DOE/ID-11441 (2022)

U.S. Department of Energy
Idaho Operations Office

National Emission Standards for Hazardous Air Pollutants - Calendar Year 2021 INL Report for Radionuclides

June 2022

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Prepared for the
U.S. Department of Energy
Idaho Operations Office

ABSTRACT

The U.S. Department of Energy (DOE) Idaho National Laboratory (INL) Site operates facilities with potential emissions of radioactive materials. This report has been prepared to comply with the *Code of Federal Regulations*, Title 40, Protection of the Environment, Part 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities" (Subpart H). Subpart H requires the measurement and reporting of radionuclides emitted from DOE facilities that result in an offsite dose from those emissions.

This report documents the calendar year 2021 radionuclide air emissions and resulting effective dose equivalent to the maximally exposed individual (MEI) member of the public from operations at the INL. The MEI is defined in Subpart H as any member of the public at any off-site location where there is a residence, school, business, or office.

For calendar year 2021 the effective dose equivalent to the maximally exposed individual member of the public was 6.67E-02 millirem (mrem) per year, which is 0.67 percent of the 10 mrem per year standard, for the INL Site. The effective dose equivalent to the maximally exposed individual for the Research and Education Campus was 6.21E-03 mrem per year or 0.062 percent of the standard.

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FIGURES

TABLES

ACRONYMS

AFF	Advanced Fuel Facility
AMWTP	Advanced Mixed Waste Treatment Project
ARP	Accelerated Retrieval Project
ATR	Advanced Test Reactor
BEA	Battelle Energy Alliance, LLC
CAP	Clean Air Act Assessment Package
CEM	Continuous Emission Monitoring
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
Ci	curies
CITRC	Critical Infrastructure Test Range Complex
CPP	Chemical Processing Plant
CY	calendar year
D&D	deactivation and decommissioning
DOE	Department of Energy
EDE	effective dose equivalent
EML	Electron Microscopy Laboratory
EPA	Environmental Protection Agency
FASB	Fuels and Applied Science Building
FAST	Fluorinel and Storage Facility
FCF	Fuel Conditioning Facility
FI	Fluor Idaho, LLC
FMF	Fuel Manufacturing Facility
HEPA	high-efficiency particulate air
HFEF	Hot Fuel Examination Facility
HPIL	Health Physics Instrument Laboratory
ICDF	Idaho CERCLA Disposal Facility
ICE	Inner Contamination Enclosure
IMCL	Irradiated Materials Characterization Laboratory
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
IRC	INL Research Center
LLMW	low-level mixed waste
L&O	Laboratory and Office Building
MEDE	melt-drain-evaporate
MEI	maximally exposed individual
MFC	Materials and Fuels Complex
mrem	millirem
MTR	Material Test Reactor
NESHAP	National Emission Standards for Hazardous Air Pollutants

NPTF	New Pump and Treat Facility
NRF	Naval Reactors Facility
NWCF	New Waste Calcining Facility
OCVZ	Organic Contamination in the Vadose Zone
OU	operable unit
QC	quality control
REC	Research and Education Campus
RCE	Retrieval Contamination Enclosure
RESL	Radiological and Environmental Sciences Laboratory
RDD	radiological dispersion device
RRTR	Radiological Response Training Range
RSWF	Radioactive Scrap Waste Facility
RWMC	Radioactive Waste Management Complex
SCMS	Sodium Components Maintenance Shop
SDA	Subsurface Disposal Area
SMC	Specific Manufacturing Capability
STAR	Safety and Tritium Applied Research
TAN	Test Area North
TDS	Thermal Desorption Spectroscopy
TMI	Three Mile Island
TRA	Test Reactor Area
TSF	Technical Support Facility
WAG	Waste Area Group
WMF	Waste Management Facility

National Emission Standards for Hazardous Air Pollutants - Calendar Year 2021 INL Report for Radionuclides

1. INTRODUCTION

This report documents radionuclide air emissions for calendar year (CY) 2021 and the resulting effective dose equivalent (EDE) to the maximally exposed individual (MEI) member of the public from operations at the U.S. Department of Energy (DOE) Idaho National Laboratory (INL) Site.

The title of each section in this report corresponds to reporting requirements found in 40 *Code of Federal Regulations* (CFR) Part 61.94. A description of the applicable reporting requirements is cited under the titles in italicized text followed by the compliance status for the INL Site facilities.

Appendix A contains information specific to INL Research and Education Campus (REC) which includes the INL Research Center (IRC) and the Radiological and Environmental Sciences Laboratory (RESL) emissions located in Idaho Falls, Idaho. Radionuclide emissions from the REC are not included in the INL Site EDE calculation since the facilities are not contiguous. Compliance to the 10 millirem (mrem) per year dose standard is demonstrated by documenting REC radionuclide air emissions and the resulting EDE to its MEI from operations at the IRC and RESL.

Appendix B of this report contains information specific to the Naval Reactors Facility (NRF) located within the INL Site boundary. The EDE for NRF radionuclide emissions is included in the INL Site EDE to demonstrate overall compliance to the 10-mrem/year dose standard set by 40 CFR Part 61, Subpart H (Subpart H), “National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities.”

For CY 2021, modeling was performed using Clean Air Act Assessment Package - 1988 PC (CAP88), Version 4.1.

2. 40 CFR PART 61.94(a) FOREWORD

"Compliance with this standard shall be determined by calculating the highest effective dose equivalent to any member of the public at any offsite point where there is a residence, school, business or office. The owners or operators of each facility shall submit an annual report to both Environmental Protection Agency (EPA) headquarters and the appropriate regional office by June 30, which includes the results of the monitoring as recorded in DOE's Effluent Information System and the dose calculations required by §61.93(a) for the previous calendar year."

This report documents the INL Site radionuclide air emissions and the resulting EDE to the MEI for CY 2021. It was prepared in accordance with Subpart H. As required, this report is submitted to both the EPA Headquarters and the appropriate regional office (EPA Region 10) no later than June 30, 2022.

Table 1 reports the annual radionuclide emissions for the INL Site sources that require continuous monitoring for compliance during CY 2021. Table 2 lists the sources used to calculate the EDE to the MEI.

Table 1. Radionuclide emissions, in curies (Ci), from the INL Site continuously monitored point sources during CY 2021.

Radionuclide	MFC[a]-1729-001	MFC-785-018	MFC-764-001	MFC-704-008	CPP[a]-767-001	WMF[a]-636-002	WMF-676-002	WMF-676-003
Pu-239	2.34E-08	8.52E-08	1.74E-08	1.28E-08	ND	ND	ND	9.91E-11
Sr-90	3.02E-07	1.05E-06	9.05E-08	7.32E-08	1.33E-07	ND	ND	ND

a. Materials and Fuels Complex (MFC), Chemical Processing Plant (CPP), Waste Management Facility (WMF).

Table 2. Sources used to calculate the EDE to the MEI.

