-03	7.26E-06	INTEC Misc
97	ANLMISC	ANNUAL	1.44E-09	4.19E-02	6.03E-05	MFC EDGs
97	ANLMISC	ANNUAL	1.44E-09	3.00E-03	4.31E-06	MFC Misc
97	NRFBOIL	ANNUAL	9.69E-09	3.72E-02	3.61E-04	NRF Boiler
97	NRFEDG	ANNUAL	2.03E-09	6.90E-02	1.40E-04	NRF EDGs
97	NRFMISC	ANNUAL	2.97E-09	1.54E-02	4.57E-05	NRF Misc
97	RWMCBOIL	ANNUAL	8.09E-09	1.70E-02	1.37E-04	RWMC Boiler
97	RWMCMISC	ANNUAL	1.52E-09	1.21E-02	1.83E-05	RWMC Misc
97	NRFBOIL	ANNUAL	9.69E-09	2.97E-02	2.88E-04	SFHPBoil
97	NRFEDG	ANNUAL	2.03E-09	1.03E-01	2.10E-04	SFHPEDG
97	TANEDG	ANNUAL	5.71E-09	4.19E-02	2.39E-04	SMC EDGs
97	TANBOIL	ANNUAL	7.36E-06	5.70E-03	4.20E-02	TAN Boiler
97	TANMISC	ANNUAL	3.14E-06	0.00E+00	0.00E+00	TAN Misc
	TOTAL				4.47E-02	

Table 17. χ/Q Values, Source Term (Q), and Scenario 6 Annual Average $PM_{2.5}$ Concentrations without Deposition in Class II Regions using AERMOD/AERMET v15181

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m³)	Q (g/s)	Concentration (μg/m³)	Source ID
97	TRAEDG	ANNUAL	1.62E-09	9.99E-02	1.62E-04	ATR EDGs
97	TRABOIL	ANNUAL	1.27E-08	3.94E-02	4.98E-04	ATR Generators
97	TRAMISC	ANNUAL	1.92E-09	1.33E-03	2.56E-06	ATR Misc
97	CFABOIL	ANNUAL	1.44E-08	1.73E-03	2.49E-05	CFA Boiler
97	CFAEDG	ANNUAL	1.33E-09	3.53E-02	4.70E-05	CFA EDGs
97	CFAMISC	ANNUAL	1.46E-09	2.16E-02	3.15E-05	CFA Misc
97	CFAEDG	ANNUAL	1.33E-09	3.53E-02	4.70E-05	CITRIC EDGs
97	NRFBOIL	ANNUAL	9.69E-09	1.47E-03	1.43E-05	EPBoil
97	NRFEDG	ANNUAL	2.03E-09	1.67E-03	3.40E-06	EPEDG
97	INTECBOIL	ANNUAL	7.78E-09	2.70E-02	2.10E-04	INTEC Boiler
97	INTECEDG	ANNUAL	1.17E-09	1.13E-01	1.33E-04	INTEC EDGs
97	INTECMISC	ANNUAL	1.80E-09	4.03E-03	7.26E-06	INTEC Misc
97	ANLMISC	ANNUAL	1.44E-09	4.17E-02	6.00E-05	MFC EDGs
97	ANLMISC	ANNUAL	1.44E-09	3.00E-03	4.31E-06	MFC Misc
97	NRFBOIL	ANNUAL	9.69E-09	2.51E-02	2.43E-04	NRF Boiler
97	NRFEDG	ANNUAL	2.03E-09	6.69E-02	1.36E-04	NRF EDGs
97	NRFMISC	ANNUAL	2.97E-09	1.54E-02	4.57E-05	NRF Misc
97	RWMCBOIL	ANNUAL	8.09E-09	1.70E-02	1.37E-04	RWMC Boiler
97	RWMCMISC	ANNUAL	1.52E-09	1.21E-02	1.83E-05	RWMC Misc
97	NRFBOIL	ANNUAL	9.69E-09	2.00E-02	1.94E-04	SFHPBoil
97	NRFEDG	ANNUAL	2.03E-09	1.00E-01	2.04E-04	SFHPEDG
97	TANEDG	ANNUAL	5.71E-09	4.17E-02	2.38E-04	SMC EDGs
97	TANBOIL	ANNUAL	7.36E-06	5.70E-03	4.20E-02	TAN Boiler
97	TANMISC	ANNUAL	3.14E-06	0.00E+00	0.00E+00	TAN Misc
	TOTAL				4.44E-02	

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Table 18. χ/Q Values, Source Term (Q), and Scenario 6 24-hour PM_{10} Concentrations without Deposition in Class I Regions using AERMOD/AERMET v15181

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m^3)	Q (g/s)	Concentration ($\mu g/m^3$)	Source ID
20	TRAEDG	24-HR	3.45E-08	1.02E-01	3.52E-03	ATR EDGs
20	TRABOIL	24-HR	3.08E-08	3.94E-02	1.21E-03	ATR Generators
20	TRAMISC	24-HR	5.99E-08	1.33E-03	7.98E-05	ATR Misc
20	CFABOIL	24-HR	3.30E-08	1.73E-03	5.69E-05	CFA Boiler
20	CFAEDG	24-HR	3.65E-08	3.53E-02	1.29E-03	CFA EDGs
20	CFAMISC	24-HR	4.78E-08	2.16E-02	1.03E-03	CFA Misc
20	CFAEDG	24-HR	3.65E-08	3.53E-02	1.29E-03	CITRIC EDGs
20	NRFBOIL	24-HR	2.27E-08	2.18E-03	4.96E-05	EPBoil
20	NRFEDG	24-HR	2.09E-08	1.72E-03	3.60E-05	EPEDG
20	INTECBOIL	24-HR	2.74E-08	2.70E-02	7.40E-04	INTEC Boiler
20	INTECEDG	24-HR	2.79E-08	1.17E-01	3.25E-03	INTEC EDGs
20	INTECMISC	24-HR	6.93E-08	4.03E-03	2.80E-04	INTEC Misc
20	ANLMISC	24-HR	1.10E-07	4.19E-02	4.62E-03	MFC EDGs
20	ANLMISC	24-HR	1.10E-07	3.00E-03	3.30E-04	MFC Misc
20	NRFBOIL	24-HR	2.27E-08	3.72E-02	8.46E-04	NRF Boiler
20	NRFEDG	24-HR	2.09E-08	6.90E-02	1.44E-03	NRF EDGs
20	NRFMISC	24-HR	5.12E-08	1.54E-02	7.88E-04	NRF Misc
20	RWMCBOIL	24-HR	5.03E-08	1.70E-02	8.52E-04	RWMC Boiler
20	RWMCMISC	24-HR	7.00E-08	1.21E-02	8.44E-04	RWMC Misc
20	NRFBOIL	24-HR	2.27E-08	2.97E-02	6.75E-04	SFHPBoil
20	NRFEDG	24-HR	2.09E-08	1.03E-01	2.16E-03	SFHPEDG
20	TANEDG	24-HR	0.00E+00	4.19E-02	0.00E+00	SMC EDGs
20	TANBOIL	24-HR	0.00E+00	5.70E-03	0.00E+00	TAN Boiler
20	TANMISC	24-HR	0.00E+00	0.00E+00	0.00E+00	TAN Misc
	TOTAL				2.54E-02	

Table 19. χ/Q Values, Source Term (Q), and Scenario 6 24-hour $PM_{2.5}$ Concentrations without Deposition in Class I Regions using AERMOD/AERMET v15181

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m^3)	Q (g/s)	Concentration (μg/m^3)	Source ID
20	TRAEDG	24-HR	2.54E-08	9.99E-02	2.54E-03	ATR EDGs
20	TRABOIL	24-HR	2.58E-08	3.94E-02	1.02E-03	ATR Generators
20	TRAMISC	24-HR	3.66E-08	1.33E-03	4.88E-05	ATR Misc
20	CFABOIL	24-HR	2.67E-08	1.73E-03	4.60E-05	CFA Boiler
20	CFAEDG	24-HR	2.64E-08	3.53E-02	9.32E-04	CFA EDGs
20	CFAMISC	24-HR	3.44E-08	2.16E-02	7.43E-04	CFA Misc
20	CFAEDG	24-HR	2.64E-08	3.53E-02	9.32E-04	CITRIC EDGs
20	NRFBOIL	24-HR	1.81E-08	1.47E-03	2.66E-05	EPBoil
20	NRFEDG	24-HR	1.66E-08	1.67E-03	2.78E-05	EPEDG
20	INTECBOIL	24-HR	2.21E-08	2.70E-02	5.98E-04	INTEC Boiler
20	INTECEDG	24-HR	1.94E-08	1.13E-01	2.19E-03	INTEC EDGs
20	INTECMISC	24-HR	4.07E-08	4.03E-03	1.64E-04	INTEC Misc
20	ANLMISC	24-HR	4.76E-08	4.17E-02	1.98E-03	MFC EDGs
20	ANLMISC	24-HR	4.76E-08	3.00E-03	1.43E-04	MFC Misc
20	NRFBOIL	24-HR	1.81E-08	2.51E-02	4.54E-04	NRF Boiler
20	NRFEDG	24-HR	1.66E-08	6.69E-02	1.11E-03	NRF EDGs
20	NRFMISC	24-HR	3.06E-08	1.54E-02	4.71E-04	NRF Misc
20	RWMCBOIL	24-HR	4.15E-08	1.70E-02	7.03E-04	RWMC Boiler
20	RWMCMISC	24-HR	5.98E-08	1.21E-02	7.21E-04	RWMC Misc
20	NRFBOIL	24-HR	1.81E-08	2.00E-02	3.62E-04	SFHPBoil
20	NRFEDG	24-HR	1.66E-08	1.00E-01	1.67E-03	SFHPEDG
20	TANEDG	24-HR	0.00E+00	4.17E-02	0.00E+00	SMC EDGs
20	TANBOIL	24-HR	0.00E+00	5.70E-03	0.00E+00	TAN Boiler
20	TANMISC	24-HR	0.00E+00	0.00E+00	0.00E+00	TAN Misc
	TOTAL				1.69E-02	

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Table 20. χ/Q Values, Source Term (Q), and Scenario 6 Annual Average PM_{10} Concentrations without Deposition in Class I Regions using AERMOD/AERMET v15181

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m^3)	Q (g/s)	Concentration ($\mu g/m^3$)	Source ID
20	TRAEDG	ANNUAL	9.40E-10	1.02E-01	9.58E-05	ATR EDGs
20	TRABOIL	ANNUAL	1.82E-09	3.94E-02	7.16E-05	ATR Generators
20	TRAMISC	ANNUAL	9.30E-10	1.33E-03	1.24E-06	ATR Misc
20	CFABOIL	ANNUAL	1.47E-09	1.73E-03	2.53E-06	CFA Boiler
20	CFAEDG	ANNUAL	7.35E-10	3.53E-02	2.60E-05	CFA EDGs
20	CFAMISC	ANNUAL	7.42E-10	2.16E-02	1.60E-05	CFA Misc
20	CFAEDG	ANNUAL	7.35E-10	3.53E-02	2.60E-05	CITRIC EDGs
20	NRFBOIL	ANNUAL	1.65E-09	2.18E-03	3.61E-06	EPBoil
20	NRFEDG	ANNUAL	9.10E-10	1.72E-03	1.57E-06	EPEDG
20	INTECBOIL	ANNUAL	1.56E-09	2.70E-02	4.22E-05	INTEC Boiler
20	INTECEDG	ANNUAL	7.50E-10	1.17E-01	8.76E-05	INTEC EDGs
20	INTECMISC	ANNUAL	8.40E-10	4.03E-03	3.39E-06	INTEC Misc
20	ANLMISC	ANNUAL	6.23E-10	4.19E-02	2.61E-05	MFC EDGs
20	ANLMISC	ANNUAL	6.23E-10	3.00E-03	1.87E-06	MFC Misc
20	NRFBOIL	ANNUAL	1.65E-09	3.72E-02	6.15E-05	NRF Boiler
20	NRFEDG	ANNUAL	9.10E-10	6.90E-02	6.27E-05	NRF EDGs
20	NRFMISC	ANNUAL	8.91E-10	1.54E-02	1.37E-05	NRF Misc
20	RWMCBOIL	ANNUAL	3.10E-09	1.70E-02	5.26E-05	RWMC Boiler
20	RWMCMISC	ANNUAL	1.41E-09	1.21E-02	1.70E-05	RWMC Misc
20	NRFBOIL	ANNUAL	1.65E-09	2.97E-02	4.91E-05	SFHPBoil
20	NRFEDG	ANNUAL	9.10E-10	1.03E-01	9.41E-05	SFHPEDG
20	TANEDG	ANNUAL	0.00E+00	4.19E-02	0.00E+00	SMC EDGs
20	TANBOIL	ANNUAL	0.00E+00	5.70E-03	0.00E+00	TAN Boiler
20	TANMISC	ANNUAL	0.00E+00	0.00E+00	0.00E+00	TAN Misc
	TOTAL				7.56E-04	

Table 21. χ/Q Values, Source Term (Q), and Scenario 6 Annual Average $PM_{2.5}$ Concentrations without Deposition in Class I Regions using AERMOD/AERMET v15181

Rec ID	χ/Q ID	Averaging Time	χ/Q (s/m³)	Q (g/s)	Concentration (μg/m³)	Source ID
20	TRAEDG	ANNUAL	9.40E-10	9.99E-02	9.39E-05	ATR EDGs
20	TRABOIL	ANNUAL	1.82E-09	3.94E-02	7.16E-05	ATR Generators
20	TRAMISC	ANNUAL	9.30E-10	1.33E-03	1.24E-06	ATR Misc
20	CFABOIL	ANNUAL	1.47E-09	1.73E-03	2.53E-06	CFA Boiler
20	CFAEDG	ANNUAL	7.35E-10	3.53E-02	2.60E-05	CFA EDGs
20	CFAMISC	ANNUAL	7.42E-10	2.16E-02	1.60E-05	CFA Misc
20	CFAEDG	ANNUAL	7.35E-10	3.53E-02	2.60E-05	CITRIC EDGs
20	NRFBOIL	ANNUAL	1.65E-09	1.47E-03	2.43E-06	EPBoil
20	NRFEDG	ANNUAL	9.10E-10	1.67E-03	1.52E-06	EPEDG
20	INTECBOIL	ANNUAL	1.56E-09	2.70E-02	4.22E-05	INTEC Boiler
20	INTECEDG	ANNUAL	7.50E-10	1.13E-01	8.50E-05	INTEC EDGs
20	INTECMISC	ANNUAL	8.40E-10	4.03E-03	3.39E-06	INTEC Misc
20	ANLMISC	ANNUAL	6.23E-10	4.17E-02	2.60E-05	MFC EDGs
20	ANLMISC	ANNUAL	6.23E-10	3.00E-03	1.87E-06	MFC Misc
20	NRFBOIL	ANNUAL	1.65E-09	2.51E-02	4.15E-05	NRF Boiler
20	NRFEDG	ANNUAL	9.10E-10	6.69E-02	6.09E-05	NRF EDGs
20	NRFMISC	ANNUAL	8.91E-10	1.54E-02	1.37E-05	NRF Misc
20	RWMCBOIL	ANNUAL	3.10E-09	1.70E-02	5.26E-05	RWMC Boiler
20	RWMCMISC	ANNUAL	1.41E-09	1.21E-02	1.70E-05	RWMC Misc
20	NRFBOIL	ANNUAL	1.65E-09	2.00E-02	3.31E-05	SFHPBoil
20	NRFEDG	ANNUAL	9.10E-10	1.00E-01	9.13E-05	SFHPEDG
20	TANEDG	ANNUAL	0.00E+00	4.17E-02	0.00E+00	SMC EDGs
20	TANBOIL	ANNUAL	0.00E+00	5.70E-03	0.00E+00	TAN Boiler
20	TANMISC	ANNUAL	0.00E+00	0.00E+00	0.00E+00	TAN Misc
	TOTAL				7.10E-04	

COMPLETENESS OF THE ONSITE METEOROLOGICAL DATA

On page 7 of their comments, IDEQ requested that the modeling report discuss whether hourly or subhourly data were obtained for the four INL met towers (Grid3, LOFT, EBR, RWMC) used as "onsite" meteorological data for dispersion modeling, and identify whether these data met minimum 90% completeness requirements. The onsite data were hourly averages and obtained from the National Oceanic and Atmospheric Administration (NOAA) Idaho Falls office. The NOAA office was asked to provide a data completeness report on January 6, 2014. Jason Rich of NOAA provided the number of hourly records that were missing measurements in a spreadsheet (Appendix A). The measured parameters were 10-m wind speed, 2-m temperature, 15-m temperature, 2-m relative humidity, solar radiation, barometric pressure, and precipitation.

The number of valid measurements was divided by the total possible number of measurements for the 5-year period (2000-2004) to give the percentage of data completeness (Table 1). The total possible number of measurements was:
(365 days/year × 3 year + 366 days/year × 2 years) × 24 hours/day × 7 measurements /hour = 306,936 measurements. The percent completeness was calculated using the following equation.

$$\%C = \left(1 - \frac{N_m}{N_T}\right) \times 100 \qquad (1)$$

All onsite data met the minimum 90% data completeness (Table 22).

Table 22. Number of missing measurements and percent data completeness for the INL meteorological towers.

Parameter	Grid3	LOFT	EBR	RWMC
Number of missing measurements	4526	5106	1651	7529
Total number of possible measurements	306,936	306,936	306,936	306,936
Percent data completeness	98.5	98.3	99.5	97.5

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APPENDIX A: MISSING DATA SPREADSHEET PRINTOUTS

Year		INTEC/ Grid 3 10m Wind	INTEC/ Grid 3 2m Temp F	INTEC/ Grid 3 15m Temp F	INTEC/ Grid 3 2m RH %	INTEC/ Grid 3 Solar Rad w/m^2	INTEC/ Grid 3 BP inches Hg	INTEC/ Grid 3 Rain inches
	2000	74	204	117	1074	78	0	119
	2001	106	119	89	145	10	0	25
	2002	145	193	66	207	2	0	16
	2003	104	212	212	252	19	18	0
	2004	82	250	320	250	5	1	12
Total Hours		43848						
Total Meas		306936						
Total missing measurements		4526						
% complete		98.53%						

RWMC 15m Wind	RWMC 2m Temp F	RWMC 15m Temp F	RWMC 2m RH %	RWMC Solar Rad w/m^2	RWMC BP inches Hg	RWMC Rain inches
207	42	236	871	21	19	308
256	333	30	351	6	0	53
218	1	27	5	12	0	80
249	691	1038	669	97	95	272
246	208	520	208	4	2	154
43848						
306936						
7529						
97.55%						

SMC 10m Wind	SMC 2m Temp F	SMC 15m Temp F	SMC 2m RH %	SMC Solar Rad w/m^2	SMC BP inches Hg	SMC Rain inches
313	540	540	904	82	0	156
39	314	314	319	55	16	252
246	0	0	6	12	0	0
92	0	0	34	1	0	0
43	196	422	205	2	2	1
43848						
306936						
5106						
98.34%						

MFC 10m Wind	MFC 2m Temp F	MFC 15m Temp F	MFC 2m RH %	MFC Solar Rad w/m^2	MFC BP inches Hg	MFC Rain inches
120	35	49	584	3	0	0
71	79	66	91	44	18	20
120	0	0	0	2	0	0
65	0	0	0	2	0	197
43	5	6	5	1	1	24
43848						
306936						
1651						
99.46%						

APPENDIX F

EVALUATION OF ROUTINE NAVAL SPENT NUCLEAR FUEL HANDLING OPERATIONS AND HYPOTHETICAL ACCIDENT CONDITIONS

F.1 Introduction

In over 6600 reactor-years of operation of naval reactors and more than 829 shipments of naval spent nuclear fuel, there has never been a nuclear reactor accident, criticality accident, or any other release of radioactivity having a significant effect on the quality of the environment (NNPP 2014). However, the consequences of radiation exposure and contamination are of interest to the general public; therefore, this Appendix addresses the potential radiological impacts to workers, the public, and the environment from routine naval spent nuclear fuel handling operations and hypothetical accidents for the proposed action to supplement Section 4.13.2.

Analyses of routine naval spent nuclear fuel handling operations, hypothetical accidents, and intentionally destructive acts (IDAs) (e.g., acts of sabotage or terrorism) are performed to estimate the potential consequences due to release of radioactive materials. The results of these analyses are presented in terms of both consequence (cancer that might be expected for an individual or population group) and risk (the increased chance of getting cancer defined as the product of the probability of occurrence of the accident times the consequence of the accident). Impacts to land which could be contaminated due to hypothetical accidents and IDAs are also discussed.

Section F.2 provides information about the nature of radiation, explains the basic concepts used to evaluate radiation health effects, and provides perspective on the calculation of cancer and risk.

Section F.3 provides the analysis methods used to evaluate radiation exposures from routine naval spent nuclear fuel handling operations, hypothetical accident scenarios, and IDAs. It describes the individuals and groups for which radiation exposures are calculated, radiation exposure pathways, computer programs used in the evaluation, and input data for the calculations.

Section F.4 provides analysis results for the evaluation of radiation exposures from routine naval spent nuclear fuel handling operations. Section 4.13.2 describes radiological exposures for the time periods associated with each alternative. These radiological exposures are split into radiation exposures to workers inside the naval spent nuclear fuel handling facilities (i.e., Expended Core Facility (ECF) or the new facility) and radiation exposures to individuals outside the naval spent nuclear fuel handling facilities. The radiation exposures to workers inside the naval spent nuclear fuel handling facilities are fully evaluated in Section 4.13.2; therefore, no additional discussion of radiation exposures to workers inside the facilities is provided in this Appendix. This Appendix focuses on the radiation exposures to individuals outside the naval spent nuclear fuel handling facilities for the post-refurbishment operational period of the Overhaul Alternative, the transition period of the New Facility Alternative, and the new facility operational period. These are the time periods for which there would be increases to the baseline radiation exposures described in Section 3.13.

Section F.5 provides analysis results for the evaluation of radiation exposures from hypothetical accident scenarios. It describes how the hypothetical accidents were selected for evaluation and the development of source terms. For each of the 12 hypothetical accident scenarios and IDAs, a description of the scenario is provided along with the scenario source term, probability, and results.

Section F.6 describes emergency preparedness and how protective action measures are not modeled in the analysis. Section F.7 describes the uncertainties associated with the radiation exposure analysis. Section F.8 describes updates to modeling methodology made since the publication of DOE 1995.

Population projections for 2010 are used to estimate the radiological effects on the General Population within 80.5 kilometers (50 miles) of the Naval Reactors Facility (NRF). Emissions for routine naval spent nuclear fuel handling operations are estimated based on routine annual releases from ECF in 2009 scaled to future activities. The New Facility Alternative would have more effective ventilation systems for naval spent nuclear fuel handling operations than ECF. Since the radiation exposures are based on ECF emissions, the radiation exposures presented in this Appendix would be conservative for routine naval spent nuclear fuel handling operations associated with the New Facility Alternative (transition period and new facility operational period).

The nature of naval spent nuclear fuel handling operations would be the same for each alternative. In general, the evaluation of hypothetical accidents applies to all alternatives and the hypothetical accidents are conservatively modeled to have the same risks regardless of alternative with the following exceptions. When necessary, the hypothetical accident scenarios account for the differences in the water pool structure between alternatives. For the drained water pool scenario, the probability varies between alternatives. For the minor water pool leak scenario, the consequences vary between alternatives. The impacts of the inter-facility transport accident scenario only apply to the New Facility Alternative because transportation between facilities of naval spent nuclear fuel for examination would only be applicable if a new facility is constructed.

For the No Action Alternative where the risks are presented consistent with the other alternatives, the risks may be conservative because the No Action Alternative does not support unloading M-290 shipping containers. For example, scenarios where the material-at-risk is the entire water pool inventory, the water pool would contain less carrier length fuel than is assumed in the water pool inventory supporting the consequence analysis. In addition, for scenarios where the probability is based on the number of shipping container unloadings, the number of shipping containers unloaded would be less than assumed.

The description of methodology for hypothetical accidents is applicable to IDAs. Since Location 3/4 and Location 6 are in close proximity to one another, the differences in weather and distance for the alternatives have no effect on the analysis results.

Much of the data in this Appendix is presented using scientific notation. Scientific notation is commonly used to represent very large or small numbers. It consists of a number multiplied by the appropriate power of 10. For example, 0.0000035 would be represented as 3.5×10^{-6} and 3,500,000 would be represented as 3.5×10^{6}. Significant digits are the number of digits needed to express the precision of the calculation. Each calculated result is rounded to two significant digits in this Appendix. Numbers in some tables may be slightly different than if the calculation were performed as written; some multi-step calculations use more significant figures than shown, and the results for each step are rounded for presentation in this Appendix.

F.2 Radiation and Human Health

This section provides information about the nature of radiation, explains basic concepts used to evaluate radiation health effects, and provides perspective on the calculation of cancer and risk.

F.2.1 Nature of Radiation

Radiation is the emission and propagation of energy through matter or space as waves or particles. Radiation generally results from processes that occur naturally. The most commonly recognized form of radiation is electromagnetic radiation emitted over a specific range of wavelengths and energies. Visible light is part of the spectrum of electromagnetic radiation. Radiation of longer wavelengths and lower energy includes infrared radiation (known for heating material when the material and the radiation interact) and radio waves. Electromagnetic radiation of shorter wavelengths and higher energy (which are more penetrating) includes ultraviolet radiation (which causes sunburn) and forms of ionizing radiation such as x-rays and gamma radiation.

Ionizing radiation is radiation that has sufficient energy to displace electrons from atoms or molecules to produce ions. The ions have the ability to interact with other atoms or molecules; in biological systems, this interaction can cause damage in tissue or to an organism.

Radioactivity is the property or characteristic of an unstable atom to undergo spontaneous transformation (to disintegrate or decay) with the emission of energy as radiation to reach a more stable state. The result of the process, called radioactive decay, is the spontaneous transformation of an unstable atom (a radionuclide) into a different nuclide, accompanied by the release of energy (as radiation) as the atom reaches a more stable, lower energy configuration.

Radiation that originates outside of an individual's body is called external or direct radiation. Such radiation can come from an x-ray machine or from radioactive materials (materials or substances that contain radionuclides), such as radioactive waste or radionuclides in soil. When radioactive materials are deposited on a surface that surface is said to be contaminated. Contamination is material that contains radiation emitting nuclides.

Internal radiation originates inside a person's body following intake of radioactive material or radionuclides through ingestion or inhalation. Once in the body, the fate of a radioactive nuclide is determined by its chemical structure and how it is metabolized. The residence time of a radionuclide in the body is commonly called the biological half-life. If the material is soluble, it might be dissolved in bodily fluids and transported to and deposited in various body organs; if it is insoluble, it might move through the gastrointestinal tract or into the lungs.

F.2.2 Radiation Measuring Units

A variety of units are used to measure radiation. These units determine the amount, type, and intensity of radiation. Amounts of radiation or its effects can be measured in units of Curies, radiation absorbed dose (rad), or dose equivalent (roentgen equivalent man, or rem). The Curie describes the rate at which a material is emitting nuclear radiation (i.e., activity). The Curie is defined as exactly 3.7×10^{10} disintegrations (decays) per second. The rad is the unit that measures the amount of energy imparted to matter per unit mass. The total energy absorbed per unit quantity of matter is referred to as absorbed dose (or simply dose). One rad is equal to the amount of radiation that leads to the deposition of 0.01 joule of energy per kilogram of absorbing material. The roentgen equivalent man (rem) is the unit that measures the absorbed dose and the relative effectiveness of the type of ionizing radiation in damaging biological systems. One rem of one type of radiation has the same biological effects as 1 rem of any other kind of radiation. This allows comparison of the biological effects of radionuclides that emit different types of radiation. The term used for reporting the collective dose (i.e., the sum of individual doses received in a given time period) by a specified population from radiation exposure to a radiation source is person-rem. For example, if 100 workers each received 0.1 rem, the collective dose would be 10 person-rem (100 people x 0.1 rem).

The units of radiation measure in the International System (SI) of Units are: Becquerel (a measure of source intensity), gray (a measure of absorbed dose), and Sievert (a measure of dose equivalent). In accordance with United States (U.S.) Department of Energy (DOE) convention, all radiation units presented in this Appendix are in terms of Curies, rad, rem, and person-rem. The conversions of the units used in this Appendix to SI units are provided in Table F.2-1.

Table F.2-1: Conversions to SI Units

1 Curie (Ci)	=	3.7 x 10^{10} disintegrations per second
	=	3.7 x 10^{10} Becquerels (1 Becquerel = 1 disintegration per second)
1 rad	=	0.01 gray (1 gray = 1 joule per kilogram)
1 rem	=	0.01 Sievert (Sv)

The average American receives a total of approximately 620 millirem per year from natural and man-made radiation sources. Approximately 310 millirem per year are from radiation exposure to natural sources (background). The largest natural sources are radon-222 and its radioactive decay products in homes and buildings, which contribute about 230 millirem per year. Additional natural sources include radioactive material in the earth (primarily the uranium and thorium decay series, and potassium-40) and cosmic rays from space filtered through the atmosphere. Approximately 310 millirem per year are from man-made radiation sources. Man-made radiation exposure is mostly from medical procedures such as computed tomography (CT) scans and nuclear medicine which contribute approximately 300 millirem per year to the dose of an average American. (NCRP 2009)

F.2.3 Radiation Dose Definitions

In quantifying the effects of radiation on humans, other terms are used to describe the dose from radiation exposure to radiation. For consistency, this Appendix uses terminology consistent with International Commission on Radiological Protection (ICRP) Publication 60 (ICRP 1991). A list of the terminology used in ICRP Publication 60 (ICRP 1991) and the terminology used in earlier guidance is shown in Table F.2-2. Although the terminology has changed, the usage is unchanged.

Table F.2-2: Radiation Dose Terminology

ICRP 60 Terminology	Previous Terminology
Tissue Weighting Factor	Weighting Factor
Effective Dose	Effective Dose Equivalent
Committed Effective Dose	Committed Effective Dose Equivalent
Total Effective Dose	Total Effective Dose Equivalent

Tissue weighting factors are used for various body organs and tissues to account for that individual organ's or tissue's proportion of risk versus the total risk when the whole body is irradiated uniformly. Organ doses are calculated for individual organs such as the lungs, stomach, small intestine, upper large intestine, lower large intestine, bone surface, red bone marrow, testes, ovaries, muscle, thyroid, bladder, kidneys, and liver. The summation of each specific organ dose, weighted by the relative risk to that organ compared to an equivalent whole-body radiation exposure, is a whole body dose. To determine the overall effect from routine naval spent nuclear fuel handling operations or hypothetical accident scenarios, whole body doses are presented in this Appendix.

A whole body dose from external radiation is called the effective dose (ED). The ED occurs instantaneously during the period when the body is exposed to direct radiation from an external radiation field. The whole body dose from internal radiation is called the committed effective dose (CED). The CED is from ingestion or inhalation of radioactive material during the radiation exposure period, and is calculated over a remaining lifetime of the individual to account for radionuclides that have long half-lives and long residence times in the body (Sections F.3.3.3 and F.3.3.5). Total effective dose (TED) is the sum of the ED and CED. All estimates of dose presented in this Appendix, unless specifically noted otherwise, are TEDs quantified in terms of rem or millirem. A millirem is one one-thousandth of a rem.

The factors used to convert estimates of radionuclide intake (by inhalation or ingestion) or external radiation exposure to dose estimates are called dose conversion factors. The ICRP and federal agencies such as the U.S. Environmental Protection Agency (EPA) publish these factors. The internal dose conversion factors used in this Appendix are based on recommendations made by the ICRP in 1990, published in 1991 (ICRP Publication 60 (ICRP 1991)), and subsequent reports based on the 1990 recommendations (ICRP Publication 68 (ICRP 1994), ICRP Publication 71 (ICRP 1995), and ICRP Publication 72 (ICRP 1996)). The external dose conversion factors for dose from external, direct radiation are based on earlier ICRP and EPA Guidance (ICRP Publication 26 (ICRP 1977), EPA 1993).

F.2.4 Radiation Exposure Limits

Radiation exposure limits for members of the public and radiation workers are developed independently by each federal agency based on the recommendations of councils of radiation experts including the ICRP and the National Council on Radiation Protection and Measurements. Radiation exposure limits are set by DOE (including the Naval Nuclear Propulsion Program (NNPP)), EPA, and the U.S. Nuclear Regulatory Commission (NRC) for radiation workers and members of the public. The DOE regulates airborne emission of radioactivity to members of the public located near a DOE site to levels that are less than the EPA annual dose limit of 10 millirem (40 C.F.R. § 61.102). The DOE and NRC both have occupational exposure limits of 5 rem per year (10 C.F.R. § 835.202 and 10 C.F.R. § 20.1201, respectively). Workers at NRF are also restricted to the NNPP limits of 5 rem per year with the additional stipulation not to exceed 3 rem in a single quarter (NNPP 2011b). NNPP radiological control practices also assure that the site meets NRC limits on commercial radiological facilities which limits public exposure at the site boundary to 0.1 rem per year (10 C.F.R. § 20.1301); this limit is used in the calculation of impacted land area following a hypothetical accident scenario provided in Section F.5.6.

To keep radiation exposure as low as reasonable achievable (ALARA), workers at NRF work towards local control levels that are much lower than the 5-rem annual limit (e.g., 100 millirem) and depend on each worker’s specific job assignment. Additionally, no NNPP personnel have exceeded 2 rem annually (40 percent of the NNPP annual 5-rem limit) since 1979 (NNPP 2011b).

F.2.5 Evaluation of Health Effects From Radiation Exposure

Radiation interacts directly and indirectly with the atoms that form cells. In a direct action, the radiation interacts directly with the atoms of the DNA molecule or some other component critical to the survival of the cell. Since the DNA molecules make up a small part of the cell, the probability of direct action is small. Because most of the cell is made up of water, there is a much higher probability that radiation would interact with water. In an indirect action, radiation interacts with water and breaks the bonds that hold water molecules together, producing reactive free radicals that are chemically toxic and destroy the cell. The body has mechanisms to repair damage caused by radiation.

Consequently, the biological effects of radiation on living cells may result in one of three outcomes: (1) injured or damaged cells repair themselves, resulting in no residual damage; (2) cells die, much like millions of body cells do every day, being replaced through normal biological processes and causing no health effects; or (3) cells incorrectly repair themselves, which results in damaging or changing the genetic code (DNA) of the irradiated cell. Stochastic effects, that is, effects that may or may not occur based on chance, may occur when an irradiated cell is incorrectly repaired rather than killed. The most significant stochastic effect of radiation exposure is that an incorrectly repaired cell may, after a prolonged delay, develop into a cancer cell. (NRC 2011)

Detrimental health effects are calculated based on the radiation exposure dose results to an individual or population group. The dose-to-health effect conversion factors used for calculations of health effects are taken from ICRP Publication 103 (ICRP 2007). Health effects from radiation exposure are used to summarize and compare results in this Appendix. Cancer is reported because cancer is the principal potential health detriment which may result from radiation exposure.

In determining a means of assessing health effects from radiation exposure, the ICRP has developed detriment-adjusted factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of non-fatal cancers upward to account for the total harm experienced as a consequence of developing the cancer. The cancer factors overstate the expected incidence of fatal cancer in the population and the use of these factors to estimate the incidence of fatal cancer (discussed in Section F.2.6) is conservative for comparison.

Table F.2-3 lists the health effect factors used in the analysis of both the routine naval spent nuclear fuel handling operations and the hypothetical accident scenarios. Different factors are used for workers and for members of the public, with a larger factor used for members of the public to account for cancer rates in children and senior individuals. Heritable effects are also shown so that the total health effects can be calculated if desired. Heritable effects are harmful genetic effects that are transmitted to subsequent generations. The number of total health effects (cancer plus heritable effects) for members of the public may be obtained by multiplying the cancer by the factor of 1.04, which is the ratio of total health effects to cancer (5.7/5.5). In this Appendix, the doses are provided to allow independent evaluation using any relation between radiation exposure and health effects.

Table F.2-3: Conversion Factors for Health Effects From Ionizing Radiation

Health Effect	Conversion Factor[1,2]	
	Worker	Members of the Public
	probability per rem	
Cancer	4.1×10^{-4}	5.5×10^{-4}
Heritable Effects	0.1×10^{-4}	0.2×10^{-4}
Total Health Effects	4.2×10^{-4}	5.7×10^{-4}

1 For high individual radiation exposures to external radiation (greater than or equal to 20 rem), the factors are multiplied by a factor of two. General Population radiation exposures are not modified because the large drop in radiation exposure with increasing distances results in radiation exposure rates below 20 rem. See Section F.7.4 for more information on uncertainties.

2 In determining a means of assessing health effects from radiation exposure, the ICRP has developed a weighting method for lethal and life impairing cancers. The values in this table are averaged over both sexes.

To determine the likelihood that an individual would develop cancer from radiation exposure, the conversion factor is multiplied by the individual dose (rem). For the General Population, the conversion factor is multiplied by the General Population dose (person-rem) to estimate the cancer that is expected to develop in a specific population.

F.2.6 Perspective on Calculations of Cancer and Risk

The topics of human health effects caused by radiation and the risks associated with routine naval spent nuclear fuel handling operations or hypothetical accident scenarios associated with naval spent nuclear fuel handling are discussed many times throughout this Environmental Impact Statement (EIS). It is important to understand these concepts and how they are used to understand the information presented in this document. It is also valuable to have some frame of reference or comparison for understanding how the risks compare to the risks of daily life.

The method used to calculate the risk of any impact is fundamental to all of the evaluations presented and follows standard accepted practices. The first step is to determine the probability that a specific event would occur. For example, the probability that a routine task, such as operating a crane, would be performed sometime during a year of routine naval spent nuclear fuel handling operations at a facility would be 1.0. Which means that the action would certainly occur. The probability that an accident would occur is less than 1.0. Accidents occur only occasionally and some of the more severe accidents, such as a catastrophic earthquake, might occur at any location only once in hundreds, thousands, or millions of years.

Once the probability of an event has been determined, the next step is to predict the consequences of the event being considered. One important measure of consequences chosen for this EIS is the cancer induced by radiation. The cancer that might be caused by routine naval spent nuclear fuel handling operations or any hypothetical accident can be calculated using a standard technique based on the amount of radiation exposure estimated to occur from all conceivable pathways and the number of people who could be affected, as discussed in Section F.2.5.

To illustrate the calculation of risk, several examples are presented. The lifetime risk of dying in a motor vehicle accident can be calculated from the likelihood of an individual being in an accident and the consequences, or number of fatalities, per accident. There were 22,555 motor vehicle accidents during 2010 in the state of Idaho resulting in 209 deaths (OHS 2010). Assuming only one person is involved in each accident, the probability of a person in Idaho being in a motor vehicle accident is 22,555 accidents divided by approximately 1,546,000 persons in Idaho (USCB 2011), or 0.015 per year. The probability of an accident causing a fatality is 0.0093 (209 deaths divided by 22,555 accidents). Multiplying the probability of the accident (0.015 per year) by the consequences of the accident (0.0093 deaths per accident) by the number of years the person is exposed to the risk (78.5 years is considered to be an average lifetime (CDC 2010)) gives the lifetime risk for any individual of being killed in a motor vehicle accident. From this calculation, the lifetime risk of an individual dying in a motor vehicle accident in Idaho is about 0.011 or 1 chance in 91.

A second example illustrates the risk from the burning of fossil fuels, such as natural gas or coal, to create electricity. Naturally occurring radioactive material is released into the air during combustion. This radioactivity (estimated to produce about 0.5 millirem (0.0005 rem) of radiation dose to the average American each year (NCRP 2009)) finds its way into our bodies through food and the air we breathe. The probability of exposure to this radioactivity is essentially 1.0 since these fuels are burned every day all over the country. The cancer risk from exposure to this radioactivity is calculated by multiplying the average radiation exposure per year (0.0005 rem per year) by the average lifetime (78.5 years), and the cancer estimated to be caused by each rem of radiation exposure (0.00055 cancers estimated to be caused by each rem (Table F.2-3)). This calculation results in a consequence of 0.000022 cancers per individual lifetime from the burning of fossil fuels. Risk can then be calculated by multiplying the probability (1.0) by the consequence (0.000022 cancers). This risk equates to about 2.2×10^{-5} or 1 chance in 46,000 of developing cancer from radioactivity during a lifetime of exposure to burning fossil fuels.

As a further comparison, the naturally occurring radioactive materials in agricultural fertilizer and waste products from phosphate mining contribute about 1 millirem per year to an average American's exposure to radiation (NCRP 2009). A calculation similar to the one in the preceding paragraph shows that the use of fertilizer to produce food crops in the U.S. and the waste products from phosphate mining results in a risk of cancer of about 4 x 10^{-5}, or 1 chance in 25,000.

The average American's risk of developing fatal cancer from a lifetime of normal activity is 1 chance in 6.7, or 0.15 over his or her lifetime (ACS 2011). Therefore, there is a much greater risk of developing fatal cancer from a lifetime of normal activity than from the two examples of radiation exposure provided above. Using the probability of 1 chance in 6.7, approximately 2.3 x 10^{4} (22,650) fatal cancers would be expected to develop during a lifetime of normal activity unrelated to NRF emissions for the General Population (approximately 151,000 people) living within an 80.5-kilometer (50-mile) radius surrounding NRF.

Risks from hypothetical accidents associated with naval spent nuclear fuel handling operations can be developed using the same methodology described above. The individual risk from hypothetical accidents associated with naval spent nuclear fuel handling operations can be compared to the risk of developing fatal cancer over an individual’s lifetime. Annual risk calculations are presented to allow comparisons between hypothetical accident scenarios. This EIS uses the conservative value for cancer from ICRP 2007 to compare to the risk of developing fatal cancer from everyday life. The cancer health conversion factor of 0.00055 cancers per rem overstates the expected incidence of fatal cancer in the population, and the use of this factor to estimate the incidence of fatal cancer is conservative.

F.3 Analysis Methods for Evaluation of Radiation Exposure

Routine naval spent nuclear fuel handling operations and hypothetical accident scenarios are evaluated to assess the possible radiation exposure to individuals due to the release of radioactive materials. This section describes the methods used in these evaluations.

F.3.1 Radiation Exposures to be Calculated

Radiation exposure to the following individual groups is calculated for routine naval spent nuclear fuel handling operations and hypothetical accident conditions. Each individual is evaluated for a 1-year period for routine naval spent nuclear fuel handling operations. For accidents the evaluation period is listed below.

- Worker. The Worker is an adult individual located 100 meters (330 feet) from the radioactive material release point. The release point (for distance from the worker) is the location of the ventilation discharge stack in the naval spent nuclear fuel handling facility or the accident location for hypothetical accident scenarios that occur outside (as noted in Section F.3.3.2, only ground-level releases are modeled). The Worker is an NRF employee walking by or working near the naval spent nuclear fuel handling facility or accident location that is not directly involved in routine naval spent nuclear fuel handling operations or the hypothetical accident scenario (i.e., an uninvolved worker). For hypothetical accidents, the Worker is evaluated for a 20-minute radiation exposure period to account for the evacuation time from the accident location. The impact of hypothetical accident scenarios on workers who are directly involved in an accident or located nearby the accident scene (involved worker) is not calculated numerically but is discussed qualitatively for each accident in Section F.5.4.

- Maximally Exposed Collocated Worker (MCW). The MCW is an adult worker at another independent facility (separate from NRF) within the Idaho National Laboratory (INL) boundary. The intent of the MCW classification is to assess the effect of routine naval spent nuclear fuel handling operations and hypothetical accident scenarios in one facility on workers in another facility on a large DOE site. The MCW is located 8 kilometers (5 miles) away from NRF at the Advanced Test Reactor (ATR) Complex. Based on experience from emergency exercises, emergency response teams would be able to evacuate workers at other INL facilities within 2 hours; therefore, a radiation exposure time of 2 hours is used for accident analysis.

- Maximally Exposed Off-Site Individual (MOI). The MOI is a theoretical individual with the characteristics and habits of an adult member of the public living at the INL property boundary who is evaluated for a 1-year period. Sixteen radial sectors around the accident location are analyzed to confirm that the limiting MOI location would be at the site boundary that is nearest to the facility. The MOI is located 10.5 kilometers (6.5 miles) away from NRF in the west-northwest (WNW) direction.

- Nearest Public Access (NPA). Publically available highways cross the INL. Consequently, these analyses included evaluation of the radiation exposure to an NPA, a theoretical motorist with the characteristics and habits of an adult member of the public who might be stranded on such a public highway within the INL boundary during a hypothetical accident scenario. The closest NPA is located 14 kilometers (8.7 miles) away from NRF in the southwest (SW) direction. Based on experience from emergency exercises, emergency response teams would be able to evacuate such an individual within 2 hours; therefore, a radiation exposure time of 2 hours is used for accident analysis. The NPA is not evaluated for routine naval spent nuclear fuel handling operations due to the short period of time that such an individual would spend on-site while driving on the public access road.

- General Population. The General Population evaluation considers the population distribution (age and location) within an 80.5-kilometer (50-mile) radius of NRF. The General Population is evaluated for a 1-year period. Doses specific to six age groups are calculated (ICRP 1996) and summed to determine the total General Population dose.

Radiation exposure is calculated to result from direct radiation from the facility and exposure to radiological emissions directly to the air and indirectly to the water. The releases to the environment could result in exposure through several pathways. The radiation exposure pathways are shown in Figure F.3-1.

- External direct exposure from immersion in the airborne radioactive plume as it progresses downwind (air immersion).

- External direct exposure to radiation not associated with the airborne plume (direct radiation). This pathway only applies to routine naval spent nuclear fuel handling operations and to hypothetical accident scenarios which involve a loss of or damage to shielding or an inadvertent criticality.

- External direct exposure from radioactive material that is deposited on the ground from the airborne plume as it passes (ground surface).

- Internal exposure from inhalation of radioactive materials for an individual located within the plume (inhalation).

- Inhalation of radioactive materials that are deposited on the ground during passage of the plume (resuspension). Resuspension is calculated for routine naval spent nuclear fuel handling operations. Resuspension is not included in the accident analysis because it is a very small contributor to the overall dose.

- Internal exposure from eating food and drinking water that is contaminated from radioactivity that falls out of the atmosphere (ingestion). Ingestion is applicable for all individuals evaluated for routine naval spent nuclear fuel handling operations. For the hypothetical accident scenarios, ingestion exposure is only applicable to the MOI and General Population exposure groups.

- Ingestion of food and water contaminated by radioactivity in water, and external direct exposure from contaminated water (waterborne). Waterborne exposure is applicable for all individuals for routine naval spent nuclear fuel handling operations. For hypothetical accident scenarios, waterborne contamination exposure is only applicable to the MOI and General Population exposure groups.

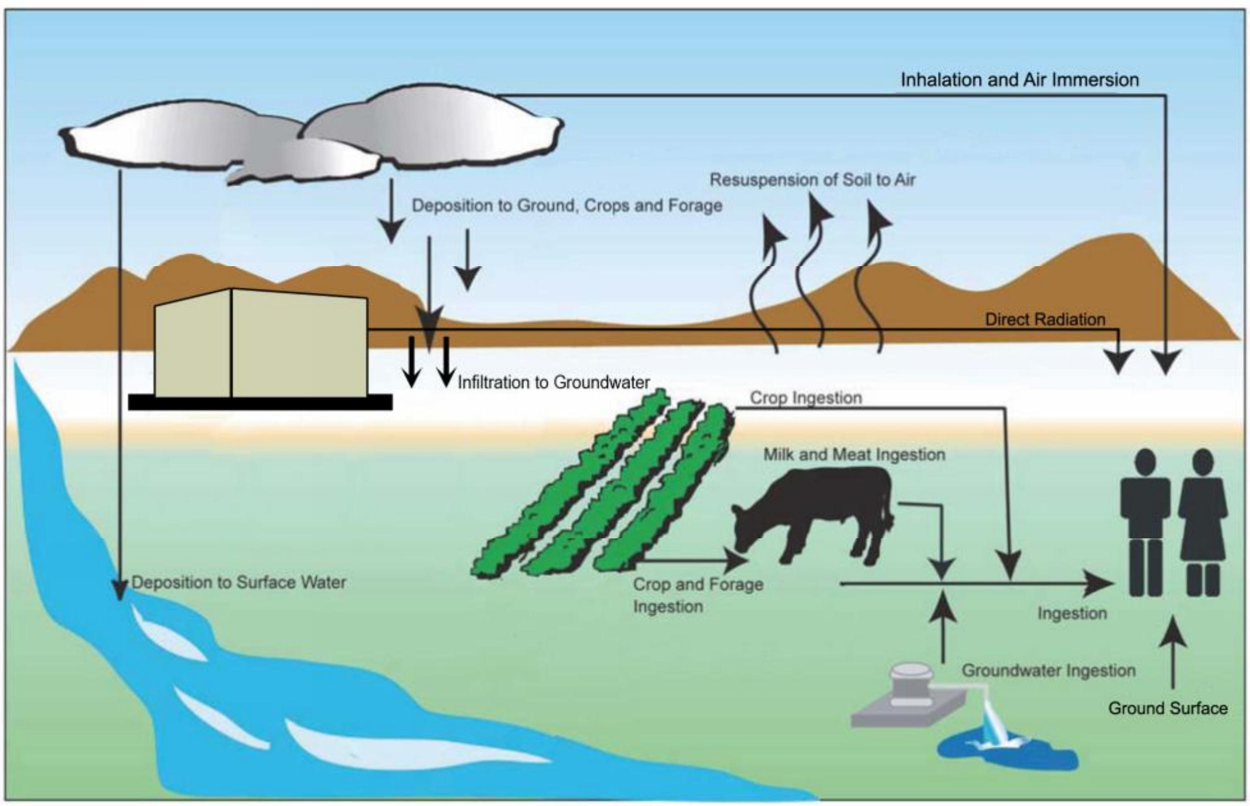

Figure F.3-1: Pathways for Radiation Exposure

The radiation exposure is calculated by the computer programs discussed in Section F.3.2 in a manner recommended by the ICRP. The radiation exposure from ingestion of contaminated food and animal products is calculated assuming a typical annual consumption. However, it is likely that continued consumption of contaminated food products by the public would be suspended in the event of a real accident after a Protective Action Guideline (PAG) is reached. In 1991, the EPA recommended PAGs for response to radiological incidents in the range of 1 to 5 rem whole-body exposure (EPA 1992c). The EPA updated PAGs in 2013 (EPA 2013c). To ensure a consistent analysis basis, no reduction of radiation exposure due to a PAG is accounted for in the analyses. This results in a conservative impact evaluation which may overestimate health effects within an exposed population.

Table F.3-1 presents an example of the results from the detailed radiation exposure calculations. The table shows the possible radiation exposure pathways and individuals analyzed for the hypothetical accident scenario with the highest annual risk (i.e., drained water pool as described in Section F.5.4.4). The TEDs reported in this Appendix include the TED from the airborne pathways (the sum of the inhalation and ingestion CEDs and the ground surface and air immersion EDs from the airborne release), the TED from waterborne contamination (the sum of the ingestion CED and the immersion ED from the waterborne release), and the ED from any direct radiation exposure, where applicable.

The patterns between different dose pathways shown in Table F.3-1 are typical of hypothetical accident scenarios. For the Worker, MCW, and NPA, inhalation is the dominant airborne pathway. Ingestion is the dominant airborne pathway for the MOI and the General Population. The waterborne pathway is a much smaller contributor to dose than the airborne pathway. The direct radiation pathway is significantly less than the airborne pathway and does not contribute noticeably to dose to most exposed individuals or the General Population.

Table F.3-1: Example of Detailed Radiation Exposure Calculation Results for Hypothetical Drained Water Pool Scenario[1]

Exposure Group	Airborne Pathways				Airborne Release TED[2]	Waterborne Release TED	Direct Radiation ED	TED[3]	Fatal Cancer per Individual[4]
	Inhalation CED	**Air Immersion ED**	**Ground Surface ED**	**Ingestion CED**					
	rem								
Worker	8.0	4.5×10^{-3}	5.5×10^{-3}	N/A	8.0	N/A	1.0	9.0	3.7×10^{-3}
MCW	1.3×10^{-2}	8.5×10^{-5}	3.3×10^{-5}	N/A	1.3×10^{-2}	N/A	2.0×10^{-24}	1.3×10^{-2}	5.5×10^{-6}
NPA	1.1×10^{-2}	4.9×10^{-5}	1.6×10^{-5}	N/A	1.1×10^{-2}	N/A	2.9×10^{-30}	1.1×10^{-2}	6.3×10^{-6}
MOI	9.1×10^{-3}	6.5×10^{-5}	6.0×10^{-2}	1.1×10^{-2}	8.0×10^{-2}	4.0×10^{-3}	1.3×10^{-26}	8.4×10^{-2}	4.6×10^{-5}
General Population within 50 miles[5]	**Inhalation CED**	**Air Immersion ED**	**Ground Surface ED**	**Ingestion CED**	**Airborne Release TED**[1]	**Waterborne Release TED**	**Direct Radiation ED**	**TED**[2]	**Fatal Cancer in the General Population**[4]
	person-rem								
	4.2×10^{1}	4.7×10^{-1}	2.8×10^{2}	5.2×10^{1}	3.7×10^{2}	1.0	6.9×10^{-19}	3.7×10^{2}	2.1×10^{-1}

[1] Hypothetical accident scenario with the highest annual risk.
[2] The Airborne Release TED equals the sum of all airborne pathways.
[3] The TED equals the sum of the Airborne Release TED, Waterborne Release TED, and Direct Radiation ED.
[4] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the MOI, NPA, and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)
[5] 50 miles = 80.5 kilometers

F.3.2 Computer Programs

Two computer programs are used to evaluate the radiation exposures to the specified individuals and General Population.

F.3.2.1 GENII

The Generalized Environmental Radiation Dosimetry Software System – Hanford Dosimetry System (GENII) Version 2 modeling code is used for the environmental transport and radiation exposure calculations for routine naval spent nuclear fuel handling operations and for the calculations of the waterborne components of the total dose for the hypothetical accident scenarios. GENII is designed to model long-term atmospheric and liquid releases of radionuclides and their human health consequences. Pacific Northwest National Laboratory developed and maintains the GENII code (PNNL 2009) and its underlying driver program Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES) Version 1.7. The code incorporates the internal dosimetry model recommended by the ICRP in Publication 72 (ICRP 1996) and the external model recommended by the EPA in Federal Guidance Report (FGR) 12 (EPA 1993).

For this EIS, site-specific data are used including location, meteorology, population, and source terms as discussed in Sections F.3.3 and F.3.4. The chronic model is used in the routine naval spent nuclear fuel handling operations evaluation to reflect long-term average radiation exposure to the radiological emissions. For the chronic evaluations, GENII uses meteorological conditions averaged over each sector to reflect radiation exposure to long-term average concentrations. The acute option is used for the waterborne accident calculations to represent the effects of an accident which occurs over a short period of time.

F.3.2.2 RSAC-7

Radiological Safety Assessment Computer Code (RSAC) Version 7.2 was developed by Westinghouse Idaho Nuclear Company, Inc., for the DOE-Idaho Operations Office and is maintained by INL, currently operated by Battelle Energy Alliance (INL 2010d). The computer program calculates the consequences of the release of radionuclides to the atmosphere during an accident. The code incorporates the internal dosimetry models recommended by the ICRP in Publication 68 (ICRP 1994) and Publication 72 (ICRP 1996) and the external model recommended by the EPA in FGR 12 (EPA 1993).

RSAC is used to evaluate the effects from an airborne plume released during the hypothetical accident scenarios. It allows the amount of each radionuclide from a radiological release to be input individually or to be calculated internally by the code. RSAC calculates potential radiation exposures to individuals via inhalation, ingestion, exposure to radionuclides deposited on the ground surface, and immersion in airborne radioactive material. RSAC meteorological capabilities include Gaussian plume dispersion for Pascal-Gifford conditions. RSAC allows reduction of nuclides by chemical group or element and calculates radioactive decay and buildup during transport through operations, facilities, and the environment. Site-specific data are used including location, meteorology, population, and source terms as discussed in Section F.3.3.

F.3.3 Input Data for Airborne Calculations

Unless stated otherwise, the following conditions are used when performing airborne release calculations with RSAC-7.2 and GENII. In most cases, these conditions are taken directly as defaults from the computer programs.

F.3.3.1 Population Data

A population distribution based on 2010 population projections from the 2000 U.S. Census in 16 compass directions and five equal radial distances from NRF (8 kilometers (5 miles), 24 kilometers (15 miles), 40 kilometers (25 miles), 56 kilometers (35 miles), and 72 kilometers (45 miles)) is used for the evaluations. The population distribution includes a breakdown in estimates for six age groups as defined in ICRP Publication 71 (ICRP 1995):

- Infants:
    - 3 months: from 0 to 12 months of age
    - 1 year: from 12 months to 2 years
- Children:
    - 5 years: more than 2 years to 7 years
    - 10 years: more than 7 years to 12 years
    - 15 years: more than 12 years to 17 years
- Adults: more than 17 years

F.3.3.2 Meteorological Data

Site tower meteorological data for 2005 to 2010 from the National Atmospheric Release Advisory Center tower at NRF is used to determine meteorology. Two different weather conditions (50 percent and 95 percent) are evaluated for hypothetical accident scenarios, based on wind speed and stability class for 16 radial directions. The 50 percent condition represents the average meteorological condition, defined as that condition for which more severe conditions with respect to accident consequences are not exceeded more than 50 percent of the time. The 95 percent condition represents the meteorological conditions which could produce the highest calculated radiation exposures, defined as that condition which is not exceeded more than 5 percent of the time or is the worst combination of weather stability class and wind speed with respect to accident consequences.

Other input assumptions related to meteorological data are:

- The release is calculated as occurring at ground level (0 meters (feet)).

- The effects of plume rise are ignored. Buoyant plume rise can occur with releases of heated gases. Jet plume rise can occur when the gases are released through a stack. Plume rise would result in additional dispersion of the plume.

- Mixing layer height is 400 meters (1320 feet). Airborne materials freely diffuse in the atmosphere near ground level in what is known as the mixing depth. A stable layer exists above the mixing depth which restricts vertical diffusion.

- Wet deposition is zero (no rain occurs to accelerate deposition and reduce the area affected).

- Dry deposition of the cloud is modeled. During movement of the radioactive plume, a fraction of the plume is deposited on the ground due to gravitational forces and becomes available for exposure by ground surface radiation and ingestion.

- The quantity of deposited radioactive material, called the deposition velocity, is proportional to the material size and speed. Deposition velocities are calculated internally by the GENII code, but are specified as inputs in RSAC. The following deposition velocities (meters per second) are used in RSAC:
    - solids = 0.001
    - halogens = 0.01
    - noble gases = 0.0
    - cesium = 0.001
    - ruthenium = 0.001

F.3.3.3 Inhalation Data

The breathing rates used are based upon ICRP 71 (ICRP 1995) methodology summarized in Table F.3-2. The breathing rate has a direct effect on the amount of radioactivity inhaled by an individual and varies with age and work conditions.

Table F.3-2: Breathing Rates

Exposed Individual Group	Breathing Rate
	cubic meters per second
Worker – Routine operations	4.69×10^{-4}
Worker – Accident	8.33×10^{-4}
MCW	4.69×10^{-4}
NPA	4.69×10^{-4}
MOI	2.57×10^{-4}
Population – Adult	2.57×10^{-4}
Population – 3-month old	3.31×10^{-5}
Population – 1-year old	5.98×10^{-5}
Population – 5-year old	1.01×10^{-4}
Population – 10-year old	1.77×10^{-4}
Population – 15-year old	2.33×10^{-4}

For routine naval spent nuclear fuel handling operations, a 1 micron particle size is used for all analysis. For accident analysis, the particle size for the NPA, MOI, and General Population is 1 micron, and for the Worker and MCW the particle size is 5 microns, consistent with the particle sizes recommended by the ICRP in Publication 60 (ICRP 1991).

The radiation exposure times for each individual type are given in Table F.3-5 and Table F.3-6. The internal radiation exposure period for infants and children is calculated from the time of initial intake until the child reaches 70 years of age. The internal radiation exposure period for adults (including workers) is 50 years.

Inhalation exposure dose conversion factors from ICRP Publication 68 (ICRP 1994) are used for the worker and MCW in RSAC. Inhalation exposure factors from ICRP Publication 72 (ICRP 1996) are used for inhalation modeling of all other individual types. The use of ICRP Publication 68 is consistent with the DOE transition to ICRP 60 series dosimetry for workers and the use of ICRP Publication 72 includes the radiation exposure estimates to multiple age groups.

F.3.3.4 Ground Surface Exposure Data

The radiation exposure times for each individual type are given in Table F.3-5 and Table F.3-6. A representative 8 hour per day exposure is used for routine naval spent nuclear fuel handling operations to represent an average day. A conservative building shielding factor of 0.7 is used for accident analysis exposing the individual to contaminated soil for approximately 16 hours a day. See Section F.6.2 for additional details on time spent outdoors. Ground surface exposure dose conversion factors published in FGR 12 (EPA 1993) are used.

F.3.3.5 Ingestion Data

Annual dietary intake is consistent with the annual average consumption for the U.S. population (SAND 2010). Ten percent of all products are assumed to be grown and consumed locally. Therefore, 10 percent of the annual diet is modeled to be contaminated with the following exceptions:

- 30 percent of the milk is assumed to be contaminated for the 5 years and older age groups (FDA 1998). This increase accounts for the fact that milk is one of the most common agricultural products produced and consumed locally in southeastern Idaho.

- 100 percent of milk is assumed to be contaminated for infants (the 3-month and 1-year age groups) because milk makes up a majority of the infant's diet and because infants often receive all of their milk from a single source (FDA 1998).

- Drinking water is modeled to be 100 percent contaminated because drinking water is often obtained from a single source.

For routine naval spent nuclear fuel handling operations, ingestion for workers including the MCW is adjusted from the adult consumption rates to account for the ingestion of contaminated food and water that occurs while the worker is at work (8 hours per day, 240 days per year).

The consumption parameters for contaminated food, milk, and water used in this analysis, after the above percentage reductions are included, are provided in Table F.3-3.

The RSAC default parameters for ingestion are based on NRC 1977. The only changes from the defaults are the annual dietary consumption rates shown in Table F.3-3. The consumption rates are modified as discussed above to represent the portion of contaminated (local) food ingested annually. The ingestion periods for each individual type are given in Table F.3-5 and Table F.3-6. Ingestion exposure dose conversion factors from ICRP Publication 72 (ICRP 1996) are used (Table F.3-4). Ingestion exposure is modeled with the individual consuming contaminated food for a 1-year period. The internal radiation exposure period for infants and children is calculated from the time of initial intake until the child reaches 70 years of age. The internal radiation exposure period for adults (including workers) is 50 years.

Table F.3-3: Annual Consumption Inputs for Ingestion of Contaminated Food, Milk, and Water

Annual Consumption Inputs for RSAC (kilograms per year unless otherwise noted)							
	3 Months	**1 Year**	**5 Years**	**10 Years**	**15 Years**	**Adult**	**Worker/ MCW[1]**
Milk (liters per year)	208	179	50.4	54.8	52.6	31.8	N/A
Meat	1.82	2.96	4.67	5.77	7.01	7.99	
Leafy Vegetables	0.12	0.23	0.55	0.84	1.06	1.53	
Stored Vegetables	7.63	9.64	13.4	16.5	17.6	16.4	
Annual Consumption Inputs for GENII (kilograms per year unless otherwise noted)							
	3 Months	**1 Year**	**5 Years**	**10 Years**	**15 Years**	**Adult**	**Worker/ MCW[1]**
Milk (liters per year)	208	179	50.4	54.8	52.6	31.8	10.4
Eggs	0.18	0.44	0.66	0.66	0.80	1.06	0.35
Meat	0.96	1.81	3.25	4.27	5.26	5.69	1.87
Poultry	0.66	0.69	0.80	0.99	1.17	1.20	0.4
Fish	0.02	0.13	0.30	0.40	0.47	0.58	0.19
Mollusk	0.005	0.005	0.011	0.020	0.031	0.055	0.018
Crustacea	0.005	0.005	0.011	0.020	0.031	0.055	0.018
Leafy Vegetables	0.12	0.23	0.55	0.84	1.06	1.53	0.5
Root Vegetables	2.81	3.21	4.24	5.39	5.74	5.71	1.88
Fruit	2.77	2.41	2.26	2.66	2.70	3.03	1
Grain	2.04	4.02	6.94	8.40	9.13	7.67	2.52
Drinking Water	113	190	292	343	402	548	180

[1] No ingestion is modeled for the Worker or MCW accident analysis because only a 20-minute radiation exposure period is evaluated.
1 kilogram = 2.2 pounds
1 liter = 0.26 gallons

F.3.3.6 Summary of Airborne Inputs

The source documents for the radiation exposure dose conversion factors used in the radiological analysis are shown in Table F.3-4.

Table F.3-4: Radiation Exposure Factors

Analysis	Pathway	Worker	MCW	NPA	MOI	General Population
Routine Naval Spent Nuclear Fuel Handling Operations	Inhalation	ICRP 72	ICRP 72	N/A	ICRP 72	ICRP 72
	Ingestion	ICRP 72	ICRP 72	N/A	ICRP 72	ICRP 72
	External	FGR 12	FGR 12	N/A	FGR 12	FGR 12
Hypothetical Accidents	Inhalation	ICRP 68	ICRP 68	ICRP 72	ICRP 72	ICRP 72
	Ingestion	N/A	N/A	N/A	ICRP 72	ICRP 72
	External	FGR 12	FGR 12	FGR 12	FGR 12	FGR 12
FGR 12 = EPA 1993 ICRP 68 = ICRP 1994 ICRP 72 = ICRP 1996						

The radiation exposure times for routine naval spent nuclear fuel handling operations and hypothetical accident analysis are shown in Table F.3-5 and Table F.3-6, respectively.

Table F.3-5: Exposure Times for Routine Naval Spent Nuclear Fuel Handling Operations

Exposed Individual	Time for Plume Exposure and Inhalation		Time for Ground Surface Exposure		Time for Direct Radiation Exposure		Ingestion Period
	hours per day	days per year	hours per day	days per year	hours per day	days per year	years
Worker and MCW	8	240	8	240	8	240	1
MOI and General Population	24	365	8	365	24	365	1

Table F.3-6: Exposure Times for Hypothetical Accident Analysis

Exposed Individual	Time for Plume Exposure		Time for Ground Surface and Direct Radiation Exposure	Ingestion Period
	Inhalation	Air Immersion		
Worker	5 minutes		20 minutes	N/A
MCW and NPA	15 minutes		2 hours	N/A
MOI and General Population	15 minutes		1 year	1 year

F.3.4 Input Data for Waterborne Calculations

GENII is used to calculate the waterborne contribution to dose. Where relevant, identical input information discussed above for airborne calculations is used in the waterborne analysis. In most cases, these conditions are taken directly as defaults from the computer program.

All radionuclides that are introduced into the water are modeled to be distributed uniformly in the water immediately following a hypothetical accident. There are two processes by which radionuclides might enter the water:

- For liquid discharges (i.e., drained water pool scenario), a fraction of the released radionuclides can enter the water accessed by humans by infiltrating through the ground to the groundwater in the aquifer. Based on water infiltration rates discussed in Section 3.4.2.1, it is conservatively modeled that it would take 2 years for the radionuclides to infiltrate through the ground to reach the aquifer. The flow of the aquifer from north to south (Figure 3.4-5) is ignored, and it is conservatively modeled that the contaminated water flows directly towards the MOI and General Population. It is also assumed that the radionuclides are carried by the aquifer to the wells or surface water located beside the MOI and General Population locations at a flow rate of 3.8 meters per day (12.5 feet per day).

- For airborne discharges, it is conservatively modeled that the entire release of radionuclides is deposited either onto bodies of surface water or directly onto the ground based on the fraction of land covered by surface water near the INL area. The radionuclides deposited on the ground are carried through the soil and reach the aquifer in the same manner described above for liquid discharges.

Radioactive decay and removal by sedimentation occurs during the infiltration time through the soil and the subsequent travel time in the aquifer. Radioactive decay also occurs during the time period when the radionuclides have left the water environment and are being transported through the pathways to humans. During this time they would be subjected to both concentration and removal mechanisms which further modify their effect upon humans. These mechanisms are modeled in GENII and include concentration in the surface deposit, animal, and crop pathways; radioactive decay during periods between harvesting a crop and its ingestion by humans; and removal of activity due to harvesting, handling, and cleaning of foodstuff. Dilution in larger volumes of water is accounted for when the radionuclide concentration in the aquifer is calculated.

The water radiation exposure pathways considered in this analysis are the direct radiation from the external pathways (swimming, shoreline exposure, and boating exposure) and the ingestion pathways (drinking water and food that contacted contaminated water).

F.4 Analysis of Routine Naval Spent Nuclear Fuel Handling Operations

This section describes the public and occupational health effects on individuals and the General Population outside the naval spent nuclear fuel handling facility (i.e., ECF or New Facility) due to routine naval spent nuclear fuel handling operations associated with the proposed action. Naval spent nuclear fuel handling facilities are designed to reduce radiation levels outside radiation areas to less than 0.06 millirem per hour. Analyses considered airborne, waterborne, and direct radiation pathways in the determination of health effects (i.e., cancer).

Section 4.13.2.1 describes radiological exposures for the time periods associated with each alternative. These radiation exposures are split into radiation exposures to workers inside the naval spent nuclear fuel handling facilities (i.e., ECF or the new facility) and radiation exposures to individuals outside the naval spent nuclear fuel handling facilities. The radiation exposures to workers inside the naval spent nuclear fuel handling facilities are fully evaluated in Section 4.13.2.1; therefore, no additional discussion of radiation exposures to workers inside the facilities is provided in this Appendix. This Appendix focuses on the radiation exposures to individuals outside the naval spent nuclear fuel handling facilities for the post-refurbishment operational period of the Overhaul Alternative, the transition period of the New Facility Alternative, and the new facility operational period. These are the time periods for which there would be increases to the baseline radiation exposures described in Section 3.13.2.

The nature of naval spent nuclear fuel handling operations would be the same for the post-refurbishment operational period of the Overhaul Alternative, the transition period of the New Facility Alternative, and the new facility operational period. During these time periods, ECF or the new facility are modeled to operate at maximum capacity for unloading M-140 shipping containers, unloading M-290 shipping containers, and loading naval spent nuclear fuel canisters to meet the needs of the naval nuclear fleet and the obligations under the Idaho Settlement Agreement (SA 1995) and its 2008 Addendum (SAA 2008). Different shipping containers (i.e., M-140 and M-290) are needed to transport different types of naval spent nuclear fuel. During the transition period, the new facility and ECF would operate in parallel. The production rates during the transition period would be bounded by the maximum capacity for unloading M-140 shipping containers, unloading M-290 shipping containers, and loading naval spent nuclear fuel canisters in either ECF (post-refurbishment operational period) or the new facility (new facility operational period). Therefore, the discussion provided in this Appendix regarding routine naval spent fuel handling operations applies to operations at maximum capacity for the three time periods. A maximum capacity year assumption for the above time periods is conservative because ECF or the new facility would not operate at maximum capacity for the entire operational period. The 2009 baseline emissions and radiation exposures from ECF and NRF provided in Section 3.6.6 and Section 3.13.2 are also discussed to support impact comparisons in Section 4.6.2 and Section 4.13.2.1.

F.4.1 Radiological Emissions From Routine Naval Spent Nuclear Fuel Operations

Radiological emissions for routine naval spent nuclear fuel handling operations for the time-frames of the proposed action described above are estimated based on routine 2009 annual releases from ECF that are scaled to future activities. The radiological emissions are related to the operational tempo of shipping container unloading and naval spent nuclear fuel canister loading. The operational tempo is set by the need to support the naval nuclear fleet and operate in accordance with SA 1995 and SAA 2008. The baseline 2009 ECF emissions are scaled to represent the capacity of future naval spent nuclear fuel handling operations based on the expected tempo of these operations.

The 2009 emissions from NRF include emissions from ECF (naval spent nuclear fuel handling and examination operations), and non-ECF operations (e.g., the prototype buildings that continue to be monitored). The 2009 NRF emissions rates are presented in Table F.4-1.

Table F.4-1: 2009 Radiological Air Emissions From NRF

Radionuclide[1]	ECF Naval Spent Nuclear Fuel Handling	ECF Examinations	Total ECF Operational Emissions	Non-ECF Emissions from NRF Operations	Total NRF Operational Emissions
	Curies per year				
C-14	8.0×10^{-1}	0.0	8.0×10^{-1}	0.0	8.0×10^{-1}
H-3	1.8×10^{-2}	5.9×10^{-3}	2.4×10^{-2}	0.0	2.4×10^{-2}
I-129	3.8×10^{-5}	0.0	3.8×10^{-5}	0.0	3.8×10^{-5}
I-131	1.1×10^{-6}	4.0×10^{-6}	5.1×10^{-6}	0.0	5.1×10^{-6}
Kr-85	1.7×10^{-2}	1.1×10^{-1}	1.3×10^{-1}	0.0	1.3×10^{-1}
Pu-239[2]	5.1×10^{-7}	1.6×10^{-7}	6.7×10^{-7}	1.1×10^{-6}	1.8×10^{-6}
Sr-90[3]	1.6×10^{-5}	5.8×10^{-6}	2.2×10^{-5}	4.3×10^{-5}	6.5×10^{-5}
Total	**8.3×10^{-1}**	**1.2×10^{-1}**	**9.4×10^{-1}**	**4.4×10^{-5}**	**9.5×10^{-1}**

[1] Radionuclides released in 2009 that are not typical are not included.
[2] Gross alpha activity is modeled as Pu-239.
[3] Gross beta activity is modeled as Sr-90.

The total ECF emissions from naval spent nuclear fuel handling and examination operations and total NRF emissions from Table F.4-1 are evaluated as the 2009 baseline for ECF and NRF. In 2009, the naval spent nuclear fuel handling operations at ECF included the unloading of eight M-140 shipping containers and the loading of sixteen naval spent nuclear fuel canisters. The impacts from the ECF and NRF baseline emissions are discussed in Section 3.6.6.

ECF currently processes M-130 and M-140 shipping containers. Under the proposed action, M-290 shipping containers would also be processed. The source of emissions from the unloading of shipping containers and loading of naval spent nuclear fuel canisters is primarily corrosion products that were activated by radiation. Although the corrosion products tightly adhere to the outside surface of the naval spent nuclear fuel, some corrosion products become dislodged from the naval spent nuclear fuel during shipment or handling and become airborne when the shipping container is opened or the naval spent nuclear fuel canister is loaded. Gaseous radionuclides (e.g., carbon-14 (C-14) and tritium (H-3)) are emitted when the shipping containers are vented. The particulate airborne contamination from shipping container unloading and naval spent nuclear fuel canister loading is controlled at the source through High-Efficiency Particulate Air (HEPA)-filtered ventilation systems at the shipping container unloading stations and naval spent nuclear fuel canister loading stations. A scaling factor for the amount of corrosion products in each type of shipping container is developed to account for the length of the aircraft carrier naval spent nuclear fuel assemblies without prior disassembly transported to NRF in an M-290 shipping container compared to the naval spent nuclear fuel assemblies transported in an M-140 shipping container. To support the operational tempo of the naval nuclear fleet, ECF or the new facility would process fourteen M-140 shipping containers and ten M-290 shipping containers per year at full capacity. Therefore, the 2009 ECF emissions generated from processing eight M-140 shipping containers (no M-130 shipping containers were processed in 2009) are scaled based on the capacity of M-140 and M-290 shipping containers that could be processed in ECF or the new facility for time-frames of the proposed action.

To support the NNPP's obligations under the SA 1995 and SAA 2008, future loading rates of naval spent nuclear fuel canisters are expected to be less than the current loading rates. The expected loading rate at full capacity would peak at 15 naval spent nuclear fuel canisters per year. Therefore, the 2009 ECF emissions generated from loading 16 naval spent nuclear fuel canisters are scaled based on the future capacity to load 15 naval spent nuclear fuel canisters per year.
The scaled emissions from shipping container unloading and naval spent nuclear fuel canister loading are added together to obtain the routine naval spent nuclear fuel handling operations emissions for a full capacity naval spent nuclear fuel handling facility in the time-frames of the proposed action. The estimated emissions from a full capacity naval spent nuclear fuel handling facility are presented in Table F.4-2. For conservatism, additional features that would be incorporated into the design of a new facility (e.g., additional HEPA ventilation) are not accounted for in the development of the emission source term. Since examination operations would continue at ECF during the post-refurbishment operational period, the transition period, and the new facility operational period, the 2009 emissions from ECF examination activities are added to the naval spent nuclear fuel handling operation emissions. Table F.4-2 also provides the naval spent nuclear fuel handling operations emissions combined with the 2009 ECF examination operations emissions for comparison to the total ECF 2009 emissions.

Table F.4-2: Estimated Future Radiological Emissions for Routine Naval Spent Nuclear Fuel Handling Operations

Radionuclide	Full Capacity Naval Spent Nuclear Fuel Handling Operations Emissions	2009 ECF Examination Emissions	Total Naval Spent Nuclear Fuel Handling and Examination Emissions
	Curies per year		
C-14	1.8	0.0	1.8
H-3	5.2×10^{-2}	5.9×10^{-3}	5.8×10^{-2}
I-129	3.6×10^{-5}	0.0	3.6×10^{-5}
I-131	3.6×10^{-6}	4.0×10^{-6}	7.6×10^{-6}
Kr-85	1.6×10^{-2}	1.1×10^{-1}	1.3×10^{-1}
Pu-239[1]	1.6×10^{-6}	1.6×10^{-7}	1.8×10^{-6}
Sr-90[2]	5.1×10^{-5}	5.8×10^{-6}	5.7×10^{-5}
Total	**1.8**	**1.2×10^{-1}**	**1.9**

[1] Gross alpha activity is modeled as Pu-239.
[2] Gross beta activity is modeled as Sr-90.

The total naval spent nuclear fuel handling and ECF 2009 examination emissions are evaluated for a full capacity naval spent nuclear fuel handling facility. The emissions from a full capacity naval spent nuclear fuel handling facility with 2009 ECF emissions are higher than the 2009 baseline emissions for ECF. The increase from the 2009 ECF baseline is due entirely to the assumption that the facility would operate at maximum capacity. The impacts from a full capacity naval spent nuclear fuel handling facility emissions are discussed in Section 4.6.2.

F.4.2 Radiation Exposure From Routine Naval Spent Nuclear Fuel Operations

The radiation exposure calculations include the radioactive particles or gases released into the atmosphere or into the aquifer from routine naval spent nuclear fuel handling operations via three pathways: airborne, waterborne, and direct radiation. Airborne contributions to dose are determined using an air dispersion modeling software (GENII) to calculate the doses attributable to air immersion, inhalation, ingestion, and ground shine (radiation from radionuclides deposited on the ground). Waterborne contributions to dose are determined using the GENII modeling software to calculate the doses attributable to water immersion and ingestion (of both water and contaminated foods). Direct radiation contributions are determined from a facility design requirement for radiation levels outside a radiological facility attenuated by distance.

Table F.4-3 presents the estimated radiation exposure and fatal cancer from the 2009 ECF and NRF emissions for members of the public (MOI and General Population). The emissions evaluated are presented in the total ECF emissions and the total NRF emissions columns of Table F.4-1.

Table F.4-3: Annual Health Effects for 2009 Routine Naval Spent Nuclear Fuel Handling Operations at NRF

<table>
<tr><th colspan="2" rowspan="2">Individual</th><th>TED</th><th rowspan="2">Fatal Cancer Per Individual[1]</th></tr>
<tr><td>rem</td></tr>
<tr><td colspan="2">2009 ECF MOI</td><td>2.7×10^{-7}</td><td>1.5×10^{-10}</td></tr>
<tr><td colspan="2">2009 NRF MOI</td><td>2.7×10^{-7}</td><td>1.5×10^{-10}</td></tr>
<tr><th colspan="3">Exposure to the General Population within an 80.5-kilometer (50-mile) Radius of NRF</th><th rowspan="2">Fatal Cancer in the General Population[1]</th></tr>
<tr><td rowspan="3">General Population of approximately 151,000</td><td></td><td>person-rem</td></tr>
<tr><td>ECF</td><td>9.0×10^{-3}</td><td>5.0×10^{-6}</td></tr>
<tr><td>NRF</td><td>9.0×10^{-3}</td><td>5.0×10^{-6}</td></tr>
<tr><td colspan="4">1 To convert dose to fatal cancer, a factor of 5.5×10^{-4} is multiplied by the dose for the MOI and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factor which includes both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factor overstates the likelihood of fatal cancer in a population and the use of this factor to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)</td></tr>
</table>

Only MOI and General Population radiation exposures are evaluated for the 2009 ECF and NRF baseline because these are the only individuals available for comparison to the INL baseline discussed in Section 3.13.2. The ECF emissions from C-14 contribute approximately 98 percent of the radiation exposure to the MOI and General Population. The radiation exposure contribution from the Pu-239 and Sr-90 not related to ECF emissions contribute approximately 2 percent or less of the radiation exposure. Therefore, the radiation exposures from NRF are essentially the same as the radiation exposures from ECF.

Table F.4-4 presents the estimated radiation exposures and fatal cancer for 1 year of routine naval spent nuclear fuel handling and examination operations of a full capacity naval spent nuclear fuel handling facility associated with the proposed action. The emissions evaluated are presented in the full capacity column of Table F.4-2.

Table F.4-4: Estimated Annual Health Effects for Routine Naval Spent Nuclear Fuel Handling Operations

Individual	TED	Fatal Cancer Per Individual[1]
	rem	
Worker	1.0×10^{-3}	4.1×10^{-7}
MCW	6.9×10^{-8}	2.8×10^{-11}
MOI	6.0×10^{-7}	3.3×10^{-10}
Exposure to the General Population within an 80.5-kilometer (50-mile) Radius of NRF		**Fatal Cancer in the General Population[1]**
General Population of approximately 151,000	person-rem	
	2.0×10^{-2}	1.1×10^{-5}

[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the MOI and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

The 2.0×10^{-2} person-rem from naval spent nuclear fuel handling and examination operations is higher than the 2009 ECF baseline radiation exposure of 9.0×10^{-3} person-rem. The increase is due entirely to the assumption that the facility would operate at maximum capacity.

The estimated likelihood of fatal cancer to the General Population living within an 80.5-kilometers (50-mile) radius of NRF due to radiological releases from 1 year of naval spent nuclear fuel handling operations at full capacity associated with the proposed action is 1.1×10^{-5} (1 in 91,000). The estimate is calculated using the methods described in Section F.3. The fatal cancer that could be developed from routine naval spent nuclear fuel handling operations under the proposed action is very low in comparison to the 2.3×10^{4} (22,650) individuals living within an 80.5-kilometers (50-mile) radius of NRF that would be expected to die from cancer from a lifetime of normal activity unrelated to NRF emissions (Section F.2.6).

F.5 Hypothetical Accident Scenario Analysis

F.5.1 Introduction

Hypothetical accident scenarios were considered for inclusion in detailed analyses if they are expected to contribute substantially to risk (defined as the product of the probability of occurrence of the accident times the consequence of the accident). The hypothetical accident scenarios chosen for evaluation represent a range of both consequence and probability. The range of hypothetical accident scenarios evaluated includes external events (e.g., earthquakes and windborne missiles (i.e., airborne projectiles)), and accidents due to human error or equipment failures (e.g., mechanical damage from naval spent nuclear fuel processing operations, inadvertent criticality, naval spent nuclear fuel assembly drop, or naval spent nuclear fuel basket tip-over). For hypothetical accidents, consequences (i.e., dose) are presented for both the 50 percent and the 95 percent meteorological conditions; annual risk calculations are presented to allow comparisons between hypothetical accident scenarios.

In addition to hypothetical accident scenarios, IDAs are also considered. These IDAs are not considered “accidents” because the event would be intentional. Although any hypothetical accident scenario evaluated could possibly be caused by an IDA, the IDAs discussed specifically in this

Appendix are unlikely to result from anything other than intentional intervention. For IDAs, consequences (i.e., dose) are presented for 50 percent and 95 percent meteorological conditions. Annual risk calculations are not completed for these scenarios because the probability of the event is considered “unknowable” (DOE 2004b). For simplicity, the descriptions of methodology for hypothetical accident scenarios are applicable to IDAs. Methodology for preventing and mitigating IDAs is discussed in Section F.6.2.

Significant releases of radioactive material to the environment or significant increases in radiation levels can only occur if an accident produces severe conditions. Some types of accidents, such as procedure violations, spills of small volumes of water containing radioactive particles, or most other types of common human error, may occur more frequently than the hypothetical accidents analyzed. However, they do not involve enough radioactive material or radiation to result in a significant release to the environment or a meaningful increase in radiation levels. The very low consequences associated with these events produce smaller risks than those for the hypothetical accidents analyzed. This is true even when the consequences of the events are combined with higher probability of occurrence. Consequently, they are not explicitly analyzed in this EIS.

The radiological impacts to the individuals and General Population described in Section F.3.1 are calculated quantitatively for each scenario. Radiological impacts to involved workers who are located at or nearby the accident scene are discussed qualitatively for each scenario.

F.5.2 Accident Selection

Various accident scenarios representing a spectrum of hypothetical events are developed for naval spent nuclear fuel handling operations. As described in Section F.5.1, initiating events were considered including natural phenomena (earthquakes, volcanic activity, tornadoes, hurricanes and other natural events) and human initiated events (human error, equipment failures, fires, explosions, plane crashes, transportation accidents, and sabotage). Guiding principles were established for the scenario development including: the radioactive materials involved must be available in a dispersible form; there must be a mechanism available for release of such materials from the facility; and, there must be a mechanism available for off-site dispersion of the released materials. Recognizing these fundamental processes, accidents involving the following basic phenomena are identified:

- Release of radioactive products to the environment due to overheating of naval spent nuclear fuel
- Release of radioactive products to the environment due to mechanical shock, damage, or inadvertent breaching of naval spent nuclear fuel cladding or containment

Accidents are selected to be representative of naval spent nuclear fuel handling operations discussed in Section 1.2.

Twelve hypothetical accident scenarios and IDAs are evaluated for naval spent nuclear fuel handling operations. These hypothetical accident scenarios include a HEPA filter fire, a shielded transfer container (STC) drop or tip-over, an airplane crash into the water pool, a drained water pool, a hydrogen detonation in the water pool, mechanical damage to naval spent nuclear fuel in the water pool, an inter-facility transport accident, an inadvertent fuel cutting in the water pool, an inadvertent criticality in the water pool, a shielded basket transfer container (SBTC) drop or tip-over, a windborne projectile into an SBTC, and a minor water pool leak into the environment. The minor water pool leak is predominantly evaluated qualitatively because of the many variables and associated uncertainties in the scenario and the low consequences expected if a minor water pool leak were to occur.

The inter-facility transport accident scenario and the airplane crash into the water pool scenario have been treated as IDAs only, and no probability of occurrence or resultant annual risk is calculated. Based on the slow travel speeds, short travel distance across NRF property, and infrequent naval spent nuclear fuel assembly transfers, the inter-facility transport accident scenario is not considered reasonably foreseeable without intentional human intervention. Similarly, because of the low level of commercial air traffic across NRF, distance from airports, and relatively small target footprint for a naval spent nuclear fuel handling facility, the airplane crash into the water pool is not considered reasonably foreseeable without intentional human intervention.

F.5.3 Radiological Accident Source Term Development

In analyzing the potential consequences of postulated scenarios, the source term as defined in this Appendix is the amount of radioactive material (in Curies) released to the environment. The airborne source term is estimated by the following equation (DOE 1994):

Source Term = MAR * DR * ARF * RF * LPF

Where:

Source Term (Curies) = the amount of radioactive material released to the environment

MAR = Material-At-Risk (Curies), the maximum amount and type of material present that may be acted upon in the scenario evaluated

DR = Damage Ratio, the fraction of the MAR impacted by the actual accident-generated conditions under evaluation

ARF = Airborne Release Fraction, the fraction of radioactive material actually affected by the accident condition that is suspended in air

RF = Respirable Fraction, the fraction of the airborne radioactive particles that are in the respirable size range (i.e., less than 10 microns)

LPF = Leak Path Factor, the cumulative fraction of materials from the postulated accident that escape to the atmosphere through containment, confinement, water, or filtration

For this EIS it is conservatively assumed that all released material is in the breathable range and the RF is set equal to 1.0. The ARF is combined with the LPF and is not calculated separately. These modifications simplify the source term calculation commonly used in DOE analysis.

For many hypothetical accident scenarios, the MAR is one or more naval spent nuclear fuel assemblies. To account for the fact that there are many different types of naval spent nuclear fuel (e.g., carrier and submarine), a representative equivalent naval spent nuclear fuel type is modeled in the analysis. The representative naval spent nuclear fuel type has the characteristics of a typical naval spent nuclear fuel assembly that would be handled at NRF during the time-frame of the proposed action. The maximum number of representative naval spent nuclear fuel assemblies that would be stored in the water pool during the time-frame of the proposed action is 400 equivalent naval spent nuclear fuel assemblies. The number of representative naval spent nuclear fuel assemblies differs from the 550 storage ports in the water pool to account for the different characteristics of the different types of naval spent nuclear fuel located in the storage ports.

Multiple LPFs are used in this EIS. Naval spent nuclear fuel overheating LPFs apply to scenarios that involve overheating naval spent nuclear fuel (e.g., in a fire) and to energetic releases (e.g., in a criticality). The release fractions are determined for various nuclide groups based on chemical property similarities and the results of NNPP and commercial testing of overheated fuels.

Water scrubbing LPFs apply to underwater releases. For hypothetical accident scenarios in which the MAR is submerged in a water pool, the water above the MAR acts as a filter for certain materials and reduces the overall release to the environment. For a non-energetic, unheated release, materials retained within the water include all particulate fission products and corrosion products. Since none of these materials reach the environment, their LPF is equal to zero. For accidents involving an energetic or heated release beneath an overlaying volume of water (e.g., an underwater criticality or hydrogen detonation), the particulates and elemental iodine are reduced by a water scrubbing factor of 10 (LPF = 0.1). With the exception of elemental iodine, water scrubbing is ineffective in reducing the release of gaseous products. These gaseous products are assumed to bubble up through the water pool water and are released to the building with an LPF of 1.0.

Filtration LPFs apply to all hypothetical accident scenarios that occur within an undamaged building. Filtered ventilation significantly reduces the overall release of all but gaseous constituents to the environment. Naval spent nuclear fuel handling facilities utilize HEPA filters to capture radioactive materials before they are released into the environment. HEPA filtration units are modeled to capture 99.9 percent of the particulates (LPF = 0.001). This represents the filtration efficiency of a single HEPA filter. Multiple HEPA filter units in series are conservatively modeled as single units. The LPF assumption is conservative because systems containing HEPA filtration are tested to ensure they are at least 99.95 percent efficient for capturing 0.7 micron particles. HEPA filtration has no effect on gaseous materials, as they are not captured by the filters (LPF = 1.0).

All noble gases and a fraction of the iodines are modeled as gaseous fission products. The noble gas release, as well as the release of gaseous iodine in the form of organic iodines, is not reduced by either HEPA filtration or water scrubbing. The release of gaseous iodine in elemental form is not reduced by HEPA filtration but, as described earlier, is reduced by water scrubbing if the release is underwater. The release of particulate iodine is reduced by both HEPA filtration and water scrubbing. For an underwater release, particulate iodine is assumed to re-evolve, in the low pH water pools, as elemental iodine.

The mechanical LPFs used in this EIS are determined individually for each scenario dependent upon the path of material release. Mechanical LPFs are associated with passage through a mechanical boundary, such as a cracked container seal. Separate LPFs are frequently used for corrosion products and fission products because the material is released by different pathways. The mechanical LPFs only apply to the particulates in the MAR because the gaseous materials are not trapped by the container or release mechanisms involved in the accident.

Table F.5-1 summarizes the factors used in source term development.

Table F.5-1: Factors in Source Term Development

Scenario	MAR	LPF	Type of Release
HEPA Filter Fire	Four Local HEPA Filter Inventories	Downstream HEPA filtration	Filtered release
Shielded Transfer Container Drop or Tip-Over	One Fuel Assembly	HEPA filtration Mechanical (0.001 for fission products; 0.005 for corrosion products)	Filtered release of fission products and corrosion products
Airplane Crash into Water Pool	Entire Water Pool Inventory of Approximately 400 Equivalent Fuel Assemblies	Water scrubbing	Underwater gaseous release of fission products
Drained Water Pool	Entire Water Pool Inventory of Approximately 400 Equivalent Fuel Assemblies	None	Release of corrosion products
Hydrogen Detonation in the Water Pool	Fuel in Storage Container	HEPA filtration Energetic water scrubbing, Mechanical (0.1)	Filtered, energetic underwater release of fission products and corrosion products
Mechanical Damage to Fuel in the Water Pool	Fuel in a Fuel Discharge Stand	Water scrubbing	Underwater gaseous release of fission product
Inter-Facility Transport Accident	One Fuel Assembly	Fuel overheating Mechanical (0.1)	Release of corrosion products and heated release of fission products
Inadvertent Fuel Cutting in the Water Pool	One Fuel Assembly	Water Scrubbing	Underwater gaseous release of fission products
Inadvertent Criticality in the Water Pool	Two Fuel Assemblies and Criticality Products	Fuel overheating Energetic water scrubbing HEPA filtration	Filtered, energetic underwater release of fission products
Shielded Basket Transfer Container Drop or Tip-Over	Fuel in SBTC	HEPA filtration Mechanical (0.001 for fission products; 0.005 for corrosion products)	Filtered release of fission products and corrosion products
Windborne Projectile into Shielded Basket Transfer Container	Fuel in SBTC	Mechanical (0.005 for corrosion products)	Release of corrosion products
Minor Water Pool Leak	This scenario is evaluated qualitatively.		

F.5.4 Hypothetical Accident Scenarios and Results

The hypothetical accident scenarios evaluated in this Appendix are discussed below.

The scenarios are discussed in operational order as discussed in Section 1.2. A description of the conditions is given to explain plausible causes of the accidents, the source of the release, and the pathways by which radioactivity is released to the environment. All of the radionuclides potentially released from an accident are used in the analyses of the accident consequences. For simplicity, tables showing the source terms include only the nuclides that result in at least 99 percent of the radiation exposure. Factors used in developing the source term are detailed in Table F.5-1 and described in Section F.5.3.

The airborne release to the environment is modeled to occur at a constant rate over a 15-minute period. In general, the estimated annual probability of each accident occurring is discussed. The radiation exposure results, health effects from radiation exposure (fatal cancer), and annual risk to the General Population that could result from each accident are summarized. 'Risk' is defined as the cancer in the General Population times the probability of occurrence of the accident. Annual risk is calculated by multiplying the annual probability of an accident and the health effect. The lifetime risk of developing fatal cancer is determined by multiplying the annual risk of developing fatal cancer by the expected time-frame of the alternative (Section 2.3).

The impact to workers involved in naval spent nuclear fuel handling (involved workers) due to the hypothetical accident scenarios is also discussed qualitatively. This evaluation focuses on the radiological consequences of the accident. A limited number of fatalities may occur due to the non-radiological physical effects of the accident (i.e., a worker who happened to be in the facility may be killed due to a plane crash, seismic event, crane failure, etc.). These non-radiological accident effects are not discussed.

F.5.4.1 HEPA Filter Fire

Description of Conditions

In this hypothetical accident scenario, a fire develops in one of the local ventilation systems used during naval spent nuclear fuel handling operations. Local filtered ventilation systems are utilized during operations with risk of airborne contamination (e.g., shipping container unloading or naval spent nuclear fuel canister loading). This scenario is assumed to occur during the unloading of a shipping container. The local ventilation systems are not run continuously and are only operated while the specific operation is in progress. This accident could be initiated by the ignition of a flammable mixture released upstream of the system or by an external, unrelated fire that spreads to the local HEPA ventilation system. Additionally, shock impact damage to a HEPA filter is assumed to ensure that damage to the HEPA filter is conservatively addressed. It is assumed that the radioactivity released from the local HEPA filters is drawn into the downstream building HEPA filtration system before being released to the environment.

Source Term

The source term used for this scenario is shown in Table F.5-2.

Table F.5-2: Source Term for the HEPA Filter Fire Scenario

Radionuclide[1]	Activity
	Curies
Co-58	1.97×10^{-6}
Co-60	5.18×10^{-6}
Fe-55	9.53×10^{-6}
Mn-54	3.25×10^{-7}
Zn-65	1.40×10^{-7}

[1]The radionuclides shown in the table contribute at least 99 percent of the radiation exposure from the scenario.

Probability

The probability of a fire in a HEPA filter is estimated based on the probability of a fire in the facility spreading to the local HEPA filter system. Fires in industrial nuclear facilities have been estimated to range from 2×10^{-3} to 5×10^{-3} per year (WSRC 1995). The probability of a fire in a HEPA filter is considered to be lower because HEPA filters are not inherently volatile or explosive. In addition, local HEPA filter systems are located nearby operations where the risks for airborne contamination release are high. Since chemicals and flammable liquids are not stored near these areas, it is estimated that the probability of a nuclear facility fire spreading to a HEPA filter is less than 1×10^{-1}. This results in a range of probabilities of 2×10^{-4} to 5×10^{-4} for a HEPA filter fire. An annual probability of 5×10^{-4} is conservatively used to develop the annual risks in Table F.5-3 (Section F.7.1).

Results

The radiation exposure results, fatal cancer from radiation exposure, and annual risk to the General Population (i.e. product of fatal cancer and probability of accident occurrence) that would result from this hypothetical accident scenario, are shown in Table F.5-3.

Table F.5-3: Health Effects From the HEPA Filter Fire Scenario

Weather Condition	Exposed Individual	TED rem	Fatal Cancer Per Individual[1]	
50 Percent Meteorology	Worker	5.5×10^{-7}	2.3×10^{-10}	**Annual Risk of Developing Fatal Cancer to the General Population**[2]
	MCW	3.6×10^{-10}	1.5×10^{-13}	
	NPA	2.8×10^{-10}	1.5×10^{-13}	
	MOI	2.1×10^{-9}	1.2×10^{-12}	
	Exposure to the General Population person-rem		**Fatal Cancer in the General Population**[1]	
	2.1×10^{-5}		1.1×10^{-8}	5.7×10^{-12}
95 Percent Meteorology	**Exposed Individual**	**TED** rem	**Fatal Cancer Per Individual**[1]	**Annual Risk of Developing Fatal Cancer to the General Population**[2]
	Worker	3.3×10^{-6}	1.4×10^{-9}	
	MCW	5.6×10^{-9}	2.3×10^{-12}	
	NPA	4.8×10^{-9}	2.6×10^{-12}	
	MOI	3.5×10^{-8}	1.9×10^{-11}	
	Exposure to the General Population person-rem		**Fatal Cancer in the General Population**[1]	
	1.6×10^{-4}		8.5×10^{-8}	4.3×10^{-11}

[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the NPA, MOI, and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

[2] Probability of scenario occurrence equals 5×10^{-4} events per year. The probability of the accident is conservative (Section F.7.1).

Impact on Involved Workers

No fatalities would be expected among nearby workers from the radiological consequences of a fire in a local HEPA filter; the release of radioactivity from a HEPA filter fire would be small. The fire could result in release of airborne radioactivity. Fire alarms and radiation alarms would sound requiring evacuation of nearby workers. At most, two or three nearby workers may receive some additional radiation exposure from the released radioactivity. However, evacuation following the radiation alarms would prevent substantial radiation exposure.

F.5.4.2 STC Drop or Tip-Over

Description of Conditions

In this hypothetical accident scenario, mechanical damage to naval spent nuclear fuel occurs while the fuel is being removed from the shipping container and transferred into the fuel discharge station during a shipping container unloading operation. Mechanical damage to the naval spent nuclear fuel can occur as the result of inadvertent dropping of the transfer container or collapse of the transfer crane. It is assumed that seals on the STC are breached resulting in a mechanical leak path factor (0.001 for fission products and 0.005 for corrosion products). The building structure would not be damaged during this scenario, and the existing HEPA filter ventilation systems would continue to operate as normal. The radioactivity release is assumed to be drawn into the filtration system without mixing or dilution in the building.

Source Term

The source term used for this scenario is shown in Table F.5-4.

Table F.5-4: Source Term for the STC Drop or Tip-Over Scenario

Radionuclide[1]	Activity Curies	Radionuclide[1]	Activity Curies
Am-241	1.92×10^{-6}	Kr-85	4.93×10^{1}
Ba-137m	5.69×10^{-3}	Nb-95	2.59×10^{-3}
Ce-144	8.33×10^{-3}	Pm-147	3.51×10^{-3}
Cm-242	2.11×10^{-5}	Pr-144	8.33×10^{-3}
Cm-244	6.75×10^{-6}	Pu-238	1.83×10^{-4}
Cs-134	2.98×10^{-3}	Pu-241	1.98×10^{-4}
Cs-137	6.03×10^{-3}	Ru-106	7.00×10^{-4}
Eu-154	1.70×10^{-4}	Sr-90	5.91×10^{-3}
H-3	2.29	Y-90	5.92×10^{-3}
I-129	5.51×10^{-6}	Zr-95	1.25×10^{-3}

[1] The radionuclides shown in the table contribute at least 99 percent of the radiation exposure from the scenario.

Probability

The STC drop causing mechanical damage to naval spent nuclear fuel is postulated to occur due to crane failure. The DOE performed evaluations of crane failure accidents in analyses for the Initial Handling Facility at Yucca Mountain (DOE 2008b) and developed a probability of 3.2×10^{-5} drops of heavy lifts per demand. The NNPP uses standards that would ensure similar or lower probability of a drop accident. Based on the number of shipping containers unloaded in a typical year, there would be 85 STC crane lifts. Although the rugged construction and design of the STC and naval spent nuclear fuel would reduce the likelihood of a drop resulting in a release to the environment, no additional factors are applied. The probability of an STC drop accident from crane failure would therefore be 2.7×10^{-3} per year. An annual probability of 2.7×10^{-3} is conservatively used to develop the annual risks in Table F.5-5 (Section F.7.1).

Results

The radiation exposure results, fatal cancer from radiation exposure, and annual risk to the General Population (i.e., product of fatal cancer and probability of accident occurrence) that would result from this hypothetical accident scenario are shown in Table F.5-5.

Table F.5-5: Health Effects From the STC Drop or Tip-Over Scenario

<table>
<tr><th rowspan="2">Weather Condition</th><th rowspan="2">Exposed Individual</th><th>TED</th><th rowspan="2">Fatal Cancer Per Individual[1]</th><th rowspan="8">Annual Risk of Developing Fatal Cancer to the General Population[2]</th></tr>
<tr><th>rem</th></tr>
<tr><td rowspan="9">50 Percent Meteorology</td><td>Worker</td><td>1.6×10^{-2}</td><td>6.6×10^{-6}</td></tr>
<tr><td>MCW</td><td>1.1×10^{-5}</td><td>4.3×10^{-9}</td></tr>
<tr><td>NPA</td><td>6.5×10^{-6}</td><td>3.6×10^{-9}</td></tr>
<tr><td>MOI</td><td>1.0×10^{-5}</td><td>5.6×10^{-9}</td></tr>
<tr><th colspan="2">Exposure to the General Population</th><th rowspan="2">Fatal Cancer in the General Population[1]</th></tr>
<tr><td colspan="2">person-rem</td></tr>
<tr><td colspan="2">9.7×10^{-2}</td><td>5.3×10^{-5}</td><td>1.4×10^{-7}</td></tr>
<tr><th rowspan="2">Exposed Individual</th><th>TED</th><th rowspan="2">Fatal Cancer Per Individual[1]</th><th rowspan="8">Annual Risk of Developing Fatal Cancer to the General Population[2]</th></tr>
<tr><td>rem</td></tr>
<tr><td rowspan="9">95 Percent Meteorology</td><td>Worker</td><td>9.7×10^{-2}</td><td>4.0×10^{-5}</td></tr>
<tr><td>MCW</td><td>1.6×10^{-4}</td><td>6.7×10^{-8}</td></tr>
<tr><td>NPA</td><td>1.1×10^{-4}</td><td>6.2×10^{-8}</td></tr>
<tr><td>MOI</td><td>1.7×10^{-4}</td><td>9.1×10^{-8}</td></tr>
<tr><th colspan="2">Exposure to the General Population</th><th rowspan="2">Fatal Cancer in the General Population[1]</th></tr>
<tr><td colspan="2">person-rem</td></tr>
<tr><td colspan="2">7.3×10^{-1}</td><td>4.0×10^{-4}</td><td>1.1×10^{-6}</td></tr>
<tr><td colspan="5">[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the NPA, MOI, and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)
[2] Probability of scenario occurrence equals 2.7×10^{-3} events per year. The probability of the accident is conservative (Section F.7.1).</td></tr>
</table>

Impact on Involved Workers

No fatalities would be expected among nearby workers from radiological consequences from an STC drop or tip-over scenario. The breach in the container seal could result in release of airborne radioactivity, and radiation alarms would sound requiring evacuation of nearby workers. At most, two or three nearby workers may receive some additional radiation exposure from the released radioactivity. However, evacuation following the radiation alarms would prevent substantial radiation exposure.

F.5.4.3 Airplane Crash Into the Water Pool

Description of Conditions

Impact into water pools by aircraft with resulting damage to the naval spent nuclear fuel assemblies stored inside the water pool is evaluated for the temporary wet storage operation. The resultant debris from the airplane crash into the facility falls into the water pool causing mechanical damage to the naval spent nuclear fuel assemblies. The building structure would be damaged as a result of the airplane crash and all existing filtered ventilation systems would be non-functional. In addition, it is unlikely that an airplane would impact the water pool at an angle steep enough to expose the floor of the pool or the walls of the pool below the water level to the direct impact. It is assumed that the water pools remain intact because the walls of the water pool are constructed of thick, reinforced concrete with earth surrounding them, making them very strong; any fires that would result do not impact the submerged naval spent nuclear fuel. Fission products and corrosion products are released from the naval spent nuclear fuel assemblies into the water pool; however, the water pool water is not released to the environment because the water pool remains intact. The presence of water pool water results in only a release of gaseous fission products to the atmosphere. The scenario conservatively includes damage to the entire water pool inventory of approximately 400 equivalent fuel assemblies.

Source Term

The source term used for this scenario is shown in Table F.5-6.

Table F.5-6: Source Term for the Airplane Crash Into the Water Pool Scenario

Radionuclide[1]	Activity
	Curies
H-3	9.22×10^{2}
I-129	4.59×10^{-3}
Kr-85	1.98×10^{4}

[1] The radionuclides shown in the table contribute at least 99 percent of the radiation exposure from the scenario.

Probability

This accident was considered for inclusion in the analysis of risk; however, because of the low-level of commercial air traffic across NRF, distance from airports, and relatively small target footprint for a naval spent nuclear fuel handling facility, this scenario is not considered reasonably foreseeable without intentional human intervention. The consequences of this scenario are analyzed, but the probability for an IDA is considered to be unknowable (DOE 2004b) and no annual risks are developed in Table F.5-7.

Results

The radiation exposure results and fatal cancer from radiation exposure that would result from this IDA are shown in Table F.5-7.

Table F.5-7: Health Effects From the Airplane Crash Into the Water Pool Scenario

Weather Condition	Exposed Individual	TED	Fatal Cancer Per Individual[1]
		rem	
50 Percent Meteorology	Worker	9.7×10^{-2}	4.0×10^{-5}
	MCW	8.0×10^{-5}	3.3×10^{-8}
	NPA	3.6×10^{-5}	2.0×10^{-8}
	MOI	2.6×10^{-4}	1.5×10^{-7}
	Exposure to the General Population		**Fatal Cancer in the General Population**[1]
	person-rem		
	3.3		1.8×10^{-3}
95 Percent Meteorology	**Exposed Individual**	**TED**	**Fatal Cancer Per Individual**[1]
		rem	
	Worker	6.0×10^{-1}	2.5×10^{-4}
	MCW	1.1×10^{-3}	4.7×10^{-7}
	NPA	5.7×10^{-4}	3.1×10^{-7}
	MOI	4.3×10^{-3}	2.3×10^{-6}
	Exposure to the General Population		**Fatal Cancer in the General Population**[1]
	person-rem		
	2.5×10^{1}		1.4×10^{-2}

[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the NPA, MOI, and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

Impact on Involved Workers

No fatalities to workers would be expected from radiological consequences. The source term would be released underwater. Attenuation by the water would occur for most radioactive products, but release of noble gases would cause radiation exposure to workers in the area. NRF Employees are trained to evacuate during radiological emergencies including the potential release of radioactive material. Evacuation following the airplane crash would prevent substantial radiation exposure.

F.5.4.4 Drained Water Pool

Description of Conditions

In this hypothetical accident scenario, an earthquake causes damage to the structure of the water pool, resulting in a complete loss of water pool water. The building structure would also be affected such that filtered ventilation systems would not be functional. For the No Action Alternative, thermal analysis of naval spent nuclear fuel that would be stored in the racks currently installed in the water pool shows that heat dissipation, largely from air circulation, is sufficient to prevent cladding failure for the time necessary to restore cooling. Similarly, for the Overhaul and New Facility Alternatives, thermal analysis for a new naval spent nuclear fuel rack design will show that heat dissipation, largely from air circulation, is sufficient to prevent cladding failure for the time necessary to restore cooling.

However, some of the corrosion products from the approximately 400 equivalent naval spent nuclear fuel assemblies stored in the water pool could be released. This release consists of corrosion products on naval spent nuclear fuel in the drained water pool that go airborne with thermal drafts generated as part of the natural circulation that prevents the naval spent nuclear fuel from overheating. In addition, corrosion products may become dislodged from the outside surface of the naval spent nuclear fuel during the earthquake and be entrained with the water that drains from the water pool. These corrosion products are modeled to be released directly into the ground.

The loss of water could result in increased direct radiation because the shielding properties of the water are removed. The impacts from the airborne release, the release of water pool water directly to the ground, and direct radiation are explicitly calculated.

Source Term

The airborne and waterborne source terms used for this scenario are shown in Table F.5-8.

Table F.5-8: Source Term for the Drained Water Pool Scenario

Radionuclide	Activity Released - Air	Activity Released - Water
	Curies	
Co-58	4.43	4.43×10^{1}
Co-60	1.25×10^{1}	1.25×10^{2}
Fe-55	2.23×10^{1}	2.23×10^{2}
Mn-54	7.36×10^{-1}	7.36
Nb-95	1.88×10^{-1}	1.88
Zn-65	3.14×10^{-1}	3.14

Probability

<u>No Action Alternative</u>

An updated seismic analysis of the ECF water pool structures concluded that the reinforced concrete portion of the pools and adjacent building superstructure meet the seismic strength requirements of DOE 2002b for a Performance Category (PC)-3 structure. The analysis verified that the ECF reinforced concrete pools would not collapse in a design basis earthquake with an annual probability of 4×10^{-4}. Since a seismic strength analysis does not confirm that the water pool would not leak subsequent to a seismic event, an annual probability of 1.0×10^{-3} is conservatively used to develop the annual risks for the No Action Alternative in Table F.5-9 (Section F.7.1).

<u>Overhaul Alternative</u>

The probability evaluation is based on the design of the water pool structures, systems, and components (SSCs) alone and does not take credit for any further reductions from mitigation features in other equipment designs, emergency response actions, or emergency response systems that may be functional after the seismic event. Seismic strength requirements are discussed in Section 4.3.

To the extent practicable, SSCs for the overhauled facility would be designed in accordance with DOE 2008a, DOE 2012b, and ANS 2004 considering the consequences of unmitigated accidents. The design basis is the combination of Seismic Design Category (SDC), Limit State, and other applicable criteria (specification of codes and standards, load combinations, quality provisions, etc.) that assure that the SSC maintains its safety function before, during, and after a seismic event. Due to existing construction and system interactions within the facility, it may be impractical to establish a design basis for SSCs in the overhauled facility that exceeds SDC-3; therefore, the probability of a seismic-related failure is based upon an SDC-3 seismic event. Based on designing and upgrading systems to meet standards, an annual probability of 1.0×10^{-4} is conservatively used to develop the annual risks for the Overhaul Alternative in Table F.5-9 (Section F.7.1).

New Facility Alternative

The new facility water pool would be designed to higher seismic standards than the current ECF water pool. DOE 2008a, DOE 2012b, and ANS 2004 would be evaluated to determine the appropriate design requirement for SSCs in a new facility considering the consequences of unmitigated accidents. The design basis is the combination of SDC, Limit State, and other applicable criteria (specification of codes and standards, load combinations, quality provisions, etc.) that assure that the SSC maintains its safety function before, during, and after a seismic event. The new facility water pool would be SDC-3 Limit State D. A water pool system designed to SDC-3 Limit State D seismic standards would have a probability of 1.0×10^{-4} per year (ANS 2004) for a seismic-related failure based on an SDC-3 seismic event. Meeting standards and applying additional factors such as designing the water pool concrete structure using SDC-5 seismic spectra and using concrete in lieu of compacted soil to backfill under and around the water pool would further reduce the probability of a seismic-related failure of the water pool. An annual probability of 7×10^{-5} is conservatively used to develop the annual risks for the New Facility Alternative in Table F.5-9 (Section F.7.1).

Results

The radiation exposure results, fatal cancer from radiation exposure, and annual risk to the General Population (i.e. product of fatal cancer and probability of accident occurrence) that would result from this hypothetical accident scenario are shown in Table F.5-9. The annual risk to the General Population for the New Facility Alternative would be smaller than the annual risk for the Overhaul Alternative due to the higher seismic standard to which the new facility water pool SCCs would be designed.

Table F.5-9: Health Effects From the Drained Water Pool Scenario

Weather Condition	Exposed Individual	TED (rem)	Fatal Cancer Per Individual[1]	
50 Percent Meteorology	Worker	2.3	9.6×10^{-4}	**Annual Risk of Developing Fatal Cancer to the General Population**[2]
	MCW	8.7×10^{-4}	3.6×10^{-7}	
	NPA	6.6×10^{-4}	3.6×10^{-7}	
	MOI	5.1×10^{-3}	2.8×10^{-6}	
	Exposure to the General Population	person-rem	**Fatal Cancer in the General Population**[1]	
	No Action Alternative	5.0×10^{1}	2.8×10^{-2}	2.8×10^{-5}
	Overhaul Alternative	5.0×10^{1}	2.8×10^{-2}	2.8×10^{-6}
	New Facility Alternative	5.0×10^{1}	2.8×10^{-2}	1.9×10^{-6}
95 Percent Meteorology	**Exposed Individual**	**TED** (rem)	**Fatal Cancer Per Individual**[1]	**Annual Risk of Developing Fatal Cancer to the General Population**[2]
	Worker	9.0	3.7×10^{-3}	
	MCW	1.3×10^{-2}	5.5×10^{-6}	
	NPA	1.1×10^{-2}	6.3×10^{-6}	
	MOI	8.4×10^{-2}	4.6×10^{-5}	
	Exposure to the General Population	person-rem	**Fatal Cancer in the General Population**[1]	
	No Action Alternative	3.7×10^{2}	2.1×10^{-1}	2.1×10^{-4}
	Overhaul Alternative	3.7×10^{2}	2.1×10^{-1}	2.1×10^{-5}
	New Facility Alternative	3.7×10^{2}	2.1×10^{-1}	1.4×10^{-5}

[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the NPA, MOI, and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

[2] Probability of scenario occurrence equals 1.0×10^{-3} events per year for the No Action Alternative. Probability of scenario occurrence equals 1.0×10^{-4} events per year for the Overhaul Alternative. Probability of scenario occurrence equals 7.0×10^{-5} events per year for the New Facility Alternative. The probabilities are conservative (Section F.7.1).

Impact on Involved Workers

No fatalities to workers would be expected due to radiological consequences from a drained water pool. Complete drainage of the large amount of water in a water pool would take several hours to several days providing ample time for workers to leave the facility. Any attempts to restore water to the water pool would be done with consideration of the dose to the workers involved.

F.5.4.5 Hydrogen Detonation in the Water Pool

Description of Conditions

This hypothetical accident scenario evaluates a hydrogen detonation in a naval spent nuclear fuel storage container during the temporary wet storage operation. This scenario would not result in any damage to the water pool structure, the building structure, or any filtered ventilation systems. This scenario models a mechanical leak path factor of 0.1 for the material released from the storage container. This event is modeled to be an energetic release because of the force of the detonation. This event would occur underwater where the containers are located during temporary wet storage. It is assumed that any radioactivity released is drawn into the HEPA filtration system without mixing or dilution in the building.

Source Term

The source term used for this scenario is shown in Table F.5-10.

Table F.5-10: Source Term for the Hydrogen Detonation in the Water Pool Scenario

Radionuclide[1]	Activity	Radionuclide[1]	Activity
	Curies		Curies
Ba-137m	7.43×10^{-4}	Pu-238	3.89×10^{-6}
C-14	2.09×10^{-3}	Rh-106	8.89×10^{-4}
Ce-144	1.34×10^{-2}	Ru-103	9.65×10^{-4}
Cs-134	4.70×10^{-4}	Ru-106	8.89×10^{-4}
Cs-137	7.88×10^{-4}	Sb-125	9.75×10^{-4}
Hf-175	3.87×10^{-3}	Sn-119m	4.37×10^{-3}
Hf-181	1.12×10^{-1}	Sr-89	3.24×10^{-3}
Kr-85	8.15×10^{-1}	Sr-90	7.88×10^{-4}
Nb-95	2.98×10^{-2}	Ta-182	2.19×10^{-2}
Nb-95m	1.77×10^{-4}	Y-91	5.55×10^{-3}
Pm-147	1.78×10^{-3}	Zn-65	7.40×10^{-5}
Pr-144	1.34×10^{-2}	Zr-95	1.51×10^{-2}

[1] The radionuclides shown in the table contribute at least 99 percent of the radiation exposure from the scenario.

Probability

The hydrogen detonation in a naval spent nuclear fuel storage container scenario would result from leakage of water into a sealed container stored in the water pool. Naval spent nuclear fuel storage containers are loaded dry and sealed to be water-tight after loading. It is modeled that the container seal degrades and is no longer water-tight. The water could disassociate due to high radiation fields into hydrogen and oxygen gas and a spark could cause a detonation. The probability for this scenario is estimated based on ECF operational experience, the materials expected to be stored, and the design of the storage container. The probability of the container having water present and developing an explosive mixture is based on NRF operational experience and the design of the container and container seal. The probability for an ignition is based on the materials being stored in the container and their potential for building up sufficient static charge to generate a spark that would ignite the mixture. The occurrence of a detonation is assumed to cause a failure in the container seal. The probability of a container rupturing is estimated as 1.6×10^{-6} per container. Based on work projections, 40 containers are estimated to be present in the water pool during a typical year. This results in an annual probability of 6.4 x 10^{-5} failures for this scenario. An annual probability of 6.4 x 10^{-5} is conservatively used to develop the annual risks in Table F.5-11 (Section F.7.1).

Results

The radiation exposure results, fatal cancer from radiation exposure, and annual risk to the General Population (i.e. product of fatal cancer and probability of accident occurrence) that would result from this hypothetical accident scenario are shown in Table F.5-11.

Table F.5-11: Health Effects From the Hydrogen Detonation in the Water Pool Scenario

Weather Condition	Exposed Individual	TED rem	Fatal Cancer Per Individual[1]	Annual Risk of Developing Fatal Cancer to the General Population[2]
50 Percent Meteorology	Worker	7.1 x 10^{-3}	2.9 x 10^{-6}	
	MCW	4.7 x 10^{-6}	1.9 x 10^{-9}	
	NPA	2.9 x 10^{-6}	1.6 x 10^{-9}	
	MOI	8.0 x 10^{-6}	4.4 x 10^{-9}	
	Exposure to the General Population person-rem		**Fatal Cancer in the General Population[1]**	
	7.8 x 10^{-2}		4.3 x 10^{-5}	2.7 x 10^{-9}
95 Percent Meteorology	**Exposed Individual**	**TED** rem	**Fatal Cancer Per Individual[1]**	**Annual Risk of Developing Fatal Cancer to the General Population[2]**
	Worker	4.3 x 10^{-2}	1.8 x 10^{-5}	
	MCW	7.2 x 10^{-5}	3.0 x 10^{-8}	
	NPA	5.0 x 10^{-5}	2.7 x 10^{-8}	
	MOI	1.3 x 10^{-4}	7.3 x 10^{-8}	
	Exposure to the General Population person-rem		**Fatal Cancer in the General Population[1]**	
	5.8 x 10^{-1}		3.2 x 10^{-4}	2.0 x 10^{-8}

[1] To convert dose to fatal cancer, a factor of 4.1 x 10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5 x 10^{-4} is multiplied by the dose for the NPA, MOI, and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

[2] Probability of scenario occurrence equals 6.4 x 10^{-5} events per year. The probability of the accident is conservative (Section F.7.1).

Impact on Involved Workers

No fatalities to workers would be expected from radiological consequences. The source term is released underwater. Attenuation by the water would occur for most radioactive products, but release of noble gases, some fission products, and some corrosion products would cause radiation exposure to workers in the area. Upon release from the surface of the water pool, radiation alarms would sound requiring evacuation of nearby workers. Evacuation following the radiation alarms would prevent substantial radiation exposure.

F.5.4.6 Mechanical Damage to Naval Spent Nuclear Fuel in the Water Pool

Description of Conditions

Accidental mechanical damage to naval spent nuclear fuel is evaluated from impact that could occur to the naval spent nuclear fuel in the water pool. It is postulated that a crane failure and an uncontrolled lowering of an STC occurs. The hypothetical accident includes damage to naval spent nuclear fuel assemblies in the fuel discharge stand, allowing fission products to escape. Gaseous and particulate nuclides are calculated to be released to the water pool. Due to the presence of the water pool water, no particulates are released into the air inside the facility. The initiating event would not impact the building or its systems, therefore the existing filtered ventilation systems would continue to operate in their normal manner. The radioactivity release is assumed to be drawn into the filtration system without mixing or dilution in the building. However, since only gases are released into the environment, the HEPA filtration has no effect on the source term.

Source Term

The source term used for this scenario is shown in Table F.5-12.

Table F.5-12: Source Term for the Mechanical Damage in the Water Pool Scenario

Radionuclide[1]	Activity
	Curies
H-3	2.30
I-129	1.12×10^{-5}
Kr-85	4.93×10^{1}

[1] The radionuclides shown in the table contribute at least 99 percent of the radiation exposure from the scenario.

Probability

At ECF and the new facility, an STC is used to bring naval spent nuclear fuel assemblies from the shipping container to the water pool. An STC is brought above an empty receiving port in a fuel discharge stand that can hold several naval spent nuclear fuel assemblies. The STC must accidentally fall from the overhead crane or the crane must fail, which damages the fuel discharge stand resulting in damage to the naval spent nuclear fuel assemblies in the stand.

As described in Section F.5.4.2, the probability of failure associated with crane failure is 3.2×10^{-5} per demand (DOE 2008b). Using an average 85 STC crane lifts per year gives a probability of 2.7×10^{-3} per year. Further, the crane failure must occur in the right location and the drop must be high enough to have sufficient energy to damage both the discharge station and the naval spent nuclear fuel inside. An additional factor of 10^{-1} is taken for this event based on the design margin of the fuel discharge stand giving a total probability of 2.7×10^{-4} for the drop of the cask in the right location to cause damage to the naval spent nuclear fuel assemblies. The probability of an STC drop on naval spent nuclear fuel is 2.7×10^{-4} events per year.

An annual probability of 2.7×10^{-4} is conservatively used to develop the annual risks in Table F.5-13 (Section F.7.1).

Results

The radiation exposure results, fatal cancer from radiation exposure, and annual risk to the General Population (i.e., product of fatal cancer and probability of accident occurrence) that would result from this hypothetical accident scenario are shown in Table F.5-13.

Table F.5-13: Health Effects From the Mechanical Damage in the Water Pool Scenario

Weather Conditions	Exposed Individual	TED rem	Fatal Cancer Per Individual[1]	Annual Risk of Developing Fatal Cancer to the General Population[2]
50 Percent Meteorology	Worker	2.4×10^{-4}	1.0×10^{-7}	
	MCW	2.0×10^{-7}	8.2×10^{-11}	
	NPA	9.0×10^{-8}	5.0×10^{-11}	
	MOI	6.5×10^{-7}	3.6×10^{-10}	
	Exposure to the General Population person-rem		**Fatal Cancer in the General Population**[1]	
	8.1×10^{-3}		4.4×10^{-6}	1.2×10^{-9}
95 Percent Meteorology	**Exposed Individual**	**TED** rem	**Fatal Cancer Per Individual**[1]	**Annual Risk of Developing Fatal Cancer to the General Population**[2]
	Worker	1.5×10^{-3}	6.2×10^{-7}	
	MCW	2.8×10^{-6}	1.2×10^{-9}	
	NPA	1.4×10^{-6}	7.8×10^{-10}	
	MOI	1.1×10^{-5}	5.8×10^{-9}	
	Exposure to the General Population person-rem		**Fatal Cancer in the General Population**[1]	
	6.1×10^{-2}		3.3×10^{-5}	9.0×10^{-9}

[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the NPA, MOI, and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

[2] Probability of scenario occurrence equals 2.7×10^{-4} events per year. The probability of the accident is conservative (Section F.7.1).

Impact on Involved Workers

No fatalities to workers would be expected from radiological consequences. The release of the source term is underwater. Attenuation by the water would occur for most radioactive products, but release of noble gases would cause radiation exposure to workers in the area. Upon releases from the surface of the water pool, radiation alarms would sound requiring evacuation of nearby workers. Evacuation following the radiation alarms would prevent substantial radiation exposure.

F.5.4.7 Inter-Facility Transport Accident

Description of Conditions

In this scenario an STC with naval spent nuclear fuel from the core examination library (being transferred from ECF to a new facility on NRF property) or examination specimens (being transferred back and forth between ECF and the new facility on NRF property) is involved in a vehicular accident. Therefore, this scenario is only applicable to the New Facility Alternative. The scenario is postulated to occur after the initial visual examination while the naval spent nuclear fuel assembly is transferred to a geographically separate core examination facility. The accident results in a mechanical impact with the transport container containing one naval spent nuclear fuel assembly, resulting in a breach of the container seals (a mechanical leak path factor of 0.1) releasing corrosion products and fission products with a subsequent fire associated with the accident vehicles. A heated release is modeled because of the vehicle fire. No filtration by HEPA filters is assumed because this event occurs outside with the transport container exposed to the environment.

Source Term

The source term used for this scenario is shown in Table F.5-14.

Table F.5-14: Source Term for the Inter-Facility Transport Accident Scenario

Radionuclide[1]	Activity
	Curies
Ba-137m	1.04×10^{1}
Cs-134	8.14×10^{1}
Cs-137	1.65×10^{2}
Sr-90	1.08×10^{1}

[1] The radionuclides shown in the table contribute at least 99 percent of the radiation exposure from the scenario.

Probability

This accident was considered for inclusion in the analysis of risk; however, because of the slow travel speeds, short travel distance across NRF property, ability to restrict access to the roadway, and infrequent naval spent nuclear fuel assembly transfers, this accident is not considered reasonably foreseeable without intentional human intervention. The consequences of this accident are analyzed, but the probability for an IDA is considered to be unknowable (DOE 2004b) and no annual risks are developed in Table F.5-15.

Results

The radiation exposure results and fatal cancer from radiation exposure that would result from this IDA are shown in Table F.5-15.

Table F.5-15: Health Effects From the Inter-Facility Transport Accident Scenario

Weather Condition	Exposed Individual	TED rem	Fatal Cancer Per Individual[1]
50 Percent Meteorology	Worker	1.3×10^{1}	5.3×10^{-3}
	MCW	8.5×10^{-3}	3.5×10^{-6}
	NPA	2.8×10^{-3}	1.5×10^{-6}
	MOI	1.0×10^{-1}	5.5×10^{-5}
	Exposure to the General Population person-rem		**Fatal Cancer in the General Population**[1]
	9.4×10^{2}		5.2×10^{-1}
95 Percent Meteorology	**Exposed Individual**	**TED (rem)** rem	**Fatal Cancer Per Individual**[1]
	Worker	7.9×10^{1}	3.2×10^{-2}
	MCW	1.3×10^{-1}	5.4×10^{-5}
	NPA	4.8×10^{-2}	2.6×10^{-5}
	MOI	1.6	9.0×10^{-4}
	Exposure to the General Population person-rem		**Fatal Cancer in the General Population**[1]
	7.0×10^{3}		3.8

[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the NPA, MOI, and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

Impact on Involved Workers

It is likely no fatalities would occur from radiological consequences. The container seal could be breached and some airborne radioactivity could be dispersed in the vehicle fire. Workers involved in the accident could be exposed to significant levels of radioactivity from the inhalation of the radioactivity released by the fire if they remain downwind of the fire.

F.5.4.8 Inadvertent Fuel Cutting in the Water Pool

Description of Conditions

This hypothetical scenario evaluates inadvertent cutting across the fuel region when removing structural material from the ends of a naval spent nuclear fuel assembly during resizing, inadvertent cutting into the fuel region when milling the naval spent nuclear fuel assembly for examination, or inadvertent drilling through the fuel region when preparing to attach neutron poison. To develop the source term, the milling operation is used for conservatism. All of these processing operations are performed underwater, resulting in the release of only gaseous products from one naval spent nuclear fuel assembly into the atmosphere. This initiating event would not impact the building or its systems; therefore, the existing filtered ventilation systems continue to operate in their normal manner. However, since only gases are released into the environment, the HEPA filtration has no effect on this scenario.

Source Term

The source term used for this scenario is shown in Table F.5-16.

Table F.5-16: Source Term for the Inadvertent Fuel Cutting in the Water Pool Scenario

Radionuclide[1]	Activity
	Curies
H-3	4.59
I-129	2.23×10^{-5}
Kr-85	9.87×10^{1}

[1] The radionuclides shown in the table contribute at least 99 percent of the radiation exposure from the scenario.

Probability

The probability of damage to naval spent nuclear fuel during resizing, securing, or milling operations is small. Since the milling operation forms the basis for the source term, it is also used to develop the scenario probability. To cut into the naval spent nuclear fuel during milling, there must be operator error in positioning the naval spent nuclear fuel in the cutting apparatus and a second error in selecting the saw cut depth. In addition, an independent inspector would need to err in checking the proper positioning of the cutting position. The combined operator errors and independent checker error probabilities for cutting into the naval spent nuclear fuel is evaluated to be less than 1.0×10^{-5} per cut; however, a conservative value of 1×10^{-5} total human error probability is used for the analysis (NRC 1983 and NRC 2005). Using an estimate of 40 milling cuts per year on naval spent nuclear fuel assemblies during milling operations results in an annual probability of cutting into the fuel region of less than 4.0×10^{-4}. An annual probability of 4.0×10^{-4} is conservatively used to develop the annual risks in Table F.5-17 (Section F.7.1).

Results

The radiation exposure results, fatal cancer from radiation exposure, and annual risk to the General Population (i.e., product of fatal cancer and probability of accident occurrence) that would result from this hypothetical accident scenario are shown in Table F.5-17.

Table F.5-17: Health Effects From the Inadvertent Fuel Cutting In the Water Pool Scenario

<table>
<tr><th rowspan="2">Weather Condition</th><th rowspan="2">Exposed Individual</th><th>TED</th><th rowspan="2">Fatal Cancer Per Individual[1]</th><th rowspan="8">Annual Risk of Developing Fatal Cancer to the General Population[2]</th></tr>
<tr><th>rem</th></tr>
<tr><td rowspan="9">50 Percent Meteorology</td><td>Worker</td><td>4.9×10^{-4}</td><td>2.0×10^{-7}</td></tr>
<tr><td>MCW</td><td>4.0×10^{-7}</td><td>1.6×10^{-10}</td></tr>
<tr><td>NPA</td><td>1.8×10^{-7}</td><td>9.9×10^{-11}</td></tr>
<tr><td>MOI</td><td>1.3×10^{-6}</td><td>7.2×10^{-10}</td></tr>
<tr><th colspan="2">Exposure to the General Population</th><th rowspan="2">Fatal Cancer in the General Population[1]</th></tr>
<tr><td colspan="2">person-rem</td></tr>
<tr><td colspan="2">1.6×10^{-2}</td><td>8.9×10^{-6}</td><td>3.5×10^{-9}</td></tr>
<tr><td colspan="2"></td><td></td><td></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="10">95 Percent Meteorology</td><th rowspan="2">Exposed Individual</th><th>TED</th><th rowspan="2">Fatal Cancer Per Individual[1]</th><th rowspan="8">Annual Risk of Developing Fatal Cancer to the General Population[2]</th></tr>
<tr><th>rem</th></tr>
<tr><td>Worker</td><td>3.0×10^{-3}</td><td>1.2×10^{-6}</td></tr>
<tr><td>MCW</td><td>5.7×10^{-6}</td><td>2.3×10^{-9}</td></tr>
<tr><td>NPA</td><td>2.8×10^{-6}</td><td>1.6×10^{-9}</td></tr>
<tr><td>MOI</td><td>2.1×10^{-5}</td><td>1.2×10^{-8}</td></tr>
<tr><th colspan="2">Exposure to the General Population</th><th rowspan="2">Fatal Cancer in the General Population[1]</th></tr>
<tr><td colspan="2">person-rem</td></tr>
<tr><td colspan="2">1.2×10^{-1}</td><td>6.7×10^{-5}</td><td>2.7×10^{-8}</td></tr>
<tr><td colspan="5">[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the NPA, MOI, and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)
[2] Probability of scenario occurrence equals 4.0×10^{-4} events per year. The probability of the accident is conservative (Section F.7.1).</td></tr>
</table>

Impact on Involved Workers

No fatalities to workers would be expected from radiological consequences. The release of the source term is underwater. Attenuation by the water would occur for most radioactive products, but release of noble gases would cause radiation exposure to workers in the area. Upon release from the surface of the water pool, radiation alarms would sound requiring evacuation of nearby workers. Evacuation following the radiation alarms would prevent substantial radiation exposure.

F.5.4.9 Inadvertent Criticality in the Water Pool

Description of Conditions

In this hypothetical accident scenario, two naval spent nuclear fuel assemblies come together and form a critical mass within the water pool during the loading of a naval spent fuel canister. This scenario assumes a drop of a naval spent nuclear fuel basket such that the basket rearranges and fuel separation is lost. An uncontrolled chain reaction producing 2×10^{19} fissions is postulated to occur between two of the dropped naval spent nuclear fuel assemblies; the integrity of the water pool would not be jeopardized by this hypothetical accident scenario because the walls of the water pool are constructed of thick, reinforced concrete with earth surrounding them, making them very strong. Since the initiating event would have no impact on the building or its systems, it is modeled that the existing HEPA-filtered ventilation systems continue to operate in their normal manner. The radioactivity release is assumed to be drawn into the filtration system without mixing or dilution in the building. An energetic release with fuel overheating is modeled because of the energy involved in a criticality event. Some removal of fission products by the water pool water due to an energetic underwater release is also included. The increase in direct radiation from the criticality event is explicitly calculated.

Source Term

The source term used for this scenario is shown in Table F.5-18.

Table F.5-18: Source Term for the Inadvertent Criticality in the Water Pool Scenario

Radionuclide[1]	**Activity**
	Curies
Ba-137m	2.28
Cs-134	1.79×10^1
Cs-137	3.62×10^1
Sr-90	2.37

[1] The radionuclides shown in the table contribute at least 99 percent of the radiation exposure from the scenario.

Probability

An inadvertent criticality during naval spent nuclear fuel handling operations is extremely unlikely. No events of this type have occurred during handling of naval spent nuclear fuel. Prevention of inadvertent, uncontrolled nuclear chain reactions is assured by the design of equipment for the naval spent nuclear fuel, primarily by diminishing the chances for a chain reaction by spacing the naval spent nuclear fuel components far enough apart to eliminate nuclear interaction. Special attention is given to the risk of inadvertent criticality which might be experienced during naval spent nuclear fuel transport and handling operations. Prevention of an inadvertent criticality is provided by designing the reactor servicing system such that criticality would not occur even in the event of unforeseen equipment failures and personnel errors. This criterion specifies that the naval spent nuclear fuel would not attain a critical condition even if any two unlikely and independent accidents occur at the same time. This scenario involves the failure of a crane causing a loaded naval spent nuclear fuel basket holding several naval spent nuclear fuel assemblies to fall. The crane failure is assumed to lead to dropping and toppling of the basket leading to the ejection of the naval spent nuclear fuel assemblies. A sufficient number of naval spent nuclear fuel assemblies are postulated to be ejected into an arrangement that would result in a criticality in two naval spent nuclear fuel assemblies. It is also postulated that the drop and subsequent criticality damages the naval spent nuclear fuel assemblies sufficiently to cause a release of the fission products.

The drop of the basket due to a failure of a crane would be similar to the shielded basket drop accident and would have a probability of less than 3.5×10^{-4} drop per year. (Section F.5.4.10.) Due to equipment designs and facility constraints, the drop of the basket would have less than a 4.2×10^{-2} probability of ejecting naval spent nuclear fuel assemblies from the basket as a result of a drop. There would be a less than a 1×10^{-1} probability that the ejected naval spent nuclear fuel assemblies would achieve a critical arrangement. Additional equipment features would reduce these probabilities by preventing toppling of the basket; however, no additional factors are applied resulting in a conservative calculation of risk. Since all of these events must occur to result in a criticality, these probabilities are multiplied, and the overall probability of an accidental criticality is less than 1.5×10^{-6}

per year. An annual probability of 1.5×10^{-6} is conservatively used to develop the annual risks in Table F.5-19 (Section F.7.1).

Results

The radiation exposure results, fatal cancer from radiation exposure, and annual risk to the General Population (i.e., product of fatal cancer and probability of accident occurrence) that would result from this hypothetical accident scenario are shown in Table F.5-19.

Table F.5-19: Health Effects From the Inadvertent Criticality in the Water Pool Scenario

Weather Condition	Exposed Individual	TED	Fatal Cancer Per Individual[1]	
		rem		
50 Percent Meteorology	Worker	4.8	2.0×10^{-3}	**Annual Risk of Developing Fatal Cancer to the General Population[2]**
	MCW	6.2×10^{-3}	2.6×10^{-6}	
	NPA	1.8×10^{-3}	9.7×10^{-7}	
	MOI	2.4×10^{-2}	1.3×10^{-5}	
	Exposure to the General Population		**Fatal Cancer in the General Population[1]**	
	person-rem			
	2.1×10^{2}		1.1×10^{-1}	1.7×10^{-7}
95 Percent Meteorology	**Exposed Individual**	**TED**	**Fatal Cancer Per Individual[1]**	**Annual Risk of Developing Fatal Cancer to the General Population[2]**
		rem		
	Worker	2.8×10^{1}	1.1×10^{-2}	
	MCW	4.2×10^{-2}	1.7×10^{-5}	
	NPA	1.4×10^{-2}	7.5×10^{-6}	
	MOI	3.6×10^{-1}	2.0×10^{-4}	
	Exposure to the General Population		**Fatal Cancer in the General Population[1]**	
	person-rem			
	1.6×10^{3}		8.5×10^{-1}	1.3×10^{-6}

[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the NPA, MOI, and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

[2] Probability of scenario occurrence equals 1.5×10^{-6} events per year. The probability of the accident is conservative (Section F.7.1).

Impact on Involved Workers

It is likely no fatalities would occur from radiological consequences. Shielding by the water would be sufficient to prevent substantial radiation exposure of other nearby workers. Expulsion of a cone of water above the criticality could lead to significant radiation exposure to any workers who might be directly above the location of the criticality.

F.5.4.10 SBTC Drop or Tip-Over

Description of Conditions

In this hypothetical accident scenario, mechanical damage to naval spent nuclear fuel occurs while the naval spent nuclear fuel is inside of the SBTC during the loading of a naval spent fuel canister. Mechanical damage to the naval spent nuclear fuel could occur as the result of inadvertent dropping of the transfer container or the transfer container tipping over due to operator error. It is assumed that seals on the SBTC are breached resulting in a mechanical leak path factor of 0.001 for fission products and 0.005 for corrosion products. The facility structure would not be damaged during this scenario, and all existing filtered ventilation systems would continue to operate as normal. The radioactivity release is assumed to be drawn into the HEPA filtration system without mixing or dilution in the building.

Source Term

The source term used for this scenario is shown in Table F.5-20.

Table F.5-20: Source Term for the SBTC Drop or Tip-Over Scenario

Radionuclide[1]	Activity Curies	Radionuclide[1]	Activity Curies
Am-241	1.92×10^{-5}	H-3	1.37×10^{1}
Ba-137m	3.73×10^{-2}	I-129	3.85×10^{-5}
Ce-144	4.79×10^{-3}	Kr-85	2.88×10^{2}
Cm-244	4.24×10^{-5}	Pu-238	1.25×10^{-3}
Cs-134	8.10×10^{-3}	Pu-241	1.21×10^{-3}
Cs-137	3.95×10^{-2}	Sr-90	3.86×10^{-2}
Eu-154	9.47×10^{-4}	Y-90	3.86×10^{-2}

[1] The radionuclides shown in the table contribute at least 99 percent of the radiation exposure from the scenario.

Probability

The SBTC drop causing mechanical damage to naval spent nuclear fuel is postulated to occur due to a lifting failure. The DOE performed detailed evaluations of crane failure accidents in analyses for the Initial Handling Facility at Yucca Mountain (DOE 2008b) and developed a probability of 3.2×10^{-5} drops of heavy lifts per demand. The NNPP uses standards that would ensure similar or lower probability of a drop accident. Based on the number of shielded baskets loaded in a typical year, there would be 11 SBTC lifting demands. Although the rugged construction and design of the SBTC and naval spent nuclear fuel would reduce the likelihood of a drop resulting in a release to the environment, no additional factors are applied. The annual probability of an SBTC drop accident would therefore be 3.5×10^{-4}. An annual probability of 3.5×10^{-4} is conservatively used to develop the annual risks in Table F.5-21 (Section F.7.1).