Facility	Source
Advanced Test Reactor (ATR) Complex:	Test Reactor Area (TRA)-670-074, ATR Chemistry Laboratory fume hoods exhaust
	TRA-670-086, laboratory fume hood exhaust
	TRA-670-098, laboratory fume hood exhaust (2 hoods)
	TRA-670, ATR canal
	TRA-678-001, Radiation Measurements Laboratory fume hoods vent
	TRA-710-001, Materials Test Reactor (MTR) stack
	TRA-715-001, Warm Waste Evaporation Pond
	TRA-770-001, ATR main stack
	TRA-1627-001, Radioanalytical Chemistry Laboratory
Central Facilities Area (CFA):	CFA-625, CFA Laboratory Complex
	CFA-1618, Health Physics Instrument Laboratory (HPIL)
	Tritium emissions from pumped aquifer water
Critical Infrastructure Test Range Complex (CITRC):	Power Burst Facility-(PBF)-612, CITRC Control System Research Facility PBF-623, CITRC Wireless Communication Support
Idaho Nuclear Technology and Engineering Center (INTEC):	Chemical Processing Plant (CPP)-603-001, Irradiated Fuels Storage Facility
	CPP-659-033, New Waste Calcining Facility (NWCF) Stack
	CPP-684-001, Remote Analytical Laboratory
	CPP-708-001, Main Stack
	CPP-749-001, Underground Fuel Storage/Vault Area
	CPP-767-001, FAST Stack
	CPP-1608-001, Manipulator Repair Cell
	CPP-1774, Three Mile Island (TMI)-2 Independent Spent Storage Installation
	CPP-2707, Dry Cask Storage Pad
	Idaho Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Disposal Facility Landfill (ICDF) emissions from solid waste disposal
	ICDF pond emissions
	Operable Unit 3-14 Evaporation Pond

Facility	Source
Materials and Fuels Complex (MFC):	CPP-653-001, Decontamination Testbed Facility
	MFC-704-008, Fuel Manufacturing Facility stack
	MFC-720-007, Transient Reactor Test Facility reactor cooling air exhaust
	MFC-752-004, Laboratory and Office Building (L&O) main stack
	MFC-752-005, L&O nondestructive assay stack
	MFC-764-001, Main Stack (Fuel Conditioning Facility [FCF] exhaust)
	MFC-768-105, Decontamination shower suspect waste tank vent
	MFC-768-108, Health Physics Area fume hood
	MFC-774-026, Electron Microscopy Laboratory (EML) exhaust
	MFC-774-027, EML exhaust
	MFC-774-028, EML exhaust
	MFC-774-029, EML exhaust
	MFC-777-002, Zero Power Physics Reactor
	MFC-784, Advanced Fuels Facility
	MFC-785-018, Hot Fuel Examination Facility stack
	MFC-787-001, Fuel Assembly and Storage Building
	MFC-792A-001, Space and Security Power Systems Facility
	MFC-793-001, Sodium Components Maintenance Shop (SCMS) stack
	MFC-794-002, Experimental Fuels Facility-West exhaust
	MFC-794-006, Experimental Fuels Facility-East exhaust
	MFC-1702, Radiochemistry Laboratory
	MFC-1729, Irradiated Materials Characterization Laboratory
Naval Reactors Facility	See Appendix B
Radioactive Waste Management Complex (RWMC):	Waste Management Facility (WMF)-601-001, Health Physics Laboratory Hood
	WMF-615-001, Drum Vent Facility
	WMF-634-001, AMWTP Characterization Facility
	WMF-636-001, Transuranic Storage Area – Retrieval Enclosure
	WMF-676-003, Glovebox Stack
	WMF-1612-001, Accelerated Retrieval Project (ARP)-II
	WMF-1614-001, ARP-III
	WMF-1615-001, ARP-IV
	WMF-1617-001, Sludge Repackaging Project, ARP V
	WMF-1619-001, ARP-VII
	WMF-1621-001, ARP-VIII
	WMF-1622-001, ARP IX
	RWMC H-3 from groundwater
	SDA Buried Beryllium Blocks
Test Area North (TAN) Specific Manufacturing Capability (SMC):	TAN-629-013, manufacturing process, Line 2A
	TAN-679-022, -023, -024 manufacturing process, north process
	TAN-679-025, -026, -027 manufacturing process, south process
	TAN-681-018, Process Reclamation Facility
	TAN-681-020, Process Reclamation Facility
	TAN-681-016, Process Reclamation Facility
	North Radiological Response Test Range (RRTR)

Facility	Source
TAN Technical Support Facility (TSF):	Operable Unit (OU) 1-07B, New Pump and Treat Facility

Subpart H requires DOE facilities to calculate the resulting dose to the offsite MEI. Previous years modeled Frenchman's Cabin (Site 1) as the MEI, however since 2019, the MEI has moved to Receptor 54. Receptor 54 is a farm and cattle operation located approximately 2.3 km south of the INL border, and northeast of the East Butte (see Figure 1). The dose to the MEI is consistent with recent years, increasing slightly from 2020 data from 0.62% to 0.67% of the standard. Approximately 95% of the dose to the MEI is derived from the emissions and proximity to 21 different sources located at MFC. This reporting year, as well as historically, the calculated EDE for INL has been less than 0.1 millirem (mrem) per year. The EDE to the MEI for this reporting year was 6.67E-02 mrem/yr, which is 0.67% of the 10-mrem/yr federal standard and was calculated using all sources that emitted radionuclides to the environment from the INL site. Table 3 provides a summary of the INL Site MEI dose by facility and source type.

Table 3. INL facility dose (mrem) contributions and total INL Site dose (mrem) to the MEI located at Receptor 54 for CY 2021 radionuclide air emissions.

Facility	Point source dose (mrem/yr)	Fugitive source dose (mrem/yr)	Total dose[a] (mrem/yr)	Notes
CFA Total	**3.27E-07**	**1.80E-06**	**2.13E-06**	Total from 3 CFA sources
CITRC Total		**3.96E-15**	**3.96E-15**	Total from 2 CITRC sources
INTEC	1.00E-06	1.06E-04	1.07E-04	13 INTEC sources including ICDF
INTEC-MS	2.00E-07		2.00E-07	INTEC Main Stack (CPP-708)
INTEC Total	**1.20E-06**	**1.06E-04**	**1.07E-04**	Total from all INTEC sources
MFC	6.42E-02		6.42E-02	19 MFC sources
MFC-MS	1.85E-08		1.85E-08	MFC Main Stack (MFC-764)
MFC-TREAT	6.16E-04		6.16E-04	TREAT Exhaust Stack
MFC Total	**6.48E-02**		**6.48E-02**	Total from all MFC sources
NRF Total	**7.26E-05**	**6.93E-07**	**7.33E-05**	Total from all NRF sources
ATR Complex	7.20E-05	7.39E-04	8.11E-04	8 ATR Complex sources
ATR Complex-ATR	1.58E-04		1.58E-04	ATR Stack (TRA-770)
ATR Complex-MTR	0.00E+00		0.00E+00	No emissions from MTR stack in CY-21
ATR Complex Total	**2.30E-04**	**7.39E-04**	**9.69E-04**	**Total from ATR Complex sources**
RWMC Total	**5.81E-05**	**3.69E-04**	**4.27E-04**	14 RWMC sources including ARPs
TAN-SMC Total	**3.42E-09**	**3.51E-04[b]**	**3.51E-04**	SMC emissions plus RRTR North
TAN-TSF Total	**2.35E-07**		**2.35E-07**	OU 1-07B emissions
INL Site Total	**6.51E-02**	**1.57E-03**	**6.67E-02**	Total MEI dose from all INL Site sources

a. Summation of values in table may not equal total dose due to rounding.
b. Fugitive dose contribution from SMC due to emissions from RRTR Northern Test Range which is located near TAN-SMC but was collocated for purposes of modeling.

3. 40 CFR PART 61.94(b) (1)

"Name and location of the facility."

Site Name: Idaho National Laboratory Site.

Site Location: The INL Site encompasses approximately 890 square miles on the upper Snake River Plain in southeastern Idaho (see Figure 1). The nearest INL boundaries to population centers are approximately 22 mi (35.3 km) west of Idaho Falls, 23 mi (37 km) northwest of Blackfoot, 44 mi (70.8 km) northwest of Pocatello, 7 mi (11.3 km) east of Arco, 1 mi (1.6 km) north of Atomic City, 3 mi (5 km) west of Mud Lake and 2 mi (3 km) south of Howe. Figure 1 below displays the INL site along with the major facilities and the off-site MEI location.