Results

The radiation exposure results, fatal cancer from radiation exposure, and annual risk to the General Population (i.e., product of fatal cancer and probability of accident occurrence) that would result from this hypothetical accident scenario are shown in Table F.5-21.

Table F.5-21: Health Effects From the SBTC Drop or Tip-Over Scenario

Weather Condition	Exposed Individual	TED rem	Fatal Cancer Per Individual[1]	Annual Risk of Developing Fatal Cancer to the General Population[2]
50 Percent Meteorology	Worker	9.6×10^{-2}	3.9×10^{-5}	
	MCW	6.3×10^{-5}	2.6×10^{-8}	
	NPA	3.8×10^{-5}	2.1×10^{-8}	
	MOI	5.5×10^{-5}	3.0×10^{-8}	
	Exposure to the General Population person-rem		**Fatal Cancer in the General Population**[1]	
	5.3×10^{-1}		2.9×10^{-4}	1.0×10^{-7}
95 Percent Meteorology	**Exposed Individual**	**TED** rem	**Fatal Cancer Per Individual**[1]	**Annual Risk of Developing Fatal Cancer to the General Population**[2]
	Worker	5.8×10^{-1}	2.4×10^{-4}	
	MCW	9.7×10^{-4}	4.0×10^{-7}	
	NPA	6.6×10^{-4}	3.6×10^{-7}	
	MOI	9.1×10^{-4}	5.0×10^{-7}	
	Exposure to the General Population person-rem		**Fatal Cancer in the General Population**[1]	
	4.0		2.2×10^{-3}	7.7×10^{-7}

1 To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the NPA, MOI, and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

2 Probability of scenario occurrence equals 3.5×10^{-4} events per year. The probability of the accident is conservative (Section F.7.1).

Impact on Involved Workers

It is likely no fatalities would occur among nearby workers from radiological consequences from an SBTC drop or tip-over accident. The breach in the container seal could result in release of airborne radioactivity, and radiation alarms would sound requiring evacuation of nearby workers. Nearby workers may receive significant radiation exposure from the released radioactivity due to loss of container shielding.

F.5.4.11 Windborne Projectile Into the SBTC

Description of Conditions

In this hypothetical accident scenario, extreme winds propel a large object (e.g., a pipe) into ECF or the new facility structures during the naval spent nuclear fuel canister loading operation. It is assumed that the propelled object impacts the SBTC causing the container seal to be breached resulting in a mechanical leak path factor of 0.005 for corrosion products. Since the wind-propelled object must first pass through the building's structural wall and then impact a robust SBTC, it is modeled that no mechanical damage of the naval spent nuclear fuel within the SBTC occurs. However, some corrosion products would be dislodged from the outside surface of the naval spent nuclear fuel and released from the container. The damage to the building structure is assumed to be extensive enough that filtered ventilation systems are not considered functional. Any radioactivity is assumed to be released directly to the atmosphere without mixing or dilution in the building.

Source Term

The source term used for this scenario is shown in Table F.5-22.

Table F.5-22: Source Term for the Windborne Projectile Into SBTC Scenario

Radionuclide[1]	Activity
	Curies
Fe-55	1.50×10^{-2}
Co-60	1.15×10^{-2}
Ni-63	5.32×10^{-3}

[1] The radionuclides shown in the table contribute at least 99 percent of the radiation exposure from the scenario.

Probability

The probability of a windborne projectile striking an SBTC is based upon ANS 2011. ANS 2011 establishes a wind speed design criteria capable of generating windborne projectiles at an annual probability of 1×10^{-3} for the region in which NRF is located. Hurricanes are not considered plausible in this region, and tornado probabilities that are capable of generating projectiles, F2 or greater, are significantly lower than straight-line winds; they are not used in this analysis. The probability of a windborne projectile striking an SBTC is estimated as 3.3×10^{-2} strikes per incident. It is assumed that a windborne projectile strike would cause a loss of the SBTC seals even though the SBTC is a very large and heavily shielded container; therefore, the annual probability of a windborne projectile strike causing a failure in the SBTC seals would be 3.3×10^{-5}. An annual probability of 3.3×10^{-5} is conservatively used to develop the annual risks in Table F.5-23 (Section F.7.1).

Results

The radiation exposure results, fatal cancer from radiation exposure, and annual risk to the General Population (i.e., product of fatal cancer and probability of accident occurrence) that would result from this hypothetical accident scenario are shown in Table F.5-23.

Table F.5-23: Health Effects From the Windborne Projectile Into SBTC Scenario

Weather Conditions	Exposed Individual	TED rem	Fatal Cancer Per Individual[1]	Annual Risk of Developing Fatal Cancer to the General Population[2]
50 Percent Meteorology	Worker	1.2×10^{-3}	4.7×10^{-7}	
	MCW	7.6×10^{-7}	3.1×10^{-10}	
	NPA	5.9×10^{-7}	3.3×10^{-10}	
	MOI	4.5×10^{-6}	2.5×10^{-9}	
	Exposure to the General Population person-rem		**Fatal Cancer in the General Population**[1]	
	4.3×10^{-2}		2.4×10^{-5}	7.9×10^{-10}
	Exposed Individual	**TED** rem	**Fatal Cancer Per Individual**[1]	**Annual Risk of Developing Fatal Cancer to the General Population**[2]
95 Percent Meteorology	Worker	7.0×10^{-3}	2.9×10^{-6}	
	MCW	1.2×10^{-5}	4.8×10^{-9}	
	NPA	1.0×10^{-5}	5.6×10^{-9}	
	MOI	7.3×10^{-5}	4.0×10^{-8}	
	Exposure to the General Population person-rem		**Fatal Cancer in the General Population**[1]	
	3.2×10^{-1}		1.8×10^{-4}	5.8×10^{-9}

[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the NPA, MOI, and General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

[2] Probability of scenario occurrence equals 3.3×10^{-5} events per year. The probability of the accident is conservative (Section F.7.1).

Impact on Involved Workers

No fatalities would be expected among nearby workers from radiological consequences from a windborne projectile into an SBTC. The container seal could be breached and some airborne corrosion products could be released. However, no damage occurs to the naval spent nuclear fuel inside the container; therefore, no fission products are released into the facility. Nearby workers may receive some radiation exposure from the released corrosion products.

F.5.4.12 Minor Water Pool Leak

According to NRC 2013, water pool leaks have been detected at 13 commercial nuclear power plant sites; of these, nine have resulted in inadvertent liquid radioactive releases to the environment. Lessons learned from studies of water pool leaks would be considered in the designs for the new facility water pool or refurbishment. This hypothetical accident scenario qualitatively evaluates the impact of a leak that develops in the water pool resulting in a discharge of water pool water to the environment.

Unlike other hypothetical accident scenarios which involve events that are acute and self-evident, a minor water pool leak might persist for some time before discovery (NRC 2006). Significant short-term water loss from the water pool is likely to be identified due to monitoring of water pool water levels. Additions of water to the water pool would be carefully tracked for unexpected trends. To go undetected, a leak rate would need to be less than the rate of make-up water added to maintain a constant water level in the pool, replacing water lost to evaporation.

Combinations of factors minimize the likelihood that a water pool leak will result in noticeable off-site environmental impacts.

- The radiological contaminants in the water pools are primarily activated corrosion products, not fission products from naval spent nuclear fuel. Additionally, the tritium in the water pool is a minor contaminant from historical operations. The contaminant levels in the water pool are minimized through the use of water pool filtration systems.

- The structural concrete walls of the pool remain formidable impediments to a release to the environment because of the very low permeability of concrete. In addition, as radionuclides migrate through the concrete structure, their concentrations in the leaked water would be reduced by sorption onto the concrete material. Sorption, a process by which a substance in solution attaches onto a solid material, can retard the movement of radionuclides and thus reduce radionuclide concentrations in the leaked water.

- Various hydrologic and chemical processes would reduce the environmental impacts of radionuclides associated with leaked water pool water. The radionuclide concentrations would continue to decrease due to mixing, dilution, and radioactive decay. In addition, adsorption of radionuclides onto subsurface materials may significantly delay the transport of radionuclides in the subsurface environment and keep radionuclide concentrations at low levels in groundwater. Further, adsorption would retard the movement of radionuclides because radionuclide mass is adsorbed on solid surfaces and becomes unavailable for transport by water. Although desorption of radionuclides from the subsurface material back into the groundwater may eventually occur, concentrations would be much less than if no sorption occurred. Different radionuclides have different degrees of adsorptive interaction with geologic media due to the geologic materials and water chemistry. Some radionuclides (e.g., tritium) do not adsorb onto soil and bedrock and, therefore, move generally at the same rate and direction as groundwater. Other radionuclides (e.g., Sr-90 and Cs-137) strongly adsorb onto geologic media and, thus, move much slower than the groundwater velocity and at reduced concentrations compared to the source of a leak. The degree of radionuclide adsorption and retardation depends on the properties of the geologic media (e.g., mineralogy, reactive surface area, and presence of organic matter) and groundwater chemistry (e.g., pH, oxidation-reduction potential, and complexing ion concentration).

- Groundwater monitoring is performed at NRF making it unlikely that leakage from the water pool would remain undetected for an extended period of time.

Based on these factors, the potential for a minor water pool leak to significantly impact the environment would be small. Nonetheless, the impact of a water pool leak three times larger than the leak assumed in the commercial industry (NRC 2013) is assessed and compared to natural background radiation.

No Action Alternative and Overhaul Alternative (Refurbishment Period)

The ECF water pool surfaces are covered with a fiberglass or epoxy coating which serves as an extra barrier to water leakage. Over the next 40 years, preventative and corrective maintenance may not be sufficient to keep the ECF infrastructure and water pools in safe working order. Maintenance and repairs without significant upgrades and refurbishments may not be sufficient to sustain the proper functioning of structures, systems, and components. Additionally, the ECF water pool does not have a liner, creating the potential for water infiltration into the reinforced concrete structure and the potential for corrosion damage of the reinforcing bar within the structure. The capability to detect and collect small leaks, a common feature in modern water pools, is not present for the ECF water pool. However, groundwater monitoring is performed at NRF making it unlikely that leakage from the water pool would remain undetected for an extended period of time.

For purpose of the No Action Alternative assessment, it is assumed that the leak persists for a 40-year duration. The 40-year leak period is applied to conservatively account for a leak that is located in an area of the water pool that cannot be repaired or a small leak that goes undetected as the pool continues to deteriorate. The rate (in gallons per day) of a leak that might develop in the future as the facility continues to degrade is uncertain. Based on current water inventory information tracked to compensate for evaporation, a bounding leak rate from the current ECF water pool would be 150 gallons per day. For conservatism, a rate of 300 gallons per day is assumed for the 40-year period.

The radionuclide inventory of the water pool water is based on analysis of the water in the ECF water pool. Assuming a leak were to occur, it is estimated that the MOI peak annual dose would be 7.6×10^{-3} millirem (7.6×10^{-6} rem), which is less than 0.0025 percent of the annual dose from natural background radiation. (An individual member of the public receives approximately 310 millirem (3.1×10^{-1} rem) per year from natural background radiation alone (Section F.2.2)). Additionally, the concentration of radionuclides in the water at the location of an individual member of the public would be much lower than the EPA Maximum Contaminant Levels (MCLs) for drinking water (Section 3.4). Therefore, the resulting impact on public health and safety from a minor water pool leak would be negligible in comparison to the amount of natural background radiation received by individuals annually.

Overhaul Alternative (Post-Refurbishment Operational Period) and New Facility Alternative

The water pool for both the Overhaul Alternative and the New Facility Alternative would be lined to form a water-tight barrier between the water in the pool and the concrete walls of the water pool. In addition, a groundwater monitoring system would actively monitor the site for leaks. It is expected that the combination of the water pool liner, concrete walls, and groundwater monitoring would prevent water pool water from leaking, undetected, into the environment. Further, the integrity of the water pool liner and structure would be ensured by maintaining a low-corrosive environment in the water pool water through proper water chemistry control.

Relatively small cracks could occur in the water pool liner due to stress-corrosion cracking and crevice corrosion of the water pool liner, seam or plug weld defects, or damage to the liner, resulting in leakage from the water pool (NRC 2012). Water that bypasses the water pool liner could migrate through construction joints and cracks in the concrete due to shrinkage, creep, or alkali-silica reaction, resulting in a release of contaminated water outside the water pool.

For purpose of the Overhaul Alternative and New Facility Alternative assessments, it is assumed that the leak persists for 5 years without detection at a rate of 300 gallons per day. The radionuclide inventory of the water pool water is based on analysis of the water in the ECF water pool. Assuming a leak were to occur, it is estimated that the MOI peak annual dose from a leak would be 2.4×10^{-3} millirem (2.4×10^{-6} rem) which is less than 0.00077 percent of the annual dose from natural background radiation. (An individual member of the public receives approximately 310 millirem (3.1×10^{-1} rem) per year from natural background radiation alone (Section F.2.2)). Additionally, the concentration of radionuclides in the water at the location of an individual member of the public would be much lower than the EPA MCLs for drinking water (Section 3.4). Therefore, the resulting impact on public health and safety from a minor water pool leak would be negligible in comparison to the amount of natural background radiation received by individuals annually.

F.5.5 Hypothetical Accident Evaluations Summary

For the hypothetical accident scenarios and IDAs evaluated, the impacts to the Worker, MCW, NPA, MOI, and General Population all result in a small likelihood of developing fatal cancer from radiation exposure. The cancer would be expected to occur over the lifetime of an individual if the accident were to occur. The hypothetical accident scenario that results in the highest annual risk is the drained water pool, and the IDA that results in the highest consequence is the inter-facility transport accident. If these hypothetical scenarios were to occur, the likelihood of fatal cancer for the Worker, MCW, NPA, MOI, and the annual risk of developing fatal cancer in the General Population is small.

For perspective, the average American's risk of dying from cancer from normal activity is 0.15, or 1 chance in 6.7, over his or her lifetime. Using this probability of 1 chance in 6.7, approximately 22,650 cancer fatalities would be expected in the General Population in the 80.5-kilometer (50-mile) radius surrounding NRF (approximately 151,000 people) during a lifetime of normal activity unrelated to NRF emissions (Section F.2.6).

For accident scenarios, the dose and likelihood of fatal cancer for the Worker, MCW, NPA, and MOI is presented (Table F.5-24 and Table F.5-25), and the dose and annual risk of developing fatal cancer is presented for the General Population (Table F.5-26 and Table F.5-27). The annual risk of developing fatal cancer with the 50 percent weather condition in the General Population (fatal cancer in the General Population multiplied by the annual probability of the accident) from a drained water pool is 1 chance in 36,000 (No Action Alternative), 1 chance in 360,000 (Overhaul Alternative), or 1 chance in 520,000 (New Facility Alternative). The increased likelihood of fatal cancer from the accident is negligible compared to the risk of developing fatal cancer from a lifetime of normal activities.

For IDAs, annual risk calculations are not completed because the probability of the event is considered “unknowable” (DOE 2004b). However, dose and consequences (likelihood of cancer) are presented for the Worker, MCW, NPA, and MOI (Table F.5-24 and Table F.5-25) and General Population (Table F.5-26 and Table F.5-27). The number of fatal cancers in the General Population with the 50 percent weather condition from an inter-facility transport accident scenario would increase by 0.52 (less than one instance of developing fatal cancer in 151,000 people). This increase in fatal cancer, if the IDA were to occur, would be added to the 22,650 fatal cancers expected in the General Population from lifetimes of normal activity. The increased likelihood of fatal cancer if this IDA were to occur is negligible compared to the risk of developing fatal cancer from a lifetime of normal activities.

Table F.5-24: Dose Impacts to Individuals From Radiological Accident Scenarios With 50 Percent Meteorology

Accident Scenario Description	Exposed Individual							
	Worker		MCW		NPA		MOI	
	Dose rem	Fatal Cancer[1]	Dose rem	Fatal Cancer[1]	Dose rem	Fatal Cancer[1]	Dose rem	Fatal Cancer[1]
HEPA Filter Fire	5.5×10^{-7}	2.3×10^{-10}	3.6×10^{-10}	1.5×10^{-13}	2.8×10^{-10}	1.5×10^{-13}	2.1×10^{-9}	1.2×10^{-12}
Shielded Transfer Container Drop or Tip-Over	1.6×10^{-2}	6.6×10^{-6}	1.1×10^{-5}	4.3×10^{-9}	6.5×10^{-6}	3.6×10^{-9}	1.0×10^{-5}	5.6×10^{-9}
Airplane Crash into Water Pool	9.7×10^{-2}	4.0×10^{-5}	8.0×10^{-5}	3.3×10^{-8}	3.6×10^{-5}	2.0×10^{-8}	2.6×10^{-4}	1.5×10^{-7}
Drained Water Pool	2.3	9.6×10^{-4}	8.7×10^{-4}	3.6×10^{-7}	6.6×10^{-4}	3.6×10^{-7}	5.1×10^{-3}	2.8×10^{-6}
Hydrogen Detonation in Storage Container in the Water Pool	7.1×10^{-3}	2.9×10^{-6}	4.7×10^{-6}	1.9×10^{-9}	2.9×10^{-6}	1.6×10^{-9}	8.0×10^{-6}	4.4×10^{-9}
Mechanical Damage to Fuel in the Water Pool	2.4×10^{-4}	1.0×10^{-7}	2.0×10^{-7}	8.2×10^{-11}	9.0×10^{-8}	5.0×10^{-11}	6.5×10^{-7}	3.6×10^{-10}
Inter-Facility Transport Accident	1.3×10^{1}	5.3×10^{-3}	8.5×10^{-3}	3.5×10^{-6}	2.8×10^{-3}	1.5×10^{-6}	1.0×10^{-1}	5.5×10^{-5}
Inadvertent Fuel Cutting in the Water Pool	4.9×10^{-4}	2.0×10^{-7}	4.0×10^{-7}	1.6×10^{-10}	1.8×10^{-7}	9.9×10^{-11}	1.3×10^{-6}	7.2×10^{-10}
Inadvertent Criticality in the Water Pool	4.8	2.0×10^{-3}	6.2×10^{-3}	2.6×10^{-6}	1.8×10^{-3}	9.7×10^{-7}	2.4×10^{-2}	1.3×10^{-5}
Shielded Basket Transfer Container Drop or Tip-Over	9.6×10^{-2}	3.9×10^{-5}	6.3×10^{-5}	2.6×10^{-8}	3.8×10^{-5}	2.1×10^{-8}	5.5×10^{-5}	3.0×10^{-8}
Windborne Projectile into Shielded Basket Transfer Container	1.2×10^{-3}	4.7×10^{-7}	7.6×10^{-7}	3.1×10^{-10}	5.9×10^{-7}	3.3×10^{-10}	4.5×10^{-6}	2.5×10^{-9}
Minor Water Pool Leak	This scenario is evaluated qualitatively in Section F.5.4.12.							

[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the NPA and MOI. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

Table F.5-25: Dose Impacts to Individuals From Radiological Accident Scenarios With 95 Percent Meteorology

Accident Scenario Description	Exposed Individual							
	Worker		MCW		NPA		MOI	
	Dose rem	Fatal Cancer[1]	Dose rem	Fatal Cancer[1]	Dose rem	Fatal Cancer[1]	Dose rem	Fatal Cancer[1]
HEPA Filter Fire	3.3×10^{-6}	1.4×10^{-9}	5.6×10^{-9}	2.3×10^{-12}	4.8×10^{-9}	2.6×10^{-12}	3.5×10^{-8}	1.9×10^{-11}
Shielded Transfer Container Drop or Tip-Over	9.7×10^{-2}	4.0×10^{-5}	1.6×10^{-4}	6.7×10^{-8}	1.1×10^{-4}	6.2×10^{-8}	1.7×10^{-4}	9.1×10^{-8}
Airplane Crash into Water Pool	6.0×10^{-1}	2.5×10^{-4}	1.1×10^{-3}	4.7×10^{-7}	5.7×10^{-4}	3.1×10^{-7}	4.3×10^{-3}	2.3×10^{-6}
Drained Water Pool	9.0	3.7×10^{-3}	1.3×10^{-2}	5.5×10^{-6}	1.1×10^{-2}	6.3×10^{-6}	8.4×10^{-2}	4.6×10^{-5}
Hydrogen Detonation in Storage Container in the Water Pool	4.3×10^{-2}	1.8×10^{-5}	7.2×10^{-5}	3.0×10^{-8}	5.0×10^{-5}	2.7×10^{-8}	1.3×10^{-4}	7.3×10^{-8}
Mechanical Damage to Fuel in the Water Pool	1.5×10^{-3}	6.2×10^{-7}	2.8×10^{-6}	1.2×10^{-9}	1.4×10^{-6}	7.8×10^{-10}	1.1×10^{-5}	5.8×10^{-9}
Inter-Facility Transport Accident	7.9×10^{1}	3.2×10^{-2}	1.3×10^{-1}	5.4×10^{-5}	4.8×10^{-2}	2.6×10^{-5}	1.6	9.0×10^{-4}
Inadvertent Fuel Cutting in the Water Pool	3.0×10^{-3}	1.2×10^{-6}	5.7×10^{-6}	2.3×10^{-9}	2.8×10^{-6}	1.6×10^{-9}	2.1×10^{-5}	1.2×10^{-8}
Inadvertent Criticality in the Water Pool	2.8×10^{1}	1.1×10^{-2}	4.2×10^{-2}	1.7×10^{-5}	1.4×10^{-2}	7.5×10^{-6}	3.6×10^{-1}	2.0×10^{-4}
Shielded Basket Transfer Container Drop or Tip-Over	5.8×10^{-1}	2.4×10^{-4}	9.7×10^{-4}	4.0×10^{-7}	6.6×10^{-4}	3.6×10^{-7}	9.1×10^{-4}	5.0×10^{-7}
Windborne Projectile into Shielded Basket Transfer Container	7.0×10^{-3}	2.9×10^{-6}	1.2×10^{-5}	4.8×10^{-9}	1.0×10^{-5}	5.6×10^{-9}	7.3×10^{-5}	4.0×10^{-8}
Minor Water Pool Leak	This scenario is evaluated qualitatively in Section F.5.4.12.							

[1] To convert dose to fatal cancer, a factor of 4.1×10^{-4} is multiplied by the dose for the Worker and MCW and a factor of 5.5×10^{-4} is multiplied by the dose for the NPAI and MOI. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factors which include both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factors overstate the likelihood of fatal cancer in a population and the use of these factors to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

Table F.5-26: Dose Impacts and Annual Risk to the General Population From Radiological Accident Scenarios With 50 Percent Meteorology

Accident Scenario Description	General Population Dose	Fatal Cancer Per Accident Occurrence[1]	Annual Probability of Accident[2]	Annual Risk of Developing Fatal Cancer to the General Population[3]
	person-rem			
HEPA Filter Fire	2.1×10^{-5}	1.1×10^{-8}	5.0×10^{-4}	5.7×10^{-12}
Shielded Transfer Container Drop or Tip-Over	9.7×10^{-2}	5.3×10^{-5}	2.7×10^{-3}	1.4×10^{-7}
Airplane Crash into Water Pool[4]	3.3	1.8×10^{-3}	NA	NA
Drained Water Pool – No Action Alternative	5.0×10^{1}	2.8×10^{-2}	1.0×10^{-3}	2.8×10^{-5}
Drained Water Pool – Overhaul Alternative	5.0×10^{1}	2.8×10^{-2}	1.0×10^{-4}	2.8×10^{-6}
Drained Water Pool – New Facility Alternative	5.0×10^{1}	2.8×10^{-2}	7.0×10^{-5}	1.9×10^{-6}
Hydrogen Detonation in the Water Pool	7.8×10^{-2}	4.3×10^{-5}	6.4×10^{-5}	2.7×10^{-9}
Mechanical Damage to Fuel in the Water Pool	8.1×10^{-3}	4.4×10^{-6}	2.7×10^{-4}	1.2×10^{-9}
Inter-Facility Transport Accident[4]	9.4×10^{2}	5.2×10^{-1}	NA	NA
Inadvertent Fuel Cutting in the Water Pool	1.6×10^{-2}	8.9×10^{-6}	4.0×10^{-4}	3.5×10^{-9}
Inadvertent Criticality in the Water Pool	2.1×10^{2}	1.1×10^{-1}	1.5×10^{-6}	1.7×10^{-7}
Shielded Basket Transfer Container Drop or Tip-Over	5.3×10^{-1}	2.9×10^{-4}	3.5×10^{-4}	1.0×10^{-7}
Windborne Projectile into Shielded Basket Transfer Container	4.3×10^{-2}	2.4×10^{-5}	3.3×10^{-5}	7.9×10^{-10}
Minor Water Pool Leak	This scenario is evaluated qualitatively in Section F.5.4.12.			

[1] To convert dose to fatal cancer, a factor of 5.5×10^{-4} is multiplied by the dose for the General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factor which includes both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factor overstates the likelihood of fatal cancer in a population and the use of this factor to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

[2] The probability of the accident is conservative (Section F.7.1).

[3] The lifetime risk of developing fatal cancer is determined by multiplying the annual risk of developing fatal cancer by the expected time-frame of the alternative (Section 2.3).

[4] No probability or annual risk is calculated for IDAs because the probability of the event is considered “unknowable” (DOE 2004b).

Table F.5-27: Dose Impacts and Annual Risk to the General Population From Radiological Accident Scenarios With 95 Percent Meteorology

Accident Scenario Description	General Population Dose (person-rem)	Fatal Cancer Per Accident Occurrence[1]	Annual Probability of Accident[2]	Annual Risk of Developing Fatal Cancer to the General Population[3]
HEPA Filter Fire	1.6×10^{-4}	8.5×10^{-8}	5.0×10^{-4}	4.3×10^{-11}
Shielded Transfer Container Drop or Tip-Over	7.3×10^{-1}	4.0×10^{-4}	2.7×10^{-3}	1.1×10^{-6}
Airplane Crash into Water Pool[4]	2.5×10^{1}	1.4×10^{-2}	NA	NA
Drained Water Pool – No Action Alternative	3.7×10^{2}	2.1×10^{-1}	1.0×10^{-3}	2.1×10^{-4}
Drained Water Pool – Overhaul Alternative	3.7×10^{2}	2.1×10^{-1}	1.0×10^{-4}	2.1×10^{-5}
Drained Water Pool – New Facility Alternative	3.7×10^{2}	2.1×10^{-1}	7.0×10^{-5}	1.4×10^{-5}
Hydrogen Detonation in the Water Pool	5.8×10^{-1}	3.2×10^{-4}	6.4×10^{-5}	2.0×10^{-8}
Mechanical Damage to Fuel in the Water Pool	6.1×10^{-2}	3.3×10^{-5}	2.7×10^{-4}	9.0×10^{-9}
Inter-Facility Transport Accident[4]	7.0×10^{3}	3.8	NA	NA
Inadvertent Fuel Cutting in the Water Pool	1.2×10^{-1}	6.7×10^{-5}	4.0×10^{-4}	2.7×10^{-8}
Inadvertent Criticality in the Water Pool	1.6×10^{3}	8.5×10^{-1}	1.5×10^{-6}	1.3×10^{-6}
Shielded Basket Transfer Container Drop or Tip-Over	4.0	2.2×10^{-3}	3.5×10^{-4}	7.7×10^{-7}
Windborne Projectile into Shielded Basket Transfer Container	3.2×10^{-1}	1.8×10^{-4}	3.3×10^{-5}	5.8×10^{-9}
Minor Water Pool Leak	This scenario is evaluated qualitatively in Section F.5.4.12.			

[1] To convert dose to fatal cancer, a factor of 5.5×10^{-4} is multiplied by the dose for the General Population. In determining a means of assessing health effects from radiation exposure, the ICRP has developed the above factor which includes both fatal and non-fatal cancers. The ICRP adjusts the incidence of fatal cancers upward to account for the total harm experienced as a consequence of developing non-fatal cancer. The factor overstates the likelihood of fatal cancer in a population and the use of this factor to estimate the likelihood of fatal cancer is conservative for comparison purposes. (Section F.2.5)

[2] The probability of the accident is conservative (Section F.7.1).

[3] The lifetime risk of developing fatal cancer is determined by multiplying the annual risk of developing fatal cancer by the expected time-frame of the alternative (Section 2.3).

[4] No probability or annual risk is calculated for IDAs because the probability of the event is considered “unknowable” (DOE 2004b).

F.5.6 Evaluation of Impacted Area

The area of land that could be contaminated following the hypothetical accident scenarios is evaluated. The impacted area surrounding a facility following an accident is determined for each scenario evaluated. The impacted area is defined as that area in which radioactive material deposits to such a degree that an individual standing on the boundary of the area would receive approximately 0.01 millirem per hour of radiation exposure. If this individual spends 24 hours a day at this location, that person would receive about 88 millirem per year from the ground shine. This is within the 100 millirem per year limit of 10 C.F.R. § 20. See Section F.2.4 for a discussion on radiation exposure limits.

To best characterize the affected areas for each hypothetical accident scenario, 50 percent meteorology is used. The results for ground surface dose are used to determine the distance downwind where the centerline dose drops to approximately 88 millirem per year based on 24 hours per day of radiation exposure. Once the footprint length is determined, the area of the contaminated footprint is calculated by integrating the area within the plume. Many of the scenarios do not have a footprint plume because they are gas-only releases, or the total activity released from the accident is small and does not contribute measurable dose from external ground contamination. These scenarios are reported with a footprint length of less than 0.1 kilometer (0.06 miles). Table F.5-28 lists each hypothetical accident scenario analyzed and the contaminated footprint associated with the scenario.

Table F.5-28: Footprint Estimates for Accidents at NRF

Accident Scenario	Footprint Length	Footprint Length	Footprint Area[1]	Footprint Beyond INL Boundary
	kilometers	miles	acres	
HEPA Filter Fire	< 0.1	< 0.06	< 0.5	No
Shielded Transfer Container Drop or Tip-Over	< 0.1	< 0.06	< 0.5	No
Airplane Crash into Water Pool	< 0.1	< 0.06	< 0.5	No
Drained Water Pool	1.7	1.0	60	No
Hydrogen Detonation in the Water Pool	< 0.1	< 0.06	< 0.5	No
Mechanical Damage to Fuel in the Water Pool	< 0.1	< 0.06	< 0.5	No
Inter-Facility Transport Accident	5.7	3.5	600	No
Inadvertent Fuel Cutting in the Water Pool	< .01	< 0.06	< 0.5	No
Inadvertent Criticality in the Water Pool	2.2	1.4	100	No
Shielded Basket Transfer Container Drop or Tip-Over	< .01	< 0.06	< 0.5	No
Windborne Projectile into Shielded Basket Transfer Container	< .01	< 0.06	< 0.5	No
Minor Water Pool Leak[2]	N/A			

[1] 1 acre = 0.4 hectares
[2] There is no airborne release from the minor water pool leak. Therefore, there would be no surface land contamination.

Although the plume would be contained within a single sector, the direction of the wind is unknown. Therefore, NRF is examined for impacts in all directions out to a distance equal to the footprint length. Since the accidents occur over a short duration of time, the acreage of the sector quoted is still an accurate indication of the total contaminated area. The extent of contaminated land is expected to remain on the INL and would not be expected to extend beyond 5.7 kilometers (3.5 miles) from NRF.

The extent of contamination would not be expected to reach the ATR Complex, the nearest INL facility. The impact of this contamination would be temporary while the area is isolated and remediation efforts completed. Identification of the potential secondary impacts is contained in Table F.5-29.

Table F.5-29: Secondary Impacts of Accidents at NRF

Secondary Impact	Description
Biota	Plants and animals on-site and around INL would experience no long-term impacts. See Section 4.5 for more details on effects on biota.
Surface Water and Ground Water	The water used for drinking and industrial purposes is monitored and use may be temporarily suspended during cleanup operations.
Economy	A small number of individuals may experience temporary job loss due to temporary restrictions on support activities near INL during cleanup operations. The job losses are expected to be minimal because many employees could be temporarily reassigned to support cleanup operations. No enduring impacts are expected.
National Defense	In the event of an accident at NRF, there could be a significant impact on the NNPP's ability to meet fleet demands. This could result in negative impacts to the U.S. Navy.
Cost of Decontamination	Contamination sufficient to exceed the 100 millirem per year limit from 10 C.F.R. § 20 is expected to remain within the INL boundaries and is expected to extend approximately 5.7 kilometers (3.5 miles) from NRF. Although some cleanup of contaminated land would be expected, providing a cost estimate for the effort is too speculative given the uncertainty associated with cleanup level, methods, and timeline.
Endangered and Protected Species	The facility accident would not affect the long-term potential for survival of any species. Section 3.5 states that no potential endangered species are present on INL, and Section 4.5 discusses candidate species and other wildlife on INL.
Land Use	Access to some areas of INL may be temporarily restricted until cleanup is completed.
Treaty Rights	Some temporary restrictions on access may be required until cleanup is completed. No enduring impacts are expected.
Transportation	No impacts are expected because no U.S. highways are within 10,000 meters (6.2 miles) of NRF.

F.6 Emergency Preparedness and Mitigative Measures

F.6.1 Emergency Preparedness

Emergency plans are in effect at NRF to ensure that workers and the public would be properly protected in the event of an accident. These response plans include the activation of emergency response teams provided by NRF or INL and an NRF emergency control center, as well as activation of a command and control network with NNPP Headquarters and supporting laboratories. The long-standing emergency planning program that exists within the NNPP includes the ability to utilize the comprehensive and extensive emergency response resources of each NNPP site and provides for coordination with appropriate civil authorities. In addition to the NNPP resources, extensive federal emergency response resources are available, as needed, to support state or local response.

Emergency response measures include provisions for immediate response to radiological emergencies at the facility location, identification of the accident conditions, communications with those providing radiological data, and recommendations for any appropriate protective actions. NRF employees are trained to respond to radiological emergencies including evacuation from areas that involve a potential release of radioactive material. In the event of an accident involving radioactive materials, workers in the vicinity of the accident would promptly leave the immediate area, typically within minutes of the accident.

Planning for emergencies is based on NNPP technical analysis as well as recommendations and guidance provided by numerous agencies experienced in emergency planning including the Department of Homeland Security (Federal Emergency Management Agency), the U.S. Navy, DOE, NRC, EPA, National Council on Radiation Protection and Measurements, and the International Atomic Energy Agency. Emergency planning for the public is based on the above-mentioned guidance as well as the specific planning requirements of local civil authorities. NNPP maintains close relationships with civil authorities to ensure that communications and emergency responses are coordinated if ever needed. (NNPP 2014)

Regularly scheduled exercises are conducted to test NRF's ability to respond to accidents. These exercises include realistic tests of people, equipment, and communications involved in all aspects of the plans; the plans are regularly reviewed and modified to incorporate experience gained from the exercises. These exercises also periodically include steps to verify the adequacy of interactions with local hospitals, emergency personnel, and state officials.

F.6.2 Mitigative Measures

For members of the general public residing at the site boundary or beyond, no credit is taken in the results presented for any preventive or mitigative actions that would limit their radiation exposure. These individuals are calculated as being exposed to the entire contaminated plume as it travels downwind from the accident site. Similarly, the models do not account for any action that could be taken to prevent individuals from continuing their routine ingestion of terrestrial food and animal products. As discussed in Section F.3.1, in the event of a real emergency, action would be taken to prevent the public from exceeding a PAG. No reduction of radiation exposure due to PAGs is accounted for in this analysis. For hypothetical accident scenarios, the public is assumed to spend approximately 30 percent of the day indoors. For routine naval spent nuclear fuel handling operations, the public is assumed to spend 66 percent of the day indoors. The exposure to ground surface radiation is therefore reduced appropriately on a yearly basis.

Individuals that work on the INL (MCW) or those that may be traversing the site in a vehicle (NPA) would be evacuated from the affected area within 2 hours. This is based on the availability of security personnel at INL and NRF to oversee the removal of collocated workers and travelers in a safe and efficient manner. Periodic training and evaluation of the security personnel is conducted to ensure that correct actions are taken during an actual casualty. Therefore, collocated workers and travelers would be exposed to the entire contaminated plume from the 15-minute accident release as it travels downwind for a period not to exceed 2 hours. Similarly, the radiation from ground surface deposited radioactive materials would be limited to a 2-hour period. No ingestion of contamination is calculated for these individuals for accident analysis because only a 2-hour radiation exposure period is evaluated.

NRF workers undergo training to take quick, decisive action in the event of an accident. These individuals quickly evacuate the area and move to previously defined areas at NRF. Workers could be exposed to 5 minutes of the radioactive plume as they move to these areas. Once the immediate threat of the plume has moved off-site and downwind, the workers would be instructed to walk to vehicles waiting to evacuate them from the site. An additional 15 minutes would be required to evacuate the workers from the contaminated area; therefore, the workers are assumed to receive a total of 20 minutes of ground surface exposure. No ingestion of contamination is calculated for these individuals for accident analysis because only a 20 minute radiation exposure period is evaluated.

Table F.3-6 provides the individual radiation exposure times utilized in the accident analyses presented in Section F.5.4.

NRF integrates safety and security safeguards to deter, detect, delay, assess, and respond to security threats which could lead to an IDA. Although IDAs cannot be categorically ruled out, appropriate security measures would be taken to lessen the chance of occurrence. These measures include security clearances for personnel, restricted access to areas containing radioactive material, and physical barriers to the facility. If an IDA were to occur at NRF, having additional measures in place (e.g., HEPA-filtered ventilation systems, fire protection systems, emergency response capabilities, and the remote location of NRF) would lessen the consequences.

F.7 Analysis of Uncertainties

The analyses of the impacts of routine naval spent nuclear fuel handling operations and hypothetical accidents associated with naval spent nuclear fuel handling presented in this Appendix are based on conservative calculations. This is necessary because virtually all of the events analyzed have a low probability of occurrence and most of the impacts of routine naval spent nuclear fuel handling operations are so small that they cannot be measured. The use of calculations introduces the possibility that the actual impacts may differ from those calculated due to uncertainties, such as differences between actual behavior and the theoretical models or equations and the variability of the values of factors used in the calculations. To portray the effects of such variability and uncertainty, the analyses performed for this Appendix are divided into four components: (1) the probability that an event, such as an accident, could occur; (2) the amount of radioactive material or radiation that might be released to the environment by the event; (3) the calculation of the potential for radiation exposure to human beings from the release; and (4) the conversion of the radiation exposure to detrimental health effects. Each of these components is discussed separately in the following sections.

The discussion in the following sections focuses on accident analyses, but it should be understood that the analysis of uncertainties for routine naval spent nuclear fuel handling operations is the same, with a few exceptions. First, routine naval spent nuclear fuel handling operations are certain to occur, so the probability of such events is effectively 1.0. Second, the source terms used for the analyses of routine naval spent nuclear fuel handling operations are based on monitoring of current operations at NRF scaled to estimate emissions based on future operations. The estimates of the amount of radiation or radioactivity involved in routine naval spent nuclear fuel handling operations would be conservative for the New Facility Alternative based on the design of the facility. It is possible that there would be some variations, and that future efforts to keep radiation exposures ALARA might reduce the source terms further. The effects of routine naval spent nuclear fuel handling operations and accidents are calculated using similar analytical methods and models for determination of radionuclide movement in the environment, pathways to humans, and conversion of radiation exposure to health effects. Therefore, the discussion of uncertainties in Sections F.7.3 and F.7.4 applies to the results of analyses of both routine naval spent nuclear fuel handling operations and hypothetical accidents.

F.7.1 Event Probabilities

The probability that an accident might occur is determined for the hypothetical accident scenarios. These probabilities are used in this Appendix to calculate the annual risk, defined as the product of the probability times the consequences, for each hypothetical accident.

The hypothetical accident scenario analysis is performed for a range of reasonably foreseeable accidents, with relative probabilities ranging from fairly probable (roughly 1 in 1000 years or smaller probability) to extremely unlikely (up to roughly 1 in 1,000,000 years). Accidents due to external events, human error, and equipment failures are considered. The set of accident scenarios considered inform the decision maker and the public of accident risks associated with the proposed action and alternatives by covering a spectrum from high consequence to lesser consequence. The probabilities of a range of accidents which might be caused by human error are also included. Such events include incorrectly performing machining procedures. For human error, a probability of one error in eight hundred operations (a frequency of 1.25×10^{-3} mean events per year) is used for operations performed by a single trained operator following a written procedure. If the procedure requires verification of the action by a second trained operator this frequency is lowered to 2.0×10^{-4}. If an additional error is also necessary for the accident to occur the calculated error frequency would be well below 1×10^{-5}; however, the minimum human error probability is conservatively set at 1×10^{-5}. These probabilities are derived from the methodology used by the NRC for assessment of human reliability (NRC 1983 and NRC 2005).

In many instances, the probabilities assigned to the events reflect the likelihood that a particular event, such as an earthquake, might occur. However, for the purpose of the analyses, the resulting accident is assumed to have quite severe consequences. The probability of such severe consequences is smaller than the probability that the initiating event might occur, with consequences as severe as used in the analyses possibly occurring only one time in 10 or 100 occurrences of the initiating event. The probabilities for most of the analyses in this Appendix use only the probability of the initiating event and do not include further reduction in the probability for the severity of consequences assumed. This is done, in part, because the severe consequences assumed, and in some cases the initiating events themselves, occur very infrequently, or have never occurred, so little data on their frequency is available.

The NNPP requirements for design and operation of naval spent nuclear fuel handling and processing systems ensure that the probability of such accidents are lower, sometimes orders of magnitude lower (on the order of 1×10^{-7}), than the probabilities assumed for accident analyses. For the purposes of analyses, the event is assumed to result in an accident with severe consequences and various features that would reduce the likelihood of the accident are conservatively omitted. Features such as the ruggedness of naval spent nuclear fuel and fuel containers, passive restraints to prevent tipping, and NNPP material controls, engineering controls and inspections, testing, and operator training and oversight would reduce the probability the initiating event would occur. As a result, the risks stated are believed to be larger than the risks that would be associated with actual accidents.

For example, one hypothetical accident analyzed is the impact on an SBTC of a projectile (e.g., a pipe) produced by high winds. The sequence of events analyzed include breaching the container seal to release radioactive material. In reality, the projectile would have to be large enough and traveling at high enough speed to cause the postulated damage. Similarly, it would have to contact the container at the correct location and at the correct angle to damage the seal. The probability assigned to this accident is 3.3×10^{-5} per year, the probability that a windborne projectile might strike a container, and does not include any factor to account for other elements in the sequence required to actually damage the seal. Therefore, the probability of the consequences calculated for this accident is much smaller than the probability of 3.3×10^{-5} per year used in the analysis.

A second example is provided by the hypothetical accidents involving damage to the naval spent nuclear fuel assemblies as a result of drop accidents. Naval fuel is designed to withstand combat shock loads and is very rugged. However, for the accidents analyzed that involved damage to naval spent nuclear fuel assemblies, no probability is assigned to the likelihood that an accident would cause impacts sufficient to result in a loss of fuel integrity. Therefore, the probability that the naval spent nuclear fuel could be damaged, and that fission products might be released, is less than the drop accident probability alone, which is the probability assigned to the consequences in this Appendix. In addition, NNPP practices include significant amounts of design conservatism, material controls, engineering controls, and inspections to reduce the probability of crane accidents below those that are assumed. Therefore, the risks for accidents resulting from drops are much smaller than stated in the analyses.

A third example is the probability of a hypothetical accident resulting in an inadvertent criticality. Equipment designs include features that are specifically designed to reduce the likelihood of a criticality in the event of an accident, such as passive feature to prevent tipping and ejection of naval spent nuclear fuel assemblies. These additional features would further reduce the probability of an inadvertent criticality; therefore, the risks presented for criticality would be smaller than presented in this analysis.

As can be seen from these examples, the actual probability of the consequences resulting from the analyses are smaller than the values presented in this Appendix, at least in part because these probabilities do not include any additional factors to reflect the accident severity used in the analyses. As a result, the risks stated in this Appendix for most hypothetical accidents are believed to be greater than the risks associated with actual accidents. However, the same probabilities have been used in the evaluation of all of the alternatives considered and all of the risks are small; so, the approach used is adequate for the comparative purposes of this EIS.

F.7.2 Release of Radioactive Material or Radiation (Source Term)

Since the source terms used in the hypothetical accident analyses are typically for scenarios which have never occurred, there is great room for uncertainty. The range of scenarios analyzed in this EIS is intended to encompass accidents which produce consequences unlikely to be exceeded by any reasonably foreseeable accident. As a result, the accidents themselves, and the sequences of events during the accidents, are chosen to maximize the source term. For example, systems such as HEPA filters are considered to be inoperative in all cases where the accident might have an opportunity to disable them, and the water pool inventory is assumed to be at peak capacity for scenarios which affect all of the naval spent nuclear fuel in the water pool (e.g., airplane crash into the water pool).

The source terms for the hypothetical accident analyses are dependent upon five factors as described in Section F.5.3. The five factors for developing the source term are chosen to ensure that the release to the environment is conservative for the hypothetical accident scenarios. For example, the MAR for the accident scenarios is always conservative and it is assumed that all released material is in the breathable range as represented by an RF set equal to 1.0. In general, for there to be an accidental release of radioactivity to the environment, there must be damage to the facility or containment. When the containment is not provided by the fuel structure (i.e., external containment) this damage is represented by leak path factors (LPFs). Furthermore, naval spent nuclear fuel must also be damaged for any release of fission products since all fission products are fully contained within naval spent nuclear fuel cladding. The amount of damage to the external containment or the naval spent nuclear fuel is dependent upon the severity and the nature of the accident. This damage is represented by damage ratios (DRs) and airborne release fractions (ARFs). In the hypothetical accidents analyzed, the assumptions concerning the containment (LPFs) or the extent of damage to the naval spent nuclear fuel assemblies (DRs and ARFs) provide a conservative evaluation whose results would not be exceeded by reasonably foreseeable accidents of a similar type.

One example of this is the evaluation of the inadvertent cutting into the fuel region of a naval spent nuclear fuel assembly. The saw blade is assumed to be parallel to the naval spent nuclear fuel assembly during the accident because this configuration has the potential to disturb the maximum amount of naval spent nuclear fuel. The parallel configuration of the saw blade demonstrates the selection of a conservative MAR and DR by maximizing the amount of fuel available for release from the naval spent nuclear fuel assembly. The actual magnitude of the release from this event would be somewhere between the value assigned in this EIS and zero.

Another example is the HEPA filter fire scenario. The inventory from four HEPA filters is the assumed MAR which is the maximum possible amount of activity that could be involved in an accident of this type based on ECF operations. The accident represents two in-parallel HEPA filter assemblies which catch on fire. The entire inventory of two HEPA filters and two pre-filters are involved in the fire. For conservatism in selecting the MAR, it is modeled that each filter contains the maximum inventory of a filter even though the downstream HEPA filter in series would contain much less inventory than the leading pre-filter. The actual magnitude of the release from this event would be somewhere between the value assigned in this EIS and zero.

All of the source terms used for the evaluation of the hypothetical accidents are developed in a similar fashion. The source term released to the environment is judged to be conservative for the hypothetical accident scenarios. Thus, the expected outcome for all of the accidents is that a smaller release to the environment is expected than is used in the analysis.

For routine naval spent nuclear fuel handling operation emissions there is also uncertainty because the exact tempo of future operations is unknown. It is conservatively assumed that the emissions are at peak capacity to represent a fully operational facility. This assumption is conservative because facilities only operate at peak capacity for short periods of time.

F.7.3 Radiation Exposure to Humans

Radiation exposure to the individual groups is evaluated with multiple computer programs. The computer programs model the movement of airborne and water contamination resulting from the postulated release using four types of pathways to the population groups. These pathways include exposure directly to the radiation from the material in the plume, direct exposure to radiation from contaminated soil or water, inhalation of air containing gases or particles, and ingestion of contaminated water or food. The analyses in this Appendix use parameter values which are conservative or based on the best information available.

The Gaussian plume model used in these analyses to represent airborne movement of radioactive material is the standard used in many evaluations of environmental effects. To ensure that calculated radiation exposures are as high as could occur under any set of conditions, a ground level release is used and no reduction in the airborne concentrations is included for either turbulence caused by buildings or the effect of plume meander which occurs naturally at the low wind speeds accompanying the 95 percent meteorological conditions (Section F.3.3.2).

The results for both the 50 percent and the 95 percent meteorological conditions are provided in detailed tables in this Appendix and show that the 95 percent meteorological conditions produce radiation exposure estimates which are 3 to 20 times higher than those for the 50 percent conditions (depending upon the specific nuclides released in the source term, and the individual group).

External radiation from contamination which results from particles from the plume deposited on the ground surface depends upon the deposition parameters which are input as best-estimate values. Faster deposition results in more material on the ground and increased ground surface exposure to those closer to the accident location but less material on the ground and decreased ground surface exposure for those farther from the accident site. External ground surface dose is a less significant pathway than the inhalation and ingestion pathways. With higher deposition velocities, fewer particles are suspended in the plume for downwind inhalation. The ingestion pathway has the same trend as the ground surface pathway because the food is contaminated at the same level as the ground surface. The effects of uncertainty in this parameter depend upon the distance at which each individual group is evaluated, the radiation exposure pathways evaluated, and the population distribution around NRF.

The possible exposure to direct radiation from material in surface water and associated sediments as a result of accidental release directly to the water or fallout from an airborne release is estimated for people involved in activities such as swimming and boating. The calculations assumed a stagnant pond and therefore take no credit for dilution by river currents. The concentrations in the air are not reduced by the amount of material deposited in the water and vice versa. Due to the conservative concentrations used in the calculations and an assumption that every member of the public in the area would be exposed to direct radiation from surface waters, radiation exposure from this pathway is very likely overestimated.

The inhalation pathway evaluation is based on average breathing rates and uptake consistent with the recommendations by the ICRP (ICRP 1995) for each age group. Higher values for these parameters would increase the estimated radiation exposures and lower values would decrease the estimates.

The ingestion pathway includes meat, seafood, dairy, food crops, and drinking water. Best-estimate parameters are used to evaluate the contamination levels in food and water when ready for consumption. Consumption rates for individuals are based on expected eating habits. The analysis also includes the assumption that 10 percent of the entire diet of the affected population group consists of contaminated products with exceptions for milk and drinking water. For milk consumption, 30 percent of the diet is assumed to be contaminated based on the amount of local milk available near NRF. (100 percent of the milk intake is assumed to be contaminated for infants because infants often receive all of their milk from a single source). Drinking water is assumed to be 100 percent contaminated because it is often obtained from a single source. Uncertainties associated with these pathways could affect the estimated impacts in either the positive or negative direction.

The drinking water contribution to the ingestion pathway is calculated by assuming that a portion of the radioactive material would become dissolved in the drinking water supply. The drinking water supply would become contaminated either through deposition of radioactive material from the plume directly onto bodies of surface water, or by the deposition of radioactive material onto the ground and its subsequent infiltration through the soil into the aquifer. The flow of the aquifer from north to south (Figure 3.4-5) is ignored, and it is conservatively modeled that the contaminated water flows directly towards the MOI and General Population. Where fresh surface water provides drinking water, any contamination of the water is assumed to occur promptly, and no decreases due to radioactive decay are used. Where aquifers are a source of drinking water, consumption of water from the aquifer is delayed for the time required for the contamination to reach the aquifer and then to reach the nearest drinking water source. Water infiltration rates are discussed in Section 3.4.2.1. To determine water ingestion doses it is conservatively assumed that the contaminated water is ingested during the radiation exposure period, and the delay time for the water contamination to occur is not considered in the radiation exposure period. It is assumed that 9.5 years would pass before water carrying the radioactive material would reach a well drawing from the aquifer. (This includes 2 years for the radioactive material to pass through the soil and reach the aquifer, and an additional 7.5 years for the aquifer flow to carry the radioactive material to the well). While the consumption rate is adjusted to correspond to each age group evaluated, the MOI is conservatively assumed to drink only water from the contaminated source and to drink 1.5 liters (0.4 gallons) of water per day during the 1-year radiation exposure period. The concentrations in these calculations are considered to be higher than expected because no reduction of the concentration by dilution is included and the fraction of each population group exposed to the affected drinking water is conservatively high.

The contamination of food crops, livestock, and local game is analyzed. The same concentration of radioactive material as in drinking water is used in the irrigation water from either surface water or ground water. Affected crops, livestock, and game are assumed to receive all water from the contaminated water source and applicable biological accumulation factors are used. Human consumption rates for the crops, livestock, and game are used to calculate the radiation exposure from this source. The uncertainty from this source is associated with the concentration of contaminants in the irrigation water, the amount of such foods consumed, and the fraction of the individual groups which ingests the affected food.

The General Population used to determine the effects of routine naval spent nuclear fuel handling operation in this Appendix is the entire population of 151,000 people within 80.5 kilometers (50 miles) downwind of the accident. The General Population used to determine the effects of hypothetical accidents in this Appendix is the entire population of 88,500 people within the worst 22.5-degree sector within 80.5 kilometers (50 miles) downwind of the accident. Actual population growth or decreases in a region could introduce small variations in impacts. Additionally, the spread of the plume for the hypothetical accident analysis does not cover the entire sector, introducing conservatism in the application of the calculations to the evaluation of the dose to the General Population.

F.7.4 Conversion of Radiation Exposure to Health Effects

The conversion of amounts of radiation or radioactive material transmitted to an individual or to population groups into health effects requires the calculation of the radiation exposure or dose received by humans caused by inhaling or ingesting radioactive material or by exposure to a radiation field. Such calculations are based on a number of factors. The factors include the nature and rate of human metabolic processes such as respiration or excretion, the type of radiation involved, the sensitivity of various organs, and the age of the individuals involved. The rates of human metabolic processes are well characterized at this time; the energies, half-lives, and similar properties of radioactive material or radiation have been measured extensively and introduce little uncertainty into the calculations in this EIS.

The numerical estimates of fatal cancer and other health effects are obtained by the practice of modeling a linear-non-threshold (LNT) dose-response relationship for the induction of fatal cancer. The LNT model assumes that the health effects from radiation increase proportionally with dose, that the effects from high doses can be extrapolated to determine the effects at low doses, and that a threshold does not exist below which no health effects occur.

However, the number of detrimental health effects which might result from exposure of a large group of people to low levels of radiation has been the subject of debate for many years and no scientific knowledge exists to confirm a quantitative model. The ICRP stated in its 2007 recommendations (ICRP 2007):

> “Although there are recognised [sic] exceptions, for the purposes of radiological protection the Commission judges that the weight of evidence on fundamental cellular processes coupled with dose-response data supports the view that, in the low dose range, below about 100 mSv

> [10 rem], it is scientifically plausible to assume that the incidence of cancer or heritable effects will rise in direct proportion to an increase in the equivalent dose in the relevant organs and tissues…However, the Commission emphasises [sic] that whilst the LNT model remains a scientifically plausible element in its practical system of radiological protection, biological/epidemiological information that would unambiguously verify the hypothesis that underpins the model is unlikely to be forthcoming."

There is much uncertainty in the understanding of dose to health effects because the data are inconclusive at small doses, and other methods of extrapolation to the low-dose region could yield higher or lower numerical estimates of cancer. Studies of human populations exposed at low doses have not shown consistent or conclusive evidence upon which to determine the incidence of cancer from radiation exposure. Attempts to observe increased cancer in human populations exposed to low doses of radiation have been difficult. There is scientific uncertainty about cancer incidence in the low-dose region below the range of epidemiologic observation (observations having to do with the branch of medicine that studies events that affect many people throughout an area at the same time), and the possibility of no incidence cannot be excluded. The reason low-dose studies cannot be conclusive is that the incidence rate, if it exists at these low levels, is too small to be seen in the presence of all the other risks of life (NNPP 2011b). However, the NNPP has always assumed that radiation exposure, no matter how small, may involve some consequence (e.g., cancer). For this Appendix, the recommendations from the ICRP (ICRP 2007) based on the LNT model are used to evaluate health effects.

The calculations of health effects performed in this EIS use the relation recommended by the ICRP because it is well documented and kept up to date by the ICRP. It is also consistent with the preferred model identified by the National Academy of Sciences in the BEIR VII report (NRC-NAS 2006), the United Nations Scientific Committee (UNSCEAR 2000) and the National Council on Radiation Protection (NCRP 2001) and is widely accepted by the scientific community as representing a method which produces estimates of health effects which would not be exceeded. However, a number of researchers believe that the ICRP relation overestimates the number of detrimental health effects produced by low levels of radiation and, in fact, the possibility of no effect cannot be excluded. Conversely, there are some who believe that exposure to low levels of radiation can produce more health effects than would be estimated using the ICRP relations.

Clearly, using a relationship developed by one or the other of these groups would produce a larger or smaller estimate of the number of health effects than the values presented in this EIS, but a factor of two change in the small risks calculated for all of the alternatives would still leave them as small risks. All of the results of analyses of routine naval spent nuclear fuel handling operations and hypothetical accidents in this Appendix include the calculated radiation exposure in addition to the number of health effects to enable independent calculations using any relation between radiation exposure and health effects judged appropriate.

The radiation exposures reported in this EIS are chronic radiation exposures based on the committed dose (50 or more years of internal dose delivery) from an accident or annual dose from routine naval spent nuclear fuel handling operations. Exposures to high levels of radiation at high dose rates over a short period (less than 24 hours) can result in acute radiation effects. Minor changes in blood characteristics might be noted at doses in the range of 25 to 50 rad. The external symptoms of radiation sickness begin to appear following acute radiation exposures of about 50 to 100 rad and can include fatigue, anorexia, nausea, and vomiting. More severe symptoms occur at higher doses and can include death at doses higher than 200 to 300 rad of total body irradiation, depending on the level of medical treatment received. Information on the effects of acute radiation exposures on humans was obtained from studies of the survivors of the Hiroshima and Nagasaki bombings and from studies following a multitude of acute accidental radiation exposures. Factors to relate the level of acute radiation exposure to health effects exist but are not applied in this EIS because acute radiation exposures (direct radiation exposure not including inhalation and ingestion) during a hypothetical accident would be well below 20 rem.

F.7.5 Summary of Uncertainties

As discussed in the preceding portions of this section, the calculations in this EIS are generally been performed in such a way that the estimates of annual risk provided are unlikely to be exceeded during either routine naval spent nuclear fuel handling operations or in the event of an accident. For routine naval spent nuclear fuel handling operations, monitoring of actual operations combined with projections for future operations provide realistic but conservative source terms, which, when combined with conservative estimates of the effects of radiation, produce estimates of risk which are very unlikely to be exceeded. The effects for all alternatives have been calculated using the same source terms and other factors, so this EIS provides an appropriate means of comparing potential impacts on human health and the environment.

The analyses of hypothetical accidents provide more opportunities for uncertainty, primarily because the calculations must be based on sequences of events and models of effects which have not occurred. In this Appendix, the goal in selecting the hypothetical accidents analyzed is to evaluate events which would produce effects which would be as severe as or more severe than any other accidents which might be reasonably foreseeable. The models provide estimates of the probabilities, source terms, pathways for dispersion and radiation exposure, and the effects on human health and the environment which are as realistic as possible. In summary, it is judged that the annual risks presented in this Appendix are believed to be greater than what would actually occur.

The use of conservative analyses is not a problem or disadvantage in this EIS since all of the alternatives are evaluated using the same methods and data, allowing a fair comparison of all of the alternatives on the same basis. Furthermore, even using these conservative analytical methods, the annual risks for all of the alternatives are small, which greatly reduces the significance of any uncertainty analysis parameters.

F.8 Updated Modeling Methodology

Many of the accident scenarios included in this EIS were also covered in DOE 1995. In general, differences between the analysis assumptions used in DOE 1995 and the analysis assumptions used for this EIS are due primarily to improved knowledge and improved modeling methodology.
A discussion of these differences is included here to allow a comparison of the results from the separate documents to the greatest extent possible. The methodology changes include:

- The projected amount of naval spent nuclear fuel assemblies stored in the naval spent nuclear fuel handling water pools has changed since 1995. The most up-to-date estimates of water pool inventory are used in this analysis.

- The types of naval spent nuclear fuel stored in the water pools have changed since 1995. A more representative naval spent nuclear fuel type is used in this analysis based on the type of naval spent nuclear fuel that would be handled at NRF during the time period of the proposed action.

- The ICRP recommendations for health effects and radiation effects have been updated based on more recent scientific and technical knowledge than was available in 1995.

- Conversion factors for health effects based on ICRP Publication 103 (ICRP 2007) guidance replace the ICRP Publication 60 (ICRP 1991) values for cancer fatalities used in 1995. The fatal cancer effects calculated in this EIS are a conservative estimate of cancer fatalities, and the use of this factor to estimate the incidence of fatal cancer is different from the methodology used in 1995.

- Internal dose conversion factors for inhalation and ingestion of radioactive products from ICRP Publication 72 (ICRP 1996) and ICRP Publication 68 (ICRP 1994) replace the ICRP Publication 30 (ICRP 1979) based FGR 11 (EPA 1988) factors used in 1995.

- Doses for six age groups based on ICRP Publication 72 (ICRP 1996) are used to evaluate the effects to the General Population in this analysis. The ability to calculate dose specific to different age group for the General Population was unavailable in 1995.

- The population of the General Population increased from approximately 116,000 to approximately 151,000.

- The speciation of iodine is adjusted based on more recent experimental and technical knowledge.

- The release mechanism and fraction of corrosion and fission products are adjusted based on more recent experimental and technical knowledge.

- The hypothetical criticality yield is adjusted based on more recent experimental and technical knowledge.

- A revised version of the downwind airborne dose code (RSAC) is used for the airborne accident analysis. The revised code incorporates the updated ICRP ingestion and inhalation parameters and contains modifications to the dispersion model.

- A revised version of the GENII code is used for routine naval spent nuclear fuel handling operations analysis. GENII is used for the waterborne accident analysis instead of the proprietary computer program (WATER RELEASE) used in 1995. The revised GENII code incorporates the updated ICRP ingestion and inhalation parameters, modification to the dispersion model, and many expanded modeling capabilities.

- A more realistic method is used for direct radiation calculations using computer capabilities that were not available in 1995.

- The range of accidents presented was revised to focus on the types of operations conducted at a naval spent nuclear fuel handling facility. DOE 1995 had a broader scope.

- Accident probabilities have been revised for consistency with expected production rates.

- Accident probability calculations are based on more recent information and calculation methodology.

APPENDIX G

COMMENTS AND RESPONSES

G.1 Background and Summary

On June 19, 2015, the Naval Nuclear Propulsion Program (NNPP) distributed the Draft Environmental Impact Statement (EIS) and announced its availability in the Federal Register, inviting interested parties to comment on the document during the public comment period ending on August 10, 2015. On June 26, 2015, the U.S. Environmental Protection Agency (EPA) announced availability of the Draft EIS in the Federal Register. The public comment period was extended to August 31, 2015, based on a request from the Shoshone-Bannock Tribes.

During the comment period, three public hearings were held and both written comments (by form) and oral comments were received at the hearings. The oral comments were captured by a stenographer in the form of transcripts. Comments were also received via letter and e-mail.

This appendix presents all comments received during the public comment period on the Draft EIS. This appendix is new in its entirety; therefore, there are no changes highlighted by sidebars. The individual comments within the comment document have side bars with a number that corresponds with the NNPP response.

Table G-1 provides a list of comment documents received during the public comment period and details regarding the source of each document. The comment documents are provided in the same order in Section G.2.

Section G.2 provides the comment documents in as-received form, including transcripts of oral comments provided during the public hearings. The NNPP responses immediately follow each comment document.

Table G-1: Comment Documents Received During the Public Comment Period

Comment Document #	Medium	Commenter & Affiliation	Page
1	E-mail	Steve Stoker Member of the Public	G-5
2	E-mail	Robert Leyse Member of the Public	G-7
3	E-mail	Robert Leyse Member of the Public	G-9
4	E-mail	Robert Leyse Member of the Public	G-11
5	E-mail	Laurence Gebhardt Member of the Public	G-13
6	E-mail	Vicki Watson Member of the Public	G-17
7	Form	Scott Hofhine Member of the Public	G-19
8	Form	Paul Loomis Mayor, City of Blackfoot	G-21
9	Form	Jim Roberts Member of the Public	G-23
10	Letter	Robert Bodell Member of the Public (also refer to Comment Document #23)	G-25
11	E-mail	Karen Donleavy Member of the Public	G-27
12	E-mail	Kathleen Whitaker Member of the Public	G-29
13	E-mail	Tyrone Belnap Member of the Public (also refer to Comment Document #25)	G-33
14	E-mail	Carolyn Smith Cultural Resources Coordinator, Shoshone-Bannock Tribes (also refer to Comment Document #33)	G-39
15	E-mail	Richard Provencher; transmitted by Mary La Marca Manager, Department of Energy, Idaho Operations Office	G-43
16	E-mail	Allison O'Brien; transmitted by Brian Milchak Regulator – Regional Environmental Officer, U.S. Department of the Interior	G-47
17	E-mail	Susan Burke INL Coordinator, Idaho Department of Environmental Quality	G-51
18	E-mail	Darin Dobbins; transmitted by Mindy Giles Assistant Vice President, Stoller Newport News Nuclear	G-55
19	E-mail	Beatrice Brailsford Nuclear Program Director, Snake River Alliance (also refer to Comment Document #27)	G-59

Table G-1: Comment Documents Received During the Public Comment Period (cont.)

Comment Document #	Medium	Commenter & Affiliation	Page
20	E-mail	Roger Turner Member of the Public	G-65
21	E-mail	Chuck Broscious Environmental Defense Institute	G-71
22	E-mail	Tami Thatcher Member of the Public (also refer to Comment Document #24)	G-107
23	Transcript	Robert Bodell Member of the Public (also refer to Comment Document #10)	G-123
24	Transcript	Tami Thatcher Member of the Public (also refer to Comment Document #22)	G-125
25	Transcript	Tyrone Belnap Member of the Public (also refer to Comment Document #13)	G-129
26	Transcript	Lonzo West Member of the Public	G-137
27	Transcript	Beatrice Brailsford Nuclear Program Director, Snake River Alliance (also refer to Comment Document #19)	G-139
28	Transcript	Kelly Bartholomew Operating Engineers of Southwest Idaho	G-145
29	Transcript	Christine Beach Member of the Public	G-147
30	E-mail	Darlene Gerry; transmitted by Linda Martin Interim Executive Director, Regional Economic Development for East Idaho	G-151
31	Letter	Christine Reichgott; transmitted by Theo Mbabaliye Manager, Environmental Review and Sediment Management Unit, U.S. Environmental Protection Agency, Region 10	G-155
32	E-mail	John Notar Air Resources Division, National Park Service, U.S. Department of the Interior	G-195
33	Letter	Carolyn Smith Cultural Resources Coordinator, Shoshone-Bannock Tribes	G-201

G.2 Comment Documents and Responses

This section provides comments received during the Draft EIS public comment period and the associated NNPP responses. Personal contact information (i.e., home address, phone number, e-mail address) is redacted to protect personal and private information. Similar information provided by organizations is not redacted.

Comment Document #1

Re: Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory

Steve Stoker <[redacted]> Sat, Jul 4, 2015 at 8:12 PM
Reply-To: Steve Stoker <[redacted]>
To: ECF Recapitalization <ecfrecapitalization@unnpp.gov>

1.1 Thanks Erik. Though now retired I'm glad to see the Navy use the NRF site for continued used-fuel processing and safely storing such containers until our nation sees to place it elsewhere. My radiological controls background assures me that the Navy demands utmost safety and environmental concern. I think you can safely store it right where it sits today, for a reasonable fee...like no Idaho state taxes. Ha.

Keep up the good work.

Steve

From: ECF Recapitalization <ecfrecapitalization@unnpp.gov>
To: [redacted]
Sent: Friday, June 26, 2015 5:05 AM
Subject: Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory

Dear Mr. Stoker,

During the public scoping phase of the proposed *Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory*, you indicated a desire to have a copy of the Draft Environmental Impact Statement (EIS) for this proposed action sent to you electronically. A Notice of Availability for the Draft EIS has been issued, and the Notice of Availability and Draft EIS are available electronically at *www.ecfrecapitalization.us*. This site also contains information on how to provide comments on the Draft EIS as well as information on upcoming public hearings, where comments may also be made.

Sincerely,

Erik Anderson
Naval Reactors
Office of Regulatory Affairs
Department of Energy

Response to Comment Document #1

Item #1.1:

The commenter's support for the recapitalization project and continued naval spent nuclear fuel handling at Naval Reactors Facility (NRF) is noted.

Comment Document #2

Deficient timing of public notice af EIS
1 message

[redacted] Sun, Jul 19, 2015 at 4:44 PM
To: ecfrecapitalization@unnpp.gov

2.1 Only recently has the press told us about this EIS.

2.2 Also, there must be a public meeting in Blaine County, preferably in Ketchum. The other sites are too far away, here they are:

The NNPP will hold three public hearings on the Draft EIS:

- *August 4, 2015: 6:00 p.m. to 9:00 p.m., Residence Inn, 635 West Broadway, Idaho Falls, Idaho*
- *August 5, 2015: 6:00 p.m. to 9:00 p.m., Red Lion Hotel, 1555 Pocatello Creek Road, Pocatello, Idaho*
- *August 6, 2015: 6:00 p.m. to 9:00 p.m., La Quinta Inn, 539 Pole Line Road, Twin Falls, Idaho*

Robert H. Leyse, [redacted]

Response to Comment Document #2

The NNPP responded to this email in real-time due to the suggestion that another public meeting should be held on the Draft EIS. The numbers in the margin of the response correspond to the numbers in the comment document.

ECF Recapitalization <ecfrecapitalization@unnpp.gov> Tue, Jul 21, 2015 at 1:45 PM
To: [redacted]

Dear Mr. Leyse,

2.1 A legal notice announcing the availability of the *Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory* and the public comment period (including the dates and locations of hearings) was published on June 24, 2015 in the Idaho Mountain Express. The Idaho Mountain Express is based in Ketchum, ID. Although the subject of your email suggests that the notice of the public hearings is "deficient", the announcement of the hearings, scheduled for August 4 through 6, gives well over the 15 day notice required by regulation. See 10 CFR 1021.313(b). The timing of the public notice for the hearings is not deficient.

2.2 Naval Reactors chose the locations for the public hearings to be centrally located to the site-specific construction project, in accordance with EPA scoping guidance. The three public hearings meet the requirements of 10 CFR 1021.313(b) for the Department of Energy (DOE) to hold at least one public hearing on DOE Draft EISs. No additional public meetings will be held.

If you are unable to attend one of the public meetings, you can submit comments on the Draft EIS via email at ecfrecapitalization@unnpp.gov or via U.S. mail:

Erik Anderson
Department of the Navy
Naval Sea Systems Command
1240 Isaac Hull Ave. SE
Stop 8036
Washington Navy Yard, DC 20376-8036

Sincerely,

Erik Anderson
Naval Reactors
Office of Regulatory Affairs
Department of Energy

Comment Document #3

[redacted] <[redacted]> Wed, Jul 22, 2015 at 11:32 AM
To: ecfrecapitalization@unnpp.gov
Cc: news@mtexpress.com, jennifer.martin@deq.idaho.gov

Thank you for the prompt reply and the reminder that all information was promptly released in the Idaho Mountain Express.