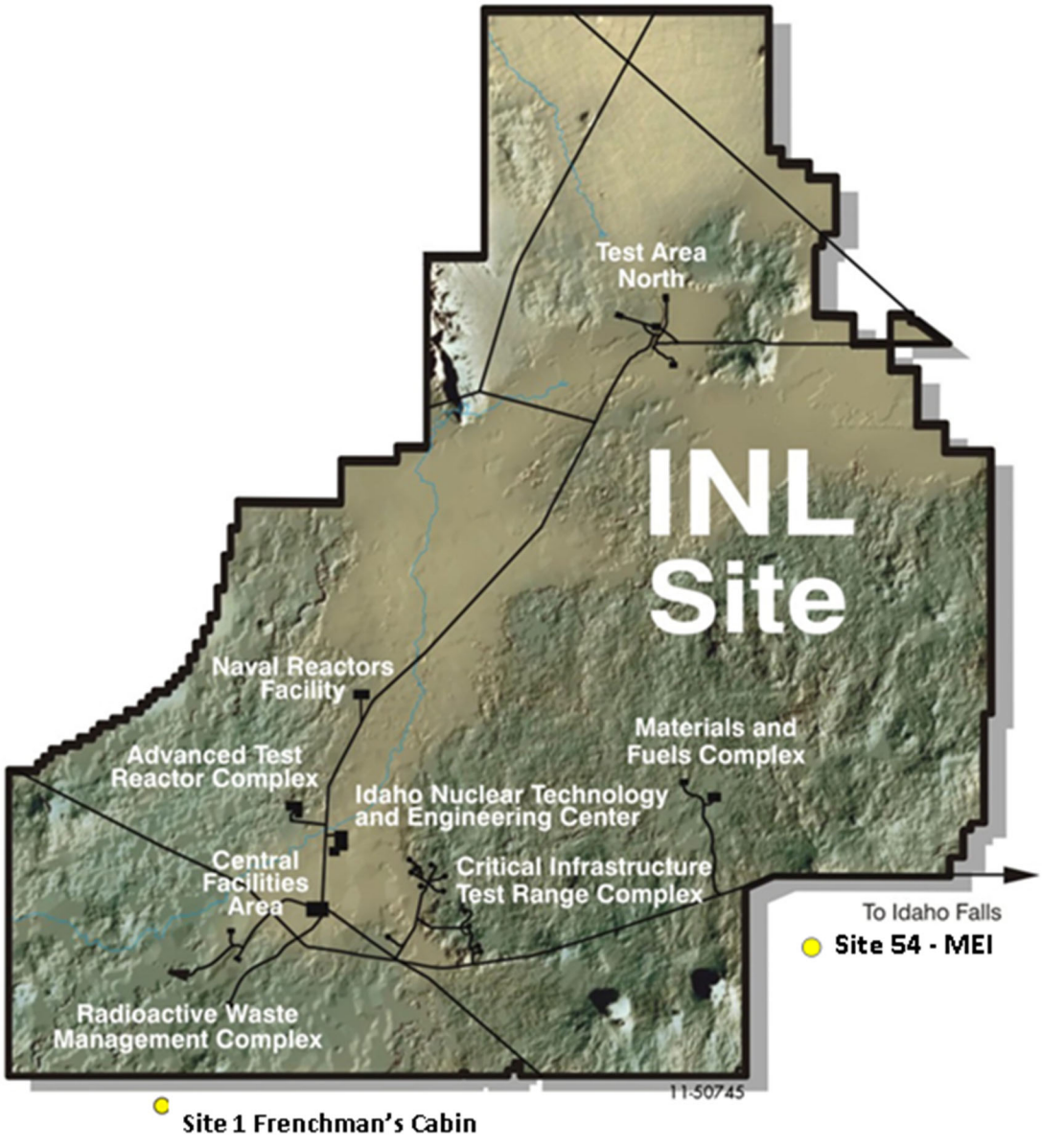

Figure 1. INL Site & MEI Location

4. 40 CFR PART 61.94(b) (2)

"A list of the radioactive materials used at the facility."

The individual radionuclides found in materials used at the INL Site during CY 2021 are listed in Table 4. These materials included, but were not limited to, samples, products, process solids, liquids and wastes that have potential emissions.

Table 4. Radionuclides in use and potentially emitted to the atmosphere from the INL Site facilities during the reporting period.

Ac-227	Co-59*	I-133	Os-191	Re-188	Tb-157	Xe-137
Ag-106	Co-60	I-134	P-32	Rh-102	Tb-158	Xe-138
Ag-108m	Co-60m	I-135	P-33	Rh-102m	Tb-160	Xe-139 (Cs-139)**
Ag-109m	Cr-51	In-114	Pa-231	Rh-103m	Tb-161	Xe-140 (Cs-140)**
Ag-110	Cs-134	In-114m	Pa-233	Rh-105	Tc-97m	Y-88
Ag-110m	Cs-135	In-115m	Pa-234	Rh-106	Tc-99	Y-89m
Ag-111	Cs-136	In-117	Pa-234m	Rh-106m	Tc-99m	Y-90
Ag-112	Cs-137	Ir-192	Pb-205	Rn-219	Te-123m	Y-91
Am-241	Cs-138	Ir-194	Pb-210	Rn-220	Te-125m	Y-91m
Am-243	Cu-64	K-40	Pb-211	Ru-103	Te-127	Y-92
Ar-39	Cu-67	K-42	Pb-212	Ru-105	Te-127m	Y-93
Ar-41	Dy-159	Kr-79	Pb-214	Ru-106	Te-129	Zn-65
Ar-42	Dy-165	Kr-81	Pd-107	S-35	Te-129m	Zn-69
As-73	Dy-166	Kr-83m	Pd-109	Sb-122	Te-131	Zn-69m
As-76	Er-169	Kr-85	Pm-146	Sb-124	Te-131m	Zn-72
As-77	Eu-152	Kr-85m	Pm-147	Sb-125	Te-132	Zr-93
As-78	Eu-154	Kr-87	Pm-148	Sb-126	Te-133	Zr-95
Ba-133	Eu-155	Kr-88	Pm-148m	Sb-126m	Te-134	Zr-97
Ba-137m	Eu-156	Kr-89	Pm-149	Sb-127	Th-227	
Ba-139	Eu-157	Kr-90 (Rb-90)**	Pm-150	Sb-128	Th-228	
Ba-140	Eu-158	Kr-91 (Sr-91)**	Pm-151	Sb-129	Th-229	
Ba-141	Fe-55	Kr-92 (Sr-92)**	Po-210	Sb-130	Th-230	
Be-10	Fe-59	La-140	Po-212	Sc-46	Th-231	
Bi-207	Fe-60	La-141	Po-215	Sc-47	Th-232	
Bi-210	Ga-68	La-142	Po-216	Sc-48	Th-234	
Bi-210m	Ga-72	Mn-52	Pr-143	Se-79	Tl-204	
Bi-211	Ga-73	Mn-53	Pr-144	Se-81	Tl-207	
Bi-212	Gd-153	Mn-54	Pr-144m	Se-81m	Tl-208	
Bi-214	Gd-159	Mn-56	Pr-145	Si-32	Tm-168	
Br-80	Ge-68	Mo-93	Pu-236	Sm-151	Tm-170	
Br-82	Ge-71	Mo-99	Pu-238	Sm-153	Tm-171	
Br-83	Ge-75	Na-22	Pu-239	Sm-156	U-232	
Br-84	Ge-77	Na-24	Pu-240	Sn-113	U-233	
C-14	Ge-78	Nb-92m	Pu-241	Sn-117m	U-234	
Ca-45	H-3	Nb-93m	Pu-242	Sn-119m	U-235	
Cd-109	He-3*	Nb-94	Pu-244	Sn-121	U-236	
Cd-113m	Hf-175	Nb-95	Ra-223	Sn-121m	U-237	
Cd-115	Hf-178m	Nb-95m	Ra-224	Sn-123	U-238	
Cd-115m	Hf-179m	Nb-96	Ra-226	Sn-125	V-48	
Cd-117	Hf-181	Nb-97	Rb-83	Sn-126	V-49	
Ce-139	Hf-182	Nd-147	Rb-84	Sn-127	W-181	
Ce-141	Hg-203	Nd-149	Rb-86	Sn-128	W-185	
Ce-143	Ho-166m	Ni-57	Rb-87	Sr-80	W-187	
Ce-144	I-125	Ni-59	Rb-88	Sr-85	W-188	
Cl-36	I-126	Ni-63	Rb-89	Sr-89	Xe-127	
Cm-242	I-128	Ni-65	Re-184	Sr-90	Xe-131m	
Cm-243	I-129	Ni-66	Re-184m	Ta-179	Xe-133	
Cm-244	I-130	Np-237	Re-186	Ta-180m*	Xe-133m	
Co-57	I-131	Np-239	Re-186m	Ta-182	Xe-135	
Co-58	I-132	Os-185	Re-187	Ta-183	Xe-135m	

* Radionuclide not included in CAP88 as it is stable.