I have found the following via the Internet for the June 24, 2015 issue:

LEGAL NOTICE SUMMARY

See the full text of all public notices in the Idaho Mountain Express, the paid newspaper, available from vending machines or by subscription. Call 726-8060

- The U.S. Department of Energy (DOE) Naval Nuclear Propulsion Program (NNPP) announces the availability of the Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory (DOE/EIS-0453-D) for public review.

3.1 You are correct, DOE complied with the law. However, DOE did not really serve the taxpayers with this terse release. And the Mountain Express certainly did not serve its public.

3.2 In that same issue, the Mountain Express devoted a lot of space to the following:

http://www.mtexpress.com/news/environment/activists-call-inl-study-inadequate/article_d0459ae2-1a02-11e5-a4e2-d741c65484d1.html

Following in italics are excerpts from a recent write up in a Seattle newspaper:

Navy considers Idaho for site to process nuclear fuel

Originally published July 17, 2015 at 11:24 am Updated July 17, 2015 at 2:56 pm
By KEITH RIDLER
The Associated Press

3.3 *"The Navy fuel is highly enriched uranium," Martin said. "When they defuel the ships, it needs to go into water storage."*

Apparently, Martin has access to information that is not otherwise available to the public, because when I do a word search on http://www.ecfrecapitalization.us/ I find no reference to highly enriched uranium.

Robert H. Leyse

Response to Comment Document #3

Item #3.1:

The Notice of Availability (NOA) was printed in its full text by the Idaho Mountain Express. The notice that the commenter reproduced was a truncated version from the Idaho Mountain Express web page. As noted on the web page, the full text of all public notices in the Idaho Mountain Express is available in their print newspaper.

Item #3.2:

The article referenced in this comment addressed a proposed action to ship small quantities of commercial spent nuclear fuel to the Idaho National Laboratory (INL) for research and development. This action is outside the scope of this EIS and unrelated to actions on the INL regarding naval spent nuclear fuel management.

Item #3.3:

The commenter is correct that the term “highly enriched uranium” was not used in the Draft EIS. However, the use of highly enriched uranium in naval cores has been described in other publicly available documents such as reports to Congress. The description of naval spent nuclear fuel in Section 1.1.2 has been updated to provide additional information on enrichment, composition, and the condition of naval spent nuclear fuel.

Comment Document #4

Finally, a month late.
1 message

[redacted] <[redacted]> Thu, Jul 23, 2015 at 11:57 AM
To: ecfrecapitalization@unnpp.gov
Cc: news@mtexpress.com, jennifer.martin@deq.idaho.gov

4.1 Finally, a month late, on July 22, 2015, the Idaho Mountain Express has a more detailed report by Associated Press of the Navy plans at INL. This is not in the front section; it is on page B2.

The Associated Press date is July 17, 2015. I copied the following from the Internet by searching Associated Press, etc. It is not posted with the Internet stuff that Mountain Express emphasizes for its July 22 issue.

Next time, the Navy should pay Mountain Express for a timely and up front press release instead of merely complying some publicly obscure regulations.

4.2 As an aside, (as I have already told you) on June 24, 2015, Mountain Express devoted a lot of front space to an absurd DOE proposal to play games with separate shipments of 25 fuel rods each from commercial nuclear power plants:
http://www.mtexpress.com/news/environment/activists-call-inl-study-inadequate/article_d0459ae2-1a02-11e5-a4e2-d741c65484d1.html

Navy considers Idaho for site to process nuclear fuel

By KEITH RIDLER Jul. 17, 2015 5:55 PM EDT

BOISE, Idaho (AP) — The U.S. Navy wants to build a $1.6 billion facility at a federal nuclear site in eastern Idaho to handle spent fuel from the nation's fleet of nuclear-powered warships.

The Navy and U.S. Department of Energy are taking public comments through Aug. 10 on a draft environmental impact statement for the jointly operated Naval Nuclear Propulsion Program at the Idaho National Laboratory.

Officials said a new facility at the 890-square-mile site is needed to replace decades-old, outdated installations to keep nuclear-powered aircraft carriers and submarines deployed. Continuing to use existing facilities, the document said, isn't viable because it could result in no longer being able to handle the nuclear waste in a safe or environmentally responsible way.

"Without significant upgrades and refurbishments, the existing facility will not be able to meet the requirements of the U.S. Navy's nuclear-powered fleet," Tom Dougan, spokesman for the Naval Nuclear Propulsion Program, said in an email to The Associated Press on Friday.

Kerry Martin, an Idaho National Laboratory Oversight Program manager with the Idaho Department of Environmental Quality, said the state agency is in favor of the plan.

"We actually think it's a very good thing," she said. "If we make comments (on the draft document), we will be in support of it. I can't say we feel that way about everything, but on this one we certainly do."

The 81-page draft document notes that the Gerald R. Ford aircraft carrier is scheduled for delivery in 2016 and that new nuclear-powered submarines are also under construction. The new facility would be able to handle a new type of spent fuel shipping container, which is not possible at the current facility. The new facility would also have a larger pool of water to cool the radioactive material.

"The Navy fuel is highly enriched uranium," Martin said. "When they defuel the ships, it needs to go into water storage."

Construction on the new facility, if approved, would last three years and give the Navy flexibility to meet future needs, the draft document said.

Public meetings on the draft document are planned in early August in Idaho Falls, Pocatello and Twin Falls.

Response to Comment Document #4

Item #4.1:

The NOA was published in the Federal Register on June 19, 2015. A legal notice summarizing the NOA was published by the Idaho Mountain Express on June 24, 2015, which was the first day that it could be published following the NOA, based on the paper's schedule. The Associated Press article that the commenter included with his comments was published in July 2015 and was based on the earlier NOA.

Item #4.2:

The article referenced in this comment addressed a proposed action to ship small quantities of commercial spent nuclear fuel to INL for research and development. This action is outside the scope of this EIS and unrelated to actions on the INL regarding naval spent nuclear fuel management.

Comment Document #5

Comment re DOE/EIS-0453-D

1 message

Laurence P. Gebhardt <[redacted]> Wed, Jul 29, 2015 at 12:06 PM

To: ecfrecapitalization@unnpp.gov

My comments about the draft EIS are included in a letter attached.

Please contact me if you perceive I can add additional information in support of ECF recapitalization.

5.1 Not included in DOE/EIS-0453-D is information about the human environment at NRF/ECF. The public can be reassured of safe and proper operations through personnel selection, training, maintenance of proficiency and related organizational design and management functions that represent a high-reliability organization. When presentations are made in Idaho and elsewhere it may be useful to include some assurance that not only facilities and recapitalization process are safe but also the operators.

Laurence P. Gebhardt, Ph.D., Captain US Navy (Retired)

Director, Research & Development

Idaho Office

[redacted]

July 29 INL ECF Comment.pdf
61K

July 29, 2015

Erik Anderson
Department of Navy - Naval Sea Systems Command
1240 Isaac Hull Avenue SE., Stop 8036
Washington Navy Yard, DC 20376-8036

Reference a: Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory(DOE/EIS-0453-D)

Dear Mr. Anderson,

This letter is my written comment about Reference a., draft EIS.

I have reviewed reference a. with special attention to Baseline Operational Characteristics, Basis for Analysis, Comparison of Alternatives, and Comparison of Environmental Impacts. I find reference a thorough and complete in its analysis of environmental issues related to recapitalization of naval spent fuel handling infrastructure at the Idaho National Laboratory. It is my opinion that the best course of action is number 3 -
5.2 New Facility Alternative at location 3/4. I reject alternatives number 1 and 2 as less safe, less functional, and less sustainable in performing expended core work.

I offer the following additional information.

- I have lived and worked in Idaho intermittently beginning in 1965 and continuously since 2001.
- I served as a US Navy submarine officer for nearly 27 years with duty in five nuclear submarines and two tours at Naval Reactors Facility (A1W prototype and S1W prototype). I am familiar with the technology of nuclear reactors, the historic and present work at NRF, the geography and demographics of the NRF region, and the impressive record of safe and proper operations at NRF.
- I support the need to continue thorough analysis of naval reactors cores, fuel, cladding, structural
5.3 materials and control systems. Lessons learned from these processes have led to improved safety, reliability, efficiency and economy that benefit the nuclear powered fleet and national security.
- Post-Navy I have helped start up develop, expand and operate three commercial shipyards so am familiar with the need for facilities recapitalization and modernization to provide safe and proper handling of materials.
- Although the Naval Nuclear Propulsion Program is a national security function, many lessons learned about safe and proper reactor design, construction, quality assurance testing, operations, maintenance, and disposal can help improve commercial, research and training reactors.

Sincerely,

Laurence R Gebhardt, Ph.D.

Laurence P. Gebhardt, Ph.D., Captain US Navy (Retired)
[redacted]

Response to Comment Document #5

Item #5.1:

Information about the human environment is discussed throughout the EIS. For example, as stated in Section 1.1.3, naval spent nuclear fuel handling operations require stringent controls to protect workers, the public, and the environment. Supervisory, quality assurance, and oversight personnel are present in the workplace during these operations to observe work in progress, and to ensure that the work is performed in accordance with the procedures. Section 3.13 describes public and occupational (i.e., worker) health and safety associated with current Expended Core Facility (ECF) naval spent nuclear fuel handling activities, including the personnel training program. Section 4.13 describes the environmental impacts of the proposed action on public and occupational health and safety.

Item #5.2:

The commenter's preference for the New Facility Alternative is noted.

Item #5.3:

The commenter's support for the analysis of naval reactor cores, fuel, cladding, structural materials, and control systems is noted.

As described in Section 1.2, the ECF capabilities for examination performed in the ECF water pools, including initial examination of naval spent nuclear fuel assemblies, resizing naval spent nuclear fuel for examination, and transfer for examination are evaluated in this EIS. Examination infrastructure for irradiated test specimen examination and destructive evaluation of naval spent nuclear fuel are capabilities independent of the spent fuel handling capabilities addressed in the EIS and will be evaluated in future National Environmental Policy Act (NEPA) documentation. As described in Section 2.1.3, the New Facility Alternative conceptual facility design includes facility attributes that allow interface with or expansion into a potential facility for future examination recapitalization plans. It has not yet been determined whether an attached or separate examination facility (either by building a new facility or by recapitalizing some ECF capabilities) provides the best alternative. This will be determined through future NEPA documentation that will provide opportunities for public review and comment.

Comment Document #6

Spent nuclear fuel from our Navy

1 message

Vicki Watson <[redacted]> Wed, Jul 29, 2015 at 9:38 PM
To: "ecfrecapitalization@unnpp.gov" <ecfrecapitalization@unnpp.gov>

6.1 I believe that new studies need to be done to re-evaluate the decision to reprocess the spent fuel and store it at INL. The latest study was done in 1995....20 years ago....new information has certainly come to light and needs to be evaluated. I also believe that spent fuel needs to be stored not over a very fragile ecosystem like the Snake River but where it was produced...

Vicki Watson
[redacted]

Sent from my iPad

Response to Comment Document #6

Item #6.1:

As noted in Section 1.5.3, alternatives for management of spent nuclear fuel within the Department of Energy (DOE) complex, including naval spent nuclear fuel, were comprehensively evaluated in DOE 1995. Based on that evaluation, ROD 1995 chose to implement regionalized spent fuel management by fuel type. Under that alternative, naval spent nuclear fuel is managed at the NRF at INL. There are no factors that warrant reconsideration of that decision.

Comment Document #7

Hello- my name is Scott Hofhine. I am a native Idahoan who has worked as an electrician for the last 18 years. I live in Custer County with my wife and ~~son~~ 7 year old son. I would like to detail my opinion about your proposed projects regarding the existing Facility at the NRF site.

First, maintenance vs. new facility:
What I personally have observed in my career is
~~that one is at a has a considerable~~
there are many benefits to a new facility vs.
Fixing/maintaining an existing one in that
with a new facility problems/difficulties with
the process due to logistics can be mitigated.
7.1 Also, newer/cleaner/more efficient technologies can
be incorporated rather than "added on" to the existing
facility/process.
Another factor to consider is that the cost of
repairing or maintaining a facility often is equal
or greater ~~the~~ the results that can be achieved
when building a new facility. Anyone who lives in
an old house would certainly know this.

On a more personal level I certainly have an
7.2 interest in seeing new projects that employ
workers in Idaho and put food on our tables.

I really dont have much more to add to the discussion but thank you for letting me participate.

Scott Hofhine

Response to Comment Document #7

Item #7.1:

The commenter’s preference for the New Facility Alternative is noted.

Item #7.2:

The commenter’s support for the recapitalization project is noted.

Comment Document #8

Comment Form - DOE/EIS-0453-D

Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory

Thank you for participating in the NEPA process. You may use this form if you would prefer to provide written comments rather than, or in addition to, making oral comments. When you have completed writing your comments, you may give this to an identified meeting representative or mail to:

Erik E. Anderson
Department of Navy
Naval Sea Systems Command
1240 Isaac Hull Avenue, SE
Stop 8036
Washington Navy Yard, DC 20376-8036

Comments may also be submitted electronically at ecfrecapitalization@unnpp.gov. All comments received within the public comment period will be addressed in the Final EIS.

Which public hearing did you attend?

☐ **August 4, 2015**
Residence Inn
Idaho Falls, Idaho

☑ **August 5, 2015**
Red Lion Hotel
Pocatello, Idaho

☐ **August 6, 2015**
La Quinta Inn
Twin Falls, Idaho

Please provide the following information:
(This information will be used to update the EIS mailing list. Please indicate your preference for receiving a copy of the Final EIS and Record of Decision: ____ Electronic Copy; ✓ Paper Copy)

X Mr. _____ Mrs. _____ Ms. _____ Dr.

Name: Paul M. Loomis

Title (if applicable): Mayor of Blackfoot

Organization (if applicable): City of Blackfoot

Address: 157 N. Broadway

City: Blackfoot State: ID Zip Code: 83221

E-Mail Address: Mayor City of Blackfoot.

Comment(s):

8.1 The EIS is well conceived and should be supported.

Response to Comment Document #8

Item #8.1:

The commenter's support for the environmental impact statement is noted.

Comment Document #9

9.1 What Emergency Management organization and equipment will be available or in place in the event of some major accident at the facility?

9.2 Are accident exercises being scheduled to address any emergency that may arise? Can the public view those exercises?

Jim Roberts

[redacted]

Response to Comment Document #9

Item #9.1:

Emergency preparedness and response is discussed in Section 3.10.3, Section 4.13, and Appendix F, Section F.6.1.

Emergency plans are in effect at NRF to ensure that workers, the public, and the environment would be properly protected in the event of an accident. These response plans include the activation of emergency response teams provided by NRF and INL and an NRF emergency control center, as well as activation of a command and control network with NNPP Headquarters and supporting laboratories. The emergency plans include (1) procedures for notification and response, (2) listings of emergency equipment and facilities (e.g., fire engines, firefighting equipment, and ambulances), (3) training programs used to prepare for emergency response, and (4) contact information for off-site organizations that could be utilized to support and supplement on-site resources.

Item #9.2:

Emergency preparedness and response is discussed in Section 3.10.3, Section 4.13, and Appendix F, Section F.6.1.

Regularly scheduled exercises are conducted to test NRF's ability to respond to accidents. These exercises include realistic tests of people, equipment, and communications involved in all aspects of the plans; the plans are regularly reviewed and modified to incorporate experience gained from the exercises. These exercises also periodically include steps to verify the adequacy of interactions with local hospitals, emergency personnel, state officials, and local officials.

Members of the public cannot view the emergency exercise at NRF due to security and site access restrictions. However, off-site medical personnel, off-site emergency personnel, state officials, and local officials are periodically included in or observe emergency planning exercises.

Comment Document #10

Eric Anderson
Naval Sea Systems Command
1240 Isaac Hull Avenue, SE
Stop 8306
Washington Navy Yard, DC 20376-8036

RE: Draft EIS Recapitalization of Infrastructure Supporting Naval Nuclear Fuel Handling at the Idaho National Laboratory DOE/EIS-0453D

Hello,
My name is Robert Bodell. I have lived in Idaho Falls for 38 years and am a native of the State of Idaho.
I want to go on record in support of the New Facility Alternative to recapitalize the naval spent nuclear fuel handling capabilities of ECF by constructing and operating a new facility at one of two potential locations at NRF.

The old ECF has served the Navy well over the years but refurbishment of such an old facility is
10.1 not in the best interests of U.S. Tax Dollars. A new facility will provide the navy safe and environmentally responsible naval spent nuclear fuel handling for the next 40 years.

We have talented and knowledgeable workmen at the INL to support the construction and operation of a new facility.

This seems like a win-win for the State of Idaho its citizens and the United States as a whole.

Again I want to emphasize that I support a New Facility for nuclear fuel handling at the NRF facility.

Thank you,

Robert Bodell
[redacted]

Response to Comment Document #10

Item #10.1:

The commenter's preference for the New Facility Alternative is noted.

Comment Document #11

Storage of Nuclear waste

1 message

orders <[redacted]> Sun, Aug 2, 2015 at 7:28 PM

To: ecfrecapitalization@unnpp.gov

11.1 I understand that Idaho is receiving shipments of Nuclear waste to be stored permanently close to Idaho Falls.

11.2 My concern is as far as I now there is not a container that will last as long as the fuel will remain radioactive (a quarter of a million years)? .So inevitable the container will leak .I would like to know what plan is in place to re package the waste? .How long the containers being used now will last? .How much it will cost to repackage the waste when the containers run the risk of leaking? .How long the waste will need to be cooled .I understand there have been earth quakes in that Area .How is the waste protected from being damaged by seismic activity? After what happened in Japan I don't think anything can be left to chance .The cost of a nuclear accident is a bankrupting prospect .

11.1 (cont.) I understand the waste will be permanently disposed of above the Snake River Aquifer. So many areas are running short on water ,and water is becoming a more and more precious resource. It concerns me that we are taking a risk something so precious .

Any answers to these questions would be appreciated .I am interested in actual plans and facts not vague reassurances.

thank you Karen

Response to Comment Document #11

Item #11.1:

As noted in Section 4.2, shipment of naval spent nuclear fuel to INL and NRF was evaluated in DOE 1995 and is managed in accordance with SA 1995. The naval spent nuclear fuel is stored at NRF temporarily. As described in Section 1.1.3, when an interim storage facility or a geologic repository is available to receive naval spent nuclear fuel, the naval spent nuclear fuel canisters will be removed from concrete overpacks and loaded into M-290 shipping containers for transport. The NNPP does not dispose of naval spent nuclear fuel over the aquifer.

Item #11.2:

The container system and locations for dry storage for naval spent nuclear fuel are outside the scope of this EIS. As stated in Section 1.5.3, the container system and method of preparing naval spent nuclear fuel for temporary dry storage and disposal would remain consistent with the method described and analyzed in DOE 1996 and are unaffected by the proposed action. Per SA 1995, the naval spent nuclear fuel canisters will be shipped to an interim storage facility or a geologic repository when available.

The comments regarding container life, repackaging costs, and length of cooling time are outside the scope of this EIS. Naval spent nuclear fuel management and the container system for managing naval spent nuclear fuel were evaluated in DOE 1995 and DOE 1996, respectively.

As stated in Section 3.0 of DOE 1996, the designs for dry storage of naval spent nuclear fuel meets the technical requirements of 10 C.F.R. § 72. These include 10 C.F.R. § 72.122 requirements that state “Structure, systems, and components important to safety must be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, lighting, hurricanes, floods, tsunami, and seiches, without impairing their capability to perform their intended design functions.”

Comment Document #12

DEIS Comment

1 message

Kathleen Whitaker <[redacted]> Tue, Aug 4, 2015 at 5:49 PM

To: ecfrecapitalization@unnpp.gov

Please see the attached comment to the Draft EIS for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling.

Kathy Whitaker

"Music gives a soul to the universe, wings to the mind, flight to the imagination and life to everything." - Plato

comment to DEIS.docx
21K

When the subject of spent fuel handling, storage or transportation is discussed, usually the amount of fuel is described in metric tons, which for several reasons is not an especially useful measure for the general, non-nuclear public if we want to understand the full scale of storage at the INL. For example, not all spent fuel is similarly configured. Nor do all types contain the same amount or types of radioactive elements with their differing half-lives and other physical characteristics. Fuel used in this country's nuclear powered fleet differs from the university, commercial and other federal spent fuel the INL safely stores. Interestingly to Idaho residents, receipt of highly radioactive spent fuel from naval reactors has continued unabated at the INL for many years with state acknowledgement if not approval, both before and since the 1995 Settlement Agreement.

In order for interested citizens, state officials and other stakeholders to advance fully informed opinions about the preferred alternative of "recapitalizing" the facility so that it may continue to accept long-term shipments containing relatively high levels of activity, the EIS should bring to the public a more complete explanation of the DOE's Navy and other spent fuel holdings at the INL. The Navy should
12.1 present, in layman's terms and in addition to metric tons, a plain English explanation of the composition of its spent fuel and a comprehensible discussion of the types, half-lives and levels of radioactivity it contains, in curies, Becquerel, rad, rem, or gray, or whatever unit of measure makes the most sense for public understanding. A comparison of representative naval spent fuel characteristics with representative commercial or university samples would serve to further inform the public about this important issue.

Two former Idaho governors and the state's attorney general stand in public opposition to the receipt at INL of small samples of commercial spent fuel for purposes of research. To eastern Idaho residents informed about and interested in activities at the DOE site, their opposition is inexplicable. For us, a clarification of differing spent fuel types and activity levels in Idaho remains an unanswered but key element in understanding and explaining the full environmental impacts and consequences of DOE activities in this state. Realizing that the alternatives investigated in the DEIS regarding the continued operation of an improved facility have only indirect relation to the INL's receipt of small commercial research samples, the characteristics of naval spent fuel is of great importance to Idaho's public and officials. Please include it. If such a disclosure has already taken place elsewhere, it has apparently not been brought to our attention. Please let us know where we may access it.

Also, in your Units of Radiation table, page S-iii, you list a rem, Sievert, and joule but you don't explain
12.2 what those units mean in terms of disintegrations or some other measure. Please provide a more meaningful explanation, perhaps in terms of everyday experience or exposures, for your non-nuclear stakeholders.

Thanks for the opportunity to comment.

Response to Comment Document #12

Item #12.1:

The commenter is correct that spent nuclear fuel can differ in physical characteristics, radionuclide content, materials, and other features. The term "metric tons of heavy metal," or MTHM, has long been established as a standard measure of the quantity of spent nuclear fuel that can be applied broadly to many types of spent nuclear fuel, including naval spent nuclear fuel. As described in Chapter 12 Glossary, metric tons of heavy metal is defined as "quantities of unirradiated and spent nuclear fuel are traditionally expressed in terms of metric tons of heavy metal (typically uranium), without the inclusion of other materials, such as cladding, alloy materials, and structural materials. A metric ton is 1000 kilograms, which is equal to about 2200 pounds."

As described in Section 1.5.3, the transportation of naval spent nuclear fuel to the INL and dry storage of naval spent nuclear fuel in canisters in concrete overpacks is outside the scope of this EIS. In addition, the management of other DOE spent nuclear fuel is also outside the scope of this EIS.

The description of naval spent nuclear fuel in Section 1.1.2 has been updated to provide additional information on enrichment, composition, and the condition of naval spent nuclear fuel; additional detailed design and characteristics of naval spent nuclear fuel is classified. However, a description of a representative canister of naval spent nuclear fuel, including a detailed list of radionuclides, was provided in DOE 2008b, Volume II, Appendix G (Table G-14) which also provided detailed lists of radionuclides for waste canisters of commercial and other types of spent nuclear fuel (Tables G11 through G14). A copy of this EIS is available at www.energy.gov/nepa-documents.

Naval spent nuclear fuel is shipped to Idaho for examination and packaging for eventual shipment to a geologic repository or interim storage facility in accordance with the agreement between the state of Idaho, DOE, and the Navy SA 1995 and SAA 2008. The samples of commercial spent fuel proposed for shipment to the INL are not naval spent nuclear fuel and are outside the scope of this EIS.

Currently, the INL has an inventory of approximately 310 MTHM of spent nuclear fuel including 32 MTHM of naval spent nuclear fuel (Table 3.15-1). The naval spent nuclear fuel is in the process of being packaged for dry storage by 2023 in accordance with SA 1995 and SAA 2008.

Item #12.2:

The Units of Radiation Table provided in the Table of Contents summarize the radiation units used in the EIS. A description of the radiation units and their physical meaning is provided in the Chapter 12 Glossary and Appendix F, Section F.2.2. A comparison of radiation dose from various radiation sources is provided in Table 3.13-1.

Comment Document #13

Public Hearing Comments (Tyrone Belnap) ECF Recapitalization

1 message

[redacted] <[redacted]> Wed, Aug 5, 2015 at 12:13 AM

To: ecfrecapitalization@unnpp.gov

Attached are my comments, please call me at [redacted] if you desire further discussion.
Thank you again for receiving my input

ECFRecapitalization Public Hearing Input.docx
15K

From: G. Tyrone Belnap
[redacted]

Date: August 4, 2015
Subject: Public Comment to Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling

The following comments are provided as input to the Public Hearing addressing the Environmental Impact Statement (EIS) for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling.

1. The EIS does not clearly address that the total calculated radiological emissions will increase
due to the addition of the new facility. The Expended Core Facility (ECF) will continue at its
13.1 current emission rate for at least a transitional period of time. The new facility will have
increased calculated emission due to the fact that it will be handling more curies of material.
2. Increase waste generation will be encountered since the new facility will be able to handle the
13.2 entire fuel "stick", without requiring removal of hardware at the shipyard facility. This will
increase activity in the water pits has hardware is removed, and as it is packaged for shipment.
Additionally, there will be increased waste shipments of hardware to a disposal facility.
3. The new facility will not accommodate any Hot Cell Operations requiring all materials needing
examination to be loaded into shipping/transfer casks, transported to the ECF, unloaded,
13.3 examined, stored, reloaded, shipped back to the new packaging facility and then placed into dry
storage or sent to a disposal facility if it is non-fuel. The EIS should address the significant
increase in handling of this material, to include increased exposure to workers performing the
associated additional transportation work. The new facility will make the examination work (the
expressed basis for needing a new facility to support Naval Operations) very cumbersome and
13.4 inefficient as compared to making the Hot Cells more accessible to the underwater storage
facility.
4. What happens to the current CSRF. The CSRF was designed to receive M-290 fuel and place
13.5 it into interim dry storage, why would we build another facility to duplicate this effort and
duplicating the cost of building the CSRF?
5. The current M-140 fuel processing area in ECF is relatively new, works well, and is linked to the
Dry Storage processing facility. It is unclear in the EIS why a new facility is needed to replace
13.6 this existing facility, weak justification of the additional cost to build. The current M140 facility
has and is expected to keep up with defueling availabilities and is conveniently located next to
the ECF Hot Cell, and other underwater examination equipment.
6. The current conceptual design on page S-11 illustrates the M-290 rail spur accesses. The
13.7 radius shown is much too small to accommodate the M-290 rail car to prevent "crabbing" around
the corner. The radius must be at least as large as the CSRF access shown.
7. During all the presentations before and during the public hearing, the "stored" fuel was
described as being temporary. When specifically asked what temporary meant, I received a
different variation with each NR representative that I spoke with, obviously a difficult political
13.8 issue being dealt with. As I examine the issue I observe the following: the stored fuel will either
remain on the concrete slab in dry storage for an indeterminate period of time, it will be sent to a
yet to be developed long term disposal facility, or it will be sent a yet to be developed
processing facility to reclaim usable fuel. I submit that it would be to the advantage of both NR

and the State of Idaho to invite the governor's staff to NRF to again examine the overpack storage, let them see and explain to them how we can with absolute confidence monitor each of the overpacks to ensure that no leakage is occurring. Suggest to the State of Idaho that NR give them a stipend for storing the fuel at NRF until such time that an efficient reprocessing facility is designed. There is little risk to the environment, it would provide additional revenue to Idaho, and it would provide an "upfront" storage facility for Naval Fuel.

8. Recommendation: Construction of a new facility without inclusions of the examination process is highly questionable. There currently exists a functional, relatively modern M-140 receiving area, and Dry Pack facility. The CSRF was expressly designed and built to receive M-290 fuel to place it into dry storage. I understand the desire for increased processing efficiency, however this was not the main delivery point of the EIS.

13.9

I recommend that NR proceed with an entire new processing facility using a "process engineered approach" to efficiently include all needed processes to include examinations. We should not settle for a $1,500,000,000.00 facility that leaves out one of the most important process operations, that increases rem exposure to personnel and generates unnecessary radioactive waste.

Thank you in advance for considering the items that I have presented.

Respectfully,

G. Tyrone Belnap

Response to Comment Document #13

Item #13.1:

There would be an increase in radiological air emissions compared to the annual NRF emission rate for routine operations (Section 4.6.2). The emissions from the period of operation when both the new facility and ECF are operational is evaluated in the EIS. This period is referred to as the new facility transition period and is described in Section 2.3. The impacts from the new facility transition period are explicitly evaluated in Chapter 4 for each resource area. Radiological air emissions from the transition period are described in Section 4.6.2.3. Although the increase in emissions would result in a release of approximately 2 Curies per year, the increase is minimal when compared to the total radiological emissions from the INL.

Item #13.2:

There would be an increase in solid low-level radioactive waste (LLW) generation compared to the annual NRF solid LLW generation rate for routine operations (Section 4.14.3). This increase in waste generation rate would be due primarily to additional waste from processing naval spent nuclear fuel that arrives in M-290 shipping containers. DON 2007 evaluated the impacts of removing and handling this additional waste from processing aircraft carrier spent fuel assemblies that arrive in M-290 shipping containers. The radionuclides in this waste are mostly contained within the non-fuel-bearing structural components and are not released into the water pool water. The overhauled facility and new facility would be designed to accommodate the additional radioactive material through the use of filtration and water purification systems. Disposal capacity is available for this waste, so the impacts would be small due to the additional solid LLW that would be generated.

Item #13.3:

As described in Section 2.1.3, one of the key attributes for the new facility is to allow interface with or expansion into a potential facility for future examination plans. The future NEPA documentation for recapitalization of examination will evaluate whether interface or expansion provides the most efficient method for examination work. However, this EIS included evaluation of worker exposure from naval spent nuclear fuel handling, including transfer for examination.

Occupational radiation exposure to workers during the New Facility Operational Period from naval spent nuclear fuel handling is discussed in Section 4.13.2.1.3. It is estimated that the annual dose to a naval spent nuclear fuel handling worker could range between 0 and 0.0010 Sievert (0.10 rem) with an expected average closer to 0.00018 Sievert (0.018 rem). Although the occupational average disused in the Section 4.13.2.1.3 is from technicians unloading shipping containers, it is estimated that similar radiation exposures would be received from transport operations because the same engineering controls including time in the radiation area, distance away from the source, and shielding would be used to keep radiation exposures as low as reasonably achievable (ALARA). The average occupational radiation exposure to workers of 0.00018 Sievert (0.018 rem) from naval spent nuclear fuel handling for all alternatives evaluated is small compared to the 0.0031 Sievert (0.31 rem) annual average individual radiation dose to a member of the public from natural background radiation shown in Table 3.13-2.

Item #13.4:

A full range of alternatives for the recapitalization of the ECF examination infrastructure remains available to the NNPP and will be assessed in a future NEPA document. As described in Section 1.2, the ECF capabilities for examination performed in the ECF water pools, including initial examination of naval spent nuclear fuel assemblies, resizing naval spent nuclear fuel for examination, and transfer for examination were evaluated in this EIS. Examination infrastructure for irradiated test specimen examination and destructive evaluation of naval spent nuclear fuel are capabilities independent of the spent fuel handling capabilities addressed in the EIS and will be evaluated in future NEPA documentation. As described in Section 2.1.3, the New Facility Alternative conceptual facility design includes facility attributes that allow interface with or expansion into a potential facility for future examination recapitalization plans. It has not yet been determined whether an attached or separate examination facility (either by building a new facility or by recapitalizing some ECF capabilities) provides the best alternative. This will be determined through future NEPA documentation that will provide opportunities for public review and comment.

The need for the recapitalization of infrastructure supporting naval spent nuclear fuel handling is described in Section 1.3. The naval spent nuclear fuel handling capabilities described in Section 1.2 are vital to the NNPP mission of maintaining the reliable operation of the naval nuclear-powered fleet. The New Facility Alternative is the preferred alternative for providing this naval spent nuclear fuel infrastructure. As described in Section 4.15, addressing naval spent nuclear fuel handling is more urgent due to the close tie to supporting fleet operations and meeting the commitments in SA 1995 and SAA 2008. There is more flexibility with respect to the timing for the recapitalization of the examination capabilities of ECF.

Item #13.5:

Regardless of the alternative selected, naval spent nuclear fuel canisters currently stored in the Overpack Storage Building (OSB) and Overpack Storage Expansions (OSEs) will be removed from concrete overpacks and loaded into M-290 shipping containers in the current Cask Shipping and Receiving Facility (CSRF) for shipment out of the state of Idaho once an interim storage facility or geologic repository is available (Section 1.2). In addition, as described in Section 2.1.3, if the preferred alternative (New Facility at NRF Location 3/4) is selected, the existing OSB, OSEs, and CSRF would be used for overpack storage and M-290 loading resulting from new facility operations. If the New Facility Alternative at Location 6 is selected, a new OSB and M-290 loading area would be built to support future operations, as shown in Figure 2.1-5. The Conceptual Facility Layout discussion in Section 2.1.3 has been revised to clarify that the existing OSB, OSEs, and CSRF are too far from Location 6 to allow for use with a new facility built at that location.

The CSRF was designed and built to support loading and unloading canisters of naval spent nuclear fuel from M-290 shipping containers; however, this facility does not have the capability to package naval spent nuclear fuel into canisters for dry storage.

Item #13.6:

Maintaining the current ECF, including the M-140 fuel processing area, would be generally consistent with the No Action Alternative. Although portions of the existing ECF are newer and are currently operating well, other portions of ECF have been in operation for many years. Older ECF infrastructure and equipment can effect overall ECF operations. As discussed in Section 2.1.1 failure to perform upgrades and refurbishments may result in ECF eventually being unavailable for handling naval spent nuclear fuel.

Overhauling older infrastructure and equipment in ECF is included in the Overhaul Alternative. This alternative was considered but not preferred because the Overhaul Alternative involves continuing to use the aging infrastructure at ECF, while incurring additional costs to provide the required refurbishments and workaround actions necessary to ensure uninterrupted aircraft carrier and submarine refuelings and defuelings. Failure to implement this overhaul in advance of infrastructure deterioration would impact the ability of ECF to operate. Further, overhaul actions would necessitate operational interruptions for extended periods of time.

The screening criteria for the New Facility Alternative included objectives to maximize the use of existing facility assets and to minimize conflicts with other NRF facilities and infrastructure, including ECF operations. Use of the M-140 shipping container unloading and processing area in conjunction with a new facility did not meet the requirement to not cause inefficient ECF operations. Due to interference from existing underground ECF infrastructure and other ongoing operation conflicts, use of any part of ECF was screened out from this alternative. See Sections 2.1.1, 2.1.2, and 2.1.3 for additional details regarding the scope of the No Action Alternative, Overhaul Alternative, and New Facility Alternative.

Item #13.7:

Figure S-5 was a conceptual layout for the New Facility Alternative at NRF Location 3/4. The rail spur access for the New Facility Alternative, if selected, will meet applicable codes and standards, including the appropriate radii. Based on preliminary design work, Figure S-5 has been updated to better depict the rail access for the new facility.

Item #13.8:

As described in Section 1.1.3, naval spent nuclear fuel is packaged into canisters that are placed inside concrete overpacks for temporary dry storage. When an interim storage facility or a geologic repository is available to receive naval spent nuclear fuel, the naval spent nuclear fuel canisters will be removed from the concrete overpacks and loaded into M-290 shipping containers for transport out of Idaho. As described in Section 1.5.3, the NNPP is committed to supporting SA 1995 and SAA 2008 and continues to prepare for shipment of naval spent nuclear fuel out of the state of Idaho once an interim storage facility or geologic repository is available. Any subsequent actions related to an interim storage facility or geologic repository will be subject to their own NEPA analysis and are beyond the scope of this EIS. Representatives of the state of Idaho have examined overpack storage facilities at NRF and routine monitoring demonstrates that there are no releases of radioactive material from the canisters into the environment.

Item #13.9:

The commenter’s preference is noted.

See Item #13.4 for discussion regarding recapitalization of examination infrastructure. See Item #13.5 and Item #13.6 regarding the use of existing NRF infrastructure.

Comment Document #14

Request for extension of comment for the DEIS Recapitalization Infrastructure Supporting NSF handling at INL

1 message

Carolyn Smith <csmith@sbtribes.com> Thu, Aug 6, 2015 at 5:12 PM
To: "ecfrecapitalization@unnpp.gov" <ecfrecapitalization@unnpp.gov>
Cc: Stacy Timbana <stimbana@sbtribes.com>, Christina Cutler <ccutler@sbtribes.com>

14.1 The Shoshone-Bannock Tribes of the Fort Hall Indian Reservation in southeast Idaho request additional time to review the DEIS for the Recapitalization of Infrastructure supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory. Respectfully a two week extension is being requested with comments being submitted by August 25, 2015.

Should you have further questions please direct them to Carolyn B. Smith.

Respectfully,

Carolyn B. Smith

TDOE-HeTO Cultural Resources Coordinator

Shoshone-Bannock Tribes

P.O. Box 306

Fort Hall, ID 83203

208-236-1086 Phone

208-221-0326 Cell

208-478-3707 Fax

csmith@sbtribes.com

Response to Comment Document #14

Item #14.1:

As a result of this request, the NNPP reopened the public comment period through August 31, 2015. The Shoshone-Bannock Tribes were notified of this decision with the following correspondence:

DEPARTMENT OF ENERGY
NAVAL REACTORS LABORATORY FIELD OFFICE
POST OFFICE BOX 2469
IDAHO FALLS, IDAHO 83403-2469

NRLFO:IBO-15/250
August 10, 2015

Blaine Edmo, Chairman
Fort Hall Business Council
Shoshone-Bannock Tribes
P. O. Box 306
Fort Hall, ID 83203

SUBJECT: REOPENING EXTENSION OF PUBLIC COMMENT PERIOD FOR DOE/EIS-0453-D - Draft ENVIRONMENTAL IMPACT STATEMENT FOR THE RECAPITALIZATION OF INFRASTRUCTURE SUPPORTING NAVAL SPENT NUCLEAR FUEL HANDLING AT THE IDAHO NATIONAL LABORATORY

On June 19, 2015 the U.S. Department of Energy (DOE) Naval Nuclear Propulsion Program (NNPP) published in the **Federal Register,** a notice of availability for the *Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory* (DOE/EIS-0453-D) for public review and comment. That notice stated that the public comment period would continue through August 10, 2015. Based on public comments received on August 6, 2015, the NNPP has decided to reopen the public comment period through August 31, 2015.

Enclosed is a copy of the notice that will be published by DOE on August 14, 2015. Comments will be accepted by mail and email through August 31, 2015. All comments received will be considered during the preparation of the Final EIS.

Sincerely,

C. M. Henvit
Naval Nuclear Propulsion Program

Enclosures

Notice of Reopening of Public Comment Period for Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory

AGENCY: DEPARTMENT OF ENERGY

ACTION: Notice of reopening of public comment period.

SUMMARY:

On June 19, 2015 the U.S. Department of Energy (DOE) Naval Nuclear Propulsion Program (NNPP) published in the **Federal Register,** a notice of availability for the *Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory* (DOE/EIS-0453-D) for public review and comment. That notice stated that the public comment period would continue through August 10, 2015. Based on a request received on August 6, 2015 the NNPP is reopening the public comment period through August 31, 2015.

DATES:

The NNPP will accept public comments on the *Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory* (DOE/EIS-0453-D) through August 31, 2015. Comments submitted prior to this announcement do not need to be resubmitted as a result of this reopening of the comment period.

ADDRESSES:

Written comments on the EIS may be submitted by mailing to:

Erik Anderson
Department of Navy
Naval Sea Systems Command
1240 Isaac Hull Avenue, SE
Stop 8036
Washington Navy Yard, DC 20376-8036

Comments provided by electronic mail (e-mail) should be submitted to:

ecfrecapitalization@unnpp.gov.

FOR FURTHER INFORMATION CONTACT:

For further information about this project, contact Mr. Erik Anderson, as described above. For information regarding the DOE NEPA process, please contact: Ms. Carol M. Borgstrom, Director, Office of NEPA Policy and Compliance (GC-54), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585, Telephone (202) 586-4600, or leave a message at (800) 472-2756.

SUPPLEMENTARY INFORMATION:

On June 19, 2015, DOE published a notice of availability (80 FR 35331), and on June 26, 2015 EPA published a notice of availability (80 FR 36803) that announced that comments on DOE/EIS-0453-D should be submitted within a 45-day period ending on August 10, 2015. The NNPP is reopening the time allowed for submittal of comments through August 31, 2015.

Comment Document #15

Fwd: OS-ESD-15-081 Draft EIS for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the INL

1 message

Laura Iannacci [redacted] <laura.iannacci@unnpp.gov> Mon, Aug 10, 2015 at 11:55 AM
To: ECF Recapitalization <ecfrecapitalization@unnpp.gov>

---------- Forwarded message ----------
From: **HENVIT, CHRISTOPHER** <christopher.henvit@inl.gov>
Date: Monday, August 10, 2015
Subject: Fwd: OS-ESD-15-081 Draft EIS for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the INL
To: "Laura Iannacci [redacted]" <laura.iannacci@unnpp.gov>

Laura,

Attached is the comment from DOE-ID.
---------- Forwarded message ----------
From: **La Marca, Mary** <lamarcm@id.doe.gov>
Date: Tue, Aug 4, 2015 at 11:08 AM
Subject: OS-ESD-15-081 Draft EIS for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the INL
To: "HENVIT, CHRISTOPHER (christopher.henvit@inl.gov)" <christopher.henvit@inl.gov>

This correspondence is sent electronic copy only; hard copies available upon request.

Mary M. La Marca

Admin. Assistant

to Jack Zimmerman

Deputy Manager, EM-Idaho Cleanup Project

208-526-3675

lamarcm@id.doe.gov

Chris Henvit
Idaho Branch Office
Assistant Manager, Facilities and External Affairs
208-533-5969 (w)
208-243-1536 (c)
[redacted]

OS-ESD-15-081 Draft EIS for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the INL.pdf - Adobe Acrobat Pro.pdf
60K

Department of Energy
Idaho Operations Office
1955 Fremont Avenue
Idaho Falls, ID 83415

August 4, 2015

Mr. Chris Henvit, Assistant Manager for Facilities and External Affairs
Naval Reactors Laboratory Field Office
Idaho Branch Office
P.O. Box 2469
Idaho Falls, Idaho 83403-2469

SUBJECT: Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory (OS-ESD-15-081)

Dear Mr. Henvit:

The Department of Energy, Idaho Operations Office has reviewed the Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory and has the following comment:

15.1 Table 5.1-1states "The Resumption of Transient Testing of Nuclear Fuels and Materials is being considered for testing fuel behavior over a brief interval of time. This action was evaluated in a Draft Environmental Assessment (EA) issued in November 2013 (DOE 2013b)." The Final EA was published February 2014 and restart activities have begun.

If you have any questions concerning the enclosed comment, please contact me at 526-7300 or the DOE-ID NEPA Compliance Officer Jack Depperschmidt at 526-5053 or depperjd@id.doe.gov.

Sincerely,

Rick Provencher

Richard B. Provencher
Manager

Response to Comment Document #15

Item #15.1:

Table 5.1-1 was updated to reflect that restart activities have begun on the Transient Reactor Test Facility (TREAT) Reactor at INL.

Comment Document #16

DEIS: DOE Naval Nuclear Propulsion Program, Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory

1 message

Milchak, Brian <brian_milchak@ios.doi.gov> Mon, Aug 10, 2015 at 11:46 AM
To: ecfrecapitalization@unnpp.gov
Cc: Lisa Treichel <lisa_treichel@ios.doi.gov>, Allison O'Brien <Allison_O'Brien@ios.doi.gov>, John Fuhrer <[redacted]>

Hello Mr. Anderson,

Attached please find the Department of the Interior's comments on the subject DEIS.

Have a great day,
Brian Milchak

--
Brian Milchak
Regional Environmental Assistant
Office of Environmental Policy and Compliance, Pacific Northwest Region
620 SW Main Street, Suite 201
Portland, OR 97205
Telephone: (503) 326-2489
Mobile: (503) 320-3319
Fax: (503) 326-2494
States: WA, OR, ID
http://www.doi.gov/pmb/oepc/portland.cfm

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United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
620 SW Main Street, Suite 201
Portland, Oregon 97205-3026

IN REPLY REFER TO:
9043.1
ER15/0347

Electronically Filed

August 10, 2015

Erik Anderson
Department of Navy, Naval Sea Systems Command
1240 Isaac Hull Avenue SE, Stop 8036
Washington Navy Yard, DC 20376–8036

Dear Mr. Anderson:

16.1 The Department of the Interior has reviewed the Draft Environmental Impact Statement for the Department of Energy, Naval Nuclear Propulsion Program, Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory. The Department has no comments on the document at this time.

We appreciate the opportunity to comment.

Sincerely,

Allison O'Brien

Allison O'Brien
Regional Environmental Officer

Response to Comment Document #16

Item #16.1:

The NNPP appreciates the Department of Interior review.

Comment Document #17

Comments from Idaho Department of Environmental Quality

1 message

Susan.Burke@deq.idaho.gov <Susan.Burke@deq.idaho.gov> Mon, Aug 10, 2015 at 12:49 PM
To: ecfrecapitalization@unnpp.gov

Please find attached comments from the Idaho Department of Environmental Quality regarding the *Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling*.

Susan Burke

INL Coordinator

Idaho DEQ

susan.burke@deq.idaho.gov

208/373-0428

comments on Navy EIS.pdf
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STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

1410 North Hilton • Boise, Idaho 83706 • (208) 373-0502
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C.L. "Butch" Otter, Governor
John H. Tippets, Director

August 10, 2015

Erik Anderson
Department of Navy
Naval Sea Systems Command
1240 Isaac Hull Avenue, SE
Stop 8036
Washington Navy Yard, DC 20376-8036

Via email

RE: Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling

Dear Mr. Anderson:

The Idaho Department of Environmental Quality (DEQ) has reviewed the above titled draft Environmental Impact Statement and supports the preferred alternative for a new facility to handle naval spent nuclear fuel at the Idaho National Laboratory Site.

Naval spent nuclear fuel has been shipped to Idaho since 1957. Certain quantities of naval spent nuclear fuel are allowed by the 1995 Settlement Agreement to be shipped to Idaho and must be shipped out of Idaho by January 1, 2035. Idaho is currently the only location in the United States where naval spent fuel is shipped for examination, processing, and temporary dry storage.

17.1 As the work performed in Idaho is of national importance to the continuation of the Navy's Nuclear Propulsion Program it must be done in a safe and reliable facility built to current codes and standards. A completely new facility is the alternative that will best meet this need and be protective of public health and the environment.

17.2 All continued work on naval spent nuclear fuel in Idaho must meet the requirements of the 1995 Settlement Agreement and its Addendum. DEQ looks forward to further involvement with the Naval Reactors Program as it continues its spent nuclear fuel operation in Idaho with eventual shipment of fuel out of State.

Sincerely,

Susan Burke

Susan Burke
INL Coordinator

c: John H.Tippets, DEQ Director

Response to Comment Document #17

Item #17.1:

The commenter's preference for the New Facility Alternative is noted.

Item #17.2:

As stated in Section 1.3, the NNPP is committed to complying with the naval spent nuclear fuel aspects of SA 1995 and SAA 2008.

Comment Document #18

Comments from Stoller Newport News Nuclear on DEIS

1 message

Mindy Giles <mgiles@stoller.com> Mon, Aug 10, 2015 at 12:50 PM
To: "ecfrecapitalization@unnpp.gov" <ecfrecapitalization@unnpp.gov>

Mr. Erik Anderson,

I have attached comments from Stoller Newport News Nuclear on the Draft Environmental Impact Statement (DEIS) regarding Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory. You will also receive a hard copy via the United States Postal Service. Please confirm receipt of this electronic transmittal.

We appreciate the opportunity to comment in the DEIS and bid you success in this venture. Any questions regarding this letter can be directed to Darin Dobbins, Assistant Vice President at 208 680-9364, or Mrs. Mindy Giles at (208) 227-9023 or at mgiles@stoller.com.

Mindy Giles

Project Engineer

mgiles@stoller.com

Office - 208-227-9023

HII Ethics and Integrity Policy, Mike Petters

Establishing and maintaining a culture dedicated to compliance and ethics takes discipline and commitment. It's a journey, not a destination. It is a process, not a program. But most importantly, it's everyone's responsibility".

SN3

Stoller Newport News Nuclear

A Subsidiary of Huntington Ingalls Industries

ECF Recapitalization EIS Comments.pdf
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SN3
Stoller Newport News Nuclear
A Subsidiary of Huntington Ingalls Industries

August 7, 2015 15-0600-15-1101

Erik Anderson
Department of Navy
1240 Isaac Hull Avenue, SE
Stop 8036
Washington Navy Yard, DC 20376-8036

RE: SN3 Comment on the Draft Environmental Impact Statement (DEIS) for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling

Dear Mr. Anderson:

Stoller Newport News Nuclear has reviewed the DEIS and offers the following comments.

We agree with the preferred alternative to recapitalize the infrastructure supporting naval spent nuclear fuel handing with a new facility at location 3 / 4. The "No Action" and "Overhaul" Alternatives are not in the best interest of the tax payer, work force and local communities or mission. We support the preferred alternative based on several key points:

- Provides the greatest degree of safety for the public and work force while improving operations reliability,
18.1 productivity, and agility for the long-term mission
- Designed with current codes, standards, modern equipment, and technologies creating an environment optimized to serve the mission
- Cost effective without adversely impacting ongoing critical mission
- Improves safety and operational risks while providing greater assurance in complying with the Idaho Settlement Agreement and its Addendum.

While examination of recapitalization is not considered in this DEIS, we recommend evaluation of the long-term loss of efficiency resulting from a constrained facility design. It is prudent to envision a facility master plan with the
18.2 potential to maximize process efficiencies readily accommodating subsequent fuel examination capabilities. While inclusion of an examination facility within the current DEIS is not possible due to fiscal constraints, it is viable to allow for construction phases to eventually maximize process efficiencies. We recommend a master plan with a phased
18.3 approach with consideration to the aging hot cells. Additionally, repurposing of the Cask Shipping and Receiving Facility should be evaluated for long term optimized benefit and for the best interest in national security.

We appreciate the opportunity to comment in the DEIS and bid you success in this venture. Any questions regarding this letter can be directed to me at 208 680-9364, or Mrs. Mindy Giles at (208) 227-9023 or at mgiles@stoller.com.

Sincerely,

Darin Dobbins
Assistant Vice President, SN3 Idaho

A SUBSIDIARY OF HUNTINGTON INGALLS INDUSTRIES
120 Technology Drive • Idaho Falls, ID 83401 • Telephone (208) 525-9358 • www.stoller.com

Response to Comment Document #18

Item #18.1:

The commenter's support for the preferred alternative is noted.

Item #18.2:

The Draft EIS did examine recapitalization. It is believed that the commenter was requesting an evaluation of recapitalization of examination be included with the evaluation of recapitalization of spent fuel handling. A full range of alternatives for the recapitalization of the ECF examination infrastructure remains available to the NNPP and will be assessed in a future NEPA document. As described in Section 1.2, the ECF capabilities for examination performed in the ECF water pools, including initial examination of naval spent nuclear fuel assemblies, resizing naval spent nuclear fuel for examination, and transfer for examination were evaluated in this EIS. Examination infrastructure for irradiated test specimen examination and destructive evaluation of naval spent nuclear fuel are capabilities independent of the spent fuel handling capabilities addressed in the EIS and will be evaluated in future NEPA documentation. As described in Section 2.1.3, the New Facility Alternative conceptual facility design includes facility attributes that allow interface with or expansion into a potential facility for future examination recapitalization plans. It has not yet been determined whether an attached or separate examination facility (either by building a new facility or by recapitalizing some ECF capabilities) provides the best alternative. This will be determined through future NEPA documentation that will provide opportunities for public review and comment.

Item #18.3:

Regardless of the alternative selected, naval spent nuclear fuel canisters currently stored in the OSB and OSEs will be removed from concrete overpacks and loaded into M-290 shipping containers in the current CSRF for shipment to an interim storage facility or geologic repository (Section 1.2). In addition, as described in Section 2.1.3, if the preferred alternative (New Facility at NRF Location 3/4) is selected, the existing OSB, OSEs, and CSRF would continue to be used for overpack storage and M-290 loading. Therefore, repurposing of the CSRF is not presently under consideration due to the need to be ready to ship naval spent nuclear fuel canisters from NRF to an interim storage facility or geologic repository whenever such a facility becomes available. Refer to Section 1.2 for further details on CSRF use.

Comment Document #19

Snake River Alliance comments

1 message

Beatrice Brailsford <bbrailsford@snakeriveralliance.org> Mon, Aug 10, 2015 at 3:04 PM
To: ecfrecapitalization@unnpp.gov

Best,

Beatrice Brailsford
Snake River Alliance
Box 425
Pocatello, ID 83204
208/233-7212
bbrailsford@snakeriveralliance.org
www.snakeriveralliance.org

nuclear Navy eis comments.pdf
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SNAKE RIVER ALLIANCE
IDAHO'S NUCLEAR WATCHDOG & CLEAN ENERGY ADVOCATE

August 10, 2015

Erik Anderson
Department of Navy
Naval Sea Systems Command
1240 Isaac Hull Avenue, SC
Stop 8036
Washington Navy Yard, DC 20376-8036
By email: ecfrecapitalization@unnpp.gov

Dear Mr. Anderson:

The Snake River Alliance has served as Idaho's grassroots nuclear watchdog and clean energy advocate since 1979. Most certainly, the Alliance supports efforts to ensure that the nuclear waste above the Snake River Aquifer is stored as safely as possible.
I submit following comments and questions on the draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling on behalf of our dues-paying members.

The Naval Nuclear Propulsion Program's first reactor began operating in March 1953 in the middle of the Arco Desert. It simulated crossing the Atlantic, leaking radiation along the way, and the nuclear Navy was born. Months later, on January 21, 1954, the nuclear Navy launched the USS Nautilus.

By 1957, INL became not just the birthplace of the nuclear Navy, but its final port of call. Every scrap of spent nuclear fuel produced by the US fleet ends up at INL's Naval Reactors Facility (where there are no reactors). Spent nuclear fuel is some of the most radioactive waste on earth. The current proposal means that the nuclear Navy will be shipping spent nuclear fuel to Idaho for more than a century. Until the Department of Energy abandoned reprocessing in the early 1990s, INL dissolved the nuclear Navy spent fuel in acid to "recover" its highly-enriched uranium (HEU) so it could be made into fresh fuel at Oak Ridge, Tennessee, and used in the
19.1 weapons production reactors at the Savannah River Site in South Carolina. But a significant portion of the reprocessed HEU was never used. Reprocessing was the source of some of the most serious groundwater contamination at INL.

Today, there are about 31 metric tons of nuclear Navy spent nuclear fuel at INL, and more accumulates every year. The 1995 Settlement Agreement allows a running average of 20 shipments of spent fuel a year from the nuclear Navy, and the State of Idaho cannot stop those shipments for cause, as it can shipments from the Department of Energy. A 2008 Addendum to the 1995 Agreement was negotiated without disclosure to or input from the people of Idaho. It requires that the nuclear Navy ship out of Idaho most of its spent fuel by 2035, but it can continue to bring in more spent fuel after that as long as its stockpile is no more than nine metric tons. Since the Settlement Agreement was signed, the nuclear Navy has brought in about 20 metric tons of spent fuel.

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WWW.SNAKERIVERALLIANCE.ORG

In numerous public discussions over the years, the nuclear Navy has asserted that all its spent nuclear fuel comes to Idaho for examination. It has never been clear how much of that examination is visual and how much is more detailed. "Detailed examination" requires that the fuel be resized, or chopped up, in the proposed facility, though the examination itself wouldn't happen there; it's conducted in a decades-old building nearby. (The original "new facility alternative" in the draft EIS was for two new buildings, one for handling and storage and the other for detailed examination. To save money, the nuclear Navy has put off the new examination
19.2 facility, despite its advertised central role.)

At any rate, the draft environmental impact statement under discussion today asserts that 10% to 20% of the nuclear Navy spent fuel brought to Idaho undergoes detailed examination. "Ten to twenty" is a remarkably and uncharacteristically inexact figure. Please provide the exact percentage in the final EIS.

When the nuclear Navy spent fuel comes to Idaho, a portion of the fuel assembly is chopped off to be disposed of separately. That material is radioactive enough that it must be handled remotely. INL's nuclear Navy and nuclear power research programs are moving forward with a plan to dispose of that material above the Snake Rive Aquifer. Evidently they have estimated their disposal needs for the next 20 years. But they are
19.3 constructing (or digging) a new disposal facility large enough that they can produce enough of this very radioactive waste to fill a 2-car garage each year for the next 50. This draft EIS assumes that nuclear Navy spent fuel will continue to come to Idaho (and presumably be chopped up) until at least 2060. Given the nuclear Navy's modernization plans, that's probably low ball.

In addition, the nuclear Navy will be following a new protocol starting in 2016. More of the structural material surrounding its fuel assemblies will remain intact because it can be accommodated in the nuclear Navy's new M290 shipping cask. That will mean more waste coming to Idaho that currently goes, evidently, to the
19.4 Savannah River Site. The outer structure will be removed here and buried above the aquifer in the new disposal facility for remote-handled waste, even though it is not remote-handled low-level waste. It is irresponsible to dispose of radioactive waste above a body of water as important as the Snake River Aquifer. Please discuss the new protocol and its implications in detail.

The nuclear Navy's history at INL is not, in and of itself, an adequate justification for continuing to ship spent nuclear fuel to Idaho. In the current analysis, the nuclear Navy cites a decision based on a programmatic study
19.5 from 1995. It does not cite its own studies from that period that concluded spent nuclear fuel could be stored safely at any one of its nuclear-capable shipyards.

Replacing the current handling capability will mean it will undergo dismantled at some predictable point. The
19.6 environmental effects of that – particularly where the contaminated debris will go – should be analyzed in this environmental impact statement.

The draft EIS consistently says that the spent fuel coming in will go to a repository or a consolidated storage
19.7 site as soon as one is available. But that misses the point. INL *is* the consolidated storage site for nuclear Navy spent fuel and will be for the foreseeable future.

Sincerely,

Beatrice Brailsford

Beatrice Brailsford
Nuclear program director

Response to Comment Document #19

Item #19.1:

INEEL 2000 Table V shows that less than 20% of the fuel reprocessed at the Idaho Nuclear Technology and Engineering Center (INTEC) was naval spent nuclear fuel. INEEL 2000 Table XIV shows that the enriched uranium recovered at INTEC was shipped out of the state of Idaho to other DOE facilities.

Past reprocessing of spent nuclear fuel at the INL is outside the scope of this EIS. Section 3.4.2.2 discusses groundwater quality, including localized plumes of radiochemical and chemical contamination that are present beneath the INL as a result of past disposal practices. Groundwater monitoring has generally shown long-term trends of decreasing concentrations for these radionuclides and current concentrations are near or below EPA maximum constituent levels (MCLs) for drinking water.

Item #19.2:

As described in Sections 1.1.3 and 1.2, each naval spent nuclear fuel assembly receives a visual examination to confirm that the assembly performed as designed, and to look for evidence of unusual conditions such as unexpected corrosion, unexpected wear, or structural defects. Some naval spent nuclear fuel is given more detailed non-destructive examinations for such purposes as confirming the adequacy of new design features, exploring material performance concerns, and obtaining detailed information to confirm or adjust computer predictions of naval nuclear core performance attributes. Non-destructive examinations could include detailed visual examinations, dimension measurements, or evaluations of corrosion product build-up. These detailed non-destructive examinations do not penetrate the naval spent nuclear fuel cladding or otherwise reduce the integrity of the naval spent nuclear fuel.

As described in Section 1.2, ECF also provides the capability to resize and transfer naval spent nuclear fuel designated for more detailed or destructive examinations in shielded cells. The resizing operation performed in the ECF water pool does not penetrate the naval spent nuclear fuel cladding or otherwise reduce the integrity of the naval spent nuclear fuel. The New Facility Alternative would provide similar resizing capabilities and the ability to transfer the naval spent nuclear fuel to the examination location (i.e., shielded cell in ECF or a new facility).

A full range of alternatives for the recapitalization of the ECF examination infrastructure remains available to the NNPP and will be assessed in a future NEPA document. As described in Section 1.2, the ECF capabilities for examination performed in the ECF water pools, including initial examination of naval spent nuclear fuel assemblies, resizing naval spent nuclear fuel for examination, and transfer for examination were evaluated in this EIS. Examination infrastructure for irradiated test specimen examination and destructive evaluation of naval spent nuclear fuel are capabilities independent of the spent fuel handling capabilities addressed in the EIS and will be evaluated in future NEPA documentation. As described in Section 2.1.3, the New Facility Alternative conceptual facility design includes facility attributes that allow interface with or expansion into a potential facility for future examination recapitalization plans. It has not yet been determined whether an attached or separate examination facility (either by building a new facility or by recapitalizing some ECF capabilities) provides the best alternative. This will be determined through future NEPA documentation that will provide opportunities for public review and comment.

A review of past and future core examination work showed that 20.0 percent of naval cores received more detailed examinations from 1994-2014, and 16.7 percent of naval cores are planned for more detailed examinations from 2015-2035. Therefore, Section 1.1.3 has been revised to provide the more precise percentage range of 15 to 20 percent.

Item #19.3:

Comments on the location and disposal capacity of the new Remote Handled Low-Level Radioactive Waste disposal facility at the INL are outside the scope of this EIS. The DOE Environmental Assessment (EA) for this facility (DOE 2011a) is publicly available at http://energy.gov/nepa. The estimates of remote-handled LLW generation in Section 4.14.3 are consistent with estimates used in DOE 2011a.

Item #19.4:

Details on the use of M-290 shipping containers were provided in DON 2009 which is available at www.nnpp-nepa.us/environmental_assessments/nrf. DON 2009 described the increase in solid LLW generation at the INL as a result of the use of this new shipping container and that this additional waste would be the same radiological classification as material typically removed from submarine spent nuclear fuel at NRF, specifically remote-handled LLW. Section 4.14.3 includes this increase in solid LLW generation of approximately 20 percent during the transition period and new facility operational period compared to the current annual NRF solid LLW generation rate for routine operations.

Comments on the location and disposal capacity of the new Remote Handled Low-Level Radioactive Waste disposal facility at the INL are outside the scope of this EIS. Comments on the use of the new M-290 shipping container are outside the scope of this EIS.

Item #19.5:

DOE 1995 considered available studies on storage of naval spent nuclear fuel, including storage of fuel at nuclear capable shipyards. Section 5.2.1 of ROD 1995 stated that "the environmental and safety consequences of any of the five spent nuclear fuel management alternatives would be small. For example, analyses of air quality, water quality, and land use for each alternative showed little or no impact." DOE 1995 described important differences between alternatives including the costs for additional (duplicate) facilities and loss or maintenance of naval spent nuclear fuel examination capability for the decentralized alternative. Based on that evaluation, ROD 1995 chose to implement regionalized spent fuel management by fuel type. Under that alternative, naval spent nuclear fuel is managed at the NRF at INL. There are no factors that warrant reconsideration of that decision.

Item #19.6:

As described in Section 2.1, any alternative involving operation of a facility would involve eventual decontamination and decommissioning (D&D) of that facility. However, the timing of future D&D activities for a new facility or ECF is not known. Detailed impacts from D&D will be assessed at the end of the operations at ECF or the proposed new facility prior to the start of such activities. When the D&D plans are developed, they will require a separate environmental review and NEPA document. No meaningful alternatives or analysis of impacts can be formulated at this time since D&D will occur at an unknown time in the future.

Item #19.7:

As noted in Section 1.5.3, alternatives for management of spent nuclear fuel managed by the DOE, including naval spent nuclear fuel, were comprehensively evaluated in DOE 1995. Based on that evaluation, ROD 1995 chose to implement regionalized spent fuel management by fuel type. Under that alternative, naval spent nuclear fuel is managed at the NRF at INL. There are no factors that warrant reconsideration of that decision. As the DOE pursues parallel paths of a consent-based siting process for disposal of spent nuclear fuel and high-level waste as described in 80 Fed. Reg. 79872 (December 23, 2015) and development of a repository for disposal of high-level radioactive waste resulting from atomic energy defense activities, the NNPP remains committed to supporting SA 1995 and SAA 2008 and continues to prepare for shipment of naval spent nuclear fuel out of the state of Idaho once an interim storage facility or geologic repository is available. Any subsequent actions related to an interim storage facility or geologic repository are beyond the scope of this EIS.

Comment Document #20

Navy EIS-recapitalization comments

1 message

Roger Turner <[redacted]> Mon, Aug 10, 2015 at 6:04 PM
To: ecfrecapitalization@unnpp.gov

August 10, 2015

Roger Turner

[redacted]

[redacted]

Via e-mail to: ecfrecapitalization@unnpp.gov

Erik Anderson

Dept. of Navy

Naval Sea Systems Command

1240 Isaac Hull Ave. SE

Stop 8036

Washington Navy Yard, DC 20376-8036

SUBJECT: Comments on DOE/EIS-0453-D, Recapitalization of Infrastructure Supporting Naval SNF Handling

20.1 I support the no-action alternative.

20.2 1. Comment: Violation of NEPA and Corruption in contracting: The Navy and DOE are corrupt and have violated NEPA (40 C.F.R. § 1506.1(a)) by letting out a contract in January of 2011 (far in advance of this pending EIS decision) to Bechtel Marine Propulsion Corp., who in turn, awarded a sub-contract to Jacobs Engineering Group Inc. to provide engineering, procurement and construction management (EPCM) services in support of the Expended Core Facility Recapitalization Project. This latter company announced the award in their 2011 dated web page: (See http://invest.jacobs.com/investors/Press-Release-Details/2011/Jacobs-Receives-Contract-From-Bechtel-Marine-Propulsion-Corporation/default.aspx. The announcement by Jacobs includes the costs: "The total construction project cost is estimated to range from $300 to $500 million." Such a large contract could not possibly be awarded if the no action alternative was selected.

By awarding this contract before the EIS is completed it reveals that the Navy and DOE: do not intend on following NEPA since the award of the contract presupposes the selection of a preferred alternative ROD decision, years in advance of the actual decision. It is obvious that the Agencies do not intend on weighing the comments on scoping, or comments from this draft EIS. Based on this violation alone, the no action alternative should be selected.

2. Comment: Examination of Navy SNF. One of the major emphases of the basis for the preferred alternative in this EIS is the need for examination and inspection of the SNF, and since that operational system exists at the INL, at least minimally, then the expansion of that capability should take place at the INL. And since it would be inspected at the INL, well why not store it there as well? These assumed goals, and the logic of them, is false. First of all, the need for visual examination of every fuel rod is not adequately covered by the EIS, and appears to be unrealistic. With the history of fuel and fuel cladding
20.3 available to the Navy, the purported need for visual examination of all rods is not adequately covered in the EIS. The draft EIS indicates that even in wrecked submarines lying for decades under the ocean, that the the fuel is so stable that no fission products are released. So safety could hardly be justification for visual inspections. But even if if it were necessary, the Navy, more logically, could inspect the fuel at its de-fueling site, and carry out the additional inspection of 10-20% of the SNF core inventory at the shipyard area, as well. (And if it were inspected at the shipyards…why not store it there, as well?)

3. Comment: Long-term Storage not adequately addressed in EIS. The draft EIS erroneously continues to assume that an interim or long-term geologic repository is available or will be available soon (See 1.1.3). As a consequence the costs and risks of SNF storage at the INL is under-reported in the EIS. In reality, every indication is that the Fuel rods will be stored at the INL forever. That is, the EIS is perpetrating an
20.4 unrealistic human health risk, environmental risks, and project costs by continuing to portray the opening of a geological storage site as a near-future event. When the threshold of maximum INL SNF storage is reached, the Navy will have to find a new storage site, in any case, so why store it at the INL in the first place? (The EIS should be re-done to assess the costs of funding another storage site, in addition to the INL, when most of the spent fuel must be shipped out of the INL in 2035)

4. Comment: Location. The nuclear navy can safely store spent fuel rods at their own shipyard area. There is no justifiable reason for storing it at the INL.

20.5

Monitoring of nuclear releases from lost submarines show that the fuel rods are and cladding are safe enough to be examined and stored at the navy shipyard area without shipping and storing them in Idaho. Certainly when you look at the total construction costs of the preferred alternative, over 500 million dollars,
20.6 then the existing infrastructure at the INL provides a very limited cost advantage compared to the long-term budget of this project. That is, over time it will be cheaper for the Navy to examine and store the SNF at their own shipyard areas by avoiding long-term shipping costs, and avoiding the additional risk of storage over the Snake River Plain Aquifer.

In summary, the DOE and Navy, by pre-awarding a huge contract on this recapitalization project have
20.7 revealed that they have no intention to deviate from the preferred alternative –regardless of public
20.8 comment. This is a violation of NEPA laws. The EIS has not provided an adequate justification for the
visual examination of the rods, nor even of the more detailed inspections. In any case, the inspections,
20.9 over the long-term can be more cost effectively carried out at the navy shipyard area. Certainly, it makes
no sense to ship the waste here and plan on its storage over one of the largest critical aquifers in the
20.10 United States. The EIS continues to base their risk assessments and costs on the near-term opening of a
geological repository when, as time goes on, this assumption is unrealistic. The no action alternative
20.11 should be selected, if the Navy does not move the operation to their shipyards.

Sincerely

Roger Turner

Response to Comment Document #20

Item #20.1:

The commenter's preference for the No Action Alternative is noted.

Item #20.2:

The Navy and the DOE are fully complying with Council on Environmental Quality (CEQ) requirements at 40 C.F.R. § 1506.1 and DOE NEPA requirements at 10 C.F.R. § 1021.211. The NNPP is taking no action concerning this proposal that would have an adverse environmental impact or limit the choice of reasonable alternatives until a Record of Decision (ROD) has been signed.

Jacobs Engineering Group Inc. was hired as the Engineering Procurement and Construction Management (EPCM) contractor for this project; however, at this point the EPCM has only been contractually authorized to assist with design and planning for the construction of a new facility. This level of effort is essential to providing sufficient definition of the New Facility Alternative to allow detailed evaluation of its potential environmental impacts. A final decision has not been made to proceed with the actual construction of a new facility. However, a new facility is the preferred alternative and planning for this alternative is proceeding in parallel with the NEPA review consistent with DOE Order 413.3B, Program and Project Management for Acquisition of Capital Assets. The EPCM actions do not have any potential for adverse environmental impact or limit the NNPP choice between alternatives and are consistent with the allowances at 40 C.F.R. § 506.1(d) that allow for development of plans and designs.

Comments on scoping were addressed in the Draft EIS. The NNPP has considered all comments that were received on the Draft EIS in the Final EIS. A final decision on the proposed action will be made with the ROD consistent with 40 C.F.R. § 1505.2 and 10 C.F.R. § 1021.315.

Item #20.3:

As described in Section 1.5.3, alternatives for management of spent nuclear fuel managed by the DOE, including naval spent nuclear fuel, were comprehensively evaluated in DOE 1995. Based on that evaluation, ROD 1995 chose to implement regionalized spent fuel management by fuel type. Under that alternative, naval spent nuclear fuel is transported to the INL for examination and storage. There are no factors that warrant reconsideration of that decision.

Examination of naval spent nuclear fuel remains necessary. The current in-service conditions experienced by naval nuclear fuel are more demanding than in the past. The designs of naval nuclear fuel systems continue to evolve, and some desirable performance characteristics (e.g., a life-of-the-ship fuel design for aircraft carriers) have not yet been achieved. The continuing comprehensive program of examining all naval spent nuclear fuel provides information that validates naval nuclear fuel designs and performance models. This validation is essential to support resolution of emergent fleet problems, further refinement of the models, and development of the next generation of naval nuclear fuel designs.

Item #20.4:

As noted in Section 1.5.3, the DOE position is that the proposed geologic repository at Yucca Mountain is not a workable option for storing spent nuclear fuel and nuclear waste generated at nuclear facilities in the United States (U.S). As the DOE pursues parallel paths of a consent-based siting process for disposal of spent nuclear fuel and high-level waste as described in 80 Fed. Reg.

79872 (December 23, 2015) and development of a repository for disposal of high-level radioactive waste resulting from atomic energy defense activities, the NNPP remains committed to supporting the SA 1995 and the SAA 2008 and continues to prepare for shipment of naval spent nuclear fuel out of the state of Idaho once an interim storage facility or geologic repository is available. Any subsequent actions related to an interim storage facility or geologic repository are beyond the scope of this EIS. Additionally, alternatives for management of spent nuclear fuel within the DOE complex, including naval spent nuclear fuel, were comprehensively evaluated in DOE 1995. Based on that evaluation, ROD 1995 chose to implement regionalized spent fuel management by fuel type. Under that alternative, naval spent nuclear fuel is managed at the NRF at INL. There are no factors that warrant reconsideration of that decision.

In DOE 1995 and DOE 1996, environmental impacts associated with normal operations and hypothetical accident scenarios for dry storage were evaluated for several container system alternatives with varying naval spent nuclear fuel capacities. For dry storage operations, arrays of 345 to 585 dry storage containers were evaluated. The NNPP does not expect to have more than 585 dry storage containers by 2048. Since each container system would be designed to meet 10 C.F.R. § 72 technical requirements for storage of spent nuclear fuel, the analyses were insensitive to container system capacity and quantity. The delay in opening a geologic repository until 2048 would not result in changes to impacts described for the containers evaluated in DOE 1996. Therefore, the previous EIS analyses and conclusions remain valid.

Item #20.5:

Refer to the response to Item #20.3.

Item #20.6:

ROD 1995 chose to implement regionalized spent fuel management by fuel type. Under that alternative, naval spent nuclear fuel is managed at the NRF at INL. Therefore, locating the proposed action off the INL site is outside the scope of this EIS. Section 5.2.1 of ROD 1995 stated that “the environmental and safety consequences of any of the five spent nuclear fuel management alternatives would be small. For example, analyses of air quality, water quality, and land use for each alternative showed little or no impact.” DOE 1995 described important differences between alternatives including the costs for additional (duplicate) facilities and loss or maintenance of naval spent nuclear fuel examination capability for the decentralized alternatives. There are no factors that warrant reconsideration of the decision to manage naval spent nuclear fuel on the INL.

Item #20.7:

Refer to the response to Item #20.2.

Item #20.8:

Refer to the response to Item #20.3.

Item #20.9:

Refer to the response to Item #20.6.

Item #20.10:

Although the NNPP has the shipping containers and facility at NRF required for shipment, the timeframe reasonably necessary for shipment of naval spent nuclear fuel to a geologic repository or interim storage facility outside of Idaho is dependent on the availability of such facilities. The timing of availability of those facilities is uncertain. If the New Facility Alternative is selected, the design and operation of the facility will employ the standards and practices that have proven effective in protecting workers, the public, and the environment from radiological accidents, without regard to the timing of the opening of a geologic repository or interim storage facility. Appendix F of this EIS discusses the probability of radiological accidents, and the probabilities used are conservative. The estimated costs of the proposed action, presented in Table 2.6-2 of this EIS, are also not dependent on the timing of the opening of a geologic repository or interim storage facility.

Item #20.11:

Refer to the response to Item #20.1.

Comment Document #21

Comments on Navy EIS

1 message

edinst@tds.net <edinst@tds.net> Mon, Aug 10, 2015 at 11:13 PM
To: ecfrecapitalization@unnpp.gov

Attached please find Environmental Defense Institute Comments
on DOE/EIS-0453-D.
Chuck Broscious
Environmental Defense Institute
edinst@tds.net

EDI-Com-NRF-EIS-Final-Wpics.pdf
1557K

Environmental Defense Institute
Troy, Idaho 83871-0220
www.environmental-defense-institute.org

EDI Comments
Draft Environmental Impact Statement for Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling

DOE/EIS-0453-D

Submitted by
Chuck Broscious

August 10, 2015

Naval Nuclear Propulsion Background

According to the FY-13 U.S. Naval Nuclear Propulsion Budget: "Naval Reactors … achieved 148 million cumulative miles of safely-steamed, militarily-effective nuclear propulsion plant operation. Outlying year funding supports Naval Reactors' core mission of providing proper maintenance and safety oversight, and addressing emergent operational issues and technology obsolescence for 103 reactor plants. This includes 71 submarines, 11 aircraft carriers, and four research and development and training platforms (including land-based prototypes)."

In August 2015, John McKenzie director of program regulatory affairs said project costs for building a new Naval Reactors Facility (NRF) "is actually the low-cost answer, and even that is $1.6 billion." More than $500 million would be spent on construction. The rest would be design, equipment costs and a "management reserve," McKenzie said. Nuclear Navy currently has 81 nuclear powered warships including submarines and aircraft carriers. [1] [2]

"Start of construction on the new Expanded Core Facility [at INL/NRF] M-290 Receiving/ Discharge line-item construction a necessary project for receipt and processing of aircraft carrier spent nuclear fuel." "Construction: Reflects an increase in funds for the 13-D-905 Remote-handled low-level Waste Disposal Project [at INL], 13-D-904 Prototype Radiological Work and Storage Building, 13-D-903 KS staff building… FY-2012 ($39,900,000); FY-2013 ($49,590,000). " [3] As discussed below, the Navy's dumping of radioactive waste previously
21.1 dumped at the RWMC, will be dumped at the new Remote-handled low-level Waste Disposal Project that is also in the Big Lost River flood zone. See attachments # 6 and 7 below.

Naval Nuclear Propulsion Program Cost (dollars in thousands) [4]

FY-2011	FY-2012	FY-2013	FY-2014	FY-2015	FY-2016	FY-2017
985,526	1,080,000	1,088,635	1,108,391	1,129,186	1,151,021	1,175,975

[1] Navy officials pitch new $1.6 billion nuclear facility, Posted on Post Register, August 4, 2015, by Luke Ramseth

[2] Green Peace reported as of 1992, the Nuclear Navy has 126 vessels active and 63 in retirement. The 126 active vessels contain 147 reactors. The 63 retired vessels contain 65 reactors. The Navy has produced, over its history, a total of 600 reactor cores for its 189 commissioned vessel fleet. Within the next eight years, the Navy will retire an additional 85 submarines. Counting refueling and retired reactors, INL has received a total of 259 core assemblies. In eight years that number will jump to 359 core assemblies.

[3] DOE/EIS-0453-D

[4] FY-2013 Congressional Budget, Naval Reactors, Pgs. 480-489.

The State of Idaho has a significant role in the garbage end of the Naval Nuclear Propulsion Program. The Addendum to the 1995 Settlement Agreement [5] outlines significant concessions by Idaho in terms of the Navy's ability to maintain its nuclear program spent nuclear fuel (SNF) needs.

On the surface, a member of the public likely will not appreciate what this all means to them and future generations that will be forced to deal with these current political decisions.
Specifically, each Navy Spent Nuclear Fuel (SNF) shipment to Idaho National Laboratory
undergoes a process (explained below) that ends up with significant highly radioactive waste
being dumped above Idaho's sole source aquifer. DOE's Supplement to Evaluation of Naval
Reactors Facility Radioactive Waste Disposed of at the Radioactive Waste Management
Complex from 1953 to 1999, lists the 22 radionuclides in the Navy's waste that total 952,986.68
curies. [6] See Attachment # 1 for the list of individual nuclides. NRF's SNF dumped in SDS
21.2 1952 to 1980 was 27,707,700 grams or 27,707.700 kilo grams. [7] NRF is the largest contributor
of SNF dumped at INL's dump. See list of SNF generators to the RWMC below.

INL's Explanation of Significant Differences Between Models Used to Access Groundwater
Impacts for Disposal of Greater-Than-Class-C-Like Waste Environmental Assessment for the
21.3 INL Remote-Handled Low-Level Waste Disposal Project states; " The total Waste volume is
11,700 cubic meters and contains a total of 159 mega curies [159 million curies] of
radioactivity." [8] See Attachment # 2 below that lists individual radionuclides.

The Navy has been using Idaho as its dumping ground for over ½ century, with tragic
21.4 impacts on contaminants migrating into the underlying Snake River Plain Aquifer. This EDI
report offers details about the extent of the "known" contaminant in the aquifer. Currently, there
21.5 is a significant deficiency in both air and ground water monitoring.

The Naval Reactor Facility's (NRF) Expended Core Facility at INL receives the whole
reactor fuel assembly module. This facility has expanded to include a Dry Cell for cutting larger
21.6 aircraft carrier reactor cores to accommodate the increased size, volume from refueling and
decommissioning. The fuel rods are not easily removed from the rest of the assembly as are
most conventional reactor cores. The steel structural core assemblies are designed to withstand
combat shocks and maintain fuel rod configuration within the core during combat scenarios.

Naval spent nuclear fuel assemblies have non-fuel-bearing structural components above and below the fuel region to maintain proper support and spacing within the reactor. Generally, these

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[5] Addendum to the 1995 Settlement Agreement, signed by, Admiral Kirkland Donald, Director Naval Nuclear Propulsion Program; C.L. "Butch" Otter, Governor of Idaho; Lawrence Wasden, Idaho Attorney General; et.al.

[6] Supplement to Evaluation of Naval Reactors Facility Radioactive Waste Disposed of at the Radioactive Waste Management Complex from 1953 to 1999, J. Giles.etal., April 2005,ICP/EXT-05-00833, pg. 18.

[7] Radioactive Waste Management Information System Database (P61SH090, and P61SH070, Run Date 10/24/89)

[8] Explanation of Significant Differences Between Models Used to Access Groundwater Impacts for Disposal of Greater-Than-Class-C-Like Waste Environmental Assessment for the INL Remote-Handled Low-Level Waste Disposal Project, page 7, INL/EXT-10-19168, Table 2 citing DOE-EIS-2011.

upper and lower non-fuel-bearing structural components are removed in preparation for packaging. Non-fuel structural material is removed in the ECF water pools using an underwater cutting saw in a process known as resizing. The non-fuel-bearing structural material removed from naval spent nuclear fuel assemblies is classified as low-level radioactive waste (LLW). Based upon the radiation levels exhibited by LLW, this waste is designated either as remote-handled (RH) or contact-handled (CH) LLW.

"Neutron poison absorbs neutrons to ensure nuclear fission does not occur. When necessary to reduce reactivity, neutron poison material is inserted into the naval spent nuclear fuel assembly." [9]

"The ECF water pool area contains various materials handling equipment to support operations, including cranes and transfer carts. This equipment is vital to supporting naval spent nuclear fuel handling operations. Walls and stainless steel gates divide the water pools into smaller work areas, or zones. This partitioning makes it possible to drain a small portion of the total water pool or isolate an individual volume when maintenance or repair is required. The water pool walls and floors are covered with a fiberglass or epoxy coating which is highly resistant to radiation damage, easy to decontaminate, and serves as an extra barrier to water leakage." [10]

According to Thereon Bradley, Manager of the NRF, the Expended Core Facility cuts (or in some cases unbolts) the metal ends from the spent fuel elements in order to inspect fuel and cladding integrity and evaluate how the fuel survived service in the reactor. [Bradley] Other core structural components are also cut off the spent fuel assembly. "All naval fuel modules have non-fuel bearing metal structures above and below the fuel region to facilitate coolant flow and maintain proper spacing within the reactor. These upper and lower non-fuel bearing structures must be removed to permit inspection of the modules. Removal reduces the storage space ultimately required for the fuel by approximately 50%." [11]

The core assembly components containing the uranium fuel sections were previously sent intact to the Idaho Chemical Processing Plant (ICPP) for reprocessing or storage. This procedure changed when reprocessing ended. The remaining reactor fuel element parts and structural components are sent to the INL Radioactive Waste Manage-Management Complex (RWMC) for
21.7 shallow burial as "low-level" Class A or B waste. Until the mid-1970's this waste was dumped in the center of pits and trenches while less radioactive waste was dumped around it to provide additional shielding. Current practice is to use individual holes or "soil vaults" at the RWMC. See Attachment # 3 that shows TRU and Soil Vaults, and Attachment # 4 Diagram of SDA pits, trenches and soil vaults.

On some select core assemblies, the Navy does a destructive examination in the water pool
21.8 by cutting up the fuel elements as a more detailed evaluation of the uranium fuel and its cladding. In the past this process of cutting away the structural components was routine when the fuel was being reprocessed at the ICPP (now called INTEC) and the structural parts had to be separated from the uranium fuel components prior to reprocessing, as was the practice prior to 1990. The ICPP and other spent fuel generating facilities also routinely cut off metal parts of fuel rods on non-Navy fuel that was slated for reprocessing or storage, and sent these metal
21.9 components to the RWMC for shallow land burial as "low-level waste." The Navy now

[9] DOE/EIS-0453-D, pg. 1-4
[10] DEIS pg. 1-6
[11] DEIS(b) @ B-10

acknowledges that "some of the structural material exceeds the 10 CFR 61 Class C concentration limits and is being stored in the water pools. Under the Low-Level Radioactive Waste Policy Amendments Act of 1985 (P.L. 99-240), DOE is responsible for ensuring safe disposal of all Greater than Class C waste in a facility licensed by the Nuclear Regulatory Commission." [12] This is a very recent policy shift by the Navy to even consider this waste Greater than Class C. Still, the Navy continues to ship this waste to the RWMC violating its own policy and DOE continues to receive and bury the waste in shallow holes. Extremely limited storage capacity in addition to DOE's inability to account for this waste in storage further challenges the Navy assertions that Greater than Class C waste is going anywhere but to the burial ground. As recently as 7/12/94 this writer observed a heavily shielded transport canister routinely used by the Navy at the RWMC beside a crane ready to unload. See Attachment # 5 for a copy of the NRF shipping records to the RWMC Subsurface Disposal Area (SDA).

"Outdated infrastructure designs and upgrades to ECF structures, systems, and components necessary to continue ECF operations in a safe and environmentally responsible manner present a challenge to the continuity of ongoing ECF naval spent nuclear fuel handling operations. Major portions of the ECF infrastructure have been in service for over 50 years. The maintenance and repair burden necessary to sustain ECF as a viable resource for long-term operations is increasing. The ECF water pools have never undergone a complete refurbishment and have not been upgraded to current seismic standards. The pool does not have a liner, creating the potential for water infiltration into the reinforced concrete structure and the potential for corrosion damage of the reinforcing bar within the structure. The absence of a liner also means the capability to detect and collect small leaks, a common feature in modern water pools, is not present for the ECF pool. Consequently, while the replacement or overhaul of the current water pool is not a matter of urgency that must be done in a very short period, it is something that needs to be planned and started soon (Section 2.3)." [13]

21.10 Since this NRF reactor core waste going to the RWMC burial grounds contains long-lived radioactive isotopes due to many years of exposure in the reactor core, it should be classified as high-level waste and treated according to Nuclear Regulatory Commission (NRC) disposal standards. At the very least this waste must be put in NRC Class C, or Greater than Class C waste category. NRC disposal criteria require that "waste that will not decay to levels which present an acceptable hazard to an intruder within 100 years is designated as Class C waste." [10 CFR 61.7] Class C waste, must, for this reason, be disposed at a greater depth than other classes, or, if that is not possible, under an intruder barrier with an effective life of 500 years. "At the end of the 500 year period," according to NRC regulations, "remaining radioactivity will be at a level that does not pose an unacceptable hazard to an intruder or public health and safety." [Ibid.] The adequacy of the NRC regulations is discussed more fully in the NRC Regulation section in this paper. There is considerable debate over NRC's non-enforcement that allows class-C and greater than class-C waste to be dumped in shallow land burial.

21.11 DOE data shows that individual NRF waste shipments to the RWMC containing greater than 81,000 curies are not uncommon. It also should be noted that this waste is currently dumped in shallow unlined holes (called "soil vaults") that would not qualify as a municipal

[12] DEIS(b) @ B-10

[13] DEIS Pg. 1-13

garbage landfill, much less a RCRA Subtitle C hazardous waste disposal site, or a NRC high-level or Class C radioactive waste repository.

Another category of Navy waste is irradiated test specimens. "The irradiated materials program evaluates small specimens of materials for use in naval reactor systems. The specimens are loaded in sample holders, and the holders are placed in test assemblies at ECF. The assemblies are irradiated at [Advanced Test Reactor] ATR, and returned to ECF for disassembly."... "After completion of the final examination, specimens are shipped to ICPP for storage or to the INL Radioactive Waste Management Complex for disposal." [DEIS(b) @ B-12] Over 4,450 specimen shipments to and from the ECF have occurred to date. [Ibid. @ A-9]

Releasable Radionuclides from Navy Test Specimens

21.12

Fission and Corrosion Products		Fission and Corrosion Products	
Nuclide	**Activity (curies)**	**Nuclide**	**Activity (curies)**
Iodine-131	1,300	Eu-156	37.5
Tritium	351	Lu-177	15.9
Iodine-132	310	Eu-152	14.1
Eu-156	37.5	Zr-95	10.7
Eu-152	14.1	Zn-65	10.7
Zr-95	10.9	Co-60	7.68
Zn-65	9.8	Ce-141	6.6
Co-60	7.68	Eu-154	6.15
Eu-154	6.15	Cs-136	4.69
Sc-46	3.25	Sc-46	3.25
Cs-137	1.78	Iodine-131	2.37
Ru-106	0.336		

Nb-95	0.264
Pr-144	0.219
Ce-144	0.219

[INL ER/WM DEIS @A-68]

Summary of Waste Dumped in the Subsurface Disposal Area

Radioactivity of Waste Dumped at the Subsurface Disposal Area 1952-1983

21.13

Major Generator	RWMIS Shipping Roll-up in Curies
Test Area North (TAN)	63,000
Test Reactor Area (TRA)	460,000
ID Chemical Processing Plant (INTEC)	690,000
Naval Reactor Facility (NRF)	4,200,000
Argonne-West Materials Fuel Complex (MFC)	1,100,000
Rocky Flats Plant (RFF)	57,000
Other	55,000
Total	11,000,000
EG&G-WM-10903 @ 6-26	

The above summary of radioactive content of waste dumped is considered understated. The Environmental Defense Institute analysis of the curie content of Navy shipments to the burial ground, for instance, adds up to 8,140,668 curies. However the above DOE data using annual summaries attributes the Navy to only 4.2 million curies or only half as much. DOE admits that the annual summaries are understated. [14]

21.14 The ECF was built in 1957. It has four separate unlined concrete water pools that contain 3 million gallons of water. The ECF does not meet current spent nuclear fuel (SNF) storage or seismic code requirements. NRF workers claim that 16,000 gallons per day are leaking from the pools. In an attempt to slow these leaks, NRF tried injecting grout around the perimeter of the pools. The grouting caused increased hydrostatic pressure that forced some horizontal leakage into the perimeter access corridor around the pools which then must be pumped out. ECF also a lacks leak detection system. All other fuel storage and processing facilities at the INL with similar characteristics have been designated unsafe and scheduled for closure. Therefore, the

21.15 Navy's claim "that operation of the INL-ECF does not result in discharges of radioactive liquids"

[14] EGG-WM-10903 @ 6-26

is inaccurate. [DEIS(b) @ 5.2-12] because "three separate milling machines in the water pools are used to separate spent fuel components into smaller sections for examination in the shielded cells" [DEIS(b) @ B-13] suggests that significant contaminates are released to the water in the pools. These processes make the uncontrolled leaks uniquely significant.

21.16 The Navy fails to provide seismic analysis documenting that the super structure of the ECF can sustain design basis earthquake and accident scenarios during transfer of fuel using the ECF bridge crane. Water Pits 1,2, and 3 were only constructed to "Zone 2 earthquake requirements which were judged to be appropriate under the USGS's classification of the area at the time [1957] of their construction." Subsequent USGS requirements for INL raised that standard to zone 3.

21.17 Flooding accident scenarios postulated in the INL Environmental Restoration/ Waste Management Draft Environmental Impact Statement (ER/WM DEIS) of Mackey Dam acknowledges that the dam "was built without seismic design criteria" and "additionally, it is not clear how resistant the dam structure is to seismic events" and the fact that "a fault segment runs within 6 kilometers of the Mackay Dam" [DEIS(b) @ B-17] is more significant than the DEIS allows. Specifically, the 16 hours' time delineated for the failed dam flood waters to reach NRF is incredible. Flood waters would move considerably faster than 2 miles per hour. The DEIS inaccurately describes the Borah Peak earthquake as 6.9 when it was actually 7.3 on the Richter scale. This is a significant inaccuracy when DOE analyst Rizzo calculated peak ground acceleration at 0.24. The Special Isotope Separator EIS used a "predicted peak ground accelerations were calculated assuming a 7.25 magnitude earthquake." [SIS EIS] The DEIS does acknowledge that "this beyond design basis earthquake might have a peak ground acceleration of 0.4 g at ECF" which is twice the 0.24 that the facility could sustain. [DEIS(b) @ B-18] Yet the DEIS fails to explicitly acknowledge that there is a significant seismic hazard.

21.18 "The [NRF] Expended Core Facility $44 million Dry Cell Project has a dry shielded fuel handling, disassembly, examination and shipping facility, a decontamination shop, and a shielded repair shop. The Dry Cell contains a semi-automated production line to receive and prepare fuel for shipment to the ICPP for chemical dissolution and recovery of unused uranium. The decontamination and repair shop will be integrally connected to the Dry Cell, and to existing water pits, to allow routine servicing of equipment without removing equipment from a shielded environment. A 10,000 foot extension to the existing facility will be used to house necessary control, receiving, storage and training spaces."

"Core examinations and preparations for shipping and dissolution are currently performed in water pits. This method is labor intensive, has notable technical disadvantages, and involves a significant burden of deliberately redundant administrative and physical controls for nuclear safety. The receipt of expended nuclear cores is expected to have increased by 1992. This surge will be compounded because many of these cores will be larger and heavier than those that are currently processed in the water pits. Existing facilities and systems cannot be economically upgraded and automated to meet the projected workload increases. The Dry Cell

Project is essential to continued timely handling of expended cores in support of scheduled naval nuclear-powered vessel refueling and inactivation's." [DOE FY-93]

An unreported nuclear fuel accident occurred at ECF that caused evacuation of the building when a transfer cask was not properly positioned over alignment posts. The bottom door cask had holes in it that are designed to receive the alignment posts on the deck above the water pools so that a tight seal is created when the bottom door opened and the fuel dropped into the water pool. In this accident the posts and holes were not aligned and therefore there was no
21.19 seal. Workers claim that when the fuel was lowered into the pool, a 25 rad per hour beam escaped between the cask and the pool exposing workers in the area. The alignment occurred on one shift and the fuel transfer to the pool occurred on the next shift. [Allan] This type of accident would not occur at the newer ICPP-666 that is equipped with underwater cask loading and unloading capability as well as fully interconnected pools that keep the fuel below the water surface at all times. Because of severe deterioration of the concrete, leaks in the pool walls, and
21.20 the gate seal leaks, the ECF pools cannot be isolated.

Navy Waste Characterization

Publicly available summary DOE data recorded between 1952 and 1981 cites the Navy's NRF as dumping 3,195,000 Ci at the RWMC, making the Navy the second largest curie contributor to INL's dump. [ID-10054-81@15] Yet, DOE's restricted access Radioactive Waste Management Information System Solid Waste Master (RWMIS) Database attributes 187,050,351 curies to Navy's NRF dumping at the RWMC between 1960 and 1981. [RWMIS, P61SH090] Between 1960 and 1989 the Navy dumped 188,140,668 curies at the RWMC. [ibid] This figure makes the Navy the largest curie contributor to INL's dump. DOE recently revised these figures claiming a mistake in data entry more fully described below. DOE now claims that there was an entry error in their database that went undetected for 24 years.

DOE/ID recently provided Environmental Defense Institute (EDI) with a copy of
21.21 EG&G's Radioactive Waste Management Information System (RWMIS) verification process that was initiated because EDI publicized the data. According to the RWMIS 1/4/88 and 10/24/89 computer runs, there were four waste shipments on 9/15/69 from the Naval Reactors Facility (NRF) to the Radioactive Waste Management Complex (RWMC). The RWMIS lists the times of the four shipments at 820, 830, 840, and 850. The 820 NRF shipment is listed as "metal scrap".

Kliss McNeel, Manager of EG&G's Environmental Technical Support Unit who reported to DOE/ID's Paul Allen (9/7/93) on their verification process of the RWMIS, made a correction to the 9/15/69 shipment number 850 entry that originally contained a 1.8 E+8 (180,000,000) curie entry. [McNeel] The correction included a new curie value of 1.8 E+4 (18,000). EG&G's accompanying explanation includes a copy of the Waste Disposal Request and Authorization form ID 124 that describes the waste as "SCRAP INSERT 176 With Dummy Source and S5W Misc. hardware from disposal effort." This description more accurately describes the 9/15/69

820 shipment listed as "metal scrap" in the 1/4/88 and 10/24/89 database runs. The 820 "metal scrap" waste shipment is missing from EG&G's "corrected" RWMIS 9/24/92 data base run.

Mr. McNeel makes no attempt to account for the deletion of the 820 NRF "metal scrap" shipment to the RWMC. The 850 shipment, which earlier was reported to have a curie content of 1.8 E+8 is described as "011 CORE + LOOP COMP." Clearly, the waste description on form ID 124 does not match the RWMIS 850 waste shipment description. Also, there is no explanation why the curie content on form ID 124 is hand written when the other data fields are type written. Do other shipping manifests for that period also contain hand written entries for curie content? Even if one accepts this change in the data, this still shows the Navy dumped nearly three times (8.14 million) more curies than publicly acknowledged total of 3.1 million curies.

The Navy's reactor core wastes that have been buried at the RWMC must be exhumed at considerable expense and hazard to workers. The core assemblies are extremely radioactive and require remote handling. Individual NRF shipments to the RWMC of 81,000 curies attest to this hazard. Furthermore, the cores are not packaged in any radiation containment unit. NRF officials only acknowledge that the waste is shipped in a canister from the NRF, and the shipping canister is returned to the facility.

Until the mid-1970 the Navy dumped fuel element parts and specimens into the RWMC pits and trenches. Since then, the Navy continues to dump reactor core assemblies at the RWMC in "soil vaults", which are defined as shallow (2 to 6 feet diameter) holes in the ground where the waste is dropped in and covered with 3 feet of soil. As of 1979, there are 1,150 "soil vaults" in 20 separate rows. Currently the RWMC is undergoing environmental restoration under the CERCLA Superfund cleanup process. Remediation projects have begun, starting with Pit 9. Even the most pedestrian of observers can see how ludicrous cleanup activities are when dumping continues in the immediate vicinity creating new Superfund cleanup actions. The Environmental Protection Agency is responsible in that the agency has been unwilling to promulgate radioactive exposure and waste disposal standards - mainly due to inter-agency disputes among DOE, NRC, and EPA. Previous attempts (1987) by EPA to establish standards were struck down by the courts as not protective of human health. It is outrageous that simultaneously the INL burial grounds are undergoing Superfund cleanup of radioactive wastes that are contaminating the aquifer below, and in the immediate vicinity, the Navy continues to bury highly radioactive waste that will be the object of future cleanup activities.

21.22 The unique nature of the Navy spent fuel assemblies and the Naval Reactor Facility's processing/inspection operations is secret. The highly enriched Navy waste poses a significantly greater environmental threat than other conventional low-enriched reactor fuel that goes directly into storage cooling ponds. 21.23 Additionally, the Navy waste going to the RWMC must be classified as high-level waste and/or Class C waste by virtue of the fact that it contains reactor core assembly sections contaminated with long-lived radionuclides. The extremely high curie content of these waste shipments attests to this fact. Institute for Energy and Environmental Research's book *High-Level Dollars, Low-Level Sense* challenges the NRC radioactive waste disposal standards:

"In examining the NRC regulations, one is thus led to believe that the class limits [Class A, B, C, and greater than C] were derived from the requirements imposed by these hazard definitions and time frames. However, even according to NRC's own definitions of what is 'hazardous' and what is 'acceptable' the time frames of 100 years [Class A] and 500 years [Class C] are logically incompatible with the class limit definitions, raising serious questions about their environmental and public health adequacy." ... "For example, much of the '100 year' waste (Classes A & B), for example, will not decay to NRC-defined 'acceptable' levels in 100 years. Consider nickel-63. Buried at Class B concentrations levels of just under 70 curies per cubic meter, waste containing nickel-63 would still have concentrations of about 35 curies per cubic meter after the institutional control period of 100 years had elapsed. According to NRC regulations, at this point the waste should have decayed to the point where it 'will present an acceptable hazard to an intruder.' Yet, at 35 curies per cubic meter, the waste, if retrieved from the disposal site and re-buried, would still be classified as Class B waste since it has concentrations levels which are 10 times higher than the Class A limits. As a matter of fact, this waste would take a total of well over 400 years to decay just to the Class A upper limits (at which point the NRC regulations would still define it as hazardous for another 100 years if it were being buried for the first time)." [IEER© @ 74&75]

"This analysis makes an even stronger case against the NRC regulations when applied to the Class C limits, which pertain to 'long-lived radionuclides'. Class C waste contaminated with technetium-99, however, buried at concentrations of just under the Class C limit of 3 curies per cubic meter, will be hazardous according to NRC definitions for far longer than 500 years. It will take such waste over the three half-lives - some 640,000 years - just to decay to the upper boundary of Class A levels. The illogical nature of the above regulatory approach is made even more explicit in the NRC's discussion of the 'long-lived' radionuclides in the waste. According to the NRC, in managing low-level waste, 'consideration must be given to the concentration of long-lived radionuclides ... whose potential hazard will persist long after such precautions as institutional controls, improved waste form, and deeper disposal have ceased to be effective. These precautions delay the time when long-lived radionuclides could cause exposures'". [IEER(c)]

"In essence, there is an admission that the hazard due to long-lived radionuclides 'will persist long after' the controls imposed by the regulations fade away. This is an extraordinary admission of the regulations fundamental inadequacy right in the text of the regulation. The only thing the NRC regulations will apparently do with respect to the long-lived components of low-level waste, is push the hazard into the future, since NRC-mandated controls will, at most, only 'delay the time when long-lived radionuclides could cause exposure'. In the case of many long-lived radionuclides, they will continue to be present in almost exactly the same concentrations when institutional controls have lapsed as when they were first buried." [IEER(c)]

21.24 The Nuclear Regulatory Commission (NRC) requires in classifying a specific waste shipment that the part of that volume that contains 90% of the radioactivity be separated and used to determine the concentration and thereby the waste classification. The Navy and DOE continue to use the entire volume of the shipment to calculate the average concentration. The result is that the radioactive concentration appears low because of dilution. The NRC's Staff Technical Position specifically prohibits this practice of factoring in other material as a means of dropping the average concentration. The Navy is also using total volume averaging to avoid NRC regulations in burial of reactor shells at the DOE Hanford site. An EG&G groundwater sampling report found radioactive contaminates at the 600 foot level under the INL burial grounds.

21.25

Summary of Nuclear Navy Waste

Dumped at INL's RWMC Burial Ground

Year Dumped	Curie Content of Waste *
1960	1,364
1961	6,717
1962#	20,900
1963	34,933
1964 Navy Knolls Lab. Reactor Core + Loop Comp.	6,400
1964	24,050
1965	517,571
1966	787,300
1967	801,100
1968#	198,600
1969#	644,000
1970	3,572,048
1971	54,669
1972	10,577
1973	9,411

1974	5,782
1975	4,911
1976	73,348
1977	144,758
1978	34,962
1979	109,171
1980	39,206
1981	19,219
1982	8,401
1983	39,035
1983 NRF S1G Reactor Vessel	5,579
1984	372,614
1985	141,748
1986	35,928
1987	29,664
1988	6,722
1989 #	126,400
1990 #	74,120
1991 #	102,600
1992 #	49,300
1993 #	27,560
Total 1960 through First Quarter 1993	8,140,668

Source for above table:

[Radioactive Waste Management Information System Master Database, P61SH090, 10/24/89]; [#] [Senate Armed Services Committee, Subcommittee on Nuclear Deterrence, Arms Control and Defense Intelligence, Hearing on: shipment of Spent Nuclear Fuel, 28 July 1993, Questions and Answers for the Record, @ 25]
* Curie content of shipments less than 1 curie were not added to the above summary table, therefore, the totals are understated. Also **not included** are Navy contractors, General Dynamics' (Electric Boat Div. and General Atomics Div.) seven shipments of "irradiated fuel" to the RWMC; and General Electric's eleven shipments of "irradiated fuel" and ten reactor "core + loop" assemblies; and Office of Isotopes Specialists' one shipment of "irradiated fuel" to RWMC. DOE and Navy officials publicly deny that spent fuel was dumped at the INL burial ground (RWMC) in direct contradiction to their own data base entries. (See Spent Nuclear Fuel Dumped in Burial Ground that shows 90.282 metric tons of irradiated fuel dumped in RWMC)

Spent fuel rods from over 40 reactors around the US and the world are being stored at various sites around INEEL. Current inventory is 1,225 metric tons total mass. [A.Hoskins, WINCO, 7/11/94] DOE plans on considerable expansion (15-20,000 metric tons) of its spent fuel processing and storage. This Plan is called "Directed Monitored Retrievable Storage", which is the product of nuclear electric utilities forcing the government to take possession of spent fuel. Since a high-level waste repository has yet to be built, the utilities do not want to store the spent fuel on their sites.

Equally significant are spent nuclear fuel related waste shipments to the RWMC burial grounds. This waste includes spent nuclear fuel parts cut off the fuel elements prior to storage and fuel storage "canal trash" that represents over **9,866,112 curies.** The burial grounds are a shallow disposal area that would not meet municipal garbage landfill regulations.

Navy Waste Characterization

Partial listing of isotopes found in Navy waste dumped at INL

Isotope	Symbol	Half-Life in days	Half-Life in Years
Americium-241	Am-241	1.7 E+5	465.7
Antimony-125	Sb-125	877	2.4
Barium-133	Ba-133	12	
Cerium-144	Ce-144	290	
Cobalt-58	Co-58	72	
Cobalt-60	Co-60	1,900	5.2
Chromium-51	Cr-51	27	
Cesium-134	Cs-134	840	2.06
Cesium-137	Cs-137	1.10 E+9	30.17

Europium-154	Eu-154	5,800	15.89
Hafnium-181	Hf-181	46	
Iron-55	Fe-55	110	
Iron-59	Fe-59	45	
Iridium-192	Ir-192	74	
Lead-210	Pb-210	7,100	19.4
Manganese-54	Mn-54	300	
Neptunium-237	Np-237	8.0 E+8	2,191,780
Nickel-59	Ni-59	2.9 E+7	79,452
Nickel-63	Ni-63	2.9 E+4	79.4
Niobium-95	Nb-95	35	
Potassium-40	K-40	.50	
Plutonium-238	Pu-238	3.3 E+4	87.7
Plutonium-239	Pu-239	8.9 E+6	24,131
Plutonium-240	Pu-240	2.4 E+6	6,575
Plutonium-241	Pu-241	4.8 E+3	14.35
Plutonium-242	Pu-242	1.4 E+8	383,561
Promethium-147	Pm-147	920	2.5
Radium-226	Ra-226	5.9 E+5	1,616
Ruthenium-106	Ru-106	365	
Silver-110M	Ag-110M	270	
Sodium-22	Na-22	950	2.6
Strontium-89	Sr-89	50	

Strontium-90	Sr-90	10,512	28.8
Technetium-99	Tc-99	7.7 E+7	210,958
Thorium-232	Th-232	5.1 E+12	13,972,600,000
Tin-119	Sn-119	112	
Uranium-233	U-233	5.9 E+7	161,643
Uranium-234	U-234	9.1 E+7	249,315
Uranium-235	U-235	2.6 E+11	712,328,767
Uranium-236	U-236	8.7 E+9	23,835,616
Uranium-238	U-238	1.6 E+12	4,383,561,644
Zirconium-95	Zr-95	63	

Source: USDOE, Radioactive Waste Management Information System Master Solid Database, 10/24/89

The above table shows clearly how Navy waste dumped in the burial grounds contains Transuranic. One of the reasons for this is the lack of precision in cutting off the structural parts of the fuel element in preparation for reprocessing or storage. Destructive tests of fuel assemblies additionally add to the fissile content of the waste stream. In recent DOE documents characterizing the waste streams going to the RWMC they acknowledge presence of, "Irradiated fuel element end boxes that were cut off of the fuel plates in the hot cells. The end boxes may contain some fuel, but generally only activation products". [EGG-WM-10903 @ 2-30] Independent characterization of this waste must be made before more is dumped at the RWMC.

Spent fuel rods from over 40 reactors around the US and the world are being stored at various sites around INEEL. Current inventory is 1,225 metric tons total mass. [A.Hoskins, WINCO, 7/11/94] DOE plans on considerable expansion (15-20,000 metric tons) of its spent fuel processing and storage. This Plan is called "Directed Monitored Retrievable Storage", which is the product of nuclear electric utilities forcing the government to take possession of spent fuel. Since a high-level waste repository has yet to be built, the utilities do not want to store the spent fuel on their sites.

Spent Reactor Fuel Dumped at INL's RWMC Subsurface Disposal Area Burial Grounds 1952 to 1980 [RWMIS]

Generator	Mass in Grams
Materials Fuels Complex (MFC) aka. Argonne Laboratory-West	2,177,150
Idaho Nuclear Technology and Environmental Center (INTEC)	9,246,306
Naval Reactors Facility (NRF)	27,707,700
General Dynamics, General Atomics Division San Diego, CA	22,861,440
General Electric, Vallecitos Atomic Laboratory Pleasenton, CA	11,568,800
Special Power Excursion Test (SPERT) INL	14,517
Test Area North (TAN) INL	16,433,193
Advanced Test Reactor Complex aka. Test Reactor Area (TRA)	273,866
21.26 Total Mass in Grams	90,282,972
Total Mass in Metric Tons	90.282

The above preliminary numbers, compiled by the Environmental Defense Institute, are drawn from DOE's Radioactive Waste Management Information System Database (P61SH090, and P61SH070, Run Date 10/24/89) and represent about 57 shipments specifically identified as "irradiated fuel". Not included in the above listing are even more numerous shipments called "unirradiated fuel", "fuel rods", "control rods", and other reactor fuel not identified specifically as "irradiated". The curie content of these shipments identified as "fuel rods" (>7,000 curies) suggests that they are also irradiated reactor fuel. The above listing also does not include 7 shipments of "irradiated fuel" during the same period to the RWMC Transuranic Storage Area amounting to 621.549 kilograms, and which also were not included in the Spent Nuclear Fuel EIS.

The Environmental Protection Agency (EPA) found that INL violates the Resource Conservation and Recovery Act and "That the presence and/or release and potential release of hazardous waste from USDOE's facility may present a substantial hazard to human health and/or the environment ..." [EPA(a),9/15/87] Substantive corrective action has yet to occur because
21.27 EPA does not have the authority to shut down any INL facility. Consequently violations are interpreted as a peer review without being binding according to a 1989 Government Accounting Office report. [GAO/RCED-89-13, p.3]

EPA's 1993 Oversight budget had been cut by one percent by the Bush Administration at a time when its oversight obligations were the greatest at DOE cleanup sites. President Clinton further cut EPA's radiation standards and Federal Facility Enforcement Office, and Congress cut

EPA's 1996 budget by yet another one-third. EPA funding remains flat after the 1996 cuts. Clearly, EPA's regulatory authority will be forced to continue to rubber stamp whatever DOE wants.

21.28 Another major assumption that is extensively evoked in the Plan is 100 years of DOE monitoring and institutional control of the contaminated sites. In real life, when entities break the law, and are required to do major corrective actions in the future, they are generally required to establish a trust fund so that if they again decide to disregard their legal requirements, or are no longer in existence, the funding will be there for the state or local government to do the job. The state of Idaho should therefore, require DOE to establish a monitoring/institutional control trust fund to cover those costs at INEEL. An example of where this issue is important is the current designation that NRF is not in the Big Lost River (one mile away) 100 year flood plain. This designation is due to Big Lost River dams that divert flood waters south into spreading areas. These dams and their related water channels require regular maintenance in order to provide that flood protection to NRF and other INEEL facilities. Prior to construction of the diversion dam, NRF was in the Big Lost River 100 year flood plain. [RI/FS@5] Nuclear Regulatory Commission (NRC) radioactive waste disposal requirements state, "waste disposal shall not take place in a 100 year flood plain." [10 CFR ss 61.50] Institutional control must include diversion dam and water channel maintenance as well as monitoring and fencing of waste

21.29 The Plan states: "The Comprehensive RI/FS Waste Area Group 8 represents the last extensive Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) investigation for the Naval Reactors Facility." This Plan is not "comprehensive" because it excludes the Retention Basin (one of the most contaminated waste sites at NRF) from the CERCLA cleanup process. The Retention Basin (OU-8-08-17) is a large concrete tank that temporarily holds liquid radioactive and chemical wastes (presumably to allow short-lived isotopes to burn off) prior to discharge to the various leach pits. The Plan fails to state that the sludge in the basin contains cesium-137 at 192,700 pico curies per gram (pCi/g) (risk-based action level is 16.7 pCi/g) and Cobalt-60 at 20,410 pCi/g. [RI/FS@H8-8] A long history of Basin leaks assures significant soil contamination under the basin and therefore must be included in the Comprehensive Plan.

21.30 The Plan's exclusion of the NRF Expanded Core Facility (ECF) leaks additionally demonstrates the incompleteness of the so called "comprehensive" Plan. The ECF, built in 1958, does not meet current spent reactor fuel storage standards that require stainless steel liner, leak containment, and leak detection systems. The ECF should be shut-down for exactly the same reasons the Idaho Chemical Processing Plant (CPP-603) Underwater Fuel Storage Facility was shut-down - it was an unacceptable hazard and did not meet current standards. ECF has been leaking significantly >62,500 gallons of radioactive water over the past decade and the soil contamination around and underneath the basins must be included in the CERCLA cleanup process. The Plan offers no soil sampling data to substantiate exclusion of the ECF from CERCLA action.

21.31 The Plan's exclusion of the Sewage Lagoon (NRF-23) from its so called "comprehensive" CERCLA cleanup, again, demonstrates the incompleteness of the Plan. Contaminate levels of arsenic, mercury, and cesium-137 would normally require remedial action. In fact, the Track 1 investigations recommended inclusion of the lagoons into the comprehensive RI/FS primarily due to radionuclides and the risk assessment results showed increased cancer rate of 1 in 10,000 from exposure to the site. [Plan@25] The Plan offers no data to substantiate the "risk management decision" to exclude the lagoons. NRF intends to continue to use these unlined leach pits despite the fact that every gallon of waste water that flows into the pit, leaches more of the contaminates toward the aquifer below. NRF should be required to close the Sewage Lagoons, remove all contaminated soil, and build new lined ponds that meet current regulations.

21.32 The Plan offers inaccurate data to support the preferred alternative. The Plan states that the maximum soil concentration at all of the 8-08 Operable Units for cesium-137 is 7,323 pCi/g. [Plan@14] Appendix H of the RI/FS however credits the S1W Leach Pit with a maximum detected cesium-137 concentration of 149,759 pCi/g. [RI/FS@H4-22] This contaminate concentration discrepancy is significant because the undisclosed higher amount qualifies under NRC radioactive waste classification criteria in 10 CFR ss 61.55 and the "technical requirements for land disposal facilities" in ss 61.50. The preferred alternative does not meet NRC requirements. Actually, DOE's preferred alternative does not even meet municipal garbage landfill requirements under Resource Conservation Recovery Act (RCRA) Subtitle D which require liner, leachate monitoring wells, impermeable cap, and location restrictions over sole source aquifers. The NRF Plan contains none of these essential features. This Plan effectively shifts the risks, hazards, and ultimate cleanup costs to future generations. The high levels of hazardous materials in the NRF waste qualify it as a mixed hazardous and radioactive waste under the 1992 Federal Facility Compliance and RCRA Land Disposal Restrictions. Hazardous contaminates in the soil include chromium at 2,090 mg/kg and lead at 1,140 mg/kg when the EPA maximum concentration level (MCL) for both is 50. Also, mercury at 56.1 exceeds the MCL at 2 mg/kg. Under the circumstances, it is difficult to see how the Plan's preferred alternative can claim to meet all the "Applicable or Relevant and Appropriate Requirements" (ARAR).

21.33 1971 sampling data buried in the Administrative Record show long-term waste mismanagement at the S1W Leach Pit with cesium-137 at 310,000 pCi/g, cesium-134 at 42,00 pCi/g, hafnium-181 at 20,000 pCi/g, and cobalt-60 at 1,300,000 pCi/g. [RI/FS@I-59] Algae (accessible to ducks using the pond) sampling show 667,447 pCi/g. [RI/FS@ pg. H6-13] By comparison, the risk based soil concentration for cesium-137 applied to this Plan is 16.7 pCi/g. These high contamination levels were due primarily to once through reactor cooling water dumped in the leach pits which was discontinued by 1980. No explanation is offered why the remediation goal applied to Waste Area Group 3 of 0.02 pCi/g for cesium-137 was changed.

21.34 NRF and DOE representatives stated at a public meeting in Moscow that the groundwater and aquifer are not at risk because contaminates are absorbed by the soil column. Review of the historical deep well sampling data at NRF does not support the Navy's conclusion. The NRF October 1995 Remedial Investigation / Feasibility Study (RI/FS) Appendix K shows Table III Deep Well Sample Results for Wells # 1, # 2, and # 3 at 60, 69, and 44 pico curies per liter respectively for gross beta. The federal drinking water standard for gross beta is 8 pico curies per liter. This deep well sample data confirm that the contaminates do migrate, contrary to the Navy's claims.

21.35 The Plan's "remediation goals" that set risk-based soil concentrations for contaminates of concern (cleanup goals) fail to include inhalation as an exposure pathway. This exclusion represents a major flaw in the Plan. Inhalation is the most biologically hazardous for alpha emitting contaminates of concern listed as americium-241, neptunium-237, plutonium-238, plutonium-244, and uranium-235, yet inhalation is not considered for these isotopes, or for lead. The wide difference between ingestion of beta/gamma contaminated soil also appears out of balance. For instance cleanup goals for cesium-137 external exposure is set at 16.7 pico-curies per gram (pCi/g) while ingestion of soil is set at 24,860 pCi/g. Additionally, the beta emitter strontium-90 is not considered for external or inhalation exposure but is considered for soil ingestion at 15,416 pCi/g and food crop ingestion at 45 pCi/g.

21.36 An integral factor in the Plan's establishing a "remediation goal" is the maximum concentration of contaminates of concern. The Plan acknowledges (pg. 14) that the maximum cesium-137 soil contamination detected at the NRF is 7,323 pCi/g which generated a risk based cleanup goal of 16.7 pCi/g. Again, this must be recalculated using the above cited maximum detected cesium-137 at 149,759 pCi/g "decay corrected to obtain equivalent 1995 results." This significant discrepancy begs the question as to the quality of regulatory review the State and EPA are bringing to the process and whether the "remediation goals" are supportable.

Attachments:

21.37
1. List of SNF radionuclides in NRF SNF pg. 18 in ICP-EXT-05-00833. When added the total curie content is 952, 986.86.

21.38
2. Greater Than Class C Low-Level Waste EIS pg. 7 (INL-EXT-11-23102).
3. RWMC SDA color diagram showing which pits, trenches and soil vaults contain TRU Waste.
4. RWMC SDA showing the number of pits, trenches, and soil vaults (EG&G-WM-9638) pg. 2-24.
5. Radioactive Waste Management Information Data Base Solid Master Data Base (P61SH090), List for 1954 to 1970, Run Date 3/29/89, pages 517, 518, 519 and 520 (RWMIS).
6. DEIS/EIS-0453-D Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel, Pg. 3-42 showing NRF contours.
7. DEIS/EIS-0453-D Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel, Pg. 3-38 showing Big Lost River Flood Zone.

References:

1. Final Comprehensive Remedial Investigation/Feasibility Study for the Naval Reactor Facility, Idaho National Engineering and Environmental Laboratory, Waste Area Group 8, October 1995, U.S. Department of Energy.

2. Nuclear Regulatory Commission 10 Code of Federal Regulation ss 61 Subpart D

3. Environmental Protection Agency, 40 Code of Federal Regulations ss 261

4. United States Nuclear Waste Technical Review Board, Summer Meeting, 6/29/2010.
21.39 States; Navy Spent Nuclear Fuel generated 65 metric tons, current inventory SNF is 25 MT, pg. 103 &104. The difference is due to reprocessing.

5. The Final Environmental Assessment and Finding of No Significant Impact prepared in accordance with the National Environmental Policy Act, herein after referred to as EA-1793, is available at:
http://www.id.energy.gov/insideNEID/PDF/Final EA DOE_EA-1793 2011-12-20.pdf

5. CONCLUSIONS AND RECOMMENDATIONS

This report documents distribution of the NRF radionuclide source term across all documented NRF waste disposal shipments sent to the SDA during the HDT, RPDT, and RPDT Supplement periods from 1953 through 1999. Best estimates from the three timeframes are presented in Table 5. The combined inventories shown in Table 5 are compiled from separate inventories presented in Sections 3 and 4.

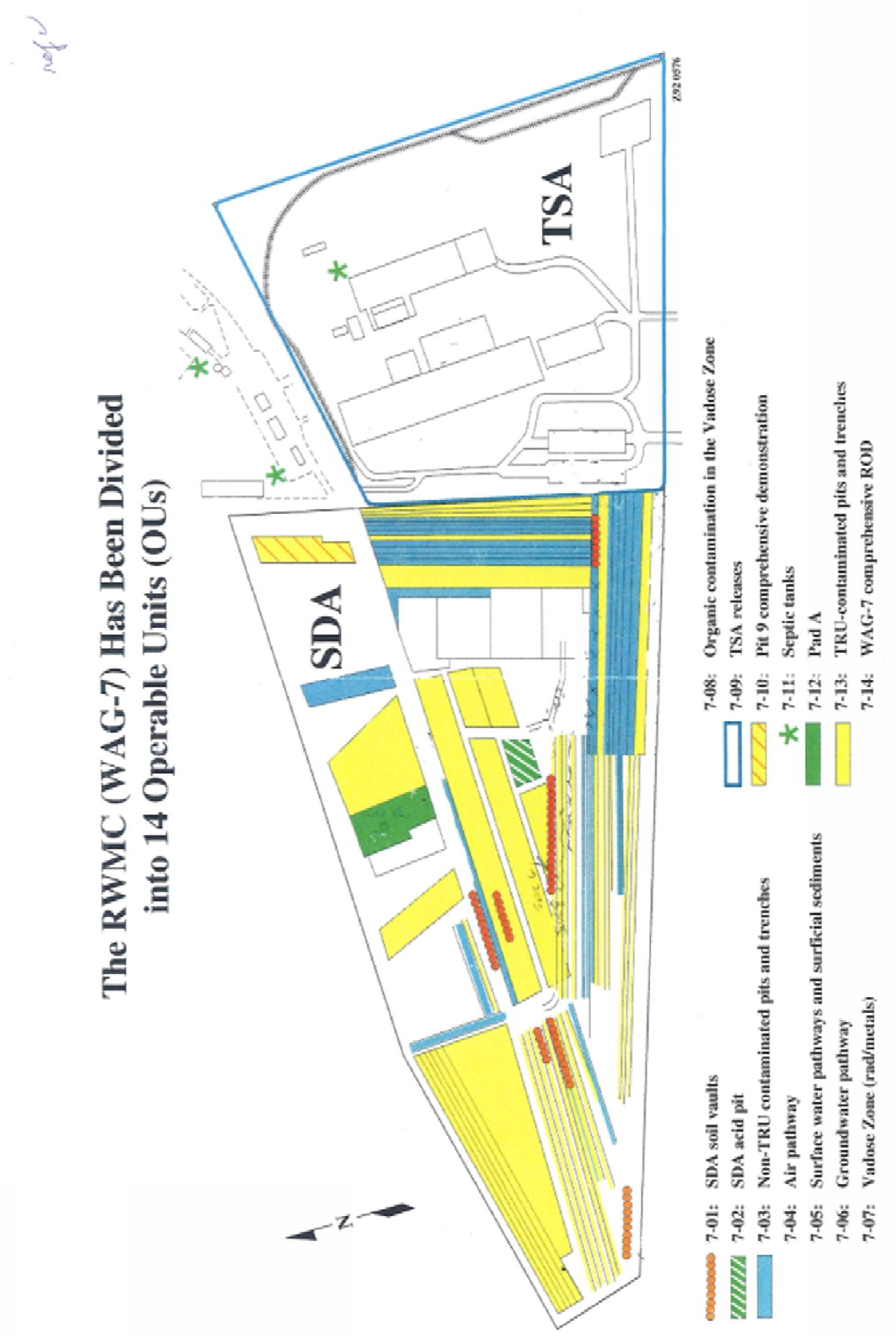
This report presents best-estimate (Appendix A) and upper-bound (Appendix B) radionuclide inventories associated with NRF operations. Estimates are based on totals by waste stream provided by DOE-IBO (Appendix C). Technically defensible estimates of radionuclide activities for individual waste shipments from NRF to the SDA were developed from detailed investigations and reviews of shipping and waste records, nuclear material accountability forms, and extensive deterministic calculations using known irradiation histories of these waste streams.

Table 5. Summary of the Naval Reactors Facility best-estimate radionuclide inventories in waste sent to the Subsurface Disposal Area from 1953 through 1999.

Radionuclide	1953 through 1983 (Ci)	1984 through 1997[a] (Ci)	1994 through 1999[b] (Ci)	Total 1953 through 1999 (Ci)
Am-241	1.18E+01	1.07E-01	1.06E-03	1.19E+01
C-14	6.20E+01	1.08E+01	1.12E+00	7.40E+01
Cl-36	1.63E-01	4.49E-02	8.53E-03	2.16E-01
Co-60	5.77E+05	1.57E+05	1.52E+03	7.36E+05
Cs-137	1.15E+04	1.07E+01	9.95E-01	1.15E+04
H-3	1.66E+02	3.09E+01	1.37E+01	2.10E+02
I-129	8.30E-03	8.83E-04	8.99E-04	1.01E-02
Nb-94	2.55E+01	5.80E+00	2.34E-01	3.15E+01
Ni-59	1.48E+03	3.97E+02	2.36E+01	1.90E+03
Ni-63	1.49E+05	4.10E+04	2.81E+03	1.93E+05
Np-237	4.39E-03	6.54E-07	—	4.39E-03
Pu-238	1.89E+01	7.41E-02	4.55E-03	1.89E+01
Pu-239	4.67E+01	5.51E-02	1.38E-04	4.68E+01
Pu-240	4.07E+01	3.42E-02	1.40E-04	4.07E+01
Pu-241	3.20E+03	4.61E+00	7.38E-02	3.21E+03
Sr-90	6.93E+03	9.78E+00	4.87E-01	6.94E+03
Tc-99	2.65E+00	2.24E-01	2.37E-03	2.88E+00
U-233	3.66E-04	5.89E-05	—	4.25E-04
U-234	8.43E-02	9.63E-05	—	8.44E-02
U-235	1.66E-03	8.88E-07	2.98E-06	1.67E-03
U-236	1.19E-02	3.11E-06	—	1.20E-02
U-238	8.32E-02	3.42E-05	5.26E-08	8.33E-02

[a]Excludes waste stream NRF-MOD-10S.

[b]Includes waste streams NRF-MOD-6S and NRF-MOD-10S.


The RWMC (WAG-7) Has Been Divided
into 14 Operable Units (OUs)
TSA
SDA
N
7-01: SDA soil vaults
7-02: SDA acid pit
7-03: Non-TRU contaminated pits and trenches
7-04: Air pathway
7-05: Surface water pathways and surficial sediments
7-06: Groundwater pathway
7-07: Vadose Zone (rad/metals)
7-08: Organic contamination in the Vadose Zone
7-09: TSA releases
7-10: Pit 9 comprehensive demonstration
7-11: Septic tanks
7-12: Pad A
7-13: TRU-contaminated pits and trenches
7-14: WAG-7 comprehensive ROD

Document EGG-WM-9638
Revision 2
Date October 1991

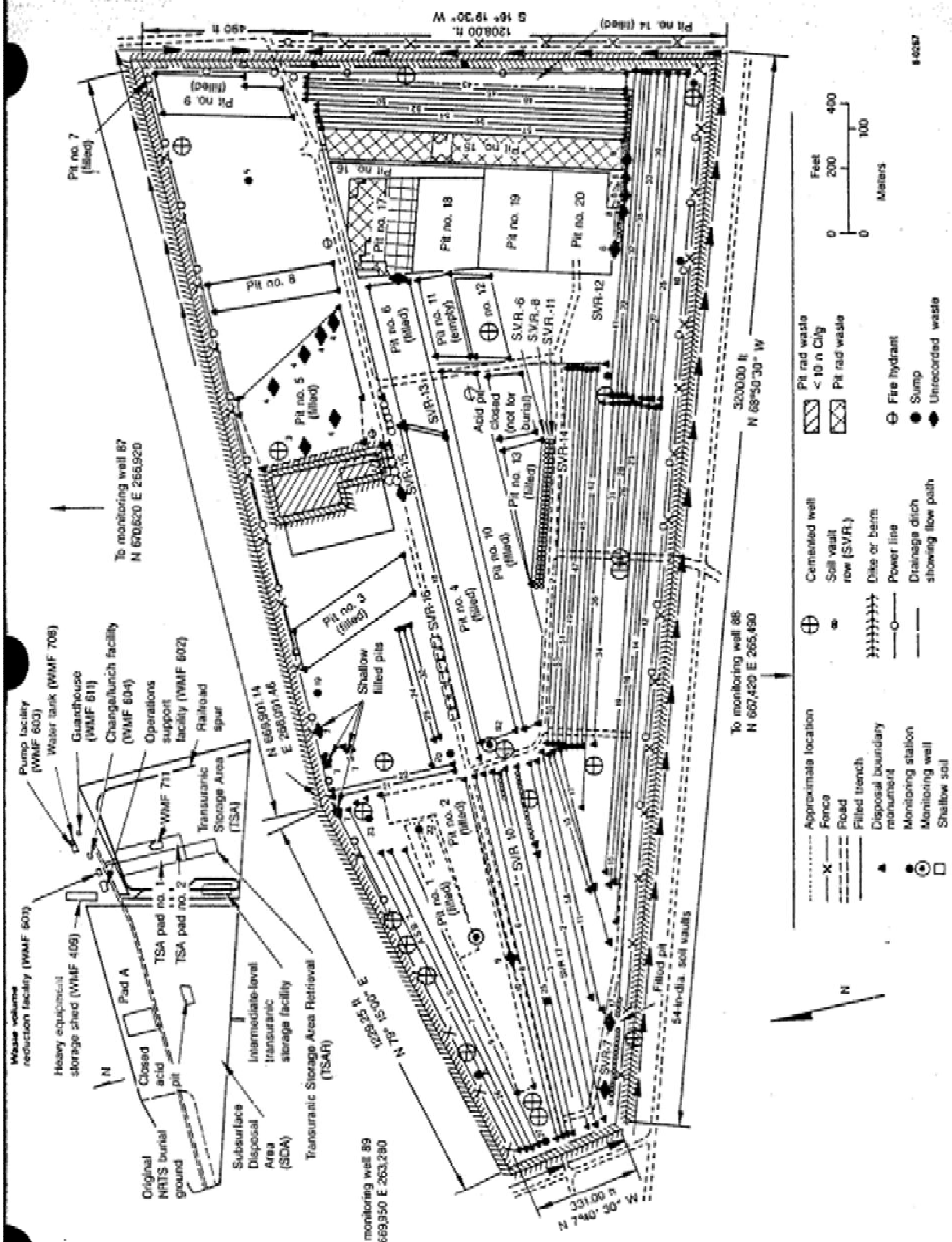


Figure 2-4. Location of the Acid Pit at the SDA.

2-24

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                                         RADIOACTIVE WASTE MANAGEMENT INFORMATION SYSTEM
                                           SOLID MASTER DATABASE (P61SH090) LIST FOR 1954 TO 1970      PAGE NO.  519

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-------------------------------------------------------------------------------------------------------------------------
TYPE  #  VOL U     DESC                   LOCATION     DATE                        NUCLIDE       CONC       CURIES    NO.

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BXC  17   12 F 007 RAD WASTE NOS    221  BGT502+55-65   09/18/69                  UN-ID-B+G     0.000E+00  1.000E-02

NRF618 S R 0 09/22/69  810  5000 300       4.531E-01  1.179E+07  3.600E+04
I      1  16 F 011 CORE+LOOP COMP.  222  UNKN UNKN      09/22/69                  MFP           0.000E+00  3.599E+04

                                                                                  U-235         1.980E+00  4.237E-06

NRF618 S R 0 09/22/69  820    40   7       5.777E+00  0.000E+00  5.000E-02
BXC  17   12 F 007 RAD WASTE NOS    223  BGT503+25-30   09/22/69                  UN-ID-B+G     0.000E+00  5.000E-02

NRF618 S R 0 09/22/69  830     8   1       5.777E+00  0.000E+00  5.000E-03
BXC  17   12 F 007 RAD WASTE NOS    224  BGT503+20-25   09/22/69                  UN-ID-B+G     0.000E+00  5.000E-03

NRF618 S R 0 09/25/69  800    20   2       5.777E+00  0.000E+00  1.300E-02
BXC  17   12 F 008 COMBUSTIBLES     226  BGT505+60-65   09/25/69                  CO-60         0.000E+00  1.300E-02

NRF618 S R 0 09/25/69  810    20   2       5.777E+00  0.000E+00  1.800E-02
BXC  17   12 F 008 COMBUSTIBLES     227  BGT503+70-80   09/25/69                  CO-60         0.000E+00  1.800E-02

NRF618 S R 0 09/26/69  800  5000 400       4.531E-01  1.179E+07  1.800E+04
I      1  16 F 011 CORE+LOOP COMP.  228  BGT508+10      09/29/69                  UN-ID-B+G     0.000E+00  1.800E+04

NRF618 S R 0 09/29/69  800    90  10       5.777E+00  0.000E+00  6.000E-02
BXC  17   12 F 007 RAD WASTE NOS    230  BGT504+25-30   09/29/69                  UN-ID-B+G     0.000E+00  6.000E-02

NRF618 S R 0 09/29/69  810    20   6       5.777E+00  0.000E+00  7.000E-03
BXC  17   12 F 007 RAD WASTE NOS    231  BGT504+30-35   09/29/69                  UN-ID-B+G     0.000E+00  7.000E-03

NRF618 S R 0 10/01/69  800  4700 480       4.531E-01  7.257E+06  2.450E+04
I      1  16 F 011 CORE+LOOP COMP.  232  BGT507+70      10/02/69                  CO-60         0.000E+00  2.450E+04

NRF618 S R 0 10/02/69  810    15   1       5.777E+00  0.000E+00  3.000E-02
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NRF618 S R 0 10/02/69  820    12   1       5.777E+00  0.000E+00  2.000E-02
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NRF618 S R 0 10/06/69  810    15   3       5.098E-01  1.179E+07  2.000E+01
I      1  18 F 011 CORE+LOOP COMP.  237  BGP10100E05SNW 10/07/69                  MFP           0.000E+00  2.000E+01

NRF618 S R 0 10/07/69  800    15   4       5.777E+00  0.000E+00  3.000E-04
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1. DATA CONTAINED IN THIS LISTING ARE KNOWN TO BE INCOMPLETE AND CONTAIN INACCURATE NUCLIDE BREAKDOWNS. ANY ATTEMPTS TO MATCH PUBLISHED DOCUMENT NUMBERS WITH NUMBERS IN THIS LIST WIL RESULT IN DISCREPANCIES.
2. NO OFFICIAL INEL DOCUMENTS USE DATA FROM THIS DATA FILE.

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                                           SOLID MASTER DATABASE (P61SH090) LIST FOR 1954 TO 1970      PAGE NO.  520

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NRF618 S R 0 10/09/69  800     2   0       5.777E+00  0.000E+00  5.000E-03
BXC  17   12 F 007 RAD WASTE NOS    239  BGT508+00-10   10/09/69                  MFP           0.000E+00  5.000E-03

NRF618 S R 0 10/09/69  810  3000 500       4.531E-01  1.179E+07  1.800E+04
I      1  16 F 011 CORE+LOOP COMP.  240  BGT507+80      10/10/69                  CO-60         0.000E+00  1.800E+04

NRF618 S R 0 10/13/69  800    12   2       5.777E+00  0.000E+00  4.000E-03
BXC  17   12 F 007 RAD WASTE NOS    241  BGT507+75-80   10/13/69                  MFP           0.000E+00  4.000E-03

NRF618 S R 0 10/13/69  810    30   6       7.646E+00  0.000E+00  5.000E-03
O      1 270 F 010 METAL SCRAP      242  BGP10640E05SNW 10/13/69                  MFP           0.000E+00  5.000E-03

NRF618 S R 0 10/13/69  820    15   1       5.098E-01  1.179E+07  2.000E+01
I      1  18 F 011 CORE+LOOP COMP.  243  BGT507+75      10/14/69                  CO-60         0.000E+00  2.000E+01

NRF618 S R 0 10/15/69  800    10   0       5.098E-01  7.257E+03  2.000E+01
I      1  18 F 011 CORE+LOOP COMP.  244  BGT507+40      10/17/69                  UN-ID-B+G     0.000E+00  2.000E+01

NRF618 S R 0 10/16/69  810   400  40       5.777E+00  0.000E+00  4.000E-02
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NRF618 S R 0 10/16/69  820   250  25       5.777E+00  0.000E+00  2.500E-02
BXC  17   12 F 003 PAPER METAL WOOD 246  BGT504+65-75   10/17/69                  CO-60         0.000E+00  2.500E-02

NRF618 S R 0 10/17/69  800    95  12       7.646E+00  4.536E+06  3.000E-02
O      1 270 F 010 METAL SCRAP      247  BGP10650E15SNW 10/20/69                  CO-60         0.000E+00  3.000E-02

NRF618 S R 0 10/20/69  800     5   1       5.777E+00  0.000E+00  9.000E-03
BXC  17   12 F 007 RAD WASTE NOS    248  BGT505+00-05   10/21/69                  MFP           0.000E+00  9.000E-03

NRF618 S R 0 10/20/69  810    15   3       5.098E-01  7.257E+06  2.000E+01
I      1  18 F 011 CORE+LOOP COMP.  249  BGT507+65      10/22/69                  CO-60         0.000E+00  2.000E+01

NRF618 S R 0 10/22/69  800   500  50       4.531E-01  7.257E+06  1.200E+04
I      1  16 F 011 CORE+LOOP COMP.  250  BGT507+40-45SN 10/23/69                  CO-60         0.000E+00  1.200E+04
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2. NO OFFICIAL INEL DOCUMENTS USE DATA FROM THIS DATA FILE.