** Radionuclide not included in CAP88 database due to short half-life. Parent converted into first progeny (shown in parentheses) included in CAP88 database.

5. 40 CFR PART 61.94(b) (3)

"A description of the handling and processing that the radioactive materials undergo at the facility."

5.1 Advanced Test Reactor Complex

The Advanced Test Reactor (ATR) Complex is operated by Battelle Energy Alliance, LLC (BEA) and is located in the south central section of INL. The ATR Complex has facilities for studying the performance of reactor materials and equipment components under high neutron flux conditions. The primary facility at ATR Complex is the ATR. Other operations at ATR Complex include research and development, and analytical laboratory services.

Radiological air emissions from ATR Complex are primarily associated with operation of the ATR. These emissions include noble gases, iodines and other mixed fission and activation products. Other radiological air emissions are associated with sample analysis, and research and development activities.

5.2 Central Facilities Area

The Central Facilities Area (CFA) is located in the south-central section of the INL Site. The CFA provides services that support the following INL Site facilities:

Maintenance shops

Vehicle maintenance facilities

Instrument calibration laboratories

Communications and security systems

Fire protection

Medical services

Warehouses

Laboratory Facilities

Other support services facilities

Minor emissions occur from CFA facilities where work with small quantities of radioactive materials is routinely conducted. This includes sample preparation and verification and radiochemical research and development. Other minor emissions result from groundwater usage via evapotranspiration from irrigation or evaporation from sewage lagoons and carbon-14 tracer release.

5.3 Critical Infrastructure Test Range Complex

The Critical Infrastructure Test Range Complex (CITRC) is located in the south-central section of the INL Site. The CITRC area supports National and Homeland Security missions of the laboratory, including program and project testing (i.e., critical infrastructure resilience and nonproliferation testing and demonstration). Wireless test-bed operations, power line and grid testing, unmanned aerial vehicle testing, accelerator testing, explosives detection and training radiological counter-terrorism emergency-response take place at the CITRC area.

The radiological releases this reporting period took place as part of a training exercise for first-responders to a release of radioactive material. Small amounts of a short-lived radionuclide were placed on various surfaces within the building as part of the training exercise. Building ventilation is not filtered.

The Plutonium, Uranium, Reduction, Extraction (PUREX) process is used for the extraction and recovery of uranium and plutonium from dissolved used nuclear fuel. A pilot plant is operated at PBF-622 that mimics several aspects of nuclear fuel reprocessing in the PUREX process using non-radioactive surrogates and some radioactive material.

5.4 Idaho Nuclear Technology and Engineering Center

The Idaho Nuclear Technology and Engineering Center (INTEC) is located in the southern portion of the INL Site and began operations in 1953 to recover and reprocess spent nuclear fuel. It was operated for the Department of Energy Idaho Operations Office by Fluor Idaho, LLC (FI) for the CY 2021 reporting period.

INTEC radiological air emission sources result from various activities and operations. It has two continuously monitored point sources (one regulated, and one voluntary) and various other diffuse and non-diffuse sources.

The New Waste Calcining Facility (NWCF) Stack, which is voluntarily monitored, provides ventilation from contaminated areas, decontamination activities, debris treatment processes, and waste repackaging activities in the NWCF. Effluent from the Fluorinel Dissolution Process and Fuel Storage Facility Stack, which is subject to continuous monitoring requirements, consists of exhaust from processing activities performed within the Fluorinel Dissolution Process Area and the Fuel Storage Area.

Emissions exhausted through the Main Stack are associated with ventilation and process and vessel off-gas exhausts from liquid waste operations, including effluent primarily from periodic operation of the Process Equipment Waste Evaporator and Liquid Effluent Treatment and Disposal, as well as relief valve emissions from the Tank Farm Facility.

Additional radioactive emissions are associated with spent nuclear fuel storage, including interim storage of nuclear reactor fuel from Three Mile Island (managed by Spectra Tech, Inc.), remote-handled transuranic and mixed waste storage and treatment, radiological and hazardous waste storage facilities, contaminated equipment servicing and repair and the Remote Analytical Laboratory (CPP-684) which is in cold standby.

Soils that were disturbed at INTEC during CY 2021 as the result of maintenance and other project activities are not being reported for CY 2021 because they were determined to have activities at background or lower radioactivity levels.

The ICDF is located on the southwest corner of INTEC. Diffuse radiological emissions from this facility are estimated from waste disposal in the landfill and evaporation pond operations.

5.5 Materials and Fuels Complex

The Materials and Fuels Complex (MFC) is located in the southeastern corner of the INL Site. MFC, a research facility operated by BEA, is involved in advanced nuclear power research and development, spent fuel and waste treatment technologies, national security programs and projects to support space exploration.

Radiological air emissions are primarily associated with spent fuel treatment at the Fuel Conditioning Facility (FCF), waste characterization and fuel research and development at the Hot Fuel Examination Facility (HFEF), fuel research and development at the Fuel Manufacturing Facility (FMF) and post irradiation examination at the Irradiated Materials Characterization Laboratory (IMCL). These facilities are equipped with continuous monitoring or continuous sampling systems. On a regular basis, the effluent streams from FCF, HFEF, FMF, IMCL and other non-CEM radiological facilities are sampled and analyzed for particulate radionuclides. Gaseous and particulate radionuclides may also be released from other MFC facilities during laboratory research activities, sample analysis, waste handling and storage and maintenance operations. Both measured and estimated emissions from MFC sources are consolidated for National Emission Standards for Hazardous Air Pollutants (NESHAP) reporting on an annual basis.

5.6 Radioactive Waste Management Complex

The RWMC, located in the southwestern corner of INL, is a controlled-access area consisting of two primary project areas: The Advanced Mixed Waste Treatment Project (AMWTP) and the Subsurface Disposal Area (SDA) and associated Accelerated Retrieval Project (ARP). The primary mission of AMWTP is to sort, characterize, and treat transuranic and mixed low-level waste, and package the treated waste for shipment offsite for disposal. Various activities are being conducted in the SDA to complete environmental cleanup of the area under CERCLA and to conduct waste storage and treatment under RCRA. These include waste retrieval activities at APR IX and operation of RCRA-permitted waste storage and treatment facility at WMF-1619. All projects at RWMC during 2021 were operated by FI.

With approval from EPA, exhumation at the CERCLA ARP IX as well as RCRA waste storage and treatment operations at ARP VII (WMF-1619) use ambient air monitoring as an alternative to air dispersion calculations to verify compliance with the emissions standard during ARP operation. Therefore, record sampling is not performed, although continuous air monitors are used for real-time monitoring for detection of off-normal emissions.

The RCRA permitted Sludge Repackage Project (SRP) at WMF-1619 facility (ARP VII) processed and treated transuranic waste (originating at AMWTP). Waste treatment included segregating/sorting waste, adding absorbents, waste and container sizing, decontaminating debris items, and waste repackaging. High efficiency particulate air (HEPA) filtered radionuclide emissions from the ARP enclosures are calculated for use with emissions measurements from other INL sources to demonstrate INL site-wide compliance using the CAP-88 model.

The AMWTP had six potential sources of radionuclide emission in operation during CY 2021, of which three are continuously monitored point sources. Radiological air emissions from the AMWTP may result from the characterization and treatment of transuranic waste, alpha-contaminated low-level mixed waste (alpha LLMW) and LLMW.

5.7 Test Area North

Test Area North (TAN) is the northernmost developed area within INL. It was originally established to support the Aircraft Nuclear Propulsion Program, which operated from 1951 to 1961. Since 1961, TAN buildings have been adapted for use by various other programs, including current BEA operations at the Specific Manufacturing Capability (SMC) facility.