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                                       RADIOACTIVE WASTE MANAGEMENT INFORMATION SYSTEM
                                          SOLID MASTER DATABASE (P61SH090) LIST FOR 1954 TO 1970      PAGE NO.  517

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O      1  175 F 009 CELITE          193  BGP10325E25NS2 08/29/69              UN-ID-B+G    0.000E+00  2.000E+00

NRF618 S R 0 08/26/69  810  2500 300     4.956E+00  0.000E+00  2.500E-01
O      1  175 F 019 EMPTY           219  BGP10335E85NS2 09/19/69              CO-60        0.000E+00  2.500E-01

NRF618 S R 0 08/27/69  800    70   5     3.823E+00  1.814E+06  7.000E-03
O      1  135 F 027 METAL COMP.     194  BGP10235E35NS2 08/27/69              UN-ID-B+G    0.000E+00  7.000E-03

NRF618 S R 0 08/27/69  810    40   4     5.437E+00  0.000E+00  8.000E-03
BXC  16   12 F 008 COMBUSTIBLES     195  BGT502+10-20   08/28/69              CO-60        0.000E+00  8.000E-03

NRF618 S R 0 08/27/69  820   100  10     5.777E+00  0.000E+00  1.400E-02
BXC  17   12 F 008 COMBUSTIBLES     196  BGT502+15-25   08/28/69              CO-60        0.000E+00  1.400E-02

NRF618 S R 0 08/29/69  800  5000 350     4.531E-01  1.179E+07  1.800E+04
I      1   16 F 011 CORE+LOOP COMP. 197  BGT508+35      08/29/69              UN-ID-B+G    0.000E+00  1.800E+04

NRF618 S R 0 08/29/69  810   250  75     1.699E+00  3.629E+05  2.500E-02
O      1   60 F 009 CELITE          198  BGP10335E25NS2 08/29/69              UN-ID-B+G    0.000E+00  2.500E-02

NRF618 S R 0 09/02/69  810    60   5     5.777E+00  0.000E+00  3.000E-02
BXC  17   12 F 007 RAD WASTE NOS    199  BGT502+30-35   09/02/69              UN-ID-B+G    0.000E+00  3.000E-02

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O      1   90 F 010 METAL SCRAP     200  BGP10550E90SNW 09/03/69              UN-ID-B+G    0.000E+00  1.000E-05

NRF618 S R 0 09/02/69  830   400  80     4.531E-01  0.000E+00  3.500E+03
I      1   16 F 028 UNIRRAD. FUEL   210  UNKN UNKN      09/11/69              MFP          0.000E+00  3.499E+03

                                                                              U-235        3.090E+00  6.613E-06

NRF618 S R 0 09/04/69  800    50  20     5.777E+00  0.000E+00  2.800E-02
BXC  17   12 F 003 PAPER METAL WOOD 201  BGT502+30      09/04/69              CO-60        0.000E+00  2.800E-02

NRF618 S R 0 09/04/69  810     7   1     5.777E+00  0.000E+00  1.000E-02
BXC  17   12 F 003 PAPER METAL WOOD 202  BGT502+50      09/05/69              CO-60        0.000E+00  1.000E-02

NRF618 S R 0 09/05/69  800   200   6     5.381E-01  1.179E+07  1.000E+03
O      1   19 F 027 METAL COMP.     203  BGT508+70      09/09/69              CO-60        0.000E+00  1.000E+03

NRF618 S R 0 09/08/69  810     5   2     5.777E+00  0.000E+00  9.000E-03
BXC  17   12 F 007 RAD WASTE NOS    204  BGT502+15-20   09/08/69              UN-ID-B+G    0.000E+00  9.000E-03

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2. NO OFFICIAL INEL DOCUMENTS USE DATA FROM THIS DATA FILE.
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SCHEDULE NO. OLDFOI                                                                          RUN DATE: 03/29/89
                                       RADIOACTIVE WASTE MANAGEMENT INFORMATION SYSTEM
                                          SOLID MASTER DATABASE (P61SH090) LIST FOR 1954 TO 1970      PAGE NO.  518

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NRF618 S R 0 09/09/69  800   100  20     9.940E+00  1.814E+06  1.000E-02
O      1  351 F 010 METAL SCRAP     206  BGP10317E50NS2 09/09/69              CO-60        0.000E+00  1.000E-02

NRF618 S R 0 09/09/69  810   200  10     5.381E-01  1.179E+07  1.000E+03
O      1   19 F 027 METAL COMP.     207  BGT508+70      09/10/69              CO-60        0.000E+00  1.000E+03

NRF618 S R 0 09/11/69  800   200  50     5.777E+00  0.000E+00  6.000E-02
BXC  17   12 F 003 PAPER METAL WOOD 208  BGT502+05-10   09/11/69              CO-60        0.000E+00  6.000E-02

NRF618 S R 0 09/11/69  810 10000 800     4.531E-01  7.257E+06  1.660E+03
I      1   16 F 011 CORE+LOOP COMP. 211  BGT508+30      09/12/69              CO-60        0.000E+00  1.660E+03

NRF618 S R 0 09/15/69  820    40   4     9.940E+00  1.814E+06  3.000E-02
O      1  351 F 010 METAL SCRAP     212  BGP10560E60SNW 09/15/69              UN-ID-B+G    0.000E+00  3.000E-02

NRF618 S R 0 09/15/69  830   400  40     5.777E+00  0.000E+00  1.330E-01
BXC  17   12 F 008 COMBUSTIBLES     213  BGT502+50-60   09/15/69              CO-60        0.000E+00  1.330E-01

NRF618 S R 0 09/15/69  840    30   3     5.777E+00  0.000E+00  4.000E-02
BXC  17   12 F 008 COMBUSTIBLES     214  BGT502+45-50   09/15/69              CO-60        0.000E+00  4.000E-02

NRF618 S R 0 09/15/69  850  3000 250     4.531E-01  1.179E+07  1.800E+08
I      1   16 F 011 CORE+LOOP COMP. 215  BGT508+15      09/15/69              UN-ID-B+G    0.000E+00  1.800E+08

NRF618 S R 0 09/16/69  800      0000     4.531E-01  1.179E+07  4.500E+04
I      1   16 F 011 CORE+LOOP COMP. 216  BGT508+20      09/16/69              UN-ID-B+G    0.000E+00  4.500E+04

NRF618 S R 0 09/16/69  810   800 100     1.133E+01  0.000E+00  6.000E-02
O      1  400 F 015 EVAP BOTTLES    229  BGP10592E50SNW 09/29/69              CO-60        0.000E+00  6.000E-02

NRF618 S R 0 09/17/69  800    15   1     4.531E-01  7.257E+06  7.500E+02
I      1   16 F 011 CORE+LOOP COMP. 217  BGT508+15      09/18/69              CO-60        0.000E+00  7.500E+02

NRF618 S R 0 09/17/69  810    50   5     1.133E+01  0.000E+00  5.000E-03
O      1  400 F 019 EMPTY           218  BGP10345E65NS2 09/19/69              CO-60        0.000E+00  5.000E-03

NRF618 S R 0 09/18/69  800    10   3     5.777E+00  0.000E+00  2.000E-02
BXC  17   12 F 007 RAD WASTE NOS    220  BGT502+65-75   09/18/69              UN-ID-B+G    0.000E+00  2.000E-02

1. DATA CONTAINED IN THIS LISTING ARE KNOWN TO BE INCOMPLETE AND CONTAIN INACCURATE NUCLIDE BREAKDOWNS.  ANY ATTEMPTS TO
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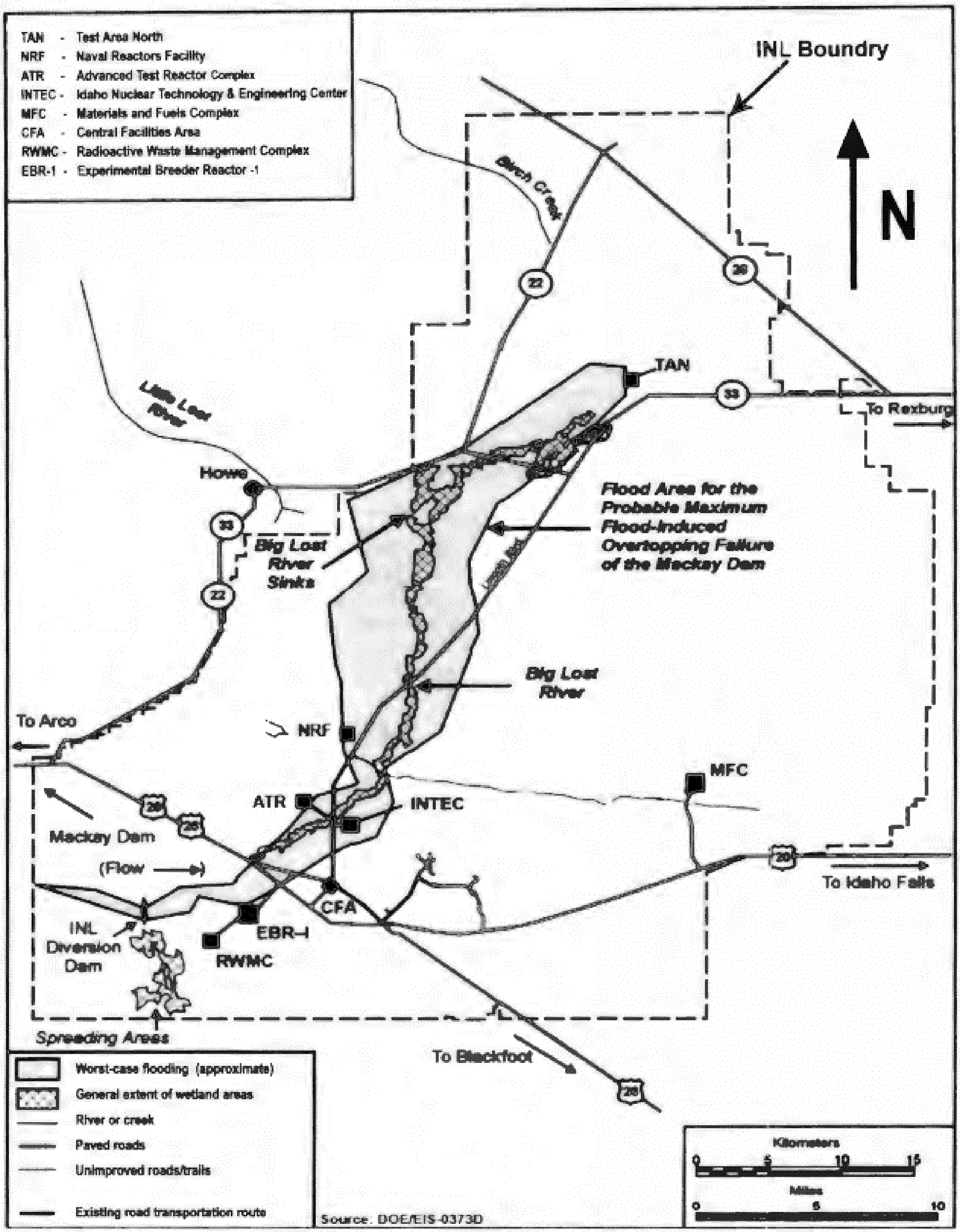

Figure 3.4-4: Surface Water Features, Wetlands, and Flood Hazard Areas at INL

Response to Comment Document #21

Item #21.1:

Comments on the location of the new Remote-Handled Low-Level Radioactive Waste disposal facility at the INL are outside the scope of this EIS.

The environmental assessment for the Remote-Handled Low-Level Radioactive Waste disposal facility, DOE 2011a, identified that the ten-acre footprint for the facility would be located outside of the 100, 500, 1,000, and 10,000-year floodplains. The figures in this EIS are consistent with DOE 2011a.

Item #21.2:

The list of radionuclides attached by the commenter is not based on naval spent nuclear fuel. The attached list is a summary of the NRF best-estimate radionuclide inventory in radioactive waste sent to the Radioactive Waste Management Complex (RWMC) Subsurface Disposal Area from 1953 through 1999. The commenter refers to a later table in his comments that contains both incorrect and superseded information. See the response to Item #21.13 which shows that NRF was not the largest contributor of waste to the RWMC. The most recent estimate of NRF radioactive waste disposed of at the RWMC is provided in ICP 2005. This document and other detailed information on the RWMC, including amounts and types of waste disposed, is available to the public at https://ar.icp.doe.gov. Historic disposal at the RWMC including the subsurface disposal area of the RWMC were previously evaluated and addressed through the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process which included opportunities for public comment. Comments on the history of disposal at the RWMC are outside the scope of this EIS

Item #21.3:

Comments on historic disposal at the RWMC are outside the scope of this EIS. See the response to Item #21.2.

Item #21.4:

INL has an extensive groundwater quality monitoring network maintained by the U.S. Geological Survey (USGS) and INL contractors. In addition, the Idaho Department of Environmental Quality (IDEQ) performs independent monitoring of air and groundwater on or near the INL and publishes these reports (IDEQ 2014). The IDEQ performs a comparison of the results of IDEQ monitoring to the results of the monitoring performed by and for the INL. IDEQ 2014 concluded:

> "In general, there is satisfactory agreement between the environmental monitoring data reported by DEQ and the DOE. This level of comparability between DEQ and DOE confirms that both programs present reasonable representations of the state of the environment surrounding the INL. This helps to foster public confidence in both the State's and DOE's monitoring programs and in the conclusions drawn from their monitoring."

Section 3.4.2 describes the groundwater quality in the Snake River Plain Aquifer on the INL. Groundwater monitoring has generally shown long-term trends of decreasing concentrations for radionuclides, and current concentrations are near or below EPA MCLs for drinking water and the sites where there is historic contamination are not used as sources for drinking water. IDEQ 2014 concludes that INL impacts to the aquifer are not identifiable in water samples collected from sites distant from the INL. Comments on historic disposal at the RWMC are outside the scope of this EIS. See the response to Item #21.2.

Item #21.5:

The commenter identifies no specific deficiencies in monitoring. The IDEQ conducts independent monitoring of both air and groundwater on or near the INL and publishes these reports (IDEQ 2014). The IDEQ performs a comparison of the results of IDEQ monitoring to the results of the monitoring performed by and for the INL. IDEQ 2014 concluded:

> “In general, there is satisfactory agreement between the environmental monitoring data reported by DEQ and the DOE. This level of comparability between DEQ and DOE confirms that both programs present reasonable representations of the state of the environment surrounding the INL. This helps to foster public confidence in both the State’s and DOE’s monitoring programs and in the conclusions drawn from their monitoring.”

Item #21.6:

DOE 2005a describes changes to the ECF Dry Cell Project and states that “process limitations identified with the Dry Cell Facility and the volume of naval spent nuclear fuel that must be processed and loaded into canisters for dry storage led Naval Reactors to the conclusion that continuation of fuel processing in water pools was more likely to support the objectives of the Idaho Settlement Agreement and support fleet operating schedules than dry fuel processing. Construction is continuing to implement canister loading and dry storage operations at production levels.” Construction of the Spent Fuel Packaging Facility is described in Section 1.1.4.

Item #21.7:

Refer to the response to Item #21.2.

As described in Section 1.1.3, non-fuel bearing structural material removed from naval spent nuclear fuel assemblies is designated as LLW and is sent to appropriate LLW disposal facilities such as the RWMC. The fuel bearing portions of naval spent nuclear fuel are placed in a naval spent nuclear fuel canister. The naval spent nuclear fuel canister is then loaded into a concrete overpack for dry storage until it can be shipped to an interim storage facility or a geologic repository.

Item #21.8:

The resizing operation described in Section 1.2 that is performed in the ECF water pool does not penetrate the naval spent nuclear fuel cladding or otherwise reduce the integrity of the naval spent nuclear fuel.

Item #21.9:

The commenter is referring to information in DOE 1995 and not this EIS.

See Chapter 12 for definitions of hazardous waste, high-level waste, low-level waste, mixed waste, and spent nuclear fuel, as used in this EIS.

Item #21.10:

NRF disposes of remote-handled LLW at the RWMC, which includes the ends of fuel modules removed at ECF. The ends of the fuel modules removed at ECF are made up of structural material which provides support within the reactor. This structural material is removed by cutting through portions of the fuel modules which contain no fuel. The source of the waste and the amounts of radioactivity in the structural material at the end of the modules require the waste to be designated as LLW.

DOE radioactive wastes are specifically managed in accordance with DOE Order 435.1, Radioactive Waste Management, which classifies radioactive wastes somewhat differently than regulations promulgated by the Nuclear Regulatory Commission (NRC) for commercial radioactive wastes. In particular, DOE LLW disposal requirements do not utilize the Class A, B, C, and Greater-than-Class-C distinctions made by the NRC. DOE LLW disposal is controlled by waste disposal acceptance criteria based on site-specific performance assessments and composite analysis. Specific management measures are prescribed for DOE LLW according to the type and quantity of radionuclides present, analogous to standards for disposal of commercial radioactive waste. The performance assessment and composite analysis conducted on the disposal facility provide the reasonable expectation that the performance objectives will be met by establishing parameters, limits and controls on the siting, design, operations, maintenance, and closure of the facility. The disposal of this structural material on the INL is accomplished in accordance with all applicable regulations.

Item #21.11:

Refer to the response to Items #21.2.

Item #21.12:

The commenter is quoting information in DOE1995; the cited information is not part of this EIS. Comments on the disposal of irradiated test specimens are outside the scope of this EIS.

Item #21.13:

The commenter included a table that cited EG&G-WM-10903; however, this report was superseded by INEL 1995. The list of radionuclides was not based on spent nuclear fuel. The table was a summary of the best-estimate radionuclide inventory in radioactive waste sent to the RWMC from 1952 through 1983. INEL 1995 Table 6-6 shows the following best estimate radioactivity totals.

Major Generator	Best Estimate (Ci)
Test Area North (TAN)	35,000
Test Reactor Area (TRA)	6,600,000
Idaho Chemical Processing Plant (ICPP now INTEC)	690,000
Naval Reactors Facility (NRF)	2,900,000
Argonne National Laboratory – West (ANL-W now MFC)	1,100,000
Rocky Flats Plant (RFP)	620,000
Other	49,000
Total	12,000,000

The most recent estimate of NRF radioactive waste disposed of at the RWMC is provided in ICP 2005. This document and other detailed information on the RWMC, including amounts and types of waste disposed, is available to the public at https://ar.icp.doe.gov. Historic disposal at the RWMC including the subsurface disposal area of the RWMC were previously evaluated and addressed through the CERCLA process which included opportunities for public comment. Comments on the history of disposal at the RWMC are outside the scope of this EIS..

Item #21.14:

The ECF water pool does not leak 16,000 gallons per day as alleged by the commenter, and there is no known leak to the environment. NRF closely compares water additions to the water pool with known evaporation rates to provide an indicator for a leak to the environment. Appendix F, Section F.5.4.12 states that additions to the water pool are about 150 gallons of water per day to compensate for evaporation. The 150 gallons per day of make-up water is consistent with expected losses due to evaporation based on the surface area of the pool and facility humidity levels. The average amount of make-up water has been consistent over many years.

Section 1.3 identifies that an updated seismic analysis of the ECF water pool reinforced concrete structures and adjacent building shell superstructure concluded that the reinforced concrete portion of the water pools and adjacent building superstructure meet the seismic strength requirements of DOE 2002b for a Performance Category 3 structure. Sample results from the NRF environmental monitoring program continue to demonstrate that operations at NRF are protective of human health and the environment.

Item #21.15:

The commenter is quoting information in DOE 1995; the cited information is not part of this EIS. Comments on DOE 1995 are outside the scope of this EIS.

Item #21.16:

Section 1.3 identifies that an updated seismic analysis of the ECF water pool reinforced concrete structures and adjacent building shell superstructure concluded that the reinforced concrete portion of the water pools and adjacent building superstructure meet the seismic strength requirements of DOE 2002b for a Performance Category 3 structure. Section 4.3 describes DOE seismic design requirements and assessments of the seismic hazard for all alternatives.

Item #21.17:

The commenter is quoting information in DOE 1995; the cited information is not part of this EIS. Comments on DOE 1995 are outside the scope of this EIS. Section 4.3 describes DOE seismic design requirements and assesses the seismic hazard for all alternatives.

Item #21.18:

Refer to the response to Item #21.6.

Item #21.19:

The described event did not occur. The cited occurrence is similar to an event that took place during unloading a shipping container in 1993. Exposure estimates were performed based on radiation surveys when work was secured, workers' positions during the event, and an engineering evaluation of the fuel module movement as well as its radiation profile. This information along with the workers' time in each location formed the basis for the exposure estimates. The highest calculated doses attributed to this event were 0.009 rem whole body and 0.022 rem extremity dose to the feet and ankles, well below Naval Reactors whole body exposure limits of 5 rem per year and 3 rem per quarter. Improvements to equipment, improved worker training, and strict compliance with procedures prevent recurrence of this event.

As described in Section 1.1.3, naval spent nuclear fuel assemblies are removed from the shipping containers one at a time and lowered into the water pool using a shielded fuel handling machine. Subsequent handling of the naval spent nuclear fuel is conducted underwater until the fuel is loaded into naval spent nuclear fuel canisters. The commenter's suggestion to perform unloading of naval spent nuclear fuel shipping containers under water is not practical for M-140 and M-290 shipping containers since the external surface of these shipping containers must be maintained radiologically clean to promptly return the shipping container to a naval shipyard for further use.

Item #21.20:

The ECF water pools are maintained in a safe and environmentally responsible manner. Although not frequently performed, the ECF water pools can be isolated if needed.

Item #21.21:

Refer to the response to Items #21.2 and #21.10.

Item #21.22:

Based on this comment and Comment #3.3, Section 1.1.2 has been updated to provide additional unclassified information on naval spent nuclear fuel.

Section 1.1.4 includes detailed information on naval spent nuclear fuel management at NRF, including a description of facilities where these activities are performed. The environmental impacts from management of naval spent nuclear fuel for all alternatives is summarized in Section 2.6 and these impacts are negligible or small. Comparisons to other conventional low-enriched reactor fuel is outside the scope of this EIS.

Item #21.23:

Refer to the response to Items #21.2 and #21.10.

Item #21.24:

Refer to the response to Item #21.10.

Concentration averaging is allowed by DOE disposal requirements and these allowances are similar to NRC allowances provided in NRC 2015. Prior to shipping any LLW to a disposal site, the NNPP performs detailed characterization to ensure that the waste meets all applicable requirements including applicable disposal site license and waste acceptance criteria.

Item #21.25:

Refer to the response to Item #21.2.

Item #21.26:

Refer to the response to Item #21.2

Item #21.27:

These comments are not applicable to NRF operations. Various aspects of the NRF Site environmental program are independently reviewed by other government agencies. A complete listing of inspections performed since 2005 at NRF by State of Idaho or federal agencies is provided in Table 7.0-1. No significant item of non-compliance in operations has been cited as a result of these inspections.

Item #21.28:

Comments on the NRF Waste Area Group 8 CERCLA remedial action plan are outside the scope of this EIS. This comment was previously addressed in the Response to Comment 9 in IDEQ 1998.

Item #21.29:

Comments on the NRF Waste Area Group 8 CERCLA remedial action plan are outside the scope of this EIS. This comment was previously addressed in the Response to Comment 11 in IDEQ 1998.

Item #21.30:

Comments on the NRF Waste Area Group 8 CERCLA remedial action plan are outside the scope of this EIS. This comment was previously addressed in the Response to Comment 12 in IDEQ 1998.

Item #21.31:

Comments on the NRF Waste Area Group 8 CERCLA remedial action plan are outside the scope of this EIS. This comment was previously addressed in the Response to Comment 13 in IDEQ 1998. Section 3.4.1.3 in this EIS discusses NRF sewage lagoons.

Item #21.32:

Comments on the NRF Waste Area Group 8 CERCLA remedial action plan are outside the scope of this EIS. This comment was previously addressed in the Response to Comment 15 in IDEQ 1998.

Item #21.33:

Comments on the NRF Waste Area Group 8 CERCLA remedial action plan are outside the scope of this EIS. This comment was previously addressed in the Response to Comment 17 in IDEQ 1998.

Item #21.34:

Comments on the NRF Waste Area Group 8 CERCLA remedial action plan are outside the scope of this EIS. This comment was previously addressed in the Response to Comment 20 in IDEQ 1998.

Item #21.35:

Comments on the NRF Waste Area Group 8 CERCLA remedial action plan are outside the scope of this EIS. This comment was previously addressed in the Response to Comment 21 in IDEQ 1998.

Item #21.36:

Comments on the NRF Waste Area Group 8 CERCLA remedial action plan are outside the scope of this EIS. This comment was previously addressed in the Response to Comment 22 in IDEQ 1998.

Item #21.37:

Refer to the response to Item #21.2.

Item #21.38:

Refer to the response to Item #21.2.

Item #21.39:

The commenter makes an incorrect explanation of the difference between two quantities of naval spent nuclear fuel described at this meeting. The 65 metric tons referred to the total amount of capacity at the geologic repository that was set aside for naval spent nuclear fuel. The 25 metric tons referred to the amount of naval spent nuclear fuel at INL at the time of the presentation in 2010.

Comment Document #22

Comments on Recapitalization of Infrastructure Supporting Naval Spent Fuel Handling at the INL

1 message

Tami Thatcher <[redacted]>
To: ecfrecapitalization@unnpp.gov

Mon, Aug 10, 2015 at 2:39 PM

Please find my attached comments for draft DOE/EIS-0453D, Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the INL.

Thank you,

Tami Thatcher

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Comments on the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory, draft DOE/EIS-0453D

Submitted August 10, 2015 by E-Mail: ecfrecapitalization@unnpp.gov

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These are comments on the Recapitialization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory in draft DOE/EIS-0453D. I am in favor of Alternative 3 to construct and operate a new facility at the Naval Reactors Facility (NRF) located at the Department of Energy's Idaho National Laboratory.

22.1

It is important to replace the leaking unlined original Expended Core Facility pool built in 1957. The Naval Reactors Program, a joint US Navy and Department of Energy organization, is to be commended for their diligent efforts to transfer their spent nuclear fuel to dry storage and make it ready for shipment to a repository. This is a long and expensive process that unfortunately the Department of Energy and commercial nuclear energy industry have not made similar progress.

1. **NRF non-military employees are excluded from EEOICPA coverage with a faulty rationale and this egregious exclusion must be removed.**

In 2000, Congress passed the Energy Employees Occupational Illness Compensation Program Act (EEOICPA) to provide an alternative Federal compensation program for workers whose health was impacted as a result of nuclear weapons related work for Department of Energy contractors. [1] The EEOICPA generally covers contractors and Department of Energy employees, as designated by the Secretary of Energy, who worked in facilities that processed or produced radioactive material for use in the production of atomic weapons. But NRF workers, predominantly non-military workers, have been excluded from this compensation.

22.2

Facilities at NRF had conducted diverse operations with the large potential for inadequately monitored overexposure. The operations have included reactor operation and fuel dissolution, and will still include spent fuel pool operation, transfers of spent fuel to pool and examination areas and airborne contamination from resizing or cutting of irradiation material. The potential for elevated airborne contamination or unplanned loss of shielding has created inadequately monitored and controlled radiation exposures at Department of Energy facilities including those at INL.

The intent to protect workers has not always coincided with effective radiological protection of workers or adequate understanding of health effects. Experience at similar INL facilities, often

[1] 42 USC 7384, The Act--Energy Employees Occupational Illness Compensation Program Act of 2000 (EEOICPA), as Amended and see the website for the Center for Disease Control, National Institute of Occupational Safety and Health, Division of Compensation Analysis and Support at http://www.cdc.gov/niosh/ocas/ and U.S. Department of Labor, Office of Workers' Compensation Programs, EEIOCPA Program Statistics, http://www.dol.gov/owcp/energy/regs/compliance/weeklystats.htm

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with management personnel having extensive naval nuclear background, has shown a multitude of issues and new issues continue to arise. Transient conditions within hot cells and transfers of material to and from hot cells, undetected penetrations of hot cells or casks, inadequate lineup of shielding during transfers, and inadequately shielded filters have occurred at INL Department of Energy facilities: why would they not have occurred at NRF through its historical operations?

Inadequate internal monitoring programs at INL historically have been found in 2015 by investigations conducted by the National Institute of Occupational Safety and Health because of the most recent INL Special Exposure Cohort petition. Inadequate radiological protection has been found from 1963 to 1975 at the Chemical Processing Plant (now INTEC) and other facilities are being reviewed.

22.3 Section 4.13.2.1 of the EIS states: "No one in the NNPP [includes NRF] has exceeded 0.02 Sievert (2 rem) of radiation exposure in 1 year (less than half the annual limit of 5 rem) since 1979." That the radiation levels prior to 1979 exceeded this, and the fact that Department of Energy employee studies have found increased levels of certain cancers for workers exposures generally below 2 rem per year is relevant. The Energy worker compensation act (EEOICPA) points out that "studies indicate than 98 percent of radiation-induced cancers within the nuclear weapons complex have occurred at dose levels below existing maximum safe thresholds." (See 42 USC 7384, The Act-Energy Employees Occupational Illness Compensation Program Act of 2000 (EEOICPA), as Amended.)

NRF workers are excluded from EEOICPA compensation "because of the effectiveness of Naval Reactors' worker protection, worker training, and workplace monitoring programs, employees who performed Naval Reactors' related work at Naval Reactors' Department of Energy facilities . . . As discussed earlier, the GAO reported to Congress in 1991 that 'Naval Reactors Laboratories are accurately measuring, recording, and reporting radiation exposures,' and 'exposures have been minimal and overall are lower than commercial nuclear facilities and other Department of Energy facilities.' This longstanding record of effectiveness supports the conclusion by Congress that workers at Naval Reactors' Department of Energy facilities did not need the compensation alternatives created for workers in the nuclear weapons complex by the EEOICPA." [2]

22.3 (cont.) The historically high allowable doses at NRF, the variety and complexity of operations at NRF, the problems of adequately monitoring internal dose and transient conditions, and the evolving science of radiation health [3] and epidemiology of radiation workers [4] showing elevated cancer

[2] Naval Nuclear Propulsion Program, Office of Naval Reactors, "Occupational Radiation Exposure from Naval Reactors' Exposure from Naval Reactors' Department of Energy Facilities," Report NT-113, Mary 2011. http://nnsa.energy.gov/sites/default/files/nnsa/02-12-multiplefiles/NT-11-3%20FINAL.pdf

[3] Kohnlein,W, PhD., and Nussbaum, R. H., Ph.D., "False Alarm or Public Health Hazard?: Chronic Low-Dose External Radiation Exposure, Medicine & Global Survival, January 1998, Vol. 5, No. 1. http://www.ippnw.org/pdf/mgs/5-1-kohnlein-nussbaum.pdf

[4] "An Epidemiology Study of Mortality and Radiation-Related Risk of Cancer Among Workers at the Idaho National Engineering and Environmental Laboratory, a U.S. Department of Energy Facility, January 2005. http://www.cdc.gov/niosh/docs/2005-131/pdfs/2005-131.pdf and http://www.cdc.gov/niosh/oerp/ineel.htm and Savannah River Site Mortality Study, 2007. http://www.cdc.gov/niosh/oerp/savannah-mortality/

risks at annual doses less than 2 rem per year point to the unsupportable rationale for excluding NRF workers from compensation. Although it would in many cases be decades late, and the compensation will never compensate for the early deaths of fine people, this exclusion must be removed. **By any measure of fairness and honest assessment, the exclusion of NRF workers from EEOICPA act compensation must be removed.**

2. **NRF Has a Long History of Burying its Radioactive Waste Over the Snake River Plain Aquifer and This Must Stop.** Waste Management (Section 3.14)

Analyses by the Department of Energy predict the eventual migration of radionuclide contamination into the soil and then aquifer from buried waste at the Radioactive Waste Management Complex (RWMC). [5] NRF waste buried at RWMC is not being removed. Future burial of NRF and other INL facility waste, some of which supports NRF operations, planned for the replacement for RWMC, the Replacement Low-Level Waste Disposal facility provide significant and virtually unending contamination of the aquifer. [6]

Historically poor record keeping was conducted with regard to the amount and type of radionuclide material buried from NRF. For many years the Department of Energy placed no limits on curie content or radionuclide inventory in its burial grounds, the RWMC. NRF wastes included significant quantities of spent nuclear fuel material from experiments and from the Shippingport spent nuclear fuel examinations (from the 1960 and continuing into the 1980s) that were buried shallowly at the RWMC. Because of the CERCLA cleanup at RWMC, efforts have
22.4 been made decades later to estimate radionuclides and curie amounts of material buried at RWMC in order to conduct waste migration studies. [7] It also is worth noting that significant aquifer contamination occurred due to fuel reprocessing at INTEC [8] in support of naval reactors programs.

The radionuclides buried at RWMC include the same radionuclides that pose the greatest concern for migration from a spent nuclear fuel repository. The radionuclides buried at RWMC include very long-lived and mobile radionuclides of carbon-14 (5,730 year half life), iodine-129 (17 million year half life), technetium-99 (213,000 year half life), nickel-59 (76,000 year half life) and uranium-238 (4.4 billion year half life). The DOE's performance assessments for disposal of these radionuclides show that they will migrate to the aquifer in significant amounts

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[5] U.S. Department of Energy, 2008. Composite Analysis for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site. DOE/NE-ID-11244. Idaho National Laboratory, Idaho Falls, ID and U.S. Department of Energy, 2007. Performance Assessment for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site. DOE/NE-ID-11243. Idaho National Laboratory, Idaho Falls, ID. Available at INL's DOE-ID Public Reading room electronic collection. (Newly released because of Environmental Defense Institute's Freedom of Information Act request.) See https://www.inl.gov/about-inl/general-information/doe-public-reading-room/

[6] US Department of Energy, "Environmental Assessment for the Replacement Capability for Disposal of Remote-Handled Low-Level Radioactive Waste Generated at the Department of Energy's Idaho Site," Final, DOE/EA-1793, December 2011. http://energy.gov/sites/prod/files/EA-1793-FEA-2011.pdf

[7] Idaho Completion Project, Bechtel BWXT Idaho, LLC, for the US Department of Energy, Idaho Operations Office, "Supplement to Evaluation of Naval Reactors Facility Radioactive Waste Disposal at the Radioactive Waste Management Complex from 1953 to 1999," ICP/EXT-05-00833, April 2005.

[8] Idaho Nuclear Technology and Engineering Center (INTEC), formerly the Chemical Processing Plant (CPP).

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for hundreds of thousands of years, see DOE/NE-ID-11243 which DOE kept from public view until 2015 upon Freedom of Information Act request.

The CERLCA cleanup effort is focused on removing the most chemically contaminated waste. [9] The amount of Rocky Flats weapons plant transuranic waste that is being cleaned up is unspecified. Less than 6 acres of the 35 acre burial ground are being exhumed. So a small fraction of buried transuranic waste from Rocky Flats weapons plant is being exhumed, but none of the waste buried from NRF or the Advanced Test reactor or other facilities is being exhumed.

The performance assessment for RWMC predicts that the radiation ingestion dose for hundreds of thousands of years near the waste dump will reach the DOE limit of 100 mrem/yr unless the engineered soil cap over the dump is assumed to perform flawlessly, limiting infiltration to 0.1 cm/yr. In the case of perfect soil cap performance, the ingestion dose is about 30 mrem/yr. No other organization deems it reasonable to rely on maintenance of a soil cap forever and five-year-reveiws forever; but it is an accepted tri-agency fiction among the DOE, Idaho Department of Environmental Quality, and the EPA for the RWMC burial ground at INL.

The population dose from the contamination due to migration of radionclides to the aquifer is unspecified. For such expansive time frames because of the large amounts of very long-lived and mobile radioactive contamination, speculation of the number of affected people has not been provided as it is for other radiological releases.

22.5 The new replacement disposal facility use of metal canisters may alleviate some of the surface contamination and subsidence (soil erosion and uneven settling problems) that occur at RWMC, but it still is acknowledged that the radionuclides will eventually migrate into the soil and to the aquifer. The amount of radionuclides to be buried in the replacement for RWMC, the Replacement Remote-handled Low-Level Waste Disposal facility is significant and approaches or exceeds Greater-Than-Class C inventory limits for some of the contaminants.

In both the analysis of RWMC and of the new replacement for RWMC, the analysis assumptions of steady infiltration and leaching keep the doses artificially steady and low. Episodic flooding is known to occur and would increase migration rate and radiation doses but has been assumed not the occur for hundreds of thousands of years.

22.6 Inconsistencies in various buried waste studies at INL are not random — they result from pressure to lower the radiation ingestion doses from the most prevalent source of contamination. More plutonium at RWMC? No problem, just raise the assumed soil sorbing coefficient. The various assumed parameters such at the soil coefficient for soil sorbing properties are adjusted by arguing whatever value selected is reasonable and conservative. Yet the variability in the soil coefficients from study to study for the Department of Energy is quite large. [10] The resulting

[9] See the CERCLA administrative record at www.ar.icp.doe.gov (previously at ar.inel.gov) and see also Parsons, Alva M., James M. McCarthy, M. Kay Adler Flitton, Renee Y. Bowser, and Dale A. Cresap, Annual Performance Assessment and Composite Analysis Review for the Active Low-Level Waste Disposal Facility at the RWMC FY 2013, RPT-1267, 2014, Idaho CleanupProject.

[10] Idaho National Laboratory, "Explanation of Significant Differences Between Models Used to Assess Groundwater Impacts for the Disposal of Greater-Than-Class C Low-Level Radioactive Waste and Greater-Than-Class-C-Like Waste Environmental Impact Statement (DOE/EIS-0375D) and the Environmental Assessment for the

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analyses for predicted buried waste facility performance are inconsistent. The analysis results are not conservative but are based on best estimate (mean or median values) of radionuclide inventory and other factors and so the radiation ingestion doses may be significantly higher than stated for a variety of reasons. The analyses for the buried waste migration over millennia have assumed there will be no episodic flooding and there will be no geologic instability: these studies are scientifically indefensible, despite the mathematical modeling complexity involved in their derivation.

The Department of Energy has continued to obscure from public view the predicted future levels of contamination, the continual migration of these contaminants to Thousand Springs and beyond and the thousands of years that the waste will continue migration to the aquifer. It kept the performance assessment of RWMC from being publically available until 2015 upon Freedom of Information Act request. The CERLCA cleanup documents made deceptive and misleading statements regarding the level of contamination after 10,000 years. The analysis gyrations and inconsistencies from study to study have been made in order to bias the results toward lower radiation ingestion results. Seemingly scientific, these studies show that radionuclide contaminants will migrate to the aquifer. But the assumptions built into the models regarding the rate and steadiness of this migration are a charade, a show made to provide studies that look scientific and protective of health when they are not.

The low-level waste from NRF and other INL facilities slated for burial over the Snake River Plain aquifer can be shipped out of Idaho to an operating low-level waste facility in Nevada. NRF needs to stop its burial practices over our aquifer especially in light of years of aquifer contamination it has caused and will cause with waste it has already buried.

22.7 3. **All Spent Nuclear Fuel at INL Needs to Made Road Ready.** Unfortunately the Department of Energy has not made similar progress for ensuring the capability for packaging non-Naval spent nuclear fuel at the INL — to make it road ready to a repository or repackage if a repository is delayed.

The mission need statement from 2007 stated that "The capability that is required to prepare Spent Nuclear Fuel for transportation and disposal outside the State of Idaho includes characterization, conditioning, packaging, onsite interim storage, and shipping cask loading to complete shipments by January 1,2035. These capabilities do not currently exist in Idaho." [11]

The Department of Energy's 2015 Supplement Analysis for bringing two proposed shipments of spent nuclear fuel into Idaho argues that there are no impediments to sending the spent nuclear fuel to the Yucca Mountain Repository. Yet, the Department of Energy has not put planning, schedules and a budget together regarding building the facility to inspect, package and make non-Naval spent nuclear fuel road ready in order to meet the 1995 Idaho Settlement Agreement.

INL Remote-Handled Low-Level Waste Disposal Project (INL/EXT-10-19168)," INL/EXT-11-23102, August 2011. http://www.inl.gov/technicalpublications/documents/5144355.pdf and a report prepared for the US Department of Energy, DOE Idaho Operations Office, "Preliminary Review of Models, Assumptions, and Key Data Used in Performance Assessments and Composite Analysis at the Idaho National Laboratory," INL/EXT-09-16417, July 2009. See p. 11, Tables 3 and 4 for sorption coefficients.

[11] Department of Energy, Mission Need Statement: Idaho Spent Fuel Facility Project, DOE/ID-11344, September 2007. http://www5vip.inl.gov/technicalpublications/Documents/3867685.pdf

Candid discussion is needed now regarding the Department of Energy on the repackaging capability and ability to make non-naval spent nuclear fuel at INL road ready instead of simply pointing to various statements about INL being the lead laboratory for DOE spent nuclear fuel ——although apparently unfunded in this regard since 2009 or being the lead nuclear research laboratory —but discussing a "transshipment" facility as though conditional upon Idaho allowing additional commercial nuclear spent fuel into the state.

4. **Drinking Water History Discussion Lacking Complete Disclosure of Historical Monitoring Deficiencies and Contamination Levels.** Water Resources (Section 3.4) and Land Use Adjacent to INL (Section 3.1)

The description of drinking water standards omits the fact that due to the non-community well loop hole for drinking water regulations, the State of Idaho, per the Department of Energy's request, does not provide radionuclide sample results by independent certified laboratory to the State of Idaho and the State of Idaho does not make publically available radionuclide monitoring results on its publically available database. Only chemical monitoring of INL drinking water is overseen by the State of Idaho Department of Environmental Quality.

The Department of Energy has historically adopted its own far more lax contaminant level guidelines for its facilities and not disclosed to workers the monitored contaminant levels. There is a lack of public disclosure of the current and historical radionuclide contaminant levels in INL drinking water including the drinking water at NRF. Workers remain uninformed of the level of contaminants in their drinking water even for years when federal maximum contaminant levels have been exceeded. Other state environmental departments recognize that federal maximum contaminant levels are not necessarily protective of health and even the Department of Energy recognized this in the early years until they came to realize that they were exceeding them. Since then, the posture is to act as though any combination of chemical and radionuclide contaminants in drinking water is of no concern as long as individually they are under the federal maximum
22.8 contaminant level. The chemical and radionuclide contamination of INL drinking water has exceeded MCL levels historically, especially prior to chemicals being monitored in the last 1980s. Radionuclide monitoring has been spotty and has not covered all of the years that contamination was present. Contaminated drinking water may explain the epidemiology reports for the INL that found specific cancers to be elevated at INL for radiation and non-radiation workers.

Historical contamination of INL drinking water commenced in the early 1950s and monitoring of contaminants often lagged by decades. When nuclear operations were releasing large amounts of airborne contamination, the US Geological Survey ceased aquifer monitoring at INL from NRF to TAN between roughly 1965 and 1975. The EIS has obscured this by presenting only an average contamination level from past operations.

It is a reminder that the US Geological Survey monitors what wells it chooses and what contaminants it chooses to monitor and this does not necessarily serve for trending or public protection. Contamination levels off site at Mud Lake that exceeded federal drinking water standards were included in reports that the USGS now says were in error. Tritium levels in the Mud Lake well in 1966 clearly exceeded the MCL at 93,000 pCi/L and yet it appears the public was never told. Publication in a report 20 years later, in 1984, also does not seem adequate (USGS Report 84-714) [12] It does appear that the levels of tritium occurred but not for a different well in the Mud Lake area. Tritium levels offsite the exceeded the federal maximum contaminant level for tritium went unexplained by the USGS for decades.

The monitoring performed and the contaminant levels measured need to be provided for NRF even though it was comparatively low to other INL facilities. Historical averaging of well water contamination levels may be convenient, as provided in Table 3.4-6, but it obscures the years when monitoring was absent or addressed an incomplete set of contaminants. And it obscures peak values. Again, unexplained lapses of USGS monitoring have occurred at NRF. USGS monitoring for radionuclides has been spotty at best. Many long-lived radionuclides present in the aquifer were not monitored until the 1990s and then not reported by USGS. [13] And USGS monitoring of chemical contaminants was non-existent until the late 1980s. In the perennial effort to give the impression of rigorous monitoring, the Department of Energy and Naval Reactors are self-serving in the lack of clarity concerning past monitoring program deficiencies and actual contaminant levels present, monitored or not.

5. **Sketchy Picture of Historical Air Emissions.** Affected Environment Air Quality (Section 3.6)

Air emissions results presented by radionuclide and curie amount in the ESER reports is information that needs to be publically available. But the ESER reports are only available since 1995 (quarterly reports) and 1997 (annual reports). Health impact is not adequately represented by curie amounts: a curie of plutonium-239 is 10,000,000 greater than a curie of Krypton. Radiation dose in typically performed for INL at Frenchman's cabin, many miles away from the facilities. Information in the ESER reports for radiological air emissions is based on DOE-provided information, which are largely unverified estimates rather than measurements.

22.9 Despite the limited air monitoring by Idaho Department of Environmental Quality and ESER, there is actually no independence of data regarding the total amounts released from INL facilities. Even for data transmitted to ESER from the DOE, ESER has made mistakes in reporting the information in its tables. I reported errors I found in the 2013 ESER report that included understatement of the total plutonium air emissions by a significant amount. They have corrected the report but have not publically admitted that the originally posted report was in error. As troubling as the lack of independent data and errors in presented data are, equally troubling is the bias toward downplaying the air emissions. These oversight organizations seem lack a questioning attitude and DOE emphasizes that the state does not regulate radionuclide emissions.

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[12] US Geological Survey, *Water-Quality Data for Selected Wells On or Near the Idaho National Engineering Laboratory, 1949 through 1982*, Report 84-714, June 1985. http://pubs.usgs.gov/of/1984/0714/report.pdf See USGS well 14 and the Mud Lake well for tritium (H-3) spikes. Multiply picocurie/milliliter (pCi/mL) by 1000 to convert to picocurie/Liter (pCi/L). The MCL for tritium is 20,000 pCi/L.

[13] T. M. Beasley, P. R. Dixon, and L. J. Mann, ^{99}Tc, ^{236}U, and ^{237}Np in the Snake River Plain Aquifer at the Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, Environ. Sci. Technol., 1998, 32, 8375-3881.

The stated INL air emissions are largely based on estimates rather than stack monitoring data and there is apparently no independent technical review of the estimation methods. The technical documents of the estimation are not available publically. There is little evidence of adequate review of monitoring equipment placement based on emission source. ESER and Idaho Department of Environmental Quality display a bias toward downplaying the releases rather than scrutinizing whether adequate monitoring, estimation techniques and monitoring is in place. And this was recognized in a Department of Energy Health and Safety (HSS) independent oversight assessment in 2010. [14]

Historical air emissions from INL as discussed in the 1991 INEL Historical Dose Evaluation (DOE/ID-12119). Emissions were ambiguously documented as "unidentified beta and gamma" or "unidentified alpha." Because of the inadequate monitoring from the 1950s to the 1970s and beyond, and inadequate technical estimation of the air emissions, extensive efforts were made to try to characterize the identity of the radionuclides released and their curie amounts based on assumed fuel composition and release mechanism. Only the large NRF release from destructive fuel tests of the S1W reactor were included as episodic releases in the 1991 HDE. These 1991 HDE estimates which focused on the off-site public remain flawed and are not adequate to address historical worker exposures. The primitive nature of INL monitoring and reporting of emissions for years should re-emphasize the false argument for excluding NRF workers from EEOICPA compensation act coverage.

6. **Accident Radiation Consequences are Not Conservative.** Accidents (Appendix F)

22.10 The case for the new facility could have been made stronger had the real leak rate from the now-operating ECF been communicated.
22.11 Remaining unstated is the time allowable to restore cooling in a pool draining event with the EIS stating only that: "thermal analysis for a new naval spent nuclear fuel rack design will show that heat dissipation largely from air circulation, is sufficient to prevent cladding failure ***for the time necessary*** to restore cooling."

22.12 It is problematic that this EIS has separated ECF from examination facilities as this allows some accident scenarios to be excluded from this EIS. Excludes from its risk assessment the transportation of irradiated test specimens to and from the Advanced Test Reactor Complex. This is 5 miles away and would have been appropriate to include fire and loss of shielding of an irradiated test specimen. Worker radiation risks within 100 meters can be occur more rapidly than pool draining and can be lethal.

22.13 The EIS includes "inter-facility transport" only, being between the new ECF pool and examination facilities. It deems an inter-facility transport accident at only being caused by an intentionally destructive act but does not assess whether a loaded transport cask is ever parked, for example in a building in which case the likelihood of a fire in a building can readily be assigned a likelihood of occurrence. Driving error by hour of driving (by inattentiveness of a health crisis of the driver (heart attack or bee sting) could be assessed based on driver accident statistics. The conclusion deeming an accident as only possible due to intentional act is not

[14] http://www.hss.doe.gov/IndepOversight/docs/reports/eshevals/2010/2010_INL_Environmental_Monitoring_final_May2010.pdf

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22.14 sufficiently supported. It would seem that an unplanned loss of shielding relevant to worker exposure should be addressed for inter-facility transport.

22.15 The overall perspective of NRF's relatively low accident risk (likelihood and consequence) leaves unstated the much higher risk posed by NRF's supporting facility for irradiation tests, the Advanced Test Reactor. An accident at the ATR reactor or spent fuel pool has been predicted to have a far greater foot print, a characterization never made for the higher hazard facility, although it poses large offsite consequences. The evacuation needs for ATR may extend beyond 65 miles. [15]

22.16 The EIS states: "The ICRP recommendations for health effects and radiation effects have been updated based on more recent scientific and technical knowledge than was available in 1995. Conversion factors for health effects based on ICRP Publication 103 (ICRP 2007) guidance replace the ICRP Publication 60 (ICRP 1991) values for cancer fatalities used in 1995. The fatal cancer effects calculated in this EIS are a conservative estimate of cancer fatalities, and the use of this factor to estimate the incidence of fatal cancer is different from the methodology used in 1995." However, more recent report of radiation health effects that predict an increased level of cancers is available in the BEIR VII report. The Department of Energy needs to use more recent provides scientific assessment by the National Research Council and includes the estimates of both cancer incidence and cancer fatalities. [16]

Also in Appendix F: "Information on the effects of acute radiation exposures on humans was obtained from studies of the survivors of the Hiroshima and Nagasaki bombings and from studies following a multitude of acute accidental radiation exposures." The multitude of problems associated with the acute gamma radiation dose from the WWII bombing studies have long been recognized and include the facts that the study was not initiated until 5 years after the bombing and the location of exposed people had to be estimated years after the event. Only the healthiest individuals survived the first five years. Then, manipulations of the model were made in order to reduce the effect of radiation exposure. Internal contamination was present but occurred in both the bomb-exposed cohort and comparison population that returned to the bombed city. Internal radiation effects are inadequately represented by the study of WWII Japanese bombing.

The Department of Energy's inclination to rely on out-of-date radiation health information would be acceptable if the old information conservatively estimated health risks. But it does not. The DOE's used of out-of-date radiation health information provides convenience for the nuclear industry but is not adequately protective of public or worker health.

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[15] EHA-50, "Emergency Management Hazards Assessment" for TRA-670, Advanced Test Reactor Building, January 2010.

[16] National Research Council, Board on Radiation Effects Research (BRER), Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2. Washington, D.C.: The National Academies Press, 2006

Response to Comment Document #22

Item #22.1:

The commenter's support for the preferred alternative is noted.

Item #22.2:

The Energy Employees Occupational Illness Compensation Program Act (EEOICPA) is outside the scope of this EIS. Details about NRF and Naval Reactors participation in the EEOICPA are discussed in NNPP 2015 available at http://nnsa.energy.cog/ourmission/poweringnavy/annualreports.

In 2000, Congress passed the EEOICPA to provide an alternative Federal compensation program for workers whose health was impacted as a result of nuclear weapons related work for DOE contractors. The EEOICPA generally covers contractors and DOE employees, as designated by the Secretary of Energy, who worked in facilities that processed or produced radioactive material for use in the production of atomic weapons. Because of the effectiveness of Naval Reactors' worker protection, worker training, and workplace monitoring programs, employees who performed Naval Reactors' related work at Naval Reactors' DOE facilities were not included in the EEOICPA. Irrespective of the applicability of the EEOICPA, personnel who believe they have received an occupational injury may file claims. The personnel who operate Naval Reactors' DOE facilities are employees of corporations operating facilities under contract to the DOE. These personnel can file claims under state workmen's compensation laws. The claim may be handled through the contractor's insurance carrier or adjudicated by an administrative law judge. Either the employee or the contractor may appeal the judge's decision. In any case, the NNPP would support any claim for radiation injury where it could be technically and scientifically shown that the injury was more likely than not caused by the individual's occupational radiation exposure from the NNPP.

There have been a total of six claims filed for injury from radiation associated with Naval Reactors' DOE facilities. Of these claims, one was awarded and five have either been denied or deferred.

The NNPP radiological control program includes checks and cross-checks, audits, and inspections of numerous kinds to ensure the high standards of the NNPP radiological control program are maintained. The General Accounting Office (GAO) performed a 14-month in depth review of various aspects of Naval Reactors DOE facilities including occupational exposure monitoring. The GAO reported to Congress in 1991 that "Naval Reactors Laboratories are accurately measuring, recording, and reporting radiation exposures," and "exposure have been minimal and overall are lower than commercial nuclear facilities and other Department of Energy facilities." (NNPP 2015)

Item #22.3:

Historical NNPP radiation exposures are discussed in Sections 3.13.2.2 and 4.13.2.1 to provide background information and establish the basis for current conditions that might be affected by the proposed action. Additional details about historical NNPP radiation exposures at Naval Reactors DOE facilities are not necessary for this EIS and are provided in NNPP 2015 available at http://nnsa.energy.cog/ourmission/poweringnavy/annualreports.

Control of radiation exposure at Naval Reactors' DOE facilities has always been based on the assumption that any exposure, no matter how small, may involve some risk; however, exposure within the accepted limits represents a small risk in comparison with the normal hazards of life. Occupational exposures to individuals working at Naval Reactors' DOE facilities are small when compared to federal limits and other populations occupationally exposed to ionizing radiation. The exposures are within the range of exposures from natural background radiation in the U.S. and worldwide. (NNPP 2015)

This EIS uses models for estimating radiation doses and consequences based on recommendations from the International Commission on Radiological Protection (ICRP). Conversion of radiation exposure to health effects is discussed in Appendix F, Section F.2.5. The uncertainties associated with radiation dose to health effects conversion, including the BEIR VII report (NRC-NAS 2006), are discussed in Appendix F, Section F.7.4. ICRP 2007 is consistent with the preferred model identified by the National Academy of Sciences in the BEIR VII report (NRC-NAS 2006), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR 2000), and the National Council on Radiation Protection and Measurement (NCRP 2001) and is widely accepted by the scientific community as representing a method which produces estimates of health effects which would not be exceeded. However, ICRP Publication 103 (ICRP 2007) provides more recent information than BEIR VII and was therefore applied in the EIS. Additional details about the results of high dose and low dose studies are discussed in NNPP 2015 available at http://nnsa.energy.cog/ourmission/poweringnavy/annualreports.

The EEOICPA is outside the scope of this EIS as discussed in Item #22.2.

Item #22.4:

The most recent estimate of NRF radioactive waste disposed of at the RWMC is provided in ICP 2005. This document and other detailed information on the RWMC, including amounts and types of waste disposed, is available to the public at https://ar.icp.doe.gov. Historic disposal at the RWMC, including the subsurface disposal area of the RWMC, were previously evaluated and addressed through the CERCLA process which included opportunities for public comment. Comments on the history of disposal at the RWMC are outside the scope of this EIS.

Item #22.5:

Comments on the location, disposal capacity, and performance modeling of the new Remote Handled Low-Level Radioactive Waste disposal facility at the INL are outside the scope of this EIS. The DOE EA for this facility (DOE 2011a) and Finding of No Significant Impact (FONSI) (DOE 2011b), including public comment on the Draft EA, are publicly available at http://energy.gov/nepa.

Item #22.6:

Refer to the responses to Items #22.4 and 22.5.

Item #22.7:

Comments on management of non-naval spent nuclear fuel at the INL are outside the scope of this EIS.

Item #22.8:

This EIS was prepared in accordance with the requirements of the Council on Environmental Quality in 40 C.F.R. 1502.15. Chapter 3 describes the environment of the area that may be potentially affected by the proposed action. Chapter 3 provides sufficient information to characterize the current environment at NRF, including drinking water and groundwater quality and no additional information is necessary. NRF conducts a comprehensive monitoring program to ensure a high quality drinking water supply is available at NRF. Drinking water at NRF meets state of Idaho and federal standards for drinking water quality.

Drinking water quality at NRF is related to groundwater quality since the source of drinking water is from the Snake River Plain Aquifer below NRF. Groundwater is discussed in Section 3.4.2. INL has an extensive groundwater quality monitoring network maintained by the USGS and INL contractors. NRF has a separate groundwater monitoring network. Groundwater monitoring is conducted to determine effects of NRF activities on water quality. BMPC 2012 documents a historical groundwater analysis that compares long-term monitoring results to federal drinking water guidelines and to local background concentration and the results of this analysis, including relevant radionuclides, are provided in Table 3.4-6. Groundwater monitoring wells selected for monitoring include, at a minimum, wells designated in the NRF CERCLA Operations and Maintenance Plan agreed to by the state of Idaho and EPA, and wells designated in the NRF Industrial Reuse Permit issued by the state of Idaho.

Drinking water is discussed in Section 3.4.2.3. Drinking water monitoring is conducted to determine if any treatment is needed for the source water and to assure that no contaminants are introduced into the water distribution system. NRF drinking water is monitored regularly and meets all state of Idaho requirements for drinking water quality. A comprehensive drinking water monitoring program is in place that includes collection and analysis of drinking water samples in compliance with requirements established by the state of Idaho and the federal requirements implementing the Safe Drinking Water Act. Drinking water quality for the alternatives is discussed in Section 4.4.

IDEQ performs independent monitoring of air and groundwater on or near the INL and publishes these reports (IDEQ 2014). The IDEQ performs a comparison of the results of IDEQ monitoring to the results of the monitoring performed by and for the INL. IDEQ 2014 concluded “In general, there is satisfactory agreement between the environmental monitoring data reported by DEQ and DOE. This level of comparability between DEQ and DOE confirms that both programs present reasonable representations of the state of the environment surrounding the INL. This helps to foster public confidence in both the State’s and DOE’s monitoring programs and in the conclusions drawn from their monitoring.”

Item #22.9:

This EIS was prepared in accordance with the requirements of the Council on Environmental Quality in 40 C.F.R. 1502.15. Chapter 3 describes the environment of the area that may be potentially affected by the proposed action. Chapter 3 provides sufficient information to characterize the current environment at NRF, including non-radiological and radiological air emissions and no additional information is necessary.

The NNPP policy on internal radioactivity for personnel associated with NNPP DOE facilities continues to be the same as it was more than five decades ago – to prevent significant radiation exposure to personnel from internal radioactivity. The NNPP requires that airborne radioactivity surveys be performed regularly in radioactive work areas. If airborne radioactivity above limits is detected in occupied areas, work that might be causing the airborne radioactivity is immediately stopped. This sensitive monitoring would detect emissions from both local NNPP sources as well as other INL sources if it were to occur. In addition, workers are required to monitor the entire body upon leaving an area with radioactive surface contamination (e.g., frisking). Monitoring of the entire body (not just hands and feet) is a requirement of NNPP DOE facilities. In addition to the control measures to prevent internal radioactivity and the frisking frequently performed by those who work with radioactive materials, more sensitive internal monitoring is also performed. NNPP DOE facilities monitor each radiological worker for internal radioactivity before initially performing radiation work, after terminating radiation work, and periodically in between. The results of this monitoring are included in NNPP 2015 along with additional details about monitoring for radiation exposure at DOE NNPP facilities. NNPP 2015 is available at http://nnsa.energy.cog/ourmission/poweringnavy/annualreports.

NRF and ECF radiological emissions are discussed in Section 3.6.6. The emissions are based on measurements from stack emissions but include calculations of gaseous radionuclides based on the number and type of work evolutions. Because some gaseous radionuclides in air emissions are difficult to measure, calculating them based on the amount of work performed and the materials handled is the most accurate method available. The National Emissions Standards for Hazardous Air Pollutants (NESHAP) methodology used for emissions reporting follows EPA regulations as discussed in Section 3.6.2.3. All calculations are conservative, and the emissions are well below regulatory limits for doses to workers and the public as described in Section 3.13.2.2.

For INL specific information, the EIS uses the latest publically available information from the INL Environmental Surveillance, Education and Research (ESER) reports. ESER 2013 states the following about INL quality assurance.

> Quality assurance and quality control programs are maintained by contractors conducting environmental monitoring and by laboratories performing environmental analyses to help provide confidence in the data and ensure data completeness. Programs involved in environmental monitoring developed quality assurance programs and documentation which follow requirements and criteria established by DOE. Environmental monitoring programs implemented quality assurance program elements through quality assurance project plans developed for each contractor.
>
> Adherence to procedures and quality assurance project plans was maintained during 2012. Data reported in this document were obtained from several commercial, university, government, and government contractor laboratories. To assure quality results, these laboratories participated in a number of laboratory quality check programs. Quality issues that arose with laboratories used by the INL, ICP, and ESER contractors during 2012 were addressed with the laboratories and have been or are being resolved.

INL responded to the 2010 Department of Health and Safety independent oversight assessment (DOE 2010d) in a 2014 “Technical Basis for Environmental monitoring and Surveillance at the Idaho National Laboratory Site” report (DOE 2014b) which states the following:

> The 2010 HSS assessment [DOE 2010d] states in the Executive Summary, “Overall, environmental monitoring and surveillance activities at the INL Site are comprehensive and meet the basic objectives of applicable DOE requirements.” However, they also identified four main areas for enhancement…. The Technical Basis for Environmental Monitoring and Surveillance at the Idaho National Laboratory [DOE 2014b] was prepared to address the areas for enhancement identified by the HSS assessment, emphasizing the scientific basis for the radiological environmental surveillance activities. Environmental surveillance monitoring is driven by DOE orders and is performed to identify key contaminants released into the environment, evaluate different pathways through which contaminants move in the environment, and determine the potential effects of these contaminants on the environment. The monitoring performed at the INL Site to demonstrate compliance with permits and other regulatory requirements is summarized in the Idaho National Laboratory Site Environmental Monitoring Plan [ESER 2013].

NRF conducts extensive environmental monitoring, including air monitoring, and reports the results of this monitoring in publicly available reports that are submitted to IDEQ and the EPA. NRF has a quality assurance program which includes procedures to ensure the accuracy and precision of effluent and environmental sampling, analysis, and reporting.

IDEQ performs independent monitoring of air and groundwater on or near the INL and publishes these reports IDEQ 2014. The IDEQ performs a comparison of the results of IDEQ monitoring to the results of the monitoring performed by and for the INL. IDEQ 2014 concluded:

> "In general, there is satisfactory agreement between the environmental monitoring data reported by DEQ and DOE. This level of comparability between DEQ and DOE confirms that both programs present reasonable representations of the state of the environment surrounding the INL. This helps to foster public confidence in both the State's and DOE's monitoring programs and in the conclusions drawn from their monitoring."

The EEOICPA is outside the scope of this EIS, as discussed in Item #22.2.

Item #22.10:

There is no known leak from ECF to the environment. NRF closely compares water additions to the water pool with known evaporation rates to provide an indicator for a leak to the environment. Appendix F, Section F.5.4.12 states that additions to the water pool are about 150 gallons of water per day to compensate for evaporation. The 150 gallons per day of make-up water is consistent with expected losses due to evaporation based on the surface area of the pool and facility humidity levels. The average amount of make-up water has been consistent over many years and there is no indication of a significant leak to the environment.

Item #22.11:

Specifics about the "time necessary to restore cooling" discussed in Appendix F, Section F.5.4.4 are not provided in the EIS because details about naval spent nuclear fuel are classified. As described in the EIS analysis provides assurance that cladding failure would not be expected to occur before cooling could be restored by on-site equipment or by off-site emergency response capabilities and equipment.

Item #22.12:

Scenarios specific to the examination facility and possible transfer of material from the Advanced Test Reactor (ATR) to an examination facility will be analyzed in future NEPA documentation for the examination project. Transfers of naval test specimen assemblies between ECF and the ATR Complex were previously assessed in DOE 1995 Volume 1, Appendix D, Part B, Attachment A and are outside the scope of this EIS.

Item #22.13:

The NNPP considered the probability that the inter-facility transport accident could reasonably be expected due to accidental causes (e.g., inattentiveness or a health crisis of the driver). As described in Appendix F, Section F.5.4.7 the probability for this accident was too low to be considered for inclusion in the analysis of risk per DOE 2004b (i.e., probability well below 1×10^{-7} per year) because of slow travel speeds, short travel distance across NRF property, ability to restrict access to the roadway, and infrequent naval spent nuclear fuel assembly transfers. For the scenario to occur both a hypothetical high speed crash damaging the transport container and the presence of a diesel fuel fire from the crashed vehicle would be necessary for the scenario to pose a significant hazard. A low speed crash or an adjacent building fire alone would be insufficient to breach the transport container and fuel cladding allowing the release of fission products. Annual risk calculations are not completed for this scenario because the probability of an Intentionally Destructive Act (IDA) is considered "unknowable" (DOE 2004b) as discussed in Appendix F, Section F.5.1.

Item #22.14:

The hypothetical inter-facility transport scenario is discussed in Appendix F, Section F.5.4.7. Loss of shielding was not considered because the transport container remains in place and only a small percentage of material could be released into the environment. Therefore, direct radiation exposure from loss of shielding to the individuals evaluated in the EIS, including the worker located 100 meters from the scenario, is expected to be negligible compared to the exposures from the hypothetical airborne release.

Item #22.15:

Hypothetical accident scenarios at ATR are outside the scope of this EIS.

Item #22.16:

Refer to the response to Item #22.3.

Comment Document #23

MR. BODELL: You would have to make me first, wouldn't you? First of all, thank you for having these hearings that we can give our opinions and input to you and to --

Anyway my name is Bob Bodell, B-O-D-E-L-L. I go by Robert. I have lived in Idaho Falls for 38 years and am a native of the state of Idaho.

23.1 I want to go on record in support of the New Facility Alternative to recapitalize the naval spent nuclear fuel handling capabilities of ECF by constructing and operating a new facility at one of two potential locations at NRF. The old ECF has served the Navy well over the years but refurbishment of such an old facility is not in the best interest of the U.S. tax dollars. A new facility will provide the Navy safe and environmentally responsible naval spent fuel handling for the next 40 years or more.

We have talented and knowledgeable workmen at the INEL to support this construction operation of the new facility. This seems like a win-win for the state of Idaho, its citizens, and the United States as a whole.

Again, I want to emphasize that I support a new facility for nuclear fuel handling at the NRF facility.

Thank you.

Response to Comment Document #23

Item #23.1:

The commenter's support for the recapitalization project is noted.

Comment Document #24

Note: The correct spelling of Ms. Thatcher's first name is Tami. Refer to Comment Document 22.

MS. THATCHER: All right. I'm Tammy Thatcher. I

24.1 live in Idaho Falls. I am in favor of you building the new facility.

24.2 I wish that DOE were taking more actions to build a similar facility for the non naval spent fuel that's at INL currently. That appears to be languishing, and it's not even being talked about.

I want to say, I appreciate the intelligent and hard working people at NRF. I have had many friends through the years. And if you live in Idaho Falls, if you've lived here long, it seems you are never too far away from someone who has worked at NRF, but you also come across someone who has lost someone to cancer who worked at NRF years ago, or not all that long ago.

24.3 I just want to remind people that the Energy Employee Occupational Illness Compensation Act specifically exempts and does not cover workers at NRF for their radiation induced cancers of chemically induced illnesses even though NRF is largely over a thousand civilian employees, 20 military employees. So these are civilians. They are not covered by the Energy Employee Occupational Compensation Act, and I find that unacceptable.

NRF has hot cells, fuel dissolution, the movement of irradiated materials, cutting of fuel, which can be a messy business, and the rationale used was that because of the effectiveness and accuracy of measuring, recording, and reporting radiation exposures, NRF did not need this Energy Employee Occupational Compensation Act.

Perhaps people who made that statement actually believed it, but human biology and our experience show that it doesn't support that rationale. So this exemption really needs to be looked at. It needs to be changed.

And finally, I want to say that for NRF to be the good neighbor that it is in so many ways, it really should not be burying long lived radioactive waste -- mobile long lived radioactive waste over our aquifer when it can easily ship this waste to Nevada's
24.4 open low level waste site. The analysis for buried waste over aquifer have been inconsistent. They've been biased. For the analysis of migration of this waste for hundreds of thousands years, it's not conservative. It's not bounding, and it is not even scientifically defensible so those are my comments.

Thank you.

Response to Comment Document #24

Item #24.1:

The commenter's support for the New Facility Alternative is noted.

Item #24.2:

Comments on management of non-naval spent nuclear fuel at the INL are outside the scope of this EIS.

Item #24.3:

The EEOICPA is outside the scope of this EIS. Details about NRF and Naval Reactors participation in the EEOICPA are discussed in NNPP 2015 available at http://nnsa.energy.cog/ourmission/poweringnavy/annualreports.

In 2000, Congress passed the EEOICPA to provide an alternative Federal compensation program for workers whose health was impacted as a result of nuclear weapons related work for DOE contractors. The EEOICPA generally covers contractors and DOE employees, as designated by the Secretary of Energy, who worked in facilities that processed or produced radioactive material for use in the production of atomic weapons. Because of the effectiveness of Naval Reactors' worker protection, worker training, and workplace monitoring programs, employees who performed Naval Reactors' related work at Naval Reactors' DOE facilities were not included in the EEOICPA. Irrespective of the applicability of the EEOICPA, personnel who believe they have received an occupational injury may file claims. The personnel who operate Naval Reactors' DOE facilities are employees of corporations operating facilities under contract to the DOE. These personnel file claims under state workmen's compensation laws. The claim may be handled through the contractor's insurance carrier or adjudicated by an administrative law judge. Either the employee or the contractor may appeal the judge's decision. In any case, the NNPP would support any claim for radiation injury where it could be technically and scientifically shown that the injury was more likely than not caused by the individual's occupational radiation exposure from the NNPP.

There have been a total of six claims filed for injury from radiation associated with Naval Reactors' DOE facilities. Of these claims, one was awarded and five have either been denied or deferred.

The NNPP radiological control program includes checks and cross-checks, audits, and inspections of numerous kinds to ensure the high standards of the NNPP radiological control program are maintained. The GAO performed a 14-month in depth review of various aspects of Naval Reactors DOE facilities including occupational exposure monitoring. The GAO reported to Congress in 1991 that "Naval Reactors Laboratories are accurately measuring, recording, and reporting radiation exposures," and "exposure have been minimal and overall are lower than commercial nuclear facilities and other Department of Energy facilities." (NNPP 2015)

Item #24.4:

Comments on the location, disposal capacity, and performance modeling of the new Remote Handled Low-Level Radioactive Waste disposal facility at the INL are outside the scope of this EIS. The DOE EA for this facility (DOE 2011a), including public comment on the Draft EA, is publicly available at http://energy.gov/nepa.

Comment Document #25

MR. BELNAP: I'm Tyrone Belnap, T-Y-R-O-N-E B-E-L-N-A-P.

Thank you for the opportunity of being here. I just heard this -- that this was going to happen on the news at noon, and I thought, well, I'd like to come and at least see what was going on. I do have a few comments.

The first is with respect to the Environmental Impact Statement itself. I could only briefly go through it. I didn't have the time to really study it thoroughly, but nonetheless it seemed to not include the duplicity of discharges when the two facilities are going to be up and running. I talked to you about that a little bit previously. There is going to be a transition time when there is going to be both facilities -- there is going to be an increase to the current discharge rate, I believe, and that probably should be reflected in the EIS.

25.1

Additionally, I believe that with the M-290 projected work, the EIS should also include the fact that there is going to be additional waste brought into the state. You may as well just address it up front with additional hardware and that that is going to be coming on with the shipments.

25.2

And also in the configuration that you presented with the new process of the facility on the west side of the CSRF will require that all exam work be taken to the current ECF hot cells via a truck cast

25.3

loading situation, which in itself inherently increased risks of transport across the site, not only the loading and unloading and the handling and exposure of personnel, I suppose of -- in that process, so, again, I would think that maybe the EIS should address that and maybe the process -- make sure we reviewed that thoroughly to make sure that is the most efficient way of lining up the facility to the needed exam work.

25.4 A question I had. I know you've said there is not questions and answers, but a question I put on the record is, what is going to happen to the current M-290 processing facility? The pictures out there showed the M-290s coming around to the other building, so we just build a -- several, you know, $100 million facility there. What is going to happen to that one when its sole purpose was to process and place into interim dry storage the fuel coming in on the M-290, so it is not clear what that is going to be.

25.5 The -- along that same trend is the -- it's interesting that the exams are going to continue in the oldest part of the current ECF facility. The part of the facility that is most vulnerable to seismic or anything else for that matter, both the water pits and cells themselves. So, again, if we are going to build a new facility I'm wondering why we would not include a hot cell facility which would eliminate entirely that liability and also would preclude the necessity of the transportation of the exam pieces from the proposed new facility to the existing old facility?

25.6 But if we are going to keep the old facility, we currently have a very serviceable, I believe anyway, M140 processing place, which is relatively new to not be considered the same as Water Pit 1, 2, or 3 or the hot cells, so again, it is unclear why we would have to face the additional costs associated with redoing an M140 processing area and perhaps we could address that.

And lastly, a suggestion. From what I see on the discussions outside, there is three routes that this fuel coming into the state of Idaho will take, coming in on either M-290s or M-140s or whatever, it is going to end up in interim and outside on the posters temporary -- interim temporary storage for some future date. The future date is dependent upon either someplace in the nation opening up a suitable long-term storage facility -- would be one option. Secondly, would be if there is a reprocessing facility that is developed where we can effectively reclaim the material that's there. Or thirdly, we just keep it in the situation that we have now in the overpack containers as they are right now. And I submit to you

25.7 that I believe it would be in the interest of both Naval Reactors and the state of Idaho if they would come together and look at that facility. With respect to even the comments that were given here just a second ago --

MODERATOR DAHL: And I'm sorry, Mr. Belnap. I just need to point out that the five minute light has lit, so if you can conclude please now, I'd appreciate that. Thank you.