The North Radiological Response Training Range (RRTR) began operation in July 2011 to support federal agencies responsible for the nuclear forensics mission.

5.7.1 Specific Manufacturing Capability

The TAN-SMC Project, managed by BEA, is a manufacturing operation that produces an armor package for the U.S. Department of the Army. The TAN-SMC Project was assigned to the INL Site in mid-1983. Operations at TAN-SMC include material development, fabrication and assembly work to produce armor packages. The operation uses standard metal-working equipment in fabrication and assembly. Other activities include developing tools and fixtures and preparing and testing metallurgical specimens. Radiological air emissions from TAN-SMC are associated with processing of depleted uranium. Potential emissions are uranium isotopes and associated radioactive progeny.

5.7.2 New Pump and Treat Facility

The main purpose of the New Pump and Treat Facility (NPTF) located at TAN-TSF is to reduce concentrations of trichloroethylene and other volatile organic compounds in the medial zone portion of the OU 1-07B contamination groundwater plume at TAN to below drinking water standards (before

reinjection into the aquifer). Low levels of Sr-90 and H-3 are also present in the treated water and are released to the atmosphere by the treatment process. The NPTF is operated by FI.

6. 40 CFR PART 61.94(b) (4) and (5)

"A list of the stacks or vents or other points where radioactive materials are released to the atmosphere. A description of the effluent controls that are used on each stack, vent, or other release point and an estimate of the efficiency of each control device."

Tables 5 through 12 list the facility stacks, vents, or other points where radioactive materials are released to the atmosphere. NRF emission points are listed in Appendix B.

Table 5. Stacks, vents, or other points of radioactive materials release to the atmosphere at ATR Complex.

Bldg	Vent	Source Description	Effluent Control Description	Efficiency
670	074	Laboratory 124 fume hoods exhaust	HEPA filter	99.97%
670	086	Laboratory 131 fume hoods exhaust	HEPA filter[b]	99.97%[b]
670	098	Laboratory 103 fume hoods exhaust (two hoods)	HEPA filter	99.97%
670	NA	ATR Canal	NA	NA
678	001	Radiation Measurements Laboratory fume hoods vent	HEPA Filter	99.97%
710	001	MTR Stack	Partial HEPA filtered[a]	99.97%
715	001	Warm Waste Evaporation Pond	NA	NA
770	001	ATR Main Stack	NA	NA
1627	001	Radioanalytical Chemistry Laboratory fume hoods stack	HEPA Filter	99.97%

a. HEPA filters are on the effluent from the Safety and Tritium Applied Research Facility (TRA-666) prior to being emitted from the MTR stack.
b. Emission reduction credit was not taken for this HEPA filter during 2021 due to HEPA filter test results.

Table 6. Stacks, vents, or other points of radioactive materials release to the atmosphere at CFA.

Bldg	Vent	Source Description	Effluent Control Description[a]	Efficiency
625	010	Laboratory fume hoods	HEPA Filter bank	99.97%
1618		HPIL	NA	NA
NA	NA	CFA-Tritium, Pumped groundwater	NA	NA

a. Bank includes multiple HEPA filters.

Table 7. Stacks, vents, or other points of radioactive materials release to the atmosphere at CITRC.

Bldg	Vent	Source Description	Effluent Control Description	Efficiency
612	NA	PBR 12, CITRC Control System Research	NA	NA
623	NA	CITRC Wireless Communication Support	NA	NA

Table 8. Stacks, vents, or other points of radioactive materials release to the atmosphere at INTEC.

Bldg	Vent	Source Description	Effluent Control Description	Efficiency
603	001	Irradiated Fuel Storage Facility	Two HEPA filters in series	99.97% each
659	033	NWCF Stack	Two HEPA filters in series	99.97%
684	001	Remote Analytical Laboratory	Two HEPA filters in series	99.97% each
708	001	INTEC Main Stack	Up to three HEPA filters in series	99.97% total

Bldg	Vent	Source Description	Effluent Control Description	Efficiency
749	001	Underground Fuel Storage/Vault Area	HEPA filter	99.97%
767	001	FAST Stack	Up to three HEPA filters in series	99.97% each
1608	001	Manipulator Repair Cell	Two HEPA filters in series	99.97% each
1774	NA	TMI-2 Independent Spent Fuel Storage Installation	HEPA filter	99.97%
CPP-2707	NA	Dry Cask Storage Pad	NA	NA
ICDF	NA	ICDF Landfill	NA	NA
OU-3-14	NA	Evaporation Pond	NA	NA

Table 9. Stacks, vents, or other points of radioactive materials released to the atmosphere at MFC.

Bldg	Vent	Source Description	Effluent Control Description[a]	Efficiency
CPP-653	001	Decontamination Testbed Facility	Two HEPA filter banks in series	99.97% each
704	008	Fuel Manufacturing Facility Stack	Two HEPA filter banks in series	99.97% each
720	007	Transient Reactor Test Facility reactor cooling air exhaust	Two HEPA filter banks in series	99.97% each
752	004	L&O Building main stack	Two HEPA filter banks in series	99.97% each
752	005	L&O Building nondestructive assay building stack	One to four HEPA filters in series	99.97% each
764	001	FCF Main Stack	Two HEPA filter banks in series	99.97% each
768	105	Decontamination shower suspect waste tank vent	HEPA filter bank	99.97%
768	108	Health Physics area fume hoods	HEPA filter bank	99.97%
774	026	EML exhaust	Two HEPA filter banks in series	99.97% each
	027	EML exhaust	Two HEPA filter banks in series	99.97% each
	028	EML exhaust	Two HEPA filter banks in series	99.97% each
	029	EML exhaust	Two HEPA filter banks in series	99.97% each
777	002	Zero Power Physics Reactor exhaust	HEPA filter bank	99.97%
784	001	Advanced Fuels Facility	One HEPA filter	99.97%
785	018	Hot Fuel Examination Facility stack	Two HEPA filter banks in series	99.97% each
787	001	Fuel Assembly and Storage Building	HEPA filter bank	99.97%
792A	001	Space and Security Power System Facility	Two HEPA filter banks in series	99.97% each
793	001	SCMS stack	HEPA filter bank	99.97%
794	002	Experimental Fuels Facility-West exhaust	HEPA filter bank	99.97%
794	006	Experimental Fuels Facility-East exhaust	HEPA filter bank	99.97%
1702	001	Radiochemistry Laboratory	HEPA filter bank	99.97%
1729	001	Irradiated Materials Characterization Laboratory	One to two HEPA filters in series	99.97%

a. Bank includes multiple HEPA filters.

Table 10. Stacks, vents, or other points of radioactive materials release to the atmosphere at RWMC.

Bldg	Vent	Source Description	Effluent Control Description	Efficiency
601	001	Health Physics Laboratory Hood	HEPA filter	99.97%
615	001	Drum Vent Facility	HEPA filter	99.97%
636	001	Transuranic Storage Area-Retrieval Enclosure (TSA-RE)	None	NA
676	003	Glovebox Stack	Three HEPA filters in series	99.97% each
1612	001	ARP-II	HEPA filter	99.97%
1614	001	ARP-III	HEPA filter	99.97%
1615	001	ARP-IV	HEPA filter	99.97%
1617	001	WMF-1617 (ARP-V) Sludge Repackage Project	HEPA filter	99.97%
1619	001	ARP-VII Debris Repackage Project	HEPA filter or two HEPA filters in series	99.97%
1621	001	ARP-VIII	HEPA filter	99.97%
1622	001	ARP-IX	HEPA filter	99.97%
SDA	1	Buried Beryllium Blocks	NA	NA
		H-3 from groundwater	NA	NA

Table 11. Stacks, vents, or other points of radioactive materials release to the atmosphere at TAN-SMC.

Bldg	Vent	Source Description	Effluent Control Description[a]	Efficiency
629	013	Line 2, manufacturing process	Two HEPA filter banks	99.97%
679	022	North manufacturing process (EF-206) and includes releases from the quality control (QC) laboratory	HEPA filter bank	99.97%
679	023	North manufacturing process (EF-205) includes releases from the QC laboratory	HEPA filter bank	99.97%
679	024	North manufacturing process (EF-204) and includes releases from the QC laboratory	HEPA filter bank	99.97%
679	025	South process (RAD Stack #8) manufacturing process (EF-203)	HEPA filter bank	99.97%
679	026	South process (RAD Stack #7) manufacturing process (EF-202)	HEPA filter bank	99.97%
679	027	South process (RAD Stack #6) manufacturing process (EF-201)	HEPA filter bank	99.97%
681	018	Process Reclamation Facility	HEPA filter bank	99.97%
681	020	Process Reclamation Facility	HEPA filter bank	99.97%
681	016	Process Reclamation Facility	NA	NA

a. Bank includes multiple HEPA filters.

Table 12. Stacks, vents, or other points of radioactive materials release to the atmosphere at TAN-TSF.

Bldg.	Vent	Source Description	Effluent Control Description	Efficiency
1611	NA	OU 1-07B Treatment Process	NA	NA

7. 40 CFR PART 61.94(b) (6)

"List distances from the points of release to the nearest residence, school, business or office and the nearest farms producing vegetables, milk and meat."

Table 13 shows distances from the points of release to the nearest residence, school, business or office and the nearest farms producing vegetables, milk and meat.

Table 13. Distances from INL facility points of release to the nearest off-Site receptor location, farm, dairy, feedlot and to Receptor 54 (INL MEI).

Facility	Distance and Direction to Nearest Residence, School, Business	Distance and Direction to Nearest Vegetable Farm	Distance and Direction to Nearest Dairy	Distance and Direction to Nearest Feedlot	Distance and Direction to MEI (Receptor 54)
MFC	8.7 km[a] SSE	13.6 km ESE	30 km ENE	8.7 km SSE	8.7 km SSE
CFA	12.5 km SE	12.5 km SE	35 km SE	27.8 km E	27.8 km E
CITRC	10.8 km SSE	10.7 km S	33.5 km SE	21.5 km E	21.5 km E
INTEC	15.3 km SSE	14.5 km SSE	38 km SE	27.2 km ESE	27.2 km ESE
NRF	13.7 km NNW	11.7 km NNW	20.9 km NNW	15.6 NNW	28.8 km ESE
RWMC/AMWTP	8.0 km SSW	14.8 km ESE	38.5 km ESE	35.3 km E	35.3 km E
TAN-TSF	10.3 km E	9.1 km E	18.2 km E	16.7 km E	36.7 km SSE
TAN-SMC	12.3 km E	11.1 km E	20.4 km E	18.9 km E	38.1 km SSE
ATR Complex	17.4 km NW	17 km SSE	41 km SE	30.2 km ESE	30.2 km ESE

a. km = kilometers.

8. 40 CFR PART 61.94(b) (7)

"The values used for all other user-supplied input parameters for the computer models (e.g. meteorological data) and the source of these data."

Tables 14 and 15 show the CAP-88 modeling input parameters for CY 2021.

Table 14. Description of data tables in NESHAP CAP-88 database

Table Name	Field Name	Description
UnitDoses	FacilityID	Facility Identification (see Table 16)
	Nuclide	Radionuclide name
	Direction	Direction to MEI
	Distance	Distance to MEI
	UDose	Unit dose (mrem/Ci)
Releases	SourceID	Source Identification
	FacilityID	Facility Identification (see Table 16)
	Fugitive	Fugitive or Non-Fugitive release flag
	Radionuclide	Nuclide name
	Q	Release rate (Ci/yr)
MkMEIsBySecName	FacilityID	Facility Identification (see Table 16)
	SectorName	Text name of the 16, 22.5-degree sectors
	Distance	Distance from the facility to the receptor
	ReceptorNum[a]	Receptor number index

a. The receptor number is the identification assigned to the 62 receptors surrounding INL. The distance and direction to each receptor varies by facility.

Table 15. INL Site meteorological files and wind measurements heights.

Facility	Facility ID	Wind File	Measurement Height (m)
Central Facilities Area	CFA	690L21.WND	10
Critical Infrastructure Test Range Complex	CITRC	PBFL21.WND	10
Idaho Nuclear Technology and Engineering Center, Idaho CERCLA Disposal Facility	INTEC	GRIL21.WND	10
Idaho Nuclear Technology and Engineering Center – Main Stack	INTEC-MS	GRIU21.WND[b]	30
Materials and Fuels Complex	MFC	EBRL21.WND	10
Materials and Fuels Complex – Main Stack	MFC-MS	EBRU21.WND	30
Materials and Fuels Complex – TREAT Stack	MFC-TREAT	EBRU21.WND	30
Naval Reactors Facility	NRF	NRFL21.WND	10
Advanced Test Reactor Complex[a]	ATRC	TRAL21.WND	10
Advanced Test Reactor Complex[a], Advanced Test Reactor Main Stack	ATRC-ATR	GRIU21.WND[b]	30
Advanced Test Reactor Complex[a], Materials Test Reactor Main Stack[c]	ATRC-MTR	GRIU21.WND[b]	30
Radioactive Waste Management Complex	RWMC	RWMCL21.WND	10

a. The Advanced Test Reactor Complex (ATRC) was formerly known as the Test Reactor Area (TRA) and Reactor Technology Complex (RTC). The acronyms based on former names may still be used to describe facility buildings, meteorological stations, etc.
b. The nearest tower with an upper (30 m) measurement height (GRID III) was used for stacks at INTEC and the ATR Complex. The GRID III tower is approximately 1.6 km north of INTEC and 1.7 km east of the ATR Complex.
c. The ATR MTR stack did not emit radionuclides during the 2021 reporting period.

9. 40 CFR PART 61.94(b) (8)

"A brief description of all construction and modifications which were completed in the calendar year for which the report is prepared, but for which the requirement to apply for approval to construct or modify was waived under §61.96 and associated documentation developed by DOE to support the waiver. EPA reserves the right to require that DOE send to EPA all the information that normally would be required in an application to construct or modify, following receipt of the description and supporting documentation"

The west room in the Fuels and Applied Science Building (MFC-787, FASB) contains inert atmosphere gloveboxes used for developing low - enrichment fuels, treating waste from glovebox operations, working with corrosive materials, and testing equipment that will be used in other facilities. The old East and West Development Gloveboxes that were primarily used by the Pyrochemistry and Molten Salt Systems Development Department were removed. They were replaced with the Pyrochemistry Glovebox, a new six-section MBraun glovebox and fume hood that is equipped with two 12-inch well furnaces, two workstation furnaces, a muffle furnace, and a multifunction furnace. Installation of the glovebox and furnaces was completed in 2020. Testing and commissioning were completed in 2021. The unmitigated EDE is calculated to be 4.54E-05 mrem/year.

The Radioactive Scrap and Waste Facility (RSWF) at MFC provides interim storage for spent nuclear fuel, remote-handled mixed-low-level waste, and other radioactive wastes in gravel-filled 16" diameter by 12'4'' long by ¼" thick carbon steel pipes (e.g., liners) that are welded shut with a shield plug or plate. The 16" liners are overpacked into 24" diameter by 13'8" long carbon steel pipes with cathodic protection. The current disposition process involves coring around the 24" large liner, extracting then packaging the liner for transport from RSWF to INTEC where it is processed for treatment and final disposition. The purpose of this project was to design, test, and implement a more efficient retrieval system capable of remotely completing the following tasks: remove the 16" liner from the 24" liner, remove the gravel from the 16" liner, attach or fabricate a new 16" liner lid, reduce the size of the 16" liner, and retrieve the size-reduced 16" liner for packaging and transportation. The prototype was designed; testing completed in 2021. The unmitigated EDE is calculated to be 7.27E-04 mrem/year; however, there were no actual emissions because there was no external contamination found during this activity.