MR. BELNAP: -- is that it would be in the best interest of both the state of Idaho and the Naval Reactors Facility -- we can monitor the overpack process very well -- absolutely, without doubt. And so if Naval Reactors were to offer the state of Idaho

25.7 (cont.) a stipend for fuel storage, why it might be something that could be agreed upon by the state and Naval Reactors were this to become the storage facility for this material that can be very well regulated and monitored until such time as we can better either store it or process it.

Thank you.

Response to Comment Document #25

Item #25.1:

There would be an increase in radiological air emissions compared to the annual NRF emission rate for routine operations (Section 4.6.2). The emissions from the period of operation when both the new facility and ECF are operational is evaluated in the EIS. This period is referred to as the new facility transition period and is described in Section 2.3. The impacts from the new facility transition period are explicitly evaluated in Chapter 4 for each resource area. Although the increase in emissions would result in a release of approximately 2 Curies per year, the increase is minimal when compared to the total radiological emissions from the INL.

Item #25.2:

There would be an increase in solid LLW generation compared to the annual NRF solid LLW generation rate for routine operations (Section 4.14.3). This increase in waste generation rate would be due primarily to additional waste from processing naval spent nuclear fuel that arrives in M-290 shipping containers. DON 2007 evaluated the impacts of removing and handling this additional waste from processing aircraft carrier spent fuel assemblies that arrive in M-290 shipping containers. The radionuclides in this waste are mostly contained within the non-fuel-bearing structural components and are not released into the water pool water. The overhauled facility and new facility would be designed to accommodate the additional radioactive material through the use of filtration and water purification systems. Disposal capacity is available for this waste, so the impacts would be small due to the additional solid LLW that would be generated.

Item #25.3:

As described in Section 2.1.3, one of the key attributes for the new facility is to allow interface with or expansion into a potential facility for future examination plans. The future NEPA documentation for recapitalization of examination will evaluate whether interface or expansion provides the most efficient method for examination work. However, this EIS included evaluation of worker exposure from naval spent nuclear fuel handling, including transfer for examination.

Occupational radiation exposure to workers during the New Facility Operational Period from naval spent nuclear fuel handling is discussed in Section 4.13.2.1.3. It is estimated that the annual dose to a naval spent nuclear fuel handling worker could range between 0 and 0.0010 Sievert (0.10 rem) with an expected average closer to 0.00018 Sievert (0.018 rem). Although the occupational average disused in the Section 4.13.2.1.3 is from technicians unloading shipping containers, it is estimated that similar radiation exposures would be received from transport operations because the same engineering controls including time in the radiation area, distance away from the source, and shielding would be used to keep radiation exposures ALARA. The average occupational radiation exposure to workers of 0.00018 Sievert (0.018 rem) from naval spent nuclear fuel handling for all alternatives evaluated is small compared to the 0.0031 Sievert (0.31 rem) annual average individual radiation dose to a member of the public exposure from natural background radiation shown in Table 3.13-2.

The consequences from an Inter-Facility Transport Accident involving the transfer of naval spent nuclear fuel to the examination facility was evaluated in Appendix F, Section F.5.4.7. This hypothetical scenario is only applicable to the New Facility Alternative. The accident was considered for inclusion in the analysis of risk; however, because of the slow travel speeds, short travel distance across NRF property, ability to restrict access to the roadway, and infrequent naval spent nuclear fuel transfers, this accident is included only as an IDA due to the corresponding severe consequences that are modeled that would not occur from anything other than an IDA.

Item #25.4:

Regardless of the alternative selected, naval spent nuclear fuel canisters currently stored in the OSB and OSEs will be removed from concrete overpacks and loaded into M-290 shipping containers in the current CSRF for shipment out of the state of Idaho once an interim storage facility or geologic repository is available (Section 1.2). In addition, as described in Section 2.1.3, if the preferred alternative (New Facility at NRF Location 3/4) is selected, the existing OSB, OSEs, and CSRF would be used for overpack storage and M-290 loading resulting from new facility operations. If the New Facility Alternative at Location 6 is selected, a new OSB and M-290 loading area would be built to support future operations, as shown in Figure 2.1-5. The Conceptual Facility Layout discussion in Section 2.1.3 has been revised to clarify that the existing OSB, OSEs, and CSRF are too far from Location 6 to allow for use with a new facility built at that location.

The CSRF was designed and built to support loading and unloading canisters of naval spent nuclear fuel from M-290 shipping containers; however, this facility does not have the capability to package naval spent nuclear fuel into canisters for dry storage.

Item #25.5:

A full range of alternatives for the recapitalization of the ECF examination infrastructure remains available to the NNPP and will be assessed in a future NEPA document. As described in Section 1.2, the ECF capabilities for examination performed in the ECF water pools, including initial examination of naval spent nuclear fuel assemblies, resizing naval spent nuclear fuel for examination, and transfer for examination were evaluated. Examination infrastructure for irradiated test specimen examination and destructive evaluation of naval spent nuclear fuel are capabilities independent of the spent fuel handling capabilities addressed in the EIS and will be evaluated in future NEPA documentation. As described in Section 2.1.3, the New Facility Alternative conceptual facility design includes facility attributes that allow interface with or expansion into a potential facility for future examination recapitalization plans. It has not yet been determined whether an attached or separate examination facility (either by building a new facility or by recapitalizing some ECF capabilities) provides the best alternative. This will be determined through future NEPA documentation that will provide opportunities for public review and comment.

The need for the recapitalization of infrastructure supporting naval spent nuclear fuel handling is described in Section 1.3. The naval spent nuclear fuel handling capabilities described in Section 1.2 are vital to the NNPP mission of maintaining the reliable operation of the naval nuclear-powered fleet. The New Facility Alternative is the preferred alternative for providing this naval spent nuclear fuel infrastructure. As described in Section 4.15, addressing naval spent nuclear fuel handling is more urgent due to the close tie to supporting fleet operations and meeting the commitments in SA 1995 and SAA 2008. There is more flexibility with respect to the timing for the recapitalization of the examination capabilities of ECF.

Item #25.6:

Maintaining the current ECF, including the M-140 fuel processing area, would be generally consistent with the No Action Alternative. Although portions of the existing ECF are newer and are currently operating well, other portions of ECF have been in operation for many years. Older ECF infrastructure and equipment can effect overall ECF operations. As discussed in Section 2.1.1, failure to perform upgrades and refurbishments may result in ECF eventually being unavailable for handling naval spent nuclear fuel.

Overhauling older infrastructure and equipment in ECF is included in the Overhaul Alternative. This alternative was considered but not preferred because the Overhaul Alternative involves continuing to use the aging infrastructure at ECF, while incurring additional costs to provide the required refurbishments and workaround actions necessary to ensure uninterrupted aircraft carrier and submarine refuelings and defuelings. Failure to implement this overhaul in advance of infrastructure deterioration would impact the ability of ECF to operate. Further, overhaul actions would necessitate operational interruptions for extended periods of time.

The screening criteria for the New Facility Alternative included objectives to maximize the use of existing facility assets and to minimize conflicts with other NRF facilities and infrastructure, including ECF operations. Use of the M-140 shipping container unloading and processing area in conjunction with a new facility did not meet the requirement to not cause inefficient operations. Due to interference from existing underground ECF infrastructure and other ongoing operation conflicts, use of any part of ECF was screened out from this alternative. See Sections 2.1.1, 2.1.2, and 2.1.3 for additional details regarding the scope of the No Action Alternative, Overhaul Alternative, and New Facility Alternative.

Item #25.7:

As described in Section 1.1.3, naval spent nuclear fuel is packaged into canisters that are placed inside concrete overpacks for temporary dry storage. When an interim storage facility or a geologic repository is available to receive naval spent nuclear fuel, the naval spent nuclear fuel canisters will be removed from the concrete overpacks and loaded into M-290 shipping containers for transport out of Idaho. As described in Section 1.5.3, the NNPP is committed to supporting SA 1995 and SAA 2008 and continues to prepare for shipment of naval spent nuclear fuel out of the state of Idaho once an interim storage facility or geologic repository is available. Any subsequent actions related to an interim storage facility or geologic repository will be subject to their own NEPA analysis and are beyond the scope of this EIS. Representatives of the state of Idaho have examined overpack storage facilities at NRF and routine monitoring demonstrates that there are no releases of radioactive material from the canisters into the environment.

Comment Document #26

MR. WEST: Lonzo West, L-O-N-Z-O W-E-S-T. I'm a third generation Idahoan. I have a little eight-year-old boy, and he'll be the fourth generation. I am very much in favor of this new facility, and I'm also an avid outdoorsman, hunter, fisher, boating -- all kinds of recreation, so I do care about the environment very much. I know you guys will be good stewards of the land and the environment. I have the utmost faith that you will carry out these duties for future generations.

26.1

Thank you very much.

Response to Comment Document #26

Item #26.1:

The commenter’s support for the preferred alternative is noted.

Comment Document #27

MS. BRAILSFORD: Thank you. My name is Beatrice Brailsford. Brailsford is B-r-a-i-l-s-f-o-r-d. And I am with the Snake River Alliance.

The Snake River Alliance has served as Idaho's grassroots nuclear watchdog and clean energy advocate since 1979. Most certainly the Alliance supports efforts to ensure that the nuclear waste of the Snake River Aquifer is stored as safely as possible. The following comments and questions on the Draft Environmental Impact Statement for the recapitalization of infrastructure supporting naval spent nuclear fuel handling are submitted on behalf of our dues-paying members.

The Naval Nuclear Propulsion Program's first reactor began operating in March 1953 in the middle of the Arco desert. It simulated crossing the Atlantic, leaking radiation along the way, and the nuclear navy was born. Months later, on January 21, 1954, the nuclear navy launched the USS Nautilus, the first nuclear-powered submarine. By 1958, INL became not just the birthplace of the nuclear navy, but its final port of call. Every scrap of spent nuclear fuel produced by the U.S. fleet ends up at INL's Naval Reactors Facility.

Spent nuclear fuel is some of the most radioactive waste on earth. And there are no reactors at the Naval Reactors Facility, just waste. Today there are about 31 metric tons of nuclear navy spent nuclear fuel at INL, and more accumulates every year. The 1995

Settlement Agreement allows a running average of 20 shipments of spent fuel a year from the nuclear navy. And the State of Idaho cannot stop those shipments for cause as it can shipments for the Department of Energy.

A 2008 addendum to the 1995 agreement was negotiated without disclosure to or input from the people of Idaho. It requires that the nuclear navy ship out of Idaho most of its spent fuel by 2035, but it can continue to bring in more spent fuel after that as long as its stockpile is no more than 9 metric tons. Since the Settlement Agreement was signed, the nuclear navy has brought in about 20 metric tons of spent fuel.

In numerous public discussions over the years, the nuclear navy has asserted that all its spent fuel comes to Idaho for examination. It has never been clear how much of that examination is visual and how much is
27.1 more detailed. Detailed examination requires that the fuel be resized or chopped up in the proposed facility, though the examination itself wouldn't happen there. It's conducted in a decades-old building nearby.

At any rate, the Draft Environmental Impact Statement under discussion today asserts that 10 to 20 percent of the nuclear navy spent fuel brought to Idaho
27.2 undergoes detailed examination; 10 to 20 percent is a remarkably and uncharacteristically inexact figure. Please provide the exact percentage in the Final EIS.

When the nuclear navy spent fuel comes to Idaho, a portion of the fuel assembly is chopped off to be disposed of separately. That material is radioactive enough that it must be handled remotely.

27.3 Current plans call for a new disposal facility large enough that the INL's nuclear navy and nuclear power research programs can produce enough of this very radioactive waste to fill a two-car garage each year for the next 50.

And now the current proposal. I've lost my place just like you did.

27.4 This Draft EIS assumes that nuclear navy spent fuel will continue to come to Idaho until at least 2060. That means the nuclear navy will be shipping some of the most radioactive waste on earth to Idaho for more than a century. The Draft EIS consistently says that the spent nuclear fuel coming in will go to a repository or consolidated storage site as soon as one is available, but that misses the point. INL is the consolidated storage site for nuclear navy spent fuel and will be so for the foreseeable future. This is a serious issue that Idahoans should think about very carefully. Thank you.

Response to Comment Document #27

Item #27.1:

As described in Sections 1.1.3 and 1.2, each naval spent nuclear fuel assembly receives a visual examination to confirm that the assembly performed as designed, and to look for evidence of unusual conditions such as unexpected corrosion, unexpected wear, or structural defects. Some naval spent nuclear fuel is given more detailed non-destructive examinations for such purposes as confirming the adequacy of new design features, exploring material performance concerns, and obtaining detailed information to confirm or adjust computer predictions of naval nuclear core performance attributes. Non-destructive examinations could include detailed visual examinations, dimension measurements, or evaluations of corrosion product build-up. These detailed non-destructive examinations do not penetrate the naval spent nuclear fuel cladding or otherwise reduce the integrity of the naval spent nuclear fuel.

As described in Section 1.2, ECF also provides the capability to resize and transfer those naval spent nuclear fuel for more detailed or destructive examinations in shielded cells. The resizing operation performed in the ECF water pool does not penetrate the naval spent nuclear fuel cladding or otherwise reduce the integrity of the naval spent nuclear fuel. The New Facility Alternative would provide similar resizing capabilities and the ability to transfer capabilities the naval spent nuclear fuel to the examination location (i.e., shielded cell in ECF or a new facility).

A full range of alternatives for the recapitalization of the ECF examination infrastructure remains available to the NNPP and will be assessed in a future NEPA document. As described in Section 1.2, the ECF capabilities for examination performed in the ECF water pools, including initial examination of naval spent nuclear fuel assemblies, resizing naval spent nuclear fuel for examination, and transfer for examination were evaluated in this EIS. Examination infrastructure for irradiated test specimen examination and destructive evaluation of naval spent nuclear fuel are capabilities independent of the spent fuel handling capabilities addressed in the EIS and will be evaluated in future NEPA documentation. As described in Section 2.1.3, the New Facility Alternative conceptual facility design includes facility attributes that allow interface with or expansion into a potential facility for future examination recapitalization plans. It has not yet been determined whether an attached or separate examination facility (either by building a new facility or by recapitalizing some ECF capabilities) provides the best alternative. This will be determined through future NEPA documentation that will provide opportunities for public review and comment.

Item #27.2:

A review of past and future core examination work showed that 20.0 percent of naval cores received more detailed examinations from 1994-2014, and 16.7 percent of naval cores are planned for more detailed examinations from 2015-2035. Therefore, Section 1.1.3 has been revised to provide the more precise percentage range of 15 to 20 percent.

Item #27.3:

Comments on the location and disposal capacity of the new Remote Handled Low-Level Radioactive Waste disposal facility at the INL are outside the scope of this EIS. The DOE EA for this facility (DOE 2011a) is publicly available at http://energy.gov/nepa. The estimates of remote-handled LLW generation in Section 4.14.3 are consistent with estimates used in DOE 2011a.

Item #27.4:

As noted in Section 1.5.3, alternatives for management of spent nuclear fuel managed by the DOE, including naval spent nuclear fuel, were comprehensively evaluated in DOE 1995. Based on that evaluation, ROD 1995 chose to implement regionalized spent fuel management by fuel type. Under that alternative, naval spent nuclear fuel is managed at the NRF at INL. There are no factors that warrant reconsideration of that decision. As the DOE pursues parallel paths of a consent-based siting process for disposal of spent nuclear fuel and high-level waste as described in 80 Fed. Reg. 79872 (December 23, 2015) and development of a repository for disposal of high-level radioactive waste resulting from atomic energy defense activities, the NNPP remains committed to supporting the SA 1995 and the SAA 2008 and continues to prepare for shipment of naval spent nuclear fuel out of the state of Idaho once an interim storage facility or geologic repository is available. Any subsequent actions related to an interim storage facility or geologic repository are beyond the scope of this EIS.

Comment Document #28

MR. BARTHOLOMEW: Let's see if I can talk. Kelly Bartholomew, B-a-r-t-h-o-l-o-m-e-w. Thank you. I'm Kelly Bartholomew. I'm from the Operating Engineers of Southwest Idaho. We've had a continued relationship with the INL for over 50 years now. You guys have continued to be good stewards of all the business that

28.1 you conduct out there. We're anxiously looking forward to continuing our work with you guys. We hope the proposal goes through, and we hope you continue to be good stewards of our future. So thank you.

Response to Comment Document #28

Item #28.1:

The commenter's support for the recapitalization project is noted.

Comment Document #29

MS. BEACH: Christine Beach, B-e-a-c-h. I'm a property owner over the aquifer at Rupert, Idaho. I just wanted to thank you all for such a great presentation. You answered just about every question I had. You're all very professional and very kind.

29.1 I still am not totally happy with the fact that we're going to bring this highly radioactive material into Idaho. I would prefer that we didn't. However, if anyone's going to monitor it and bring it in, I'm glad it's the United States Navy. I know you'll take good care of it; you'll do what you can to keep it safe. Some of you work there, which I actually really enjoyed hearing that because I figure you'll protect your own skins as well as the environment.

And I have something that I'm going to -- I'm going to tell you a short story, and I'm going to wave this handkerchief. My dad actually wore this handkerchief when he farmed in the '50s, '60s, '70s, '80s. When it was 1972, I was in school at Rexburg, and I had a geology professor, which we all liked, but we thought he was a little nutty. He came into our class every week, and he'd wave a red flag, and he'd say, Why isn't anybody listening to me? This dam -- I think it was called the Teton Dam; I called it the Rexburg Dam -- it's an urban dam, and if they get a big slosh of water, you know, it's going to breach. And, you know, I said to him one day, You know, Professor, it hasn't breached yet; maybe you should relax a little bit, and it will be okay. And he turned to me kind of furiously and said, Everything's okay until it isn't, and then it's too late.

So we have this saying in my house, and it's called, Load for bear, and you'll hit the hair. So when you guys develop your scenarios, worst-case scenarios,
29.2 just be aware that really bad things happen and things that you can't even imagine would happen.

I moved to Salt Lake, and just a short time later my dad called me and said, Honey, I hate to tell you, but the dam is broken, and it just totally wiped out a lot of Rexburg, and we're getting in a bus to go up and try to help them clean up. And then he said these words. He said, It could have been a lot worse; only 11 people died. And I wasn't too comforted by that because I kept thinking, what about the mothers and the fathers of those kids, the friends, the family, or those people?

So but all I want to say to you gentlemen is, load for bear because accidents happen. My garage rattled the day that the plane went into the -- in Falls Church the day the plane went into the Pentagon. And every time I drive up to Hershey, Pennsylvania, I see Three Mile Island, and it's sitting there not doing anything.

There was just an article in the paper, the LA Times, August 1st about the regulators closing a case questioning the California reactor. It went to go

on-line, and they were cleaning it up, I guess, and all the parts were faulty. So if you need more money to do
29.3 a good job on this, as a taxpayer I'm telling you, take it. Thank you.

Response to Comment Document #29

Item #29.1:

The commenter's confidence in the Navy's ability to properly manage naval spent nuclear fuel is noted.

Item #29.2:

Section 3.13 has been modified to provide a description of the safety strategy that the NNPP utilizes to ensure the safety of naval spent fuel handling. The NNPP safety strategy is to provide robust protection to the public, workers, and the environment against the effects of ionizing radiation and radioactive contamination resulting from work performed within the facility.

Emergency plans are in effect at NRF as described in Appendix F, Section F.6.1, to ensure that workers and the public would be properly protected in the event of an accident. These response plans include the activation of emergency response teams provided by NRF or INL and an NRF emergency control center, as well as activation of a command and control network with NNPP Headquarters and supporting laboratories. Emergency response measures include provisions for immediate response to radiological emergencies at the facility location, identification of the accident conditions, communications with those providing radiological data, and recommendations for any appropriate protective actions. NRF employees are trained to respond to radiological emergencies including evacuation from areas that involve a potential release of radioactive material.

In addition, twelve hypothetical accident scenarios and IDAs were evaluated in Appendix F. As stated in Section F.1, a description of each scenario is provided in Section F.5, along with the scenario source term, probability, and results. For the hypothetical accident scenarios and IDAs evaluated, the impacts to workers, nearby individuals, and the General Population all result in a small likelihood of developing fatal cancer from radiation exposure. The increased likelihood of fatal cancer from these hypothetical accident scenarios and IDAs is negligible compared to the risk of developing fatal cancer from a lifetime of normal activities. Refer to Appendix F, Section F.5.5 for further summary information on hypothetical accident scenarios and IDAs.

Item #29.3:

The NNPP is committed to ensuring that naval spent nuclear fuel is handled in a safe and environmentally responsible manner. A new facility, including installed equipment, would be designed, built, tested, and checked to ensure that all applicable requirements are met. The cost for this quality control, oversight, and testing are included in the estimated cost provided in Section 2.6.2.

Comment Document #30

COMMENTS re DOE/EIS-0453-D

1 message

Linda Martin <lmartin@redi4idaho.org> Mon, Aug 31, 2015 at 2:43 PM
To: ecfrecapitalization@unnpp.gov
Cc: dgerry@redi4idaho.org

Please see the attached comments for the above referenced DOE/EIS-0453-D.

Thank you,

Linda K. Martin, CEcD

REDI for East Idaho

151 North Ridge, Suite A

Idaho Falls, ID 83402

208-522-2014

www.redi4idaho.org

lmartin@redi4idaho.org

REDI Support Letter for DOE EIS 0453 D NRF ECF.pdf
365K

REDI
REGIONAL ECONOMIC DEVELOPMENT FOR EAST IDAHO

August 31, 2015 Comments Sent Via: ecfrecapitalization@unnpp.gov

Erik Anderson
Department of Navy
Naval Sea Systems Command
1240 Isaac Hull Avenue, SE
Stop 8036
Washington Navy Yard, DC 20376

Dear Mr. Anderson,

RE: DOE/EIS-0453-D

REDI for East Idaho is the regional economic development corporation for eastern Idaho. We want to comment in favor of the draft Environmental Impact Statement to support the $1.6 Billion recapitalization and building of a new Expanded Core Facility (ECF) which is operated by the US Navy and the US Department of Energy, and managed by Bechtel Marine Propulsion Corp. as part of the Naval Nuclear Propulsion Program (NNPP).

30.1 Since 1957, the ECF has been handling and processing spent fuel from the Navy's fleet of nuclear powered aircraft carriers, submarines, and other vessels. More significantly, these operations have been conducted in a safe and environmentally responsible manner in our community over these many years.

It is clear that to continue this important mission for the national security, and to maintain reliable operations of the transfer, handling, examination, testing, and packaging of this spent nuclear fuel, it is imperative to recapitalize the infrastructure for these activities. The new ECF facility will enable the NNPP to continue to operate in a safe manner in our community, protect our local environment, provide additional safety for its workers as well as our citizens, and contribute to our socioeconomic region.

We strongly urge the Department of the Navy to accept the findings in the draft Environmental Impact Statement and proceed with the recapitalization of the ECF.

Sincerely,

Darlene E. Gerry
Interim Executive Director

151 North Ridge Avenue Suite A., Idaho Falls, ID 83402-4002 208.522.2014 redi4idaho.org

Response to Comment Document #30

Item #30.1:

The commenter's support for the preferred alternative is noted.

Comment Document #31

Fwd: EPA comments on your DEIS for the proposed Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the INL

2 messages

Laura Iannacci ([redacted]) <laura.iannacci@unnpp.gov> Mon, Aug 31, 2015 at 3:57 PM
To: ECF Recapitalization <ecfrecapitalization@unnpp.gov>

---------- Forwarded message ----------
From: **HENVIT, CHRISTOPHER** <christopher.henvit@inl.gov>
Date: Monday, August 31, 2015
Subject: Fwd: EPA comments on your DEIS for the proposed Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the INL
To: "Laura Iannacci ([redacted])" <laura.iannacci@unnpp.gov>, "Anderson, Erik E CIV SEA 08 NR" <erik.e.anderson1@nmci-isf.com>

I just received this from Theo.
---------- Forwarded message ----------
From: **Mbabaliye, Theogene** <Mbabaliye.Theogene@epa.gov>
Date: Mon, Aug 31, 2015 at 11:42 AM
Subject: EPA comments on your DEIS for the proposed Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the INL
To: "HENVIT, CHRISTOPHER" <christopher.henvit@inl.gov>
Cc: "Wright, Wendy" <Wright.Wendy@epa.gov>

Chris,

Attached please find the EPA comments on the subject proposal. A hard copy of the same comments is being mailed to the Naval Sea Systems Command Office in DC under separate cover via the US Postal Service and should arrive soon. In the meantime, please let me know if you have any question about our comments for assistance.

Again, thank you for involving us in this project EIS review and we look forward to reviewing the final EIS when it will be available.

Thank you.

Theo Mbabaliye, Ph.D.
US EPA Region 10
1200 6th Ave., Suite 900, ETPA-202-3
Seattle, WA 98101-3140
Phone: (206) 553-6322
Fax: (206) 553-6984

2 attachments

EPA EIS Rating System.pdf
18K

94-032-DOE DEIS Naval Spent Nuclear Fuel Handling INL.pdf
535K

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
ECOSYSTEMS,
TRIBAL AND PUBLIC
AFFAIRS

August 28, 2015

Erik Anderson
Department of the Navy
Naval Sea Systems Command
1240 Isaac Hull Avenue South East, Stop 8036
Washington Navy Yard, DC 20376-8036

Dear Mr. Anderson:

In accordance with our responsibilities under Section 309 of the Clean Air Act, the National Environmental Policy Act (NEPA), and the Council on Environmental Quality regulations for implementing NEPA, the U.S. Environmental Protection Agency has reviewed the Draft Environmental Impact Statement (DEIS) for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory (INL) in Butte County, Idaho (EPA Project No. 94-032-DOE).

The DEIS evaluates potential environmental impacts associated with a Department of Energy (DOE) proposal to recapitalize infrastructure needed to ensure the long-term capability of its Naval Nuclear Propulsion Program to support naval spent nuclear fuel handling for at least the next 40 years or until 2060. The existing Expended Core Facility (ECF) infrastructure for processing the fuel has been in service for over 50 years and needs significant renovations to continue fuel handling operations. If implemented as proposed, this project would ensure safe and environmentally responsible management of the fuel at this unique Naval Reactors Facility (NRF) and effective support of the U.S. Navy national security missions. The DEIS tiers to DOE's 1995 Programmatic Spent Nuclear Fuel Management and INL Environmental Restoration and Waste Management Programs Final EIS and related Settlement Agreement, as amended in 2008, among the State of Idaho, DOE, and the U.S. Navy.

Analysis of potential impacts from the project considered three action alternatives, including a No Action (p. 2-1). Under the New Facility Alternative (Proposed action and Preferred Alternative), DOE would acquire capital assets to recapitalize the naval spent nuclear fuel handling capabilities, while leveraging existing ECF infrastructure and use of newer equipment designs. The new facility would consist of all current spent nuclear fuel handling operations conducted at the ECF and new capability, such as unloading fuel rods from new shipping containers (M-290), handling aircraft carrier spent nuclear fuel assemblies without prior disassembly, and enhanced security infrastructure to protect against threats. The Overhaul Alternative would upgrade and refurbish the existing ECF and related facilities, while the No Action Alternative would maintain existing infrastructure as is and provide only preventive and corrective maintenance. The DEIS indicates that, comparatively, it would be significantly cheaper and more beneficial to construct the New Facility Alternative than the other proposed action (p. 2-79).

The DEIS includes a good description of natural resources within the project area, analysis of
anticipated environmental impacts, measures to offset the impacts, and monitoring programs to detect
environmental impacts during implementation and demonstrate compliance with applicable
environmental requirements. DOE proposes to develop a Mitigation Action Plan after publication of the
Record of Decision for this project (p. 6-1). Because a draft of such plan was not included in the DEIS,
31.1 the final EIS should make it clear that development of the Mitigation Action Plan would include
opportunities for the public to review and comment.

Overall, most direct impacts of the project would be due to construction activities, which would generate
both temporary and permanent impacts related to the project footprint and long-term operation and
maintenance of facilities. Our concerns with implementing the proposed project relate to its potential
31.2 impacts on water resources, air quality, ecological and other resources as discussed below. We
recommend that DOE continue to work with the Idaho Department of Environmental Quality and
31.3 affected tribes to assure air quality and water resources protection as the project is implemented.
Because of occurrence of vegetation and wildlife of concern in the project area, including sage-grouse
and pigmy rabbits, DOE should also continue to coordinate with the US Fish and Wildlife Service and
31.4 the Idaho Department of Fish and Game to identify effective measures to take to reduce risks to species
and protect habitat.

Based on our review and concerns about potential impacts on water and air resources and unclear or missing information, we have assigned a rating of EC-2 (Environmental Concerns – Insufficient Information) to the DEIS. For your reference, a copy of the rating system used in conducting our review is enclosed.

Thank you for the opportunity to review and comment on this DEIS. If you have questions about our comments, please contact me at (206) 553-1601 or by electronic mail at reichgott.christine@epa.gov or contact Theo Mbabaliye of my staff at (206) 553-6322 or by electronic mail at mbabaliye.theogene@epa.gov.

Sincerely,

Linda Anderson-Carnahan for

Christine B. Reichgott, Manager
Environmental Review and Sediment Management Unit

Enclosures:

1. EPA Detailed Comments on the DEIS for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at INL Project
2. U.S. EPA EIS Rating System

EPA Detailed Comments on the Draft EIS for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at INL Butte County, ID

Impacts on Water Resources

The DEIS indicates that water quality may be adversely affected if the project construction activities 31.5 such as surface grading, excavation, surface pavement, and building roofs alter the hydrology of springs and surface runoff such that erosion carries sediment to surface waters and pollutants to local drainages and the underlying aquifer. In addition, groundwater extraction in the analysis area and vicinity, land disturbance, material storage, waste and wastewater disposal, inadvertent chemical or hazardous liquid spills, and compaction produced by vehicular traffic can all affect recharge to the local aquifer and groundwater quality. Because of the project, there would be an increase in discharge volume (about 17 31.6 million gallons) to the Industrial Waste Ditch (IWD), which would increase erosion and sedimentation in the IWD, resulting in an increased amount of water seeping into the perched water zone at the outfall of the IWD (p. 4-46). Water use during construction of the project would also increase by 50 percent (or 62,830,000 gallons) over the NRF baseline (p. 4-45) which could exacerbate the seepage that could in 31.7 turn facilitate migration of contaminants (e.g. salts in process wastewater discharges) to the Snake River Plain Aquifer – an EPA designated sole source aquifer (p. 3-39) still vulnerable to contamination from surface activities.

We recognize that the proposed surface water drainage and retention systems, and Best Management Practices will lessen the impacts of stormwater runoff from impervious surfaces, but pollutants are still likely to accompany discharges to surface waters and infiltrate to groundwater. To address this, DOE should consider use of Low Impact Development techniques[1] during the proposed project in order to 31.8 reduce stormwater volumes and thus mimic natural conditions as closely as possible. These techniques lessen the impacts of stormwater runoff from impervious surfaces such as paved roads, parking lots, and roofs and can also provide energy and other utility savings. As the DEIS indicates that construction of 31.9 the new facility will disturb up to 150 acres of land, a National Pollutant Discharge Elimination System (NPDES) permit from the EPA for the project will also be required. Other measures to conserve energy and resources may include those under the Energy Independence and Security Act of 2007. The EPA 31.10 Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act can be accessed online. In addition to strategies outlined in this guidance, it will also be useful to consult the Idaho Department of 31.11 Environmental Quality (IDEQ) on measures to take to manage stormwater and protect water quality in the project area.

Recommendations:

31.12
- *The final EIS should include updated information on the NPDES permit application process and measures to protect water quality.*

31.13
- *Continue to work with the IDEQ and tribes that may be affected by the project to assure that state and tribal water resources are protected and used wisely.*

31.14
- *Include the Energy Independence and Security Act of 2007 among other applicable Federal laws and regulations, and update the list of required permits for the project with inclusion of the* 31.15 *NPDES permit because the project activities would disturb one or more acres (150 acres).*

[1] http://www.epa.gov/owow/NPS/lid/

Air Quality Impacts

The DEIS describes current air quality conditions in the project area and indicates that the INL as a whole is designated as "attainment" or "unclassified/attainment" (p. 3-92). The DEIS also indicates the INL is currently a major source of hazardous air pollutants or HAPs (p. 3-101) and that the three fuel oil-fired boilers used to generate steam for heating several of the facility buildings including the ECF, and four large Emergency Diesel Generators are the major sources of non-radiological air emissions at the NRF (p. 3-111). Other sources of criteria, toxic, and HAPs in the analysis area include miscellaneous small gasoline, diesel, and propane combustion sources, and miscellaneous chemical usage.

31.16 While the DEIS provides valuable air quality information and data, including evaluation of HAPs and greenhouse gas emissions, the documentation of the modeling results is lacking. Appendix E of the DEIS goes into great detail about the inputs used in the various models, but nowhere does it report on the outputs of these models. Appendix E should include actual model outputs and a table that summarizes air quality impacts for the three different scenarios. In addition, the DEIS does not include emissions from the various scenarios, either reported individually or in comparison to each other to support the overall conclusion that air emission impacts are insignificant. The model output results that led to that conclusion would be useful.

31.17 Even though current concentrations of criteria pollutants within the project area are below National Ambient Air Quality Standards, there is potential for significant air emissions from project construction due to fugitive dust releases during ground-disturbing activities, as well as cumulative impacts when considering surrounding activities such as road construction, regular traffic on dirt roads, and emissions from agriculture and fires. The DEIS indicates, for example, that during new facility construction (3 years), daily traffic to and from the NRF would be expected to increase up to 6 percent and NRF employees, some of whom may be sensitive to air quality conditions, are expected to increase from the current number of 1370 to 2180.

Recommendations:

- 31.18 *The final EIS should include modeling output data to show that the proposed project would not result in any significant increase in criteria, toxic and Prevention of Significant Deterioration air pollutant emissions.*
- 31.19 *Maximum implementation of mitigation measures described in the DEIS to reduce emissions associated with the proposed project activities.*
- 31.20 *Monitoring of air quality conditions on site and taking corrective actions to prevent local air quality deterioration. Monitoring strategies tailored to local conditions would ensure that localized air quality impacts do not exceed standards when area-wide and/or long-term monitoring data may show compliance with air quality regulatory requirements.*
- 31.21 *Continued coordination with other entities in the area, especially IDEQ and affected tribes, to assure emissions due to the proposed action are reduced over the project lifespan (40 years).*

Impacts of Climate Change:

Section 3.6 of the DEIS discusses greenhouse gases (GHGs) and climate change and indicates that there has been overall declining trends in emissions as inventoried at both INL and the proposed project area between 2008 and 2012 (p. 3-111, 3-117). We thank you for the data provided and efforts made to reduce emissions; however, the GHG inventories for 2013 and 2014 were not included in the DEIS for review. The DEIS indicates that because of the proposed action, GHG emissions could increase due to worker commuting, purchased electricity, operation of construction equipment, and use of diesel generators and fuel oil-fired boilers for heating (p. S-73). In addition, continued climate change could impact the proposed project, posing threats to infrastructure and higher risks to worker health and safety through increased frequency and severity of wildfires, as well as persistent drought leading to power disruptions and increased cooling demands in summer months.

Recommendations:

31.22
- *The final EIS should include all GHG emission inventories from 2008 to 2014 and an updated analyses of climate change impacts. The INL, including NRF, has the potential to emit greater than 100,000 MT CO_2 emissions per year and is, therefore, subject to the mandatory reporting requirements (p. 3-100).*

31.23
- *Consider the approaches for climate impact assessment outlined in the Council on Environmental Quality's current "Revised Draft Guidance for Greenhouse Gas Emissions and Climate Change Impacts[2]."*

31.24
- *Implement practicable mitigation opportunities for reducing GHGs during the proposed project period, consistent with Executive Order 13514[3] and other federal, state and local requirements to limit GHG emissions.*

Impacts on Ecological Resources

The DEIS discusses the proposed project's impacts to ecological resources (p. 4-52) and indicates that vegetation removal, habitat fragmentation, and ground disturbance would affect plant communities, migratory birds, and other wildlife species of concern, with most impacts to these resources occurring during new facility construction (p. 4-62). In particular, there would be habitat alteration for sage grouse (candidate species for listing under the Endangered Species Act) and pygmy rabbits, loss of native grasslands and sagebrush steppe habitats, and potential impacts to nesting migratory birds (p. 4-53). Some of the impacts would be indirect, while others would be direct, cumulative and unavoidable.

While we appreciate the avoidance measures of limiting the project footprint and using previously disturbed areas, we note that clearing and grading during construction would result in complete removal of vegetation on nearly 140 acres at location 3/4 or 6. Of the 140 acres, less than half (40 acres) would remain permanently developed for facilities and infrastructure. Crested wheatgrass and the Big Sagebrush plant communities would sustain the largest losses. Such habitat loss and fragmentation would have direct impacts on wildlife (loss of cover and food, displacement, increased noise, etc.), tribal resources (ethobotanical plants, wildlife), soil (exposure, erosion, sedimentation, noxious weeds), and potentially mortality of small mammals, lizards, and raptors that occur in construction locations. Given that wildlife (e.g., sage grouse) and vegetation of concern (e.g., sagebrush steppe) use and occur in the project area, respectively, impacts to those species should be avoided, minimized and mitigated.

Recommendation:

31.25
- *Continue to work with the U. S. Fish and Wildlife Service and the Idaho Department of Fish and Game to determine the level of risk to vegetation and wildlife species and identify effective*

[2] https://www.whitehouse.gov/sites/default/files/docs/nepa_revised_draft_ghg_guidance_searchable.pdf
[3] http://www.epa.gov/greeningepa/practices/eo13514.htm

measures to reduce the risks and protect species. The final EIS should include the outcomes of this work with the agencies.

Seismic Risk

The DEIS discusses seismic hazards at the INL and NRF (p. 3-23) and indicates seismic hazards could affect buildings, structures, cranes, water pools, infrastructure systems, and fuel handling equipment, resulting in failure of structures, systems, and components and causing potential hazards to workers, public safety, and the environment due to potential release of radioactive or hazardous materials into the environment (p. 4-19). The DEIS also states that a sensitivity analysis was completed for the NRF using existing data and that the analysis showed little change from ground motion levels in the 2000 Probabilistic Seismic Hazard Analysis (PSHA).

31.26 It is not clear what those ground motion levels were in 2000 and changes observed after sensitivity analysis, and what the levels would be after construction of the proposed new facility.

31.27 While we appreciate that additional geologic characterization will be done to update the 2000 PSHA, a summary of the 2000 PSHA and related sensitivity analyses should be included in the EIS.

Recommendation:

- 31.28 *The final EIS should include summary results of the 2000 PSHA and related sensitivity analyses.* 31.29 *If construction and operation of the new facility would significantly increase seismic risk, then the EIS would need to include measures to minimize impacts due to that risk and cumulative risk due to other projects in the area.*

U.S. Environmental Protection Agency Rating System for Draft Environmental Impact Statements Definitions and Follow-Up Action*

Environmental Impact of the Action

LO – Lack of Objections
The U.S. Environmental Protection Agency (EPA) review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC – Environmental Concerns
EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce these impacts.

EO – Environmental Objections
EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no-action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU – Environmentally Unsatisfactory
EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

Adequacy of the Impact Statement

Category 1 – Adequate
EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis of data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2 – Insufficient Information
The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses or discussion should be included in the final EIS.

Category 3 – Inadequate
EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the National Environmental Policy Act and or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

* From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment. February, 1987.

Response to Comment Document #31

Background

In April 2016, representatives of the Naval Nuclear Propulsion Program (NNPP) met with representatives of Region 10 of the Environmental Protection Agency (EPA) to consult on the planned responses to EPA comments in Comment Document #31. The agreements and commitments resulting from the meeting are provided in Appendix B. For completeness, additional technical information related to the response to Item #31.9 (technical paper titled “An Evaluation of the Need for a General Permit for Storm Water Discharges at the Naval Reactors Facility”), is included at the end of the Response to Comment Document #31.

Item #31.1:

A Mitigation Action Plan (MAP) will be developed in accordance with DOE requirements at 10 C.F.R. § 1021.331. DOE requirements specify that a MAP be prepared that addresses mitigation commitments expressed in the ROD prior to taking any action directed by the ROD that is the subject of a mitigation commitment. Per 10 C.F.R. § 1021.331(d), copies of the MAPs will be available for inspection in appropriate DOE public reading rooms and will be available upon written request. Comments on the MAP will not be solicited; however, any comment received will be considered.

The MAP will be used to track mitigation commitments. The MAP would explain the planned mitigation measures and the monitoring needed to ensure compliance. These measures are expected to include actions identified during consultation with agencies (Appendix B), and actions where credit is taken for reducing impacts. The expected mitigation measures are listed in Chapter 6 of the EIS.

Item #31.2:

Refer to the responses to Items #31.5 through 31.25.

Item #31.3:

Refer to the responses to Items #31.13 and #31.21.

Item #31.4:

Refer to the responses to Item #31.25.

Item #31.5:

There are no springs or local drainages (e.g., streams or creeks) on or near NRF property that could be impacted by construction activities. Natural water features are described in Section 3.4.1. Section 4.4.3 in the Draft EIS describes alternative management practices for construction storm water that would 1) keep storm water on the construction site, and 2) discharge storm water to the Industrial Waste Ditch (IWD). Therefore, surface runoff from construction activities would not carry sediment or pollutants to surface waters such as rivers, lakes, or streams (also see response to Item # 31.9 below). As discussed in Section 4.4.3, pollutants that may be present in runoff water will not impact the underlying aquifer during construction due to best management practices.

Upon further review of EPA’s “Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act” and to improve efforts to incorporate low impact development techniques, the NNPP no longer intends to discharge construction storm water to the IWD. The NNPP would manage the construction storm water on-site using low impact development techniques such as grading and local infiltration, evapotranspiration, silt fencing, and infiltration basins. Section 4.4.3 of the Final EIS reflects this change.

Item #31.6:

The potential increase in discharge volume to the IWD during construction reported in the Draft EIS is about 5 million gallons per year, not 17 million gallons as indicated by the EPA comment (see Table 4.4-5 in Section 4.4.3 of the Draft EIS). This increase would result in only small impacts to sedimentation and erosion in the IWD and small impacts on water seepage to the perched water zone.

As discussed in the response to Item #31.5, the NNPP no longer intends to discharge construction storm water to the IWD. The NNPP would manage the construction storm water on-site using low impact development techniques such as grading and local infiltration, evapotranspiration, silt fencing, and infiltration basins. In addition, since the Draft EIS was published, water pool design and leak testing methodology has been further developed. The preferred method for managing water used to leak test the pools is to move it between gated sections of the pool and not discharge the water to the environment. Alternative methods would be to discharge the water from leak testing the pools (up to 5 million gallons) to the sewage lagoons or to the IWD during the last year of construction. The preferred location for discharge is to the sewage lagoons (shorter distance, high capacity). Discharge to the IWD would be the last choice. This discharge would occur over a short period of time (about 6 days) but, in general, is not expected to exceed the infiltration capacity or the maximum flow distance (1.8 miles) previously recorded for the IWD. The permitted annual discharge rate for the IWD would not be exceeded. Section 4.4.3 reflects this potential discharge of water for pool leak testing.

Item #31.7:

The increase in water use during construction reported in the Draft EIS is 21,550,000 gallons per year over the NRF baseline, not 62,830,000 gallons as indicated by the EPA (see Table 4.4-6 in Section 4.4.3).

The EPA stated that water use during construction could “exacerbate seepage that could in turn facilitate migration of contaminants to the Snake River Plain Aquifer.” This comment seems to equate water use with water discharge. With the exception of the potential 5 million gallon discharge of clean pool leak test water to the IWD during the last year of construction (Item #31.6), none of the water that is used is expected to be available to infiltrate into the Snake River Plain Aquifer. For example, the increase in potable water use would be consumed as drinking water, water used to make concrete would be retained in the concrete or evaporated, and water used for the final fill of pools would be contained in the pools or evaporate. For construction processes such as dust control, soil and engineered fill compaction, or landscaping, the water would evaporate, be retained (e.g., soil compaction), or used by plants in the transpiration process (see Section 4.4.3). Therefore, the potential impact of contaminant migration to the Snake River Plain Aquifer will be significantly less than under the assumption that the volume of water used during construction activities is the same as the volume of water discharged to the environment.

Items #31.8:

The design of the storm water management system for the New Facility Alternative has matured since publication of the Draft EIS. Section 4.4.3 reflects these changes and describes compliance with Section 438 of the Energy Independence and Security Act and the use of low impact development techniques.

Item # 31.9:

Construction will disturb up to 150 acres of land; however, the project will not discharge to the Big Lost River which is the National Pollutant Discharge Elimination System (NPDES) permit driver. This is stated in Section 4.4 and supported in Section 3.4.1.4. Additional evidence and rationale to support this position is provided in a technical paper, which is attached at the end of this document. Consultation with EPA on the justification for not needing a NPDES permit is documented in Appendix B.

Item #31.10:

Refer to the response to Item #31.8.

Item #31.11:

The NNPP will continue to monitor IWD effluent and groundwater constituents and report to the IDEQ per requirements as identified in Section 4.4.3. The IDEQ does not regulate methods of storm water management that are not related to use of the IWD.

Item #31.12:

See response to Item #31.9 on the need for a NPDES permit for construction storm water. See Section 4.4.3 for measures to protect water quality.

Item #31.13:

Both IDEQ and the Shoshone-Bannock Tribes were invited to review and comment on the Draft EIS to get their input and concerns on the project. Responses to their comments are included in Appendix G. No concerns over water resources were identified in those comments. IDEQ will be consulted on water resources according to permit requirements, state law, and as described in Item #31.11 and Appendix C.

NNPP provides IDEQ and the tribes with the annual Environmental Monitoring Report to keep them informed on the status of water resources and other environmental aspects at NRF. NNPP will continue providing this information to IDEQ and the tribes.

Item #31.14:

The Energy Independence and Security Act of 2007 has been included with applicable federal laws and regulations in Appendix C.

Item #31.15:

Refer to the response to Item #31.9.

Item #31.16:

Air quality modeling results and the air quality impacts from the project are provided in Section 4.6. A comparison of the air quality impacts for the project alternatives is in Section 2.6, Table 2.6-1. Air quality impacts for the affected environment are in Section 3.6. The modeling results are used to support the overall conclusion that air emission impacts are insignificant (see Section 4.6). The emissions for the INL and project sources are in Appendix E of the Draft EIS. The location of the modeling results and emissions in the Draft EIS are provided for the affected environment and project alternatives in Table 1.

Table 1: Location of Air Quality Modeling Results and Emissions in Draft EIS

Affected Environment	**Draft EIS Section**	**Draft EIS Table**
INL (including NRF)	3.6.3 E.2.1	3.6-7, 3.6-8, 3.6-9, 3.6-10, 3.6-12, 3.6-13, 3.6-14 E.2-5, E.2-6
Expended Core Facility at NRF	3.6.4 E.2.2.1	3.6-15, 3.6-16, 3.6-17, 3.6-18, 3.6-19, 3.6-20, 3.6-21 E.2-7, E.2-8
Project Alternatives	**Draft EIS Section**	**Draft EIS Table**
No Action	4.6.1.3 E2.2.2	3.6-7, 3.6-8, 3.6-9, 3.6-10, 3.6-12, 3.6-13, 3.6-14, 3.6-21 E.2-7, E.2-8
Overhaul Alternative	4.6.1.4 E.2.2.3	
Refurbishment Period	4.6.1.4 E.2.2.3	3.6-8, 3.6-9, 3.6-10, 3.6-12, 3.6-13, 3.6-15, 3.6-16, 3.6-17, 3.6-18, 3.6.-19, 3.6-20, 3.6-21 E.2-7, E.2-8
Post Refurbishment Period	4.6.1.4 E.2.2.3	3.6-8, 3.6-9, 3.6-10, 3.6-12, 3.6-13, 3.6-15, 3.6-16, 3.6-17, 3.6-18, 3.6.-19, 3.6-20, 3.6-21 E.2-7, E.2-8
New Facility Alternative	4.6.1.5 E.2.2.4	
Construction Period	4.6.1.5 E.2.2.4	4.6-1, 4.6-2, 4.6-3, 4.6-4 E.2-11, E.2-12, E.2-15, E.2-18, E.2-22, E.2-24, E.2-26
Transition Period	4.6.1.5 E.2.2.4	4.6-5, 4.6-6,4.6-7, 4.6-8 E.2-28, E.2-29
Operational Period	4.6.1.5 E.2.2.4	4.6-5, 4.6-6,4.6-7,4.6-8 E.2-28, E.2-29

Parameters for new facility construction that affect inputs to the air quality models have changed based on updated design/construction information. The construction emissions have been recalculated based on the updated inputs, and the air quality models (AERMOD, CALPUFF, and VISCREEN) have been redone. The revised results are included in the Final EIS consistent with the Draft EIS sections described above. IDEQ and the National Park Service have been consulted on these changes. This consultation is documented in Appendix B.

Item #31.17:

As described in Section 4.6.1.5, projected emissions due to construction do not result in pollutant concentrations that are above regulatory limits, even when modeled cumulatively with INL facilities (see modeling results in Tables 4.6-1, 4.6-2, and 4.6-3). This includes fugitive dust releases during ground disturbing activities and traffic emissions (see Appendix E, Section E.2.2.4 for construction emissions). Surrounding activities such as road construction, traffic on dirt roads, and emissions from agriculture and fires are intermittent/unpredictable sources and were not included in the cumulative model. As described in Section 3.6.2.1, air quality for the INL is categorized as “attainment,” “better than national standards,” or “unclassifiable/attainment” depending on the criteria pollutant, and as a Prevention of Significant Deterioration (PSD) Class II area (an areas with reasonable or moderately good air quality while still allowing moderate industrial growth). Therefore, intermittent activities in surrounding areas are not expected to cause cumulative pollutant concentrations in the Region of Influence to exceed regulatory limits, or to cause health problems for sensitive employees.

Item #31.18:

Refer to the response to Item #31.16.

Item #31.19:

For the proposed action, complying with permits, following standard procedures and management practices, and implementing best management practices, when applicable, are considered to be part of normal operations and are not included in Chapter 6 as mitigation measures. Applicable Idaho Administrative Procedures Act (IDAPA) rules for control of air pollution and air permit requirements will be followed.

The changes to new facility construction include efforts to minimize the production of nitrates and sulfates such as use of ultra-low sulfur diesel fuel, limiting engine idling, and using electrical power (as opposed to diesel generators) for temporary heat and lighting the facility. These efforts were added to Chapter 4.6.1.5 for the Final EIS. In addition, either electrical power or EPA certified Tier 4 engines will be used for powering the batch plants. Use of Tier 4 engines was added to Chapter 6 as a mitigation measure in the Final EIS.

Item #31.20:

NNPP performs quarterly on-site inspections and semi-annual reporting of visible stationary source emissions and fugitive dust per the INL Tier I (Title V) Operating Permit requirements and Idaho Air Rules. Fugitive dust monitoring would be performed during construction according to permit requirements. This was added to the EIS. Personnel monitoring as required by 29 CFR 1926 or other regulatory requirements will be conducted as appropriate.

As described in Section 3.6.2.1, the Title V permit is issued by IDEQ, and its purpose is to ensure adequate control of emissions to protect public health and safety. The INL has applied to IDEQ for a synthetic minor, site-wide, air quality permit to construct with a facility emission cap component. The NNPP will continue to comply with applicable air quality permits and Idaho Air Rules throughout the life of the project.

Item #31.21:

NNPP will continue to work on reducing greenhouse gas (GHG) emissions, as required by Executive Order (EO) 13693, *Planning for Federal Sustainability in the Next Decade*. There are no other emission reduction requirements associated with the project. However, air quality permits are issued by IDEQ and IDEQ will continue to be consulted as required over the project lifespan. All air quality permit requirements will be met over the project lifespan. NNPP would comply with any new air regulations that require emissions reductions over the project lifespan.

NNPP provides IDEQ and the tribes with the annual Environmental Monitoring Report to keep them informed on the status of air emissions and other environmental aspects at NRF. NNPP will continue providing this information to IDEQ and the tribes.

Item #31.22 and Item #31.23:

Sections 3.6.3.5, and 3.6.4.4 were updated to include GHG emission inventories from 2010 to 2015 and the 2008 baseline. The first Site Sustainability Plans for INL and NRF were issued in 2010 and GHG inventories had not been established for NRF prior to that. Therefore, a 2009 inventory is not included.

The climate change impact analyses for current conditions in Sections 3.6.2.2, 3.6.3.5, and 3.6.4.4 were updated to better reflect the CEQ “Revised Draft Guidance for Greenhouse Gas Emissions and Climate Change Impacts” (CEQ 2014) and recent climate change literature.

The climate change impacts in Section 4.6.1 were updated to better reflect the CEQ “Revised Draft Guidance for Greenhouse Gas Emissions and Climate Change Impacts” (CEQ 2014).

Item # 31.24:

For the proposed action, complying with permits or regulations, following standard procedures and management practices, and implementing best management practices, when applicable, are considered to be part of normal practices and are not included in Chapter 6 as mitigation measures.

Section 4.6.1.5 of the EIS includes a statement that design and construction strategies would be developed to optimize energy performance for a new facility which would function to reduce Scope 2 GHGs (consistent with EO 13693). Reference to compliance with Federal High Performance and Sustainable Building (HPSB) Guidance Requirements (Guiding Principles), and an example of using refrigerants with lower global warming potential and lower ozone depletion potential were added to the Final EIS.

Item #31.25:

The NNPP has been proactive in coordination with the U.S. Fish and Wildlife Service (USFWS) and Idaho Department of Fish and Game (IDFG) and will continue this coordination as needed. Documentation of informal consultation with the USFWS regarding listed plants and animals is provided in Appendix B. Section 3.5 identifies threatened, endangered, and sensitive plants and animals that could occur on the INL and NRF property and conservation measures that are currently in place for those species. Section 4.5 also discusses conservation measures and best management practices. For example:

- DOE and USFWS cooperatively developed the greater sage-grouse candidate conservation agreement. NRF is subject to this agreement and it will remain in place even though the USFWS ruled that the bird did not warrant listing under the Endangered Species Act. The greater sage-grouse candidate conservation agreement has best management practices that include re-establishing sagebrush in natural vegetation communities that have been disturbed by construction.

- Migratory birds are protected through compliance with all provisions of the Migratory Bird Treaty Act, with a USFWS migratory bird take permit, and with the INL Migratory Bird Conservation Plan.
- A bat monitoring plan was implemented to learn more about bat ecology on the INL. A bat protection plan for the INL and NRF is being developed in cooperation with the IDFG and the USFWS in response to the rapid spread of white nose syndrome in eastern and northeastern bat populations that are susceptible to the disease.

Item #31.26, #31.27, and #31.28:

Section 3.3.3 has been revised to include a summary of the Probabilistic Seismic Hazard Analysis (PSHA) work. Section 3.3.3 has been revised to indicate that the sensitivity analysis showed that the 2011 and 2000 hazard analysis resulted in similar ground motion results.

Item #31.29:

As described in Section 4.3.3, the construction and operation of a new facility would decrease the impacts from seismic hazards (to small) since structures, systems, and components important to safety would be designed to the appropriate natural phenomena hazard category using DOE 2008a based on the potential for radiological release consequences calculated using the process provided in DOE 2014g. The impact of a design basis earthquake to ECF, without additional refurbishment or upgrades, would be moderate because continuing to operate an aging facility could increase the potential seismic hazard. Therefore, constructing and operating a new facility would lower the impact from seismic hazards and represents the measure taken to minimize impacts from seismic hazards.

An Evaluation of the Need for a General Permit for Storm Water Discharges
at the Naval Reactors Facility
(Revision 1)

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1.0 Introduction

The Naval Nuclear Propulsion Program (NNPP) was established in 1948 and is a joint U.S. Navy and U.S. Department of Energy organization with responsibility for all matters pertaining to naval nuclear propulsion from design through disposal. A crucial component of the NNPP mission, naval spent nuclear fuel handling, occurs at the end of each nuclear propulsion system's useful life or when naval nuclear fuel has been depleted. The NNPP oversees the removal of the naval spent nuclear fuel from the reactors and its transport to the Naval Reactors Facility (NRF) where it is examined and processed for transfer to an interim storage facility or geologic repository. Currently, spent nuclear fuel handling capabilities are provided by the Expended Core Facility (ECF) at NRF. These facilities are within the boundaries of the Idaho National Laboratory (INL) in southeastern Idaho. To ensure that these capabilities are available through at least 2060, the NNPP is evaluating options for recapitalizing ECF.

In 2015, NNPP published a Draft Environmental Impact Statement (DEIS) for recapitalizing the spent nuclear fuel handling capabilities of ECF at NRF. The affected environment section of the DEIS contains a discussion of the INL National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges from Construction Sites. The discussion includes the determination that NRF does not discharge storm water to the Big Lost River system (i.e., the Big Lost River, Playas and Sinks); therefore, NRF does not operate under the INL general permit (Section 3.4.1.4).

During the public comment period for the DEIS, the Environmental Protection Agency (EPA) commented that a NPDES permit will be required for the project because construction will disturb up to 150 acres of land. Based on this comment and the boundaries of the INL storm water corridor (see discussion below), NNPP decided that additional information supporting the determination that NRF does not discharge to the Big Lost River should be provided to the EPA in order to obtain concurrence on this matter. This document provides the information needed to support the determination that storm water discharges from any industrial or construction activity at the NRF Site, which includes the NRF Administrative Area and the NRF Industrial Complex, would not reach the Big Lost River and therefore NRF is not subject to NPDES permit requirements.

1.1 Background Information

1.1.1 Alternatives in the DEIS

The DEIS evaluates three alternatives for recapitalizing spent fuel handling capabilities of ECF at NRF: 1) No Action Alternative, 2) Overhaul Alternative, and 3) New Facility Alternative. All work associated with the No Action and Overhaul Alternatives would be performed outside of the INL storm water corridor (see discussion on the INL storm water corridor in Section 1.1.4 below). The New Facility Alternative evaluates construction and operation of a new facility at one of two potential locations at NRF. Locations 6 and 3/4 are situated within the NRF Administrative Area (Figure 1). Location 6 is located to the west of Washington Boulevard outside of the INL storm water corridor and Location 3/4 is located to the east of the NRF Industrial Complex, within the INL storm water corridor. Therefore, the discussion in Section 2 below focusses on the New Facility Alternative at Location 3/4 and the NRF Administrative Area.

1.1.2 INL Hydrologic Units and Watersheds

The U.S. Geological Survey (USGS) describes hydrologic units using numeric Hydrologic Unit Codes (HUCs). The HUC system is a hierarchical system; the more numerical digits included in the code, the more specifically it defines the hydrologic unit (e.g., eight digit hydrologic unit codes represent a "sub-basin" level, 10 digit hydrologic unit codes represent a smaller "watershed" level). Three sub-basins associated with the INL contain naturally occurring perennial, intermittent and ephemeral waters; the Big Lost River (HUC 17040218), the Little Lost River (HUC 17040217), and Birch Creek (HUC 17040216). Each of these waters has perennial flows near their headwaters; however, each becomes intermittent or terminates prior to flowing onto the INL due to upstream diversions, variable flows, or high rates of evaporation and infiltration on the Snake River Plain.

The NRF Site, which is located on the INL, consists of a 4,400 acre administrative area that encompasses an 89 acre industrial complex (Figure 1). NRF is wholly contained within a watershed designated HUC 1704021809, which is located within the Big Lost River sub-basin (Figure 2). The sub-basin is a "closed" hydrologic unit (i.e., all water within the sub-basin either evaporates to the atmosphere or infiltrates into the ground, potentially recharging the eastern Snake River Plain aquifer). This watershed is the terminal watershed within the sub-basin (i.e., no storm water flows out of the watershed). The Big Lost River channel enters the southwest corner of the INL near the Radioactive Waste Management Complex and then flows north to pass approximately three quarters of a mile east of the NRF Administrative Area boundary and it terminates in the Big Lost River Playas near Test Area North (Figure 2). A few tributary and non-tributary ephemeral stream channels occur within the watershed. These stream channels typically flow only when large local snow packs on frozen ground melt quickly during rapid warming events. Such events occur infrequently (e.g., on a decade to decades scale). Only the Big Lost River and a few isolated, non-tributary ephemeral stream channels (historic Big Lost River "meander channels") occur on or near the NRF site. No other rivers, streams, lakes, wetlands, or natural surface waters are located on or near the NRF site.

1.1.3 Storm Water Management at NRF

Storm water runoff at NRF is managed in five ways:

1) Most storm water runoff from the NRF Industrial Complex (i.e., within the NRF perimeter fence), which primarily originates from buildings, roads and parking lots, is directed to the NRF Industrial Waste Ditch (IWD) through a series of open unlined ditches and buried culverts. This water is discharged to an open ditch at the IWD outfall in the northwest corner of NRF for evapotranspiration and for rapid infiltration into the subsurface. The remaining storm water runoff infiltrates into the ground within the Industrial Complex or evaporates prior to reaching the IWD outfall. Currently NRF discharges approximately 6 million gallons of wastewater to the IWD each year. Approximately three million gallons of this wastewater is runoff, with most of the remaining discharges to the IWD being related to on-site water softening and reverse osmosis processes.

Discharges to the IWD are regulated by the state of Idaho's wastewater reuse rules (Idaho Administrative Procedures Act (IDAPA) 58.01.17), wastewater rules (IDAPA 58.01.16) and ground water quality rule (IDAPA 58.01.11) under a state of Idaho Industrial Reuse Permit (LA-000155-01). Under this permit, effluent quality is determined monthly through samples collected at the IWD outfall.

2) A small amount of storm water runoff, particularly in the northeast quadrant of the NRF Industrial Complex, is collected into buried culverts that discharge to the NRF sewage treatment lagoons. The lagoons are fully lined and lose water through evaporation only; therefore, the lagoons are not regulated by the Clean Water Act (CWA). The lagoons are not required to be permitted; however, they were constructed in accordance with the state of Idaho wastewater rules (IDAPA 58.01.16).

3) Small amounts of storm water in the NRF Industrial Complex are discharged to shallow injection wells which are governed by the state of Idaho's injection well rules (IDAPA 37.03.03).

4) Storm water runoff from three parking lots in the NRF Administrative Area is directed into two rock-lined detention basins where it is allowed to evaporate (or transpire) to the atmosphere or infiltrate into the subsurface.

5) Storm water runoff in the undeveloped portions of the NRF Administrative Area that have little or no critical infrastructure infiltrates naturally into the subsurface, evaporates, or is used by plants (transpiration).

1.1.4 INL Storm Water Corridor

The CWA requires the regulation of industrial and construction activities that have a reasonable potential of discharging storm water into regulated waters. In the early 2000's, the INL prime contractor used a USGS study (Reference (a)) and additional information (e.g., Reference (b)) to estimate the area of land at the INL that could potentially contribute storm water runoff directly to the Big Lost River (see Figures 1 and 3). Lands shown in blue on Figure 3 have been accepted site-wide as being in the "INL Storm Water Corridor". The INL Storm Water Corridor map is used by INL contractors as an administrative guide for determining when a construction or industrial activity requires a permit for managing potential storm water discharges. The current corridor map (Reference (c)) indicates the western boundary of the corridor near NRF is present along a north-south line along the east perimeter fence of NRF's Industrial Complex (see Figures 1 and 3). Therefore, the eastern portion of the NRF Administrative Area is currently included in the corridor.

In June 2003, the U.S. Department of Energy, Idaho Operations Office, sent a letter to the Environmental Protection Agency (EPA) requesting the removal of three INL sites from the designated INL Storm Water Corridor (Reference (d)) as they did not have a reasonable potential to discharge industrial or construction storm water to the Big Lost River. EPA agreed that these areas did not have a reasonable potential to discharge industrial or construction storm water to the Big Lost River and concurred with termination of permit coverage for these three sites in October 2003 (Reference (e)). EPA's conclusion was based on the 1) the semi-arid conditions at the INL (climate); 2) the distance and the topography between these sites and the Big Lost River or Birch Creek (topology); 3) the porous soil conditions (generally high infiltration rates) present at the INL sites; 4) other hydrologic factors; 5) the observation that none of these sites had ever recorded a release to the Big Lost River (Reference (e)).

2.0 Discussion

As described in Section 1.1.1, portions of the proposed New Facility Alternative construction area at Location 3/4 are in the eastern side of the NRF Administrative Area. Part of the construction area (e.g., parking lots, construction lay-down areas and batch plant) is located on lands mapped within the INL Storm Water Corridor (Figure 4). NRF has proposed to direct storm water runoff associated with construction activities for the New Facility Alternative at Location 3/4 and Location 6 to one of several potential areas around NRF including low-lying areas in the desert surrounding the various construction and staging areas (which include historic meander channels), or to retention basins.

Based on its review of the DEIS, EPA recommended that these construction activities should be conducted under a NPDES General Permit for Storm Water Discharges from Construction Activities. However, NRF Environmental Engineering (EE) has determined that neither the New Facility Alternative Locations (3/4 or 6) nor any other area at the NRF Site (i.e., within the NRF Administrative Area and the NRF Industrial Complex), have a reasonable potential for discharging pollutants to the Big Lost River This determination is based on the following criteria: 1) an evaluation of the physical and hydrologic attributes of the IWD, and 2) criteria similar to those considered by the INL and EPA to justify termination of permit coverage for the three INL sites. The criteria include the following:

- the climatic conditions at or near NRF;

- the distance to and the topography between NRF and the Big Lost River;
- the generally high infiltration rates associated with the soil at and near NRF;
- other hydrologic conditions at or near NRF; and,
- the fact that no releases from NRF to the Big Lost River have ever been recorded in literature or have been observed.

The information used to support NNPP's decision not to pursue a General Permit for Storm Water Discharges from Construction Activities is discussed in Sections 2.1 and 2.2 below.

2.1 Physical and Hydrologic Attributes of the IWD

Several different strategies have been proposed to manage storm water runoff associated with the New Facility Alternative. Among these is the potential of discharging storm water to the NRF IWD. A large amount of information has been gathered relative to the IWD over the past 25 years.

As described in Section 1.1.3, storm water from the NRF Industrial Complex is primarily discharged to the IWD. The IWD has been used by NRF since 1953 for the disposal of non-radioactive, non-sewage, industrial wastewater, and storm water within the NRF Industrial Complex. It consists of two discrete parts. The interior portion of the IWD system is comprised of a network of buried pipes, culverts, and open channels within the NRF Industrial Complex. This network discharges storm water and process water into open ditches and buried culverts, which flows through an environmental monitoring station vault, and ultimately outfalls to the exterior IWD at the northwest corner of NRF.

The exterior portion of the IWD is an unlined, open channel comprised of two historical “meander channels” that have been artificially joined. These old channels are remnants of the natural evolution of the Big Lost River fluvial plain over tens of thousands of years. The IWD meander channels extend north-northeasterly approximately seven miles from the northwest corner of NRF, terminating in the desert west of the Big Lost River (Figure 5). There is no direct hydrological connection between the IWD meander channel and the Big Lost River. The portion of the IWD channel used for wastewater disposal is physically blocked approximately 3.2 miles downstream of the outfall by a 10-15 foot high berm associated with an old irrigation ditch that was built in the early 1900's as part of the Carey Act, Powell Irrigation Tract and was abandoned in the 1920s (See Figures 6a and 6b), (Reference (f)). Water is typically present in the IWD channel only in the first 300 feet and is often present to 1500 feet (see Figure 7). Since the IWD was put into service, no discharges associated with activities at NRF have been observed flowing more than 1.8 miles from the outfall.

In 1992, the NRF Site contractor performed a review of federal and state regulations that potentially pertained to the IWD (Reference (g)). As a result of the review, the contractor concluded that because the IWD did not discharge to the Big Lost River, it did not fall under the jurisdiction of the CWA. Based on this assessment, it was concluded that: 1) a NPDES permit was not necessary to continue discharges of nonhazardous effluent to the IWD; 2) the IWD did not qualify as a wetland that would fall under the jurisdiction of the CWA; 3) that a Section 404 permit from the Army Corp of Engineers was not necessary to conduct routine maintenance (e.g., dredging).

In addition, in the fall of 1992 the U.S. Department of Energy, Idaho Field Office (DOE-ID) consulted with the EPA to clarify the areas at the INL that should reasonably be considered for or excluded from NPDES permitting (Reference (h)). DOE-ID issued a letter to EPA Region 10 summarizing the factors that should be considered for including or excluding an area from needing a NPDES permit, including: 1) aridity, 2) intermittent streams which do not flow for long periods of time, 3) the Big Lost River and tributaries with defined channels that directly connect to the Big Lost River, and the Big Lost River Playas, and 4) the presence of intermittent streams without defined channels that do not connect to the Big Lost River. In the letter, DOE-ID concluded that at least three facilities at the INL, including NRF:

"…would have runoff that would be directed to isolated, intermittent streams and would not be subject to NPDES permitting requirements…because the potential to discharge to "waters of the United States" is practically non-existent at the above facilities…For other NPDES permitting purposes, runoff from the above facilities into isolated, intermittent streams would not be considered as runoff into "waters of the United States."

2.2 Criteria Considered by EPA and the INL

2.2.1 Climatic Conditions

NRF receives approximately 8.5 inches of precipitation annually (Reference (i)). The highest precipitation months are May and June. Since 1972, the highest monthly precipitation at the Central Facilities Area, which is located on the INL approximately five miles south of NRF, was in June 1995 (4.64 inches for the month – 2.22 inches over a nine day period during the month; and, 1.79 inches during a 24-hour period centered about the 5th day of the month). The greatest one-hour precipitation event recorded on the INL was 0.71 inches on June 5th, 1995 (Reference (i)). For comparison, the estimated 50- and 100-year, 24-hour rain events for NRF are 2.10 and 2.70 inches of precipitation (Reference (j)).

Because of relatively hot summers usually accompanied by low humidity and precipitation, the pan evaporation rate for NRF is approximately 35 inches of water per year (Reference (k)), the bulk of which occurs during the hotter months of June, July, and August. The high pan evaporation rate at NRF supports conditions where a large proportion of any precipitation event, whether due to sustained rains or intense, short-duration thunderstorms, will eventually evaporate to the atmosphere either directly from the land surface or through capillary suction in the shallow soil column, or through plant transpiration. The remainder of the precipitation will generally infiltrate into the porous soils. Spring snowmelt runoff occurs when evapotranspiration and infiltration rates are generally lower; hence water is more susceptible to pooling on the land surface or becoming overland flow. However, because of the relatively flat topology surrounding NRF and localized surface depressions, most snowmelt runoff does not flow far from its point of origin prior to evaporating/transpiring or infiltrating into the soil.

Overall, climatic conditions at NRF significantly reduce the potential that storm water or snow melt runoff from construction activities in the NRF Administrative Area would reach the Big Lost River.

2.2.2 Distance and Topography

The NRF Administrative Area is located on the Big Lost River fluvial plain, approximately three quarters of a mile from the closest reach of the Big Lost River (Figure 1). Both the local and regional ground surface surrounding NRF slope gently to the north, ranging in elevation from 4,870 feet above sea level south of NRF to 4,810 feet above sea level north of NRF (Figure 5). NRF has proposed that storm water runoff associated with construction activities for the New Facility Alternative at Location 3/4 be directed to one of several potential areas around NRF including low-lying areas in the desert surrounding the various construction and staging areas (which include historic meander channels), or to retention basins.