The Advanced Fuel Facility (MFC-784, AFF) at MFC was previously referred to as the Zero Power Physics Reactor Materials and Controls Building. The scope of operations in AFF now involves R&D associated primarily with uranium-bearing fuels and associated surrogate materials in order to increase advanced fuel manufacturing capabilities at MFC. To that end, an experiment vehicle assembly (EVA) glovebox that provides an inert atmosphere and a Sodick small hole drilling machine were installed in AFF in 2021. The unmitigated EDE for AFF is calculated to be 7.66E-02 mrem/year.

The purpose of the FASB Fermi melt-drain-evaporate (MEDE) system was to demonstrate the technological feasibility of using the MEDE system on full-length Fermi-1 assemblies. The project designed and fabricated a MEDE system for operation with a single full-length Fermi-1 blanket assembly. The project installed the first MEDE system in a new inert-atmosphere glovebox at FASB. The MEDE apparatus was operated using one loose unirradiated Fermi-1 blanket element to assess operating conditions necessary for bond sodium removal from full length materials. After operating conditions were defined, the project used the MEDE apparatus to demonstrate bond sodium removal using a bundle of 9 elements and the last intact unirradiated full-length Fermi-1 radial blanket assembly. Installation and operation completed in 2021. The unmitigated EDE is calculated to be 2.77E-09 mrem/year.

The Decontamination Testbed Facility (CPP-653) is primarily used for the Zircex Nuclear Fuel Dissolution Testing at CPP-653. The processing method uses reactions of the fuel with chlorine and HCl to separate zirconium or aluminum cladding in the fuel from uranium, so that these separated valuable materials can be further reprocessed and reused. Radiological emissions from the Zircex project originate from activities involving unirradiated fuel samples of uranium and zirconium or uranium and aluminum. Chemical emissions from the facility originate from the Zircex process that passes through a wet scrubber. Emissions from the Zircex process also pass through two HEPA filters prior to discharge through the stack. The project initiated unirradiated fuel testing in CY-2021. The unmitigated EDE is calculated to be 3.49E-03 mrem/year.

Thermal Desorption Spectroscopy (TDS) will be performed on irradiated samples at the Safety and Tritium Applied Research (STAR) Facility located at the ATR Complex. This activity is expected to emit radionuclides resulting in a calculated EDE of 3.03E-05 mrem/year. The calculated EDE is less than 1% of the standard, negating the requirement to obtain an application to construct.

During calendar year 2021, FI claimed an exemption from having to submit an application to construct or modify for waste treatment activities performed at the INTEC, NWCF (CPP-659). These activities were determined to not be subject to continuous monitoring requirements, with an unabated effective dose equivalent of 1.76E-02 mrem/year and an abated EDE of 3.91E-06 mrem/year, which is less than 1% of the standard prescribed in Section 61.92.

Appendix A

INL Research and Education Campus

INL Research and Education Campus

This report documents radionuclide air emissions for calendar year (CY) 2021 and the resulting effective dose equivalent (EDE) to the maximally exposed individual (MEI) member of the public from operations at Idaho National Laboratories (INL) at the INL Research Center (IRC) and the Department of Energy - Idaho Operations Office (DOE-ID) Radiological and Environmental Sciences Laboratory (RESL) on the INL Research and Education Campus (REC).

The heading of each section in this report corresponds to the citation found in 40 *Code of Federal Regulations* (CFR) Part 61.94. The applicable reporting requirement is cited under the heading in italicized text followed by the compliance report for REC.

40 CFR 61.94(a)

"Compliance with this standard shall be determined by calculating the highest effective dose equivalent to any member of the public at any offsite point where there is a residence, school, business or office. The owners or operators of each facility shall submit an annual report to both Environmental Protection Agency (EPA) headquarters and the appropriate regional office by June 30, which includes the results of the monitoring as recorded in DOE's Effluent Information System and the dose calculations required by §61.93(a) for the previous calendar year."

No radionuclide emissions for the IRC or RESL required continuous monitoring for compliance during CY 2021. Table 1A lists the sources used to calculate the EDE to the MEI.

Table 1A. Sources used to calculate the EDE to the MEI.

Facility	Source
IRC:	IF-603, IRC Laboratory (IRC-L) Building
	IF-611, National Security Laboratory (NSL)
RESL:	IF-683, Radiological and Environmental Sciences Laboratories

Subpart H requires DOE facilities to calculate the resulting dose to the offsite MEI. The location of IRC/RESL MEI for CY 2021 is an office building 115 meters south southeast of RESL. The EDE to the MEI was 6.21E-03 mrem/yr, which is 0.062% of the 10-mrem/yr federal standard and was calculated using all sources that emitted radionuclides to the environment from IRC/RESL. Table 2A provides a summary of IRC/RESL Site MEI dose by facility and source type.

Table 2A, Dose (mrem) contributions and total IRC/RESL dose (mrem) to the MEI located 0.1 km south of the IRC/RESL for CY 2021 radionuclide air emissions.

Source ID	Non Fugitive Dose (mrem/yr)	Percent of Total MEI Dose	Notes
RESL IF-683	4.61E-03	74.2%	DOE RESL Sources
IF-611	1.03E-03	16.5%	National Security Laboratories
IF-603	5.77E-04	9.3%	IRC Laboratories
REC Total	**6.21E-03**	**100%**	**IRC Total**

40 CFR 61.94(b)

"In addition to paragraph (a), the annual report will include the following information:"

40 CFR 61.94(b)(1)

"The name and location of the facility."

IRC and RESL facilities are located contiguously on a partially developed 14.3-ha (35.5-acre) plot of the REC on the north side of the City of Idaho Falls. Though programs and operations at the IRC/RESL are affiliated with INL, the IRC/RESL is located within the city limits of Idaho Falls and is not contiguous with the INL Site, the nearest boundary of which is approximately 22 mi west of Idaho Falls.

BEA facilities include three, one-story laboratory buildings containing 66 laboratories in IRC-L (Building IF-603) and NSL (IF-611). RESL (IF-683) consists of 8 radiochemistry laboratories, stable chemistry laboratories, offices and conference areas.

40 CFR 61.94(b)(2)

"A list of the radioactive materials used at the facility."

The individual radionuclides found in materials used at the IRC and RESL during CY 2021 are listed in Table 3A. These materials included, but were not limited to, samples, products, process solids, liquids and wastes that have potential emissions. Table 3A does not contain radionuclides with an activity <1E-25.

Table 3A. Radionuclides in use and potentially emitted to the atmosphere from REC facilities in CY 2021

Ac-227	I-129	Th-229
Ag-110m	I-131	Th-230
Am-241	Ir-192	Th-232
Am-243	Kr-85	U-232
Ba-133	Mn-54	U-233
Ba-140	Nb-95	U-234
C-14	Ni-63	U-235
Cd-109	Np-237	U-238
Ce-139	Pa-231	Xe-131m
Ce-144	Pu-238	Xe-133
Cf-252	Pu-239	Xe-135
Cm-244	Ra-226	Y-88
Co-57	Ru-103	Zn-65
Co-60	Ru-106	Zr-95
Cs-134	Sb-125	
Cs-137	Sc-46	
Eu-152	Se-75	
Eu-154	Sm-151	
Eu-155	Sn-113	
Fe-55	Sr-85	
Gd-148	Sr-89	
H-3	Sr-90	
Hg-203	Tc-99	
I-125	Tc-99m	

40 CFR 61.94(b)(3)

"A description of the handling and processing that the radioactive materials undergo at the facility."

The IRC is principally an experimental research facility dedicated to a wide range of research areas including microbiology, geochemistry, materials characterization, welding, ceramics, thermal fluids behavior, materials testing, nondestructive evaluation of materials using standard industrial x-ray processes, x-ray diffraction and x-ray fluorescence, analytical and environmental chemistry and biotechnology. Non-research activities include analytical chemistry and preparation of reference radioactive and nonradioactive standards for performance evaluation programs.