The local land surface around NRF contains numerous localized depressions, mounds and other small geomorphologic features. These features capture much of the overland flow. Computer generated flow lines show that rather than long, unidirectional flow paths towards the Big Lost River, surface water runoff near NRF will generally flow to nearby small local depressions (Figure 8). In addition, the lands near NRF are covered with a mix of shrubs, grasses and forbs that slow and filter overland flow; thereby further reducing the potential of storm water discharges reaching the Big Lost River.

Furthermore, Figure 4 shows a topographic high area that lies just east of the NRF Industrial Complex. The area inside the yellow lines shown on this figure is elevated approximately 2 to 3 feet above the surrounding areas and is bordered on the north and northwest by a low basalt ridge. Several basalt outcrops occur towards the southeast side of the area. Some of these outcrops rise 10 feet above the surrounding terrain. The entire area inside of the yellow lines shown on Figure 4 is conspicuously lacking any indications of the presence of old meander channels due to its relative elevated position compared to the surrounding terrain. This area acts as a barrier to water flow towards and from the Big Lost River. Any water flow within this area would be towards NRF and away from the INL Storm Water Corridor or into old meander channels that border its east flank.

Aerial photographs taken of the area surrounding NRF (including the proposed construction Location 3/4) show a mosaic of old meander channels located east and northeast of NRF, between NRF and Lincoln Boulevard (see Figures 4 and 9). Several prominent channels are visible on these aerial photographs. These are the same channels discussed in the paragraph above. The channels are 12 to 20 feet across and 6 to 8 feet deep, dry and show signs of advanced wind-/rain-erosion (e.g., the banks are nearly level with the surrounding terrain, the channel is rounded and not vertical like the current active Big Lost River channel is, and few to no obvious stream-erosion features remain – i.e., signs of active water flow). The age of these meander channels is estimated to be greater than 15,000 years (Reference (l)). These channels coalesce with one another and intersect an old irrigation canal, approximately 2 miles north of NRF (see Figures 9, 10a and 10b). Field evaluations confirmed that this canal does not physically extend to or connect with the Big Lost River. Any overland flow or flow within existing channels that could occur due to storm water runoff from NRF would essentially flow parallel to the Big Lost River and never reach it (Figure 5).

It should be noted that many of the meander channels on or adjacent to NRF are expressed as “tributaries” and/or “intermittent streams” on various maps, including USGS topographical maps, and INL geographical information system (GIS) figures and in Reference (h). Based on formal inspections and informal field observations in the area around NRF, with the exception of the Big Lost River, there are no tributaries or intermittent streams on or adjacent to NRF. Depending on the given map or figure, the features shown as “tributaries” and/or “intermittent streams” near NRF are actually old meander channels and/or historical irrigation ditches not active tributaries or streams.

2.2.3 Soil Infiltration rates

Subsurface sediments at NRF are associated with the Big Lost River fluvial plain, which were deposited during a period of time that was considerably wetter than the climate of today (Reference (l)). At present, the plain is experiencing a dryer climate and reduced deposition.

The Big Lost River fluvial plain is approximately three miles wide near NRF and is generally oriented north-south. The plain is bounded by basalt bluffs, which are located on either side of the plain and rise to a maximum height of approximately 30 feet above the plain. Most of the surface soil near NRF is described as sandy loam or loess. Sediments vary from zero feet to an excess of 60-feet deep at some locations. Subsurface sediments are primarily comprised of interbedded sand, gravel, silt, and clay; this type of soil profile promotes the infiltration of water into the subsurface. Over the past 25 years, NRF has collected data from several sources that supports this observation. This information is discussed below.

Several engineered earthen covers have been constructed around NRF using local materials. These “evapotranspiration” covers are designed to roughly mimic the surrounding soil composition in order promote and maintain healthy native plant communities. By doing so, the covers can mitigate water infiltration to the wastes interred beneath them through the use of a low permeability layer and the process of evapotranspiration associated with the vegetation cover. To assess the effectiveness of the covers in accomplishing this goal, the covers are routinely monitored for soil moisture.

Soil moisture content within the engineered cover at each site is estimated by obtaining measurements from neutron probes via access tubes that were installed on the engineered cover areas. Soil moisture data are used to monitor the depth of the wetting front attributed to percolating water from precipitation. Special efforts are made to perform soil moisture measurements after intense or large sustained precipitation events.

Results from this monitoring show that soil moisture increases rapidly at shallow depths after these precipitation events; typically penetrating the earthen cover about 3.5 feet (Reference (m)). Soil moisture data also show that the level of moisture decreases rapidly during dry periods as evaporation combined with transpiration by the plants draws moisture up from the subsurface (Reference (n)). Since the composition of the earthen material used to construct the covers is similar to the surrounding natural soils, a similar response to precipitation events (particularly rapid infiltration) is expected. Therefore, it is expected that most storm water flow near NRF will do the same (i.e., rapidly infiltrate into and remain in the shallow soil column until most is lost via evapotranspiration) rather than run-off toward the Big Lost River.

Most storm water runoff generated within the NRF Industrial Complex is discharged to the IWD. Bechtel Marine Propulsion Corporation (BMPC) personnel estimate that NRF discharges approximately 3 million gallons of runoff per year, which is about half of the total wastewater discharged to the IWD. During its maximum use (1992), NRF discharged approximately 172 million gallons of water to the IWD (Reference (m)); however, even at these higher discharge rates, water only flowed along IWD channel to a maximum distance of 1.8 miles.

Since the prototypes at NRF were placed into caretaker status in 1990s, discharges to the IWD have declined significantly. Since 2000, NRF discharged between 4.1 and 12.2 million gallons of water per year (Reference (n)), which has resulted in standing water typically occurring in the IWD to a distance of 300 feet and often to 1500 feet from the outfall (see Figure 7) and on rare occasions even further. In 2014, indications of flow in the IWD channel were observed to a distance of 1.2 miles after an extraordinarily wet period (second only to the 1995 event discussed above). Never-the-less, wastewater discharges to the IWD have never been observed reaching the historic earthen berm 3.2 miles downstream of the outfall.

In the early 1990s, NRF conducted an infiltration study at the IWD to determine how infiltration rates varied along different segments of the IWD (Reference (o)). The typical soil column at and around NRF consists of zero to five feet of loess overlying zero to 60 feet of sand and gravel deposits interlayered with thin clay lenses and is analogous to the sediments underlying the IWD. Results indicated that on average the IWD lost approximately 15 inches of water per square unit of channel surface per day due to infiltration and evapotranspiration.

In 1995, the area near NRF experienced a 0.71-inch, 1-hr and a 1.79-inch, 24-hour rain event (Reference (i)). Because the soil's ability to infiltrate water into the subsurface exceeds these extreme precipitation events, no wide-spread flooding was experienced in or around NRF. For the same reason, no wide-spread flooding would be expected to occur during more intense 50-year or 100-year rain events (2.10 in. and 2.70 in. per day, respectively) (Reference (j)), because local infiltration rates (~15 inches per day) exceed these potential precipitation intensities.

If significant storm water runoff were to enter the meander channels located between the New Facility Alternative construction site at Location 3/4 and Lincoln Boulevard, similar rates of infiltration would be expected since these meander channels were formed by the same hydrogeological processes and have the same general physical and sedimentological attributes as the old meander channels associated with the IWD. Therefore, it is improbable that overland flow accumulating in the meander channels would flow very far. This assessment notwithstanding, an inspection of these meander channels has revealed that they are not physically connected to the Big Lost River.

2.2.4 Other Hydrologic Barriers

Lincoln Boulevard is a prominent man-made feature located approximately one-half mile east of NRF and is the major north-south highway on the INL. It was constructed approximately 3 to 5 feet above the surrounding desert terrain (see Figures 11a and 11b) and is situated between NRF and the adjacent reach of the Big Lost River (Figure 9). This highway is approximately 50 feet wide and no culverts pass beneath the roadway between where the Big Lost River flows underneath the highway to the east side of the highway at the Idaho Nuclear Technology and Engineering Center (approximately five miles south of NRF) and where the Big Lost River flows back underneath to the west side of the highway approximately two miles north of NRF. In effect, Lincoln Boulevard acts as a hydrologic barrier to both storm water runoff (i.e., overland flow) and potential flood flows between NRF and the Big Lost River. In conjunction with the other factors discussed above (e.g., topography, distance, infiltration, climate), Lincoln Boulevard provides a significant barrier to overland flow to the Big Lost River due to storm water runoff. Because of this, the closest accessible river reach is approximately 1.5 miles northeast of proposed construction Location 3/4.

Even without the presence of Lincoln Boulevard, the potential would be low for NRF-related storm water runoff reaching the Big Lost River or flood water from the Big Lost River from reaching NRF since NRF does not lie within the Big Lost River 500-year flood plain according to a recent study (Reference (p)). This study reinforces the conclusion that NRF is not located in close hydrologic proximity of the Big Lost River relative to storm water discharges and the probability that NRF will be affected by flooding of the Big Lost River is very low.

2.2.5 No Past Discharges from NRF to the Big Lost River

In nearly 65 years of operations, NRF has never discharged industrial or construction storm water to the Big Lost River. Numerous environmental documents (e.g., Reference (o)) indicate that all past environmental releases have been limited in extent or contained within well-defined boundaries (e.g., the IWD). Historical records have been confirmed by eye witness accounts of long-term past employees during the initial Comprehensive Environmental Response, Compensation, and Liability Act investigations. Localized overland flow has been observed at/near NRF; however, there is no hydrologic evidence that storm water has flowed overland to the Big Lost River from the NRF Site.

3.0 Summary and Conclusion

The DEIS evaluates three alternatives for recapitalizing spent fuel handling capabilities of ECF at NRF: 1) No Action Alternative, 2) Overhaul Alternative, and 3) New Facility Alternative. All activities associated with the No Action Alternative, Overhaul Alternative, and the New Facility Alternative construction site at Location 6 would be performed outside of the INL Storm Water Corridor.

The proposed New Facility Alternative construction site at Location 3/4 will encompass an area of approximately 150 acres. However, any industrial- or construction-related storm water runoff produced from the site will be directed to low-lying areas in the desert (including historic meander channels), or to the NRF IWD.

All evidence indicates that storm water runoff from any location in the NRF Site, including the proposed New Facility Alternative construction site at Location 3/4, will not reach the Big Lost River even during an extreme weather event (e.g., a 50- or 100-year, 24 hours rain event regardless if runoff is directed to low-lying desert areas, to the historic meander channels east of the NRF Industrial Complex, to infiltration basins, or to the IWD north of the NRF Industrial Complex.

Mitigating factors that prevent discharges to the Big Lost River from NRF include the following:

- The distance to the Big Lost River
    - Approximately three-quarters of a mile from the closest Administrative Area boundary;
    - Approximately 7 miles from the IWD outfall to the terminus of the IWD west of the Big Lost River Sinks/Playas); and,
    - 1.5 miles between proposed construction Location 3/4 and the closest accessible reach of the Big Lost River.
- The semiarid conditions at NRF;
- Local topography (e.g., the nearby topographic ridges, historic meander channels and canals that do not extend to the river);
- The porous soil conditions; and,
- The location and elevation of Lincoln Boulevard.

Compared to the INL/EPA analysis of the three INL facilities that have been excluded from the INL Storm Water Corridor map (Reference (c)), there is a much lower probability of NRF-related storm water flowing to the Big Lost River than from the excluded INL facilities (generally due to greater distance from the Big Lost River).

Based on the information provided above, NNPP requests EPA's concurrence that industrial and construction activities occurring at the NRF Site (including the NRF Administrative Area, NRF Industrial Complex and ER Project locations) cannot reasonably discharge to the Big Lost River; therefore, such activities do not require NPDES permits for storm water discharges. Based on EPA's concurrence, NRF will work with DOE-ID to adjust the INL Storm Water Corridor Map to indicate that the NRF Site is not located within the INL Storm Water Corridor.

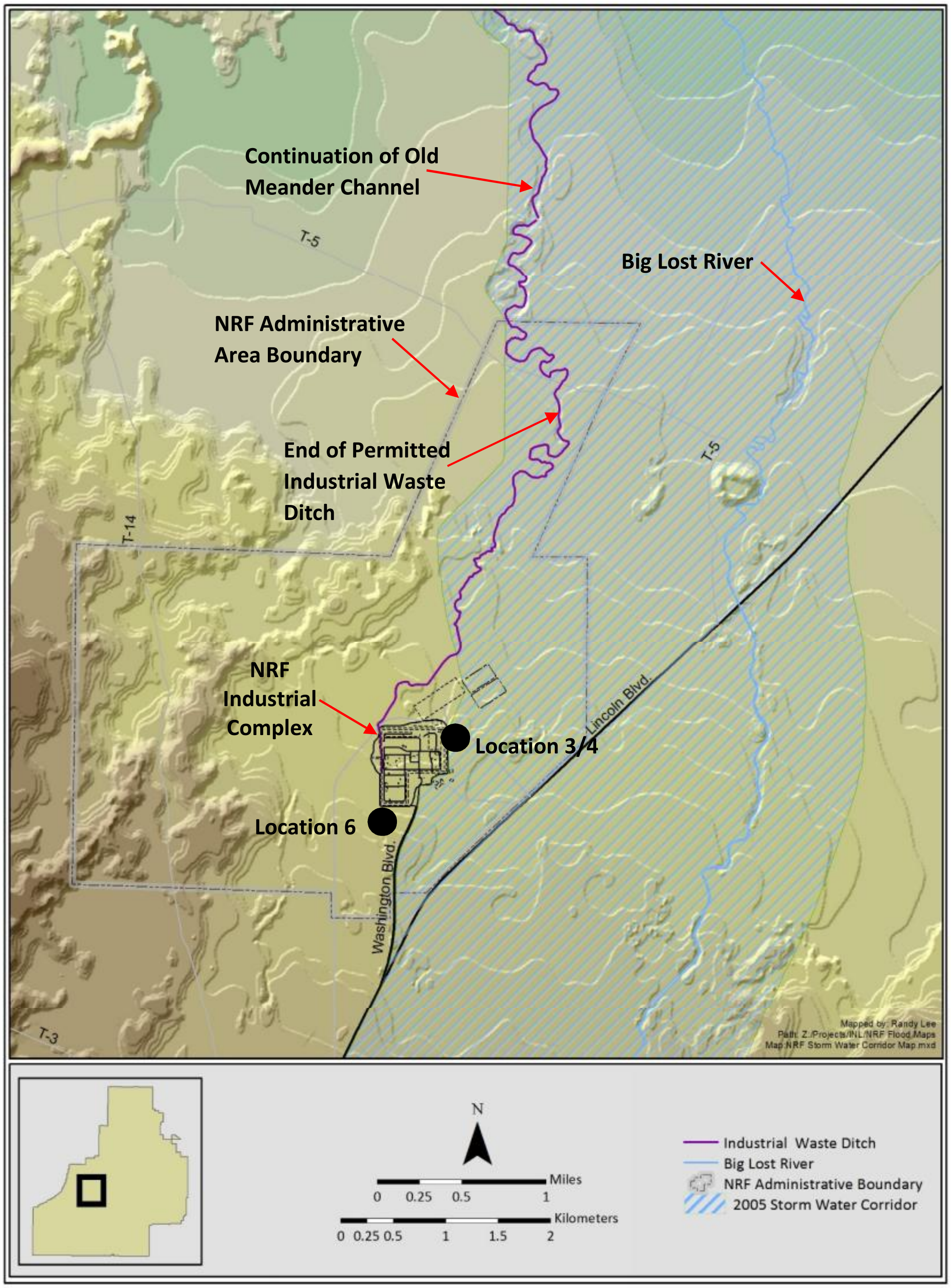

Figure 1. Location of NRF Relative to the Storm Water Corridor and Big Lost River

11

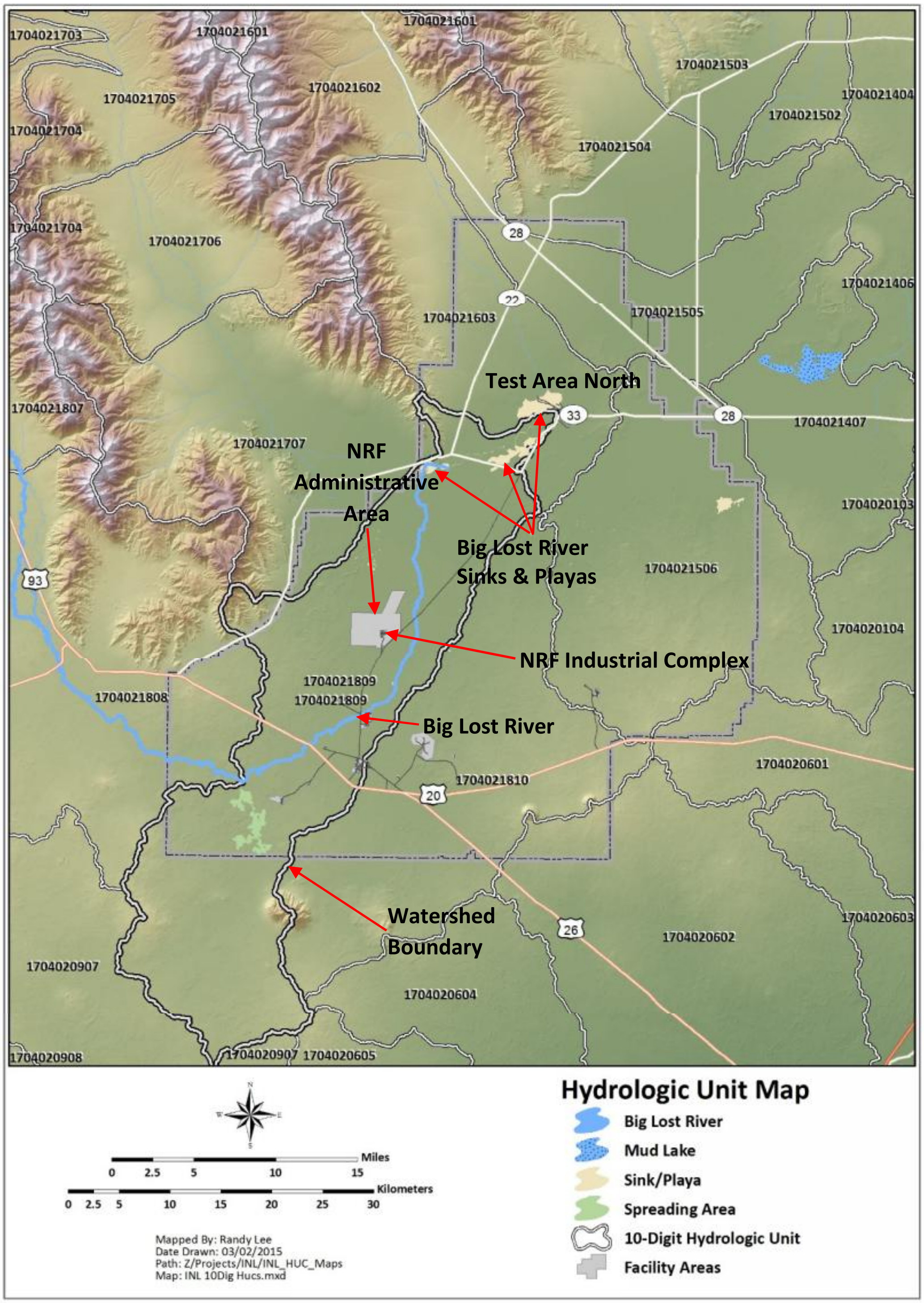

Figure 2. Hydrologic Unit Map for the INL showing NRF in Hydrologic Unit 1704021809

12

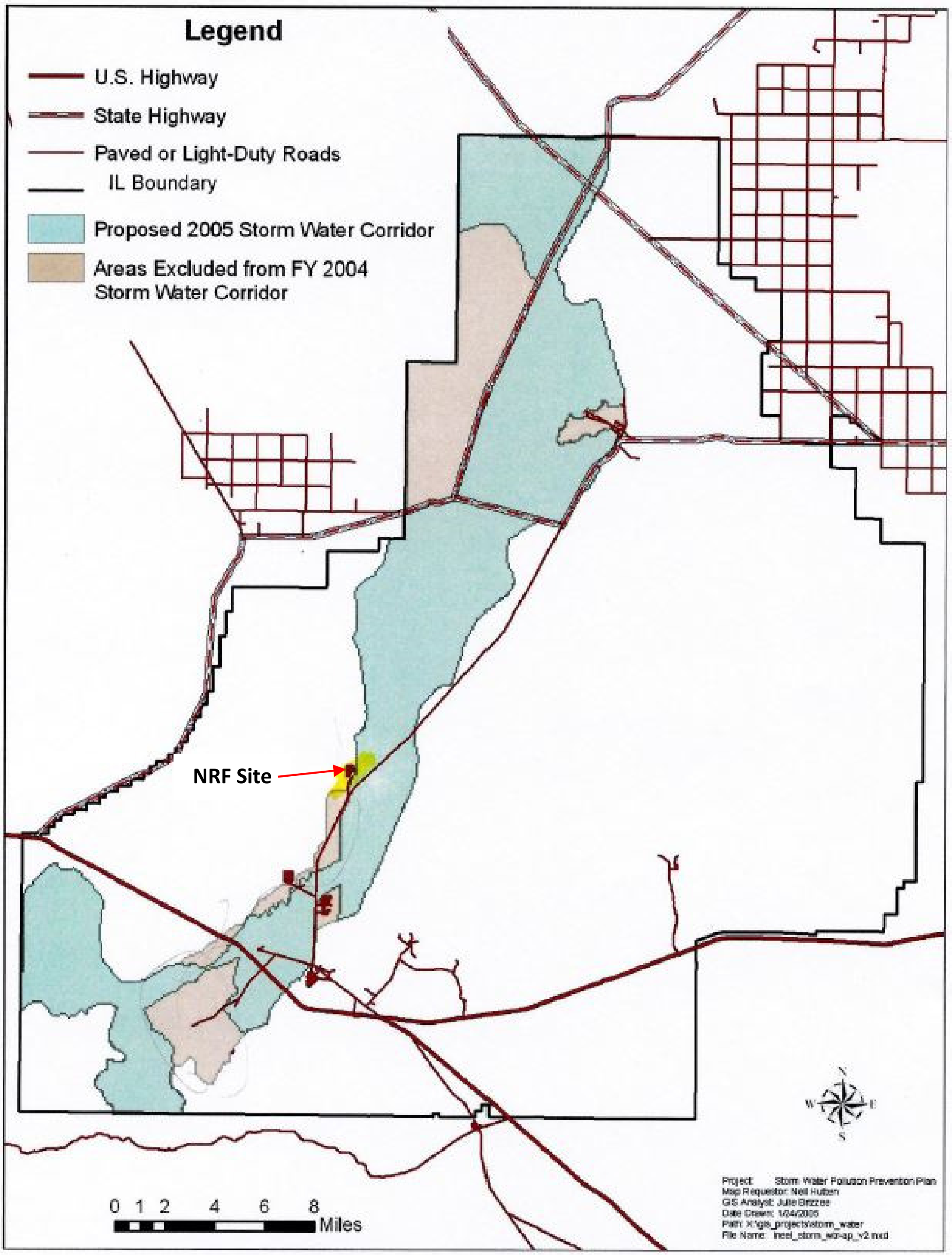

Figure 3. INL Storm Water Corridor (Reference (b))

13

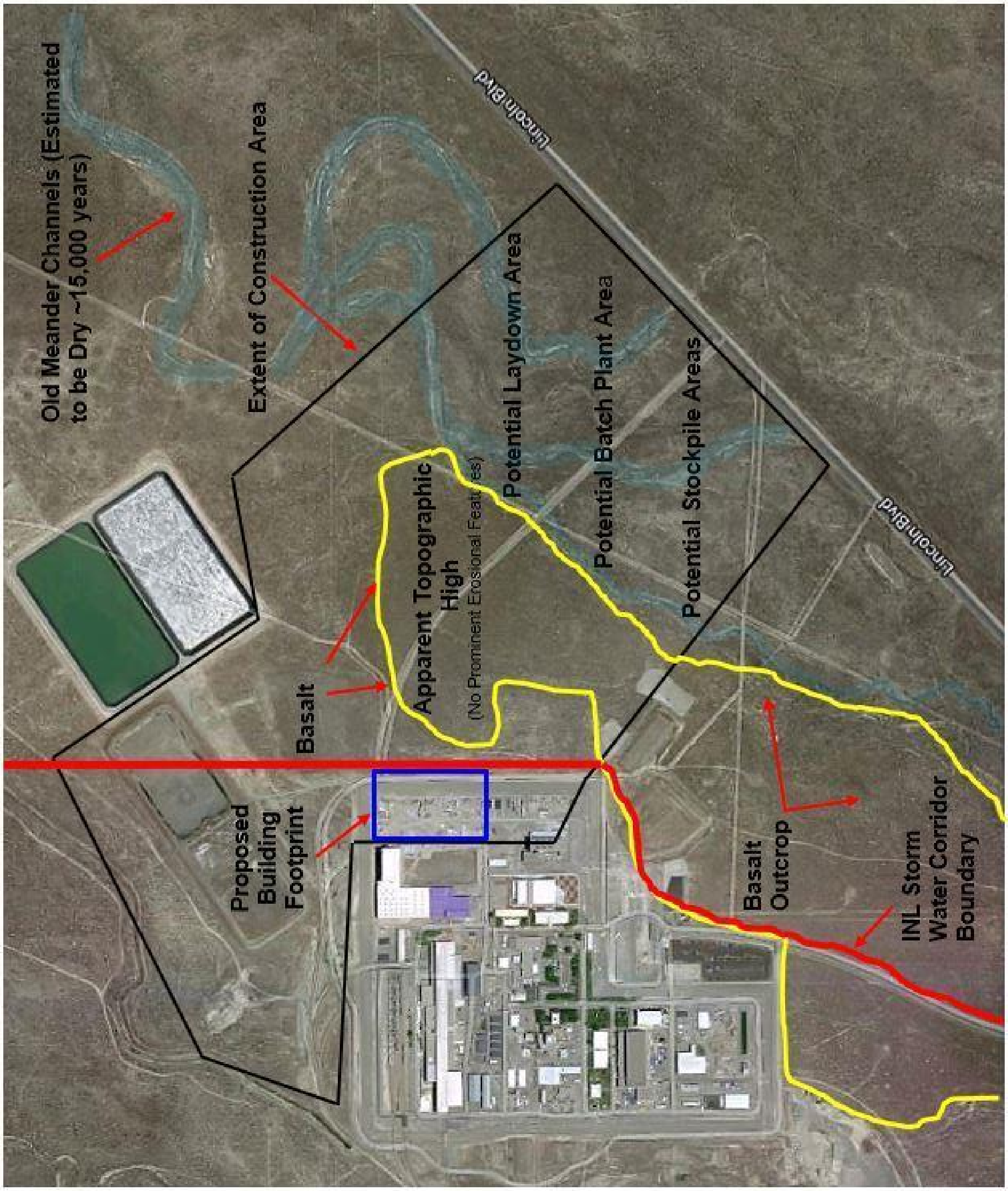

Figure 4. Apparent Topographic High and Old Meander Channels Compared to Potential Construction Area 3/4

14

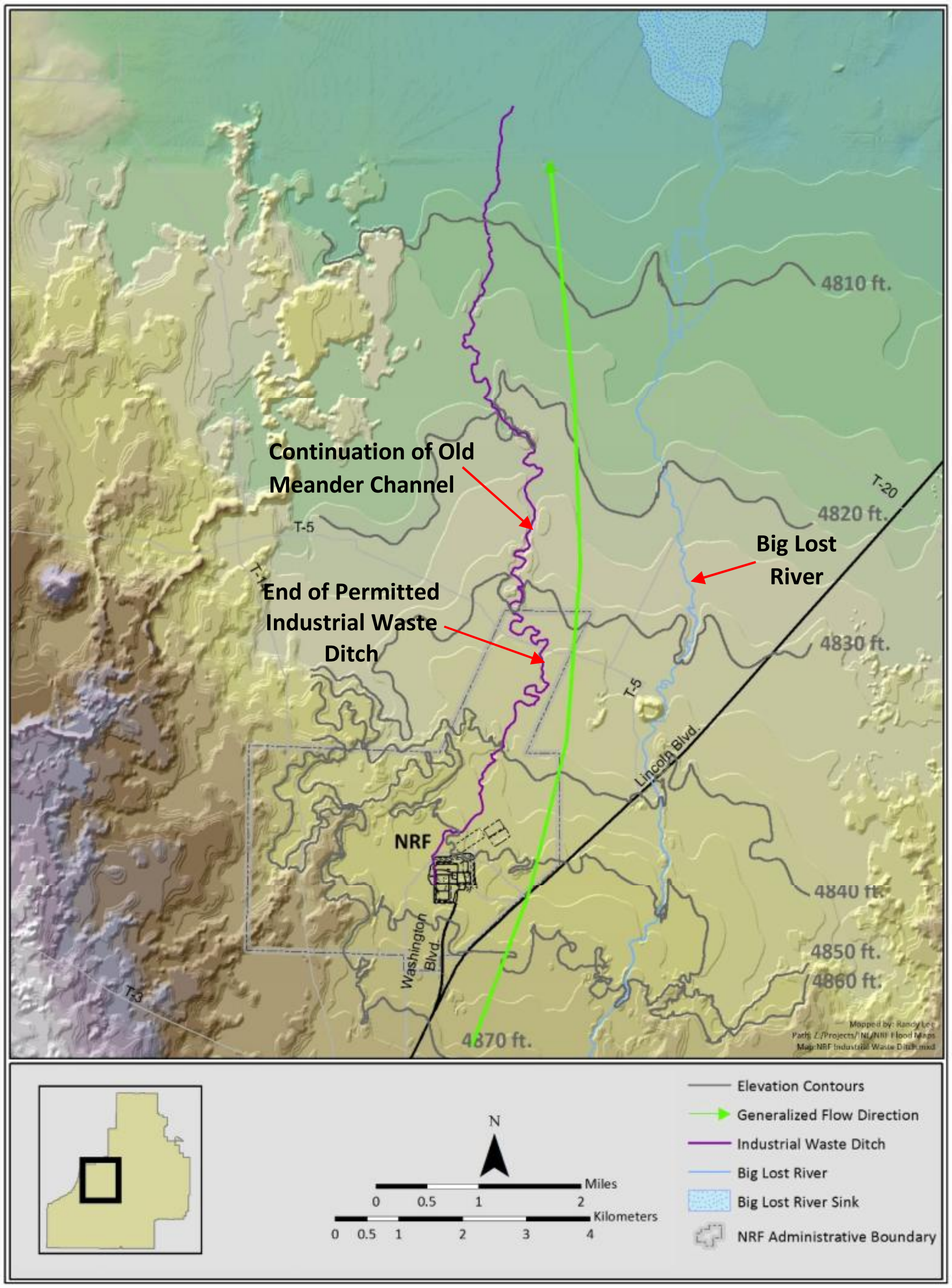

Figure 5. Generalized Surface Water Flow Direction and Surface Elevation

15

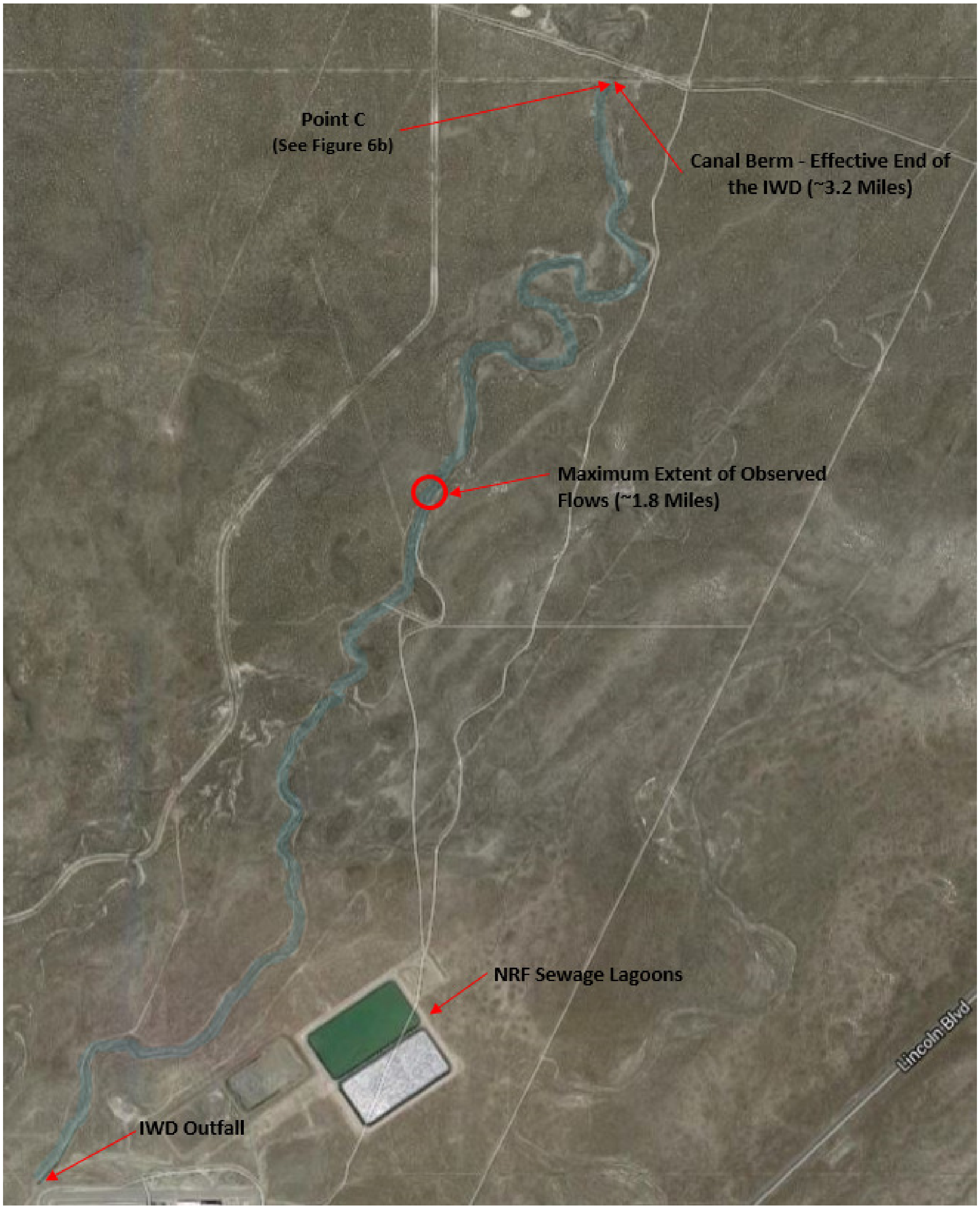

Figure 6a. Maximum Extent of Flow and End of IWD

16

Figure 6b. Berm at the End of the IWD (see point C on Figure 6a)

17

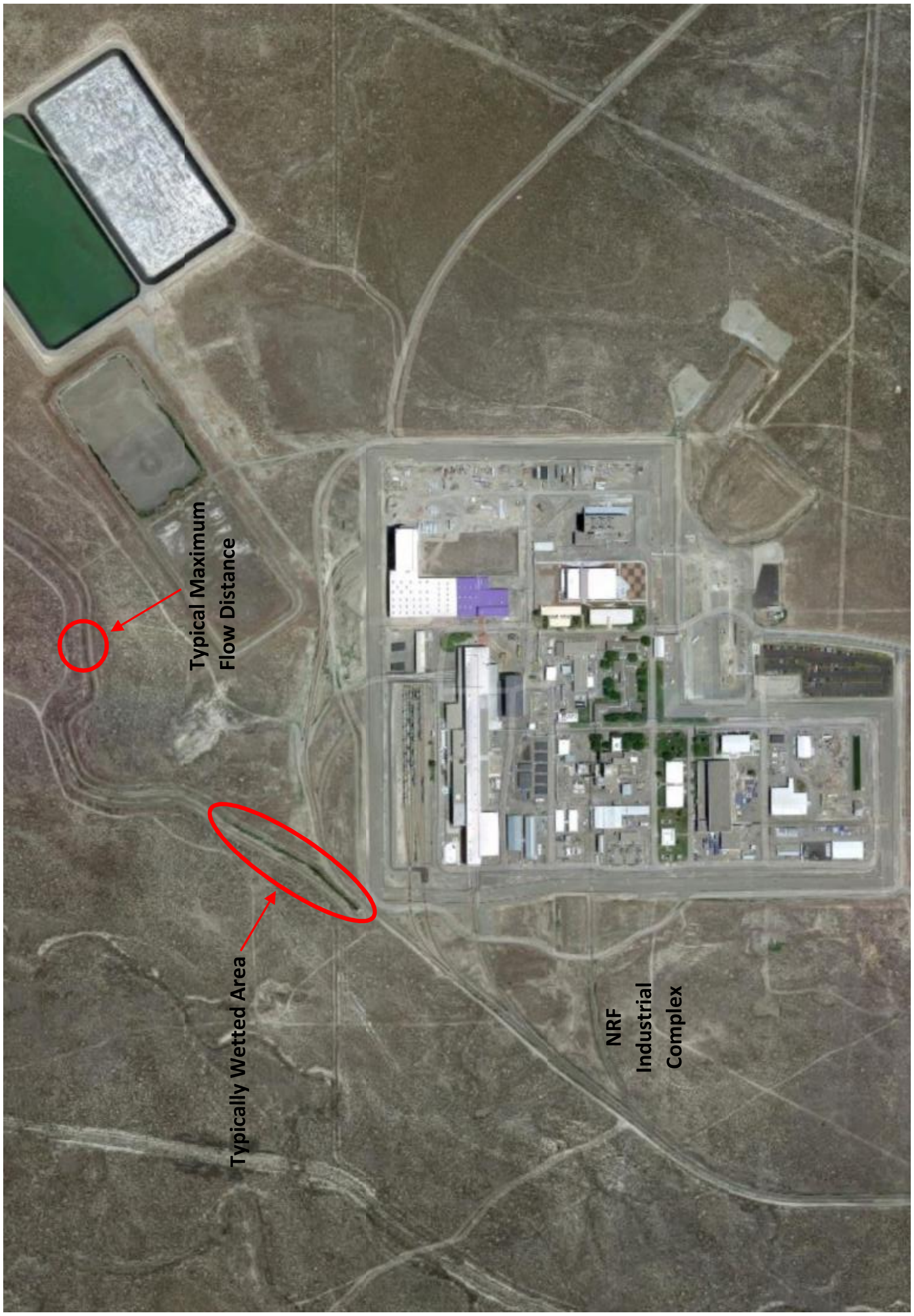

Figure 7. Aerial Photograph of IWD Showing Extent of "Typical" and Maximum Flows

18

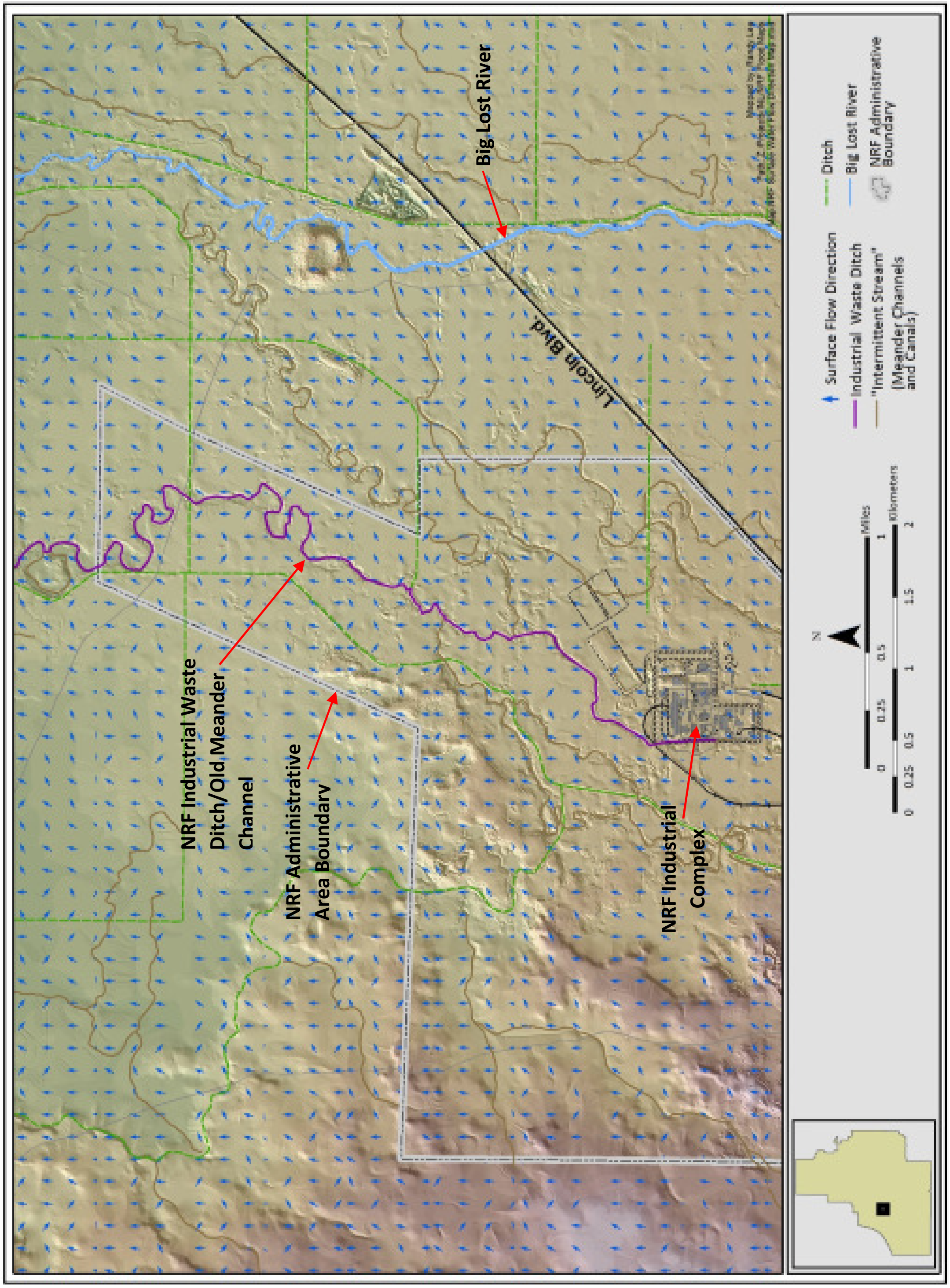

Figure 8. Surface Water Flow Directions

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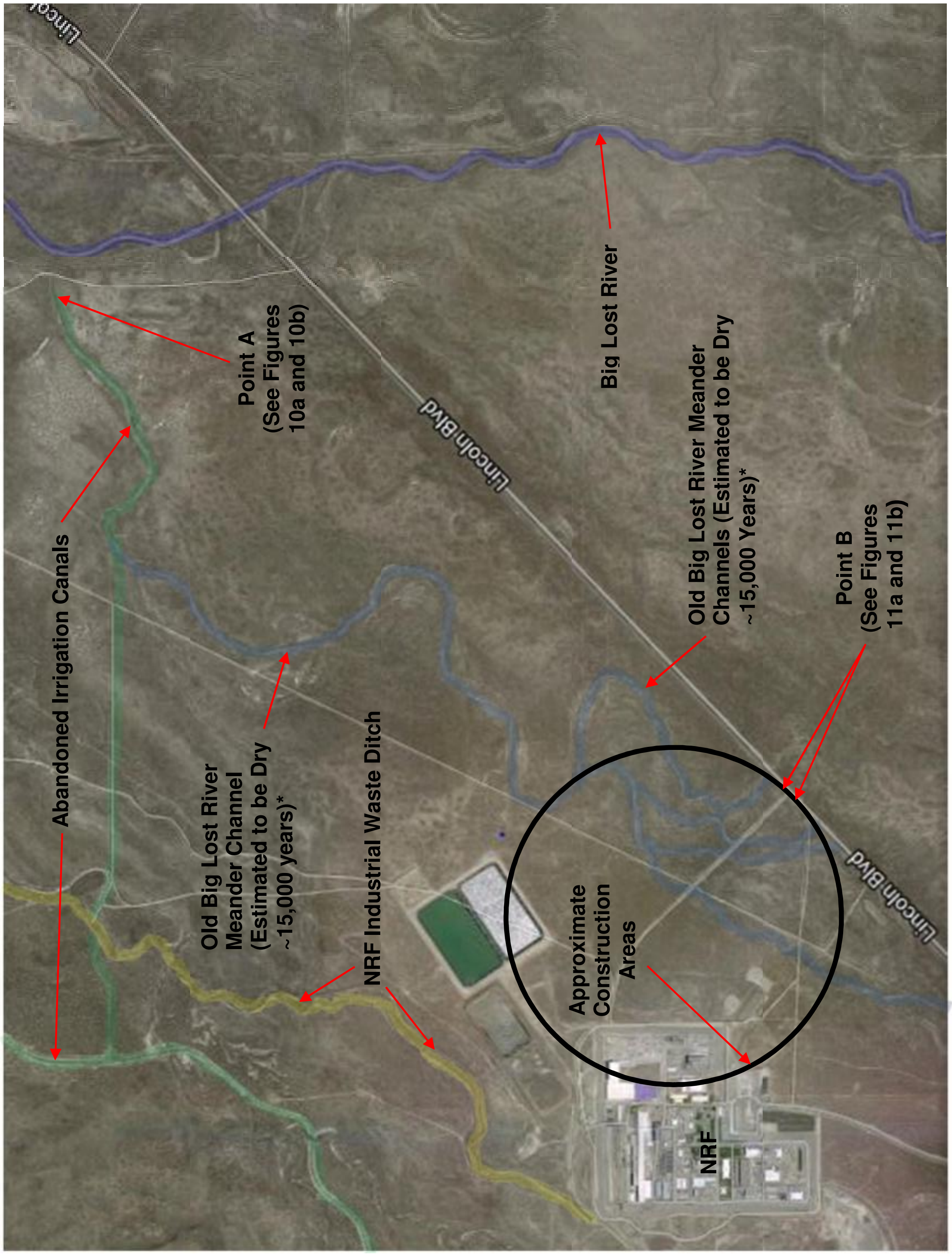
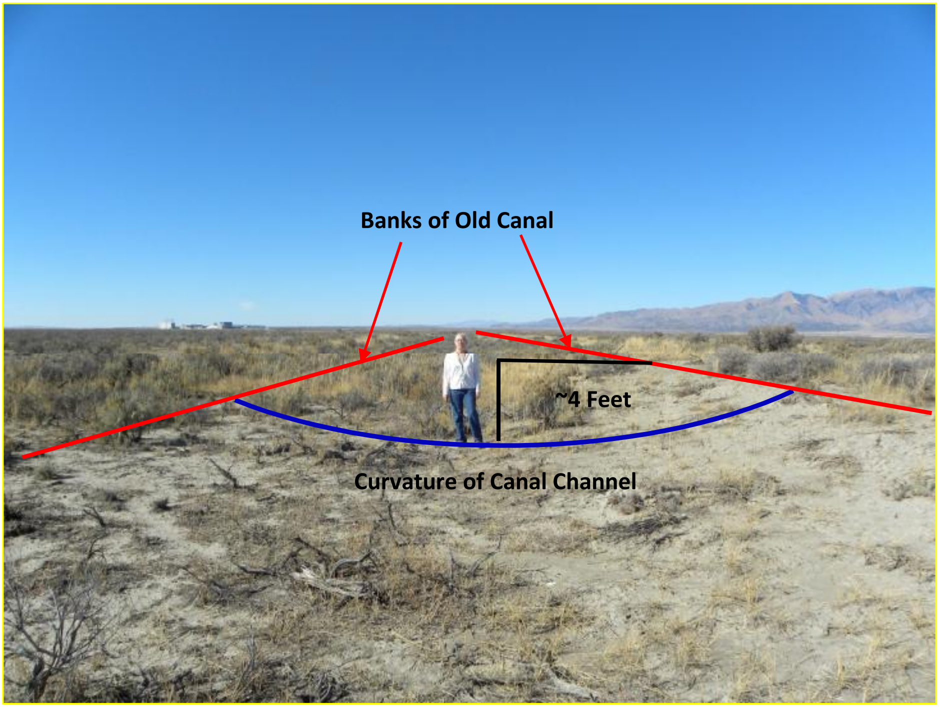


Figure 9 Historical Big Lost River Meander Channels, Man-Made Canal and Big Lost River (*See Section 2.2.2 & Reference (I))

20



Figures 10a. End of the Man-Made Canal Looking West– See Point A on Figure 9

Figure 10b. End of Man-Made Canal Looking East – See Point A on Figure 9

21

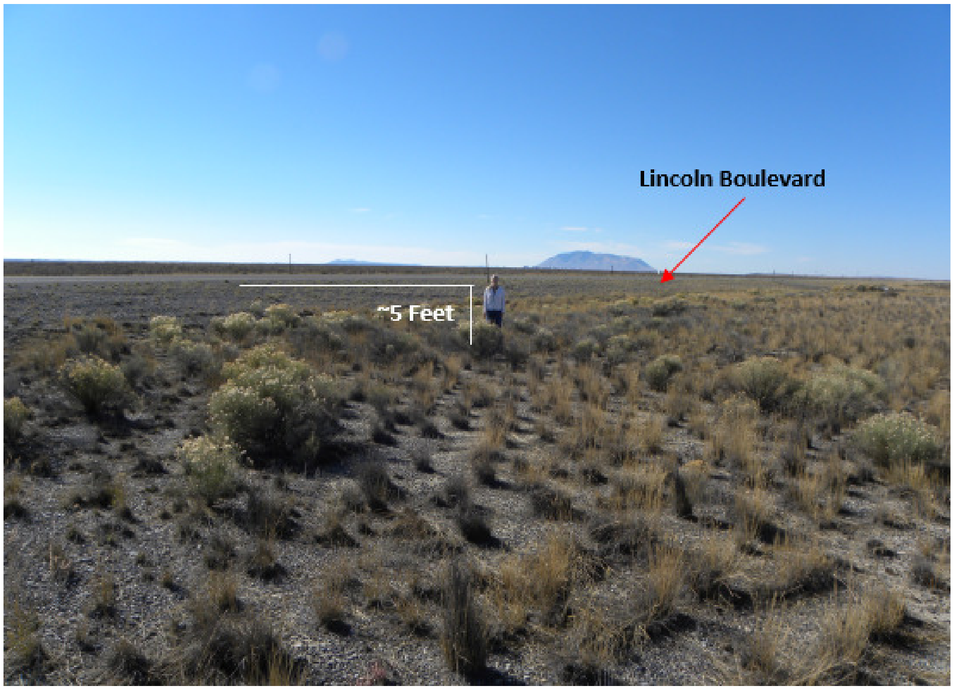


Figure 11a. Lincoln Boulevard Elevated Above Ground Level – See Point B on Figure 9

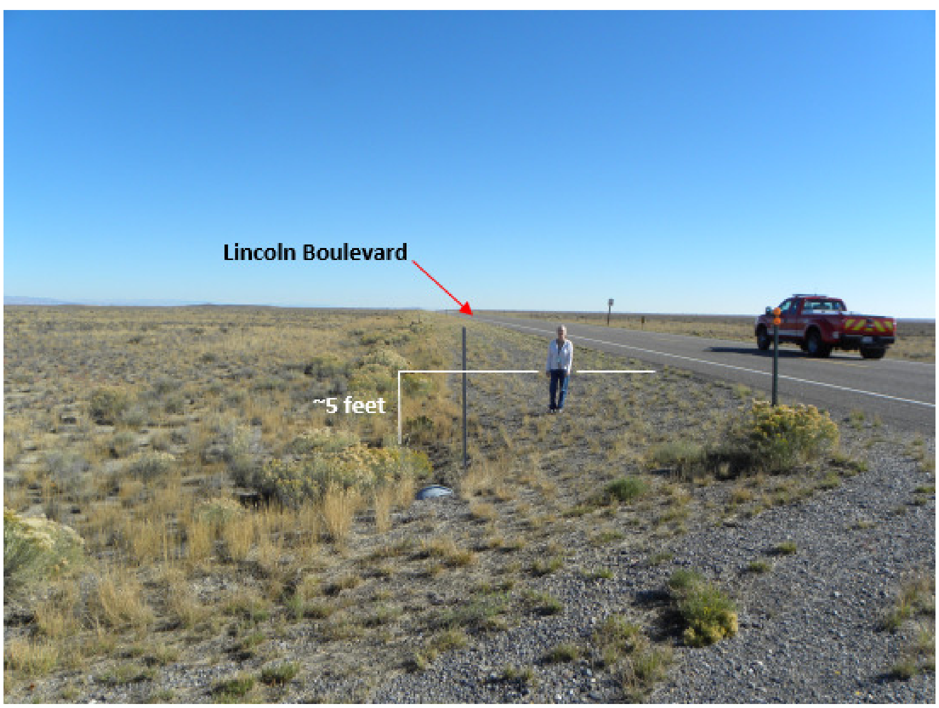


Figure 11b. Lincoln Boulevard Looking North – See Point B on Figure 9

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Reference (c). Brizzee, J. and N. Hutten, 2004. GIS Map of Lands Excluded from Current (2004) Storm Water Corridor, Idaho National Laboratory and Idaho Completion Project, Idaho Falls, Idaho, September 14, 2004.

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Reference (e). EPA, 2003; Stormwater Compliance at the INEEL, U.S. Environmental Protection Agency; letter to the U.S. Department of Energy, Idaho Operations Office dated October 27, 2003.

Reference (f). DOE 2007. Idaho National Laboratory Cultural Resource Management Plan, U.S. Department of Energy, Idaho Operations Office, DOE/ID-10997, Revision 2, February 2007.

Reference (g). Industrial Waste Ditch Modifications; Regulatory Requirements (WAPD-C(C)-0316), Contracts & Legal Review letter to J. G. Podgursky, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania, December 22, 1992.

Reference (h). DOE 1993. Strategy to Identify “Waters of the United States” at the INEL (AM/AES-ESD-92-494), (AM/SES-ESD-92-494), U.S. Department of Energy, Idaho Field Office (Hinman) letter to EPA Region 10 (Bubnick), January 5, 1993.

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Reference (j). Spent Fuel Handling Recapitalization Project (SFHP) Facility Study: Storm Water Drainage (ST-12-005), Revision D, Jacobs Engineering, January 30, 2014.

Reference (k). Materials Testing & Inspections, 2011; Lagoon Seepage Test for the Naval Reactors Facility Wastewater Lagoons owned by the Department of Energy Naval Reactors, Submitted to DEQ on December 15, 2011 via letter NR:IBO-11/244.

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Reference (m). BMPC, 2012, Five-year Review of CERCLA Response Actions at the Naval Reactors Facility, February 2012, Bechtel Marine Propulsion Corporation, Pittsburgh, Pennsylvania.

Reference (n). BMPC, 2008 through 2015, Reuse Site Performance Reports, Annual document sent to the Idaho Department of Environmental Quality

Reference (o). WEC 1994; Final Remedial Investigation/Feasibility Study for the Exterior Industrial Waste Ditch, Operable Unit 80-07, Naval Reactors Facility, Volume 1, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania.

Reference (p). Ostenaa, D. A. and R. H. O'Connell, 2005. Big Lost River Hazard Study, Idaho National Laboratory, Report 2005-2, Seismotechtonics and Geophysics Group, Technical resource Center, U.S. Bureau of Reclamation, Denver, Colorado.

Comment Document #32

Comments on EIS-0453 “Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory Project”. to air quality at nearby National Park Service units

1 message

Notar, John <john_notar@nps.gov> Mon, Aug 31, 2015 at 11:51 PM
To: ecfrecapitalization@unnpp.gov

National Park Service Comments EIS-0453 Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory.docx
22K

United States Department of the Interior

NATIONAL PARK SERVICE
Air Resources Division
P.O. Box 25287
Denver, CO 80225-0287

TRANSMITTED VIA ELECTRONIC MAIL - NO HARDCOPY TO FOLLOW

N3615 (2350)

Date: August 31, 2015

Memorandum

To: Erik Anderson
Department of Navy
1240 Isaac Hull Avenue, SE
Stop 8036
Washington Navy Yard, DC 20376-8036

From: John Notar
National Park Service
Air Resources Division

Subject: EIS -0453; Impacts to air quality in nearby National Park Service units from the "Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory Project".

The National Park Service (NPS) administers three Class I units which are located less than 300 kilometers (km) from the proposed Naval Spent Nuclear Fuel Handling project located on the Department of Energy's (DOE) Idaho National Laboratory (INL). Craters of the Moon National Monument (CRMO) is mostly located less than 50 km from the Project, with a small portion of CRMO being located farther than 50 km from the project. Both Yellowstone National Park (YELL) and Grand Teton National Park (GRTE) are located at a distance of 110 km and greater from the project. The EIS addressed impacts to air quality at these three NPS areas from the Project's three main phases, that being, the construction phase, the transition period phase (5-12 years) and the operation phase of the Expended Core Facility (ECF).
For assessing impacts to air pollutant concentrations in the near field, at distances less than 50 km, which only evaluated impacts at CRMO, the EPA AERMOD air quality dispersion model was used. The AERMOD model used five years of on-site surface meteorological data collected at INL and upper air from the nearby Boise International Airport National Weather Service site. The AERMOD dispersion modeling analysis predicted that the impacts from all three phases of the Project will be far below the National Ambient Air Quality Standards (NAAQS) for the

criteria pollutants of sulfur dioxide (SO_2) nitrogen dioxide (NO_2), both fine and coarse particulate matter (PM $_{2.5}$ and PM $_{10}$), carbon monoxide, and lead for all averaging periods. The near field modeling analysis with AERMOD also calculated impacts to the Prevention of Significant Deterioration (PSD) Class I increments. The near field Class I increment analysis indicated that that the impacts from all three phases of the Project will be far below the PDS Class I increments for SO_2, NO_2, PM $_{2.5}$ and PM $_{10}$ for both the short term and annual averaging periods. The impacts in the far field (greater than 50 km from the project) to the NAAQS and PDS Class I increments at YELL and GRTE were calculated with the EPA guideline long-range dispersion model CALPUFF model. The CALPUFF analysis calculated that the impacts from all three phases of the Project will be far below the NAAQS for the six criteria pollutants for both the short term and annual averages. The CALPUFF model was also used to calculate the impacts to the PSD Class I increments at both YELL and GRTE. This analysis indicated that that the impacts from all three phases of the Project will be far below the PDS Class I increments for SO_2, NO_2, PM $_{2.5}$ and PM $_{10}$ for both the short term and annual averaging periods. The potential increase in ozone formation from all three phases of the project will be limited to a negligible level due to the controlling of NO_x emissions and volatile organic compounds.

The impacts to Air Quality Related Values (AQRVs) followed the methodology found in the Federal Land Managers' Air Quality Related Values Work Group (FLAG 2010). The AQRV analyses evaluated impacts to visibility in the near field. The near field visibility analysis, using the FLAG methodology and the EPA VISCREEN coherent plume model indicated that there will be no coherent visible plume impacts at CRMO for any of the three phases of the project.

Based on correspondence from the NPS Air Resource Division (July 2013) to Mr. Robert Ramsey, Naval Reactors INL which followed recommendation in the FLM's FLAG guidance document there was no far field visible haze analysis required for YELL or GRTE due to the fact the FLM criteria of emissions (Tons per year divided by distance in kilometers) were far below the value of 10 which triggers a visible haze analysis. The NPS in this correspondence also waived an acid deposition analysis due to the very low annual emission rates for the three phases of the project.

The impacts of Hazardous Air Pollutants (HAPs) are calculated to be below significant impact levels outside of the INL facility and therefore also at the three NPS units. The impacts of Radionuclides from the Post-Refurbishment Operational Period is calculated to only have a 0.03 percent increase (2 Curies per year) over present emission levels of greater than 7000 Curries per year. Based on the distances to the three NPS units these increases are not significant.

Hazardous Air Pollutants (HAPs) are calculated to be below significant impact levels outside of the INL facility and therefore also at the three NPS units.

32.1 In conclusion based on the air quality analysis contained in the NEPA document "Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory Project", the NPS does not anticipate any significant impact to air quality at the three Class I units.

cc:

bcc:
ARD-WASO: Julie Thomas McNamee
ARD-DEN: Johnson, McCoy, Vimont, Permit Review Group, Reading and Project File
ARD-DEN:JNotar: 303.969.2079:August 31, 2015: National Park Service Comments EIS-0453 Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling at the Idaho National Laboratory.docx

Response to Comment Document #32

Item #32.1:

The National Park Service review of the EIS is appreciated.

Comment Document #33

Fwd: ShoshoneBannockTribes TDOE HeTO letter to DEIS

2 messages

Laura Iannacci ([redacted]) <laura.iannacci@unnpp.gov> Mon, Sep 14, 2015 at 10:11 AM
To: ECF Recapitalization <ecfrecapitalization@unnpp.gov>

---------- Forwarded message ----------
From: **HENVIT, CHRISTOPHER** <christopher.henvit@inl.gov>
Date: Monday, September 14, 2015
Subject: Fwd: ShoshoneBannockTribes TDOE HeTO letter to DEIS
To: "Anderson, Erik E CIV SEA 08 NR" <erik.e.anderson1@nmci-isf.com>, "Laura Iannacci ([redacted])" <laura.iannacci@unnpp.gov>

Attached are comments from the Shoshone Bannock Tribes.
---------- Forwarded message ----------
From: **Carolyn Smith** <csmith@sbtribes.com>
Date: Fri, Sep 11, 2015 at 4:56 PM
Subject: ShoshoneBannockTribes TDOE HeTO letter to DEIS
To: "HENVIT, CHRISTOPHER" <christopher.henvit@inl.gov>

Please see attached.

Carolyn B. Smith

TDOE-HeTO Cultural Resources Coordinator

Shoshone-Bannock Tribes

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2061K

The SHOSHONE-BANNOCK TRIBES

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FORT HALL INDIAN RESERVATION
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FORT HALL, IDAHO 83203

August 31, 2015

Erik Anderson
Department of Navy
Naval Sea Systems Command
1240 Isaac Hull Avenue, SE
Stop 8036
Washington Navy Yard, DC 20376-8036

RE: Draft Environmental Impact Statement for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling

Dear Mr. Anderson:

The Shoshone-Bannock Tribal Department of Energy (TDOE) and the Heritage Office (HeTO) appreciates the opportunity to review and provide technical comments to the Draft Environmental Impact Statement (DEIS)for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel Handling.

According to the DEIS, "the proposed action is needed because significant upgrades are necessary to the Expended Core Facility (ECF) infrastructure to continue safe and environmentally responsible naval spent nuclear fuel handling until at least 2060. The three alternatives are: No action alternative, Overhaul alternative, and New facility alternative. The preferred alternative is to build a new facility.

"The Shoshone-Bannock Tribes (Tribes) HeTO submitted comments to the Cultural Resource Investigations in 2014 for the Recapitalization of Infrastructure Supporting Naval Spent Nuclear Fuel (SNF) Handling at the Naval Reactors Facility (NRF) at the Idaho National Laboratory.

Geographically, INL lies within the inherent ancestral territory of the Shoshone and Bannock People. The area includes a major corridor to the Salmon River, the Lemhi Range, Pahsimeroi Range, bitterroot valleys, bison, deer, elk and other wild game habitat in Montana and Wyoming. The land provided subsistence of various resources such as plants, roots, fish, minerals, in their travels and countless features on the surface were utilized as campsites and living areas. Hunting and gathering occurred on the INL as evidenced by the copious amount of archaeological sites left by the original inhabitants.

The original inhabitants consisted of family bands that migrated with the seasons. These were the ancestors of the Shoshone and Bannock people today. They were the Agai-Dika (salmon eaters), Tuku-Dika (mountain sheep-eaters), Pohogoy (sagebrush people), Yahan-dika (ground hog eaters), to name a few bands. This land is the legacy of the Shoshone-Bannock Tribes today and only one region of their larger inherent ancestral territory. Tribal traditional and cultural practices remain alive today through continual use of this area as a corridor to their inherent ancestral areas subsistence resources.

33.1 Within the DEIS Affected Environment section, 3.8 Cultural Resources, Early Native American Cultures, 1st paragraph begins, "the Shoshone-Bannock Tribes believe that native people were created on the North American continent; they regard all prehistoric resources at INL as ancestral and important to their culture." This paragraph is quite generalized that it does not adequately provide the ancestral peoples tie to the land. It offers only a modicum of their inherent relationship to the area.

33.2 The Tribes HeTO is opposed to the display of maps that provide boundaries of cultural resources significant to the Tribes. In Section 3.8-1, page 3-129 there is a map that displays the Cultural Resources at the INL. This may be a predicted model as it displays zones that may have high or low probability models where cultural resources may occur. This needs to be removed from the document. There is always potential for adverse effects involving projects when excavation or ground disturbance occurs, but there are very serious impacts when individuals do this illegally. The map shows probability areas near and off the boundaries of the INL that may provide undue impacts to cultural and archaeological resources near or off the boundary of the INL. This impacts the Tribes Treaty resources that occur on federal lands that lie adjacent to the INL boundary.

According to the DEIS, there are currently 51 archaeological sites located in the surface area that encompasses the APE associated with the proposed action, however, none are eligible for the National Register and are located within the direct APE for the New Facility Alternative Location 3/4 APE, the New Facility Alternative Location 6 APE and the Overhaul Alternative. According to the 2013 Cultural Resource Investigations Report conducted by the INL Cultural Resource Management Office, a finding of no effects to historic properties and no adverse impacts to known resources of cultural significance was recommended for the proposed projected locations previously named.

APE

- 51 archaeological resources
    - 21 prehistoric isolates locations
        - evaluated as ineligible for nomination to the NR, unlikely to yield additional information

- 2 historic isolate locations
  - evaluated as ineligible for nomination to the NR, unlikely to yield additional information
- 22 prehistoric sites
  - 7 prehistoric sites-potential for yielding additional information, evaluated as potentially eligible pending additional data recovery and research (located outside of the APE)
  - 8 prehistoric archaeological sites are unlikely to yield any additional information beyond that which has been collected during the intensive data recovery...all 8 are evaluated as ineligible for nomination to the NR.
  - 7 sparse scatters of prehistoric artifacts that appears to be restricted to a shallow surface zone are also evaluated as ineligible for the NR
- 2 historic sites associated with Euro American settlement
  - potential for yielding additional information, evaluated as potentially eligible pending additional data recovery and research)located outside of the APE)
- 3 historic resources associated with World War II and the Post War Period
  - potential for yielding additional information, evaluated as potentially eligible pending additional data recovery and research (located outside of the APE)
- 1 modern Rock Cairn
  - potential for yielding additional information, evaluated as potentially eligible pending additional data recovery and research (located outside of the APE)

The letter from Mr. Henvit on April 30, 2013 states, "Although direct impacts are unlikely, there is potential for undesirable indirect effects to cultural resources that are located just outside the APE. Project related activity levels are projected to increase significantly during construction and the overall developed footprint of NRF would expand permanently any archaeological resources or natural resources of potential concern to the Shoshone-Bannock Tribes or others located near the newly developed perimeter could be affected indirectly due to the increased activity in these previously undeveloped areas. In particular, artifacts may be subject to unauthorized collection or impacted by off-road vehicle use and other small ground disturbing activities that commonly occur around developed areas."

33.3 The perimeters need buffer zones to eliminate the chances of disturbing significant sites that may be located in or near the APE. Off road vehicle use, if planned properly will not occur especially if it is pointed out in the sensitivity training that will be offered by NNPP.

The Draft EIS states, in a letter dated June 9, 2014, that for the New Facility Alternative, the NNPP will implement the additional protective measure, identified in Section 8.3 of the 2013 Cultural Resources Investigations Report, including conducting cultural resource sensitivity training for personnel to discourage unauthorized artifact collection, off road vehicle use, and other activities that may affect cultural resources.

On October 2, 2013, a recommendation to minimize disturbance to plant species, and the possible implementation of seasonal and time of day restrictions on ground disturbance to minimize disturbance to wildlife species. A plan by NNPP was made to revegetate disturbed areas with native plant species, to implement good housekeeping practices during construction, seasonal and time of day restrictions should be implemented on ground disturbance to protect the sage grouse. The CCA does not require seasonal or time of day restrictions on ground disturbance for the proposed action because the disturbances are not within 1 kilometer of a breeding habitat or lek, and the NNPP does not plan to implement any seasonal or time-of-day restrictions.

The Draft EIS reads that collected artifacts will be collected for permanent curation and possible further study. The Shoshone-Bannock Tribes are concerned with the collection of artifacts and would like the artifacts returned back to their original locations or as close as possible. But, upon further evaluation, the NNPP concluded they cannot comply with the request because it is in conflict with 36 CFR 79 since the artifacts that were collected would no longer be "protected" in a secure place.

33.4 The Tribes' HeTO will be able to participate in the monitoring process during key ground disturbance activities consistent with the INL Cultural Resources Management Plan

33.5 As always our concerns are with worker safety, and the protection of the environment and the protection of the Fort Hall Reservation. The best way to protect both workers and the environment is to ensure that the facilities are the best that they can be. Facilities need to be in good repair, good working order and in this case met or exceed best management practices for storing and handling nuclear materials.

The purpose of this letter is to provide technical input and not intended as formal government to government consultation. Should there be any questions or concerns, feel free to contact me at (208) 236-1086 or email at: csmith@sbtribes.com.

Sincerely

Carolyn B. Smith

Carolyn B. Smith
Cultural Resources Coordinator
Shoshone-Bannock Tribes

CC: File: Location and State and Agency

Response to Comment Document #33

Item #33.1:

To address the comment to adequately provide the ancestral people's tie to the land, the sentence cited by the commenter was replaced in Section 3.8.1 with the following sentence:

> "Although no Native American cultural resources have been specifically identified within the 850-acre survey area that encompasses the three alternatives under consideration for the proposed action, representatives from the Shoshone-Bannock Tribes Heritage Tribal Office (HeTO) have indicated that prehistoric archaeological sites, native plants and animals, water, and other natural landscape features across the INL area continue to fill important roles in tribal heritage and ongoing cultural traditions. (Appendix B)"

Item #33.2:

The map showing cultural resource probability zones on the INL has been removed.

Item #33.3:

As agreed to with the Fort Hall Business Council (Appendix B, page B-47), the NNPP would implement protective measures for the New Facility Alternative, if selected, that include conducting cultural resource sensitivity training for personnel to discourage unauthorized artifact collection, off-road vehicle use, and other activities that may affect cultural resources. Therefore, buffer zones would not be necessary around the perimeter of a new facility.

Item #33.4:

Consistent with the INL Cultural Resources Management Plan, NNPP will provide the Shoshone-Bannock Tribes with the opportunity to monitor key ground disturbance activities that may occur at NRF in support of recapitalization activities (Appendix B, page B-64, NNPP Action #6).

Item #33.5:

The commenter's support for the recapitalization project is noted.