Radiological emissions from the IRC could arise from uncontrolled laboratory fume hoods within the facility. Exhaust from most of the fume hoods is released directly to the outside atmosphere via the heat recovery fan system of the IRC heating, ventilating, and air conditioning system. The heat recovery fan system exhausts to the outside via vents on the north side of the mechanical penthouse on top of the IRC laboratory building. The height of these vents is 7.6 m (25 ft). The exhausts from other fume hoods (not exhausted to the heat recovery fan) are released to the atmosphere via a 2.1-m (7.0-ft) stack above the roof or two 8.5-m (28-ft) stacks above the roof.

Emissions can occur from other areas as well. Not all radiological emissions will occur from work in a fume hood. Some work is done on work benches or in bay areas.

The Radiological and Environmental Sciences Laboratory (RESL) is a federally owned and operated laboratory by the Department of Energy (DOE). The laboratory's focus is primarily in analytical chemistry, radiation protection and as a reference laboratory for numerous performance evaluation programs. RESL emissions are from low-level radiological performance testing sample preparation and verification.

Radiological emissions from the DOE-ID RESL (Bldg IF-683) could be emitted from uncontrolled laboratory fume hoods. The fume hoods are identified by vent numbers and the emissions exhaust directly to the outside atmosphere via individual stacks on the south side of the building roof. These stacks all have a height of 9.6m (31.6ft). Radiological emissions from RESL could also be emitted from the centralized building exhaust system (F-1 and F-2) located in all the south labs plus the following rooms: Alpha and Gamma spectrometry, Beta Counting, Radiological Standards Vault and the Sample and Radiological Storage. The stack height for the centralized exhaust system is 7.4m (24.3ft) and is located on the east side, center, of the building roof. All heights are from ground level.

40 CFR 61.94(b)(4)

"A list of the stacks or vents or other points where radioactive materials are released to the atmosphere."

Tables 4A and 5A list the facility stacks, vents, or other points where radioactive materials were released to the atmosphere during CY 2021.

Table 4A. Stacks, vents, or points of radioactive materials release to the atmosphere at IRC.[1]

Building	Vent	Source Description	Effluent Control Description	Efficiency
IF-603	HRF-4	Laboratories A13, A15, A20 and B4-B6	NA	NA
IF-603	HRF-5	Laboratory B12	NA	NA
IF-603	HRF-6	Laboratories C6 and C10	NA	NA
IF-611	HV[1]-EF-4	Laboratory 104	NA	NA
IF-611	HV-EF-6	Laboratory 105	NA	NA
IF-611	Blower EF-5	Laboratory 105	NA	NA
IF-638		IRC Physic Laboratory	NA	NA

1. Key- EF: exhaust fan, AHU: air handler unit, HRF: heat recovery fan, HV: heating ventilation.

Table 5A. Stacks, vents, or points of radioactive materials release to the atmosphere at RESL.

Building	Vent	Source Description	Effluent Control Description	Efficiency
IF-683	F-9	Laboratory 129 fume hood exhaust	NA	NA
IF-683	F-10	Laboratory 129 fume hood exhaust	NA	NA
IF-683	F-11	Laboratory 130 fume hood exhaust	NA	NA
IF-683	F-12	Laboratory 130 fume hood exhaust	NA	NA
IF-683	F-13	Laboratory 131 fume hood exhaust	NA	NA
IF-683	F-14	Laboratory 131 fume hood exhaust	NA	NA
IF-683	F-15	Laboratory 132 fume hood exhaust	NA	NA
IF-683	F-16	Laboratory 132 fume hood exhaust	NA	NA
IF-683	F-17	Laboratory 133 fume hood exhaust	NA	NA
IF-683	F-18	Laboratory 133 fume hood exhaust	NA	NA
IF-683	F-19	Laboratory 134 fume hood exhaust	NA	NA
IF-683	F-20	Laboratory 134 fume hood exhaust	NA	NA
IF-683	F-21	Laboratory 135 fume hood exhaust	NA	NA
IF-683	F-22	Laboratory 135 fume hood exhaust	NA	NA
IF-683	F-23	Laboratory 136 fume hood exhaust	NA	NA
IF-683	F-24	Laboratory 136 fume hood exhaust	NA	NA
IF-683	F-1, F2	Building exhaust	NA	NA

40 CFR 61.94(b)(5)

"A description of the effluent controls that are used on each stack, vent, or other release point and an estimate of the efficiency of each control device."

No effluent control equipment is associated with any release points of radioactive material at IRC facilities.

40 CFR 61.94(b)(6)

"Distances from the points of release to the nearest residence, school, business or office and the nearest farms producing vegetables, milk and meat."

The nearest residence is approximately 0.4 km (0.25 mi.) to the west. The nearest school is approximately 0.4 km (0.25 mi.) to the south. The nearest business or office is approximately 0.1 km (0.0620 mi.) east, north and south of the IRC/RESL. The nearest farm producing vegetables, milk and meat is 0.35 km (0.22 mi.) to the north of the IRC/RESL.

40 CFR 61.94(b)(7)

"The values used for all other user supplied input parameters for the computer models (e.g., meteorological data) and the source of these data."

The meteorological input file used to calculate the MEI was IDAL18.WND from the NOAA station at Fanning Field in Idaho Falls, ID. The measurement height is 15 meters.

The CAP88-PC Version 4.1 modeling was performed for facilities in Idaho Falls using emission rates for radionuclides listed in Table 3A. For IRC facility and RESL, releases were calculated from a single ground-level point source for receptors in each of the 16, 22.5-degree sectors.

40 CFR 61.94(b)(8)

"A brief description of all construction and modifications that were completed in the calendar year for which the report is prepared, but for which the requirement to apply for approval to construct or modify was waived under § 61.96 and associated documentation developed by DOE to support the waiver."

None.

Appendix B

Naval Reactors Facility National Emission Standards for Hazardous Air Pollutants - Radionuclides Annual Report for 2021

Naval Reactors Facility

National Emission Standards for Hazardous Air Pollutants

Report on Radionuclide Air Emissions

For Calendar Year 2021

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Prepared for the U.S. Department of Energy by

Fluor Marine Propulsion, LLC

Calendar Year 2021

Naval Reactors Facility

National Emission Standards for Hazardous Air Pollutants

Report on Radionuclide Air Emissions

As required under 40 CFR 61 Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities"

Site Name: Idaho National Laboratory (INL)

Area: Naval Reactors Facility (NRF)

Area Information for NRF

Operator: Fluor Marine Propulsion, LLC
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I. FACILITY INFORMATION

Site Description

The Naval Reactors Facility (NRF) is located in the west-central part of Idaho National Laboratory (INL), as shown in Figure 1. The nearest population center is Howe, which is located approximately 16.3 kilometers (10.1 miles) north-northwest of NRF.

The climate of INL is characterized as semi-arid. INL is located on the Snake River Plain with an elevation of approximately 1500 meters (5000 feet). Air masses entering the Snake River Plain from the west lose most of their moisture as precipitation prior to reaching INL; therefore, annual precipitation at INL is light. Winds are channeled over the Snake River Plain by bordering mountain ranges so that winds from the southwest and northeast predominate over INL. The meteorological data for the area is used in the dose modeling, as described in Section III.

Established in 1949, NRF is operated for the U. S. Naval Nuclear Propulsion Program by Fluor Marine Propulsion, LLC. The operations area of NRF within the security fence consists of buildings, streets, and equipment covering about 89 acres. The principal facilities at NRF are three former naval reactor prototypes (S1W, A1W, and S5G) and the Expended Core Facility (ECF). The S1W, A1W, and S5G prototypes were shut down in 1989, 1994, and 1995, respectively.

Developmental nuclear fuel material samples, naval spent fuel, and irradiated reactor plant components/materials are examined at ECF. The knowledge gained from these examinations is used to improve current designs and to monitor the performance of existing reactors. The naval spent fuel examined at ECF is critical to the design of longer-lived reactor cores, which results in the generation of less spent fuel requiring disposition. NRF also prepares and packages spent naval fuel for dry storage and eventual transport to a permanent repository.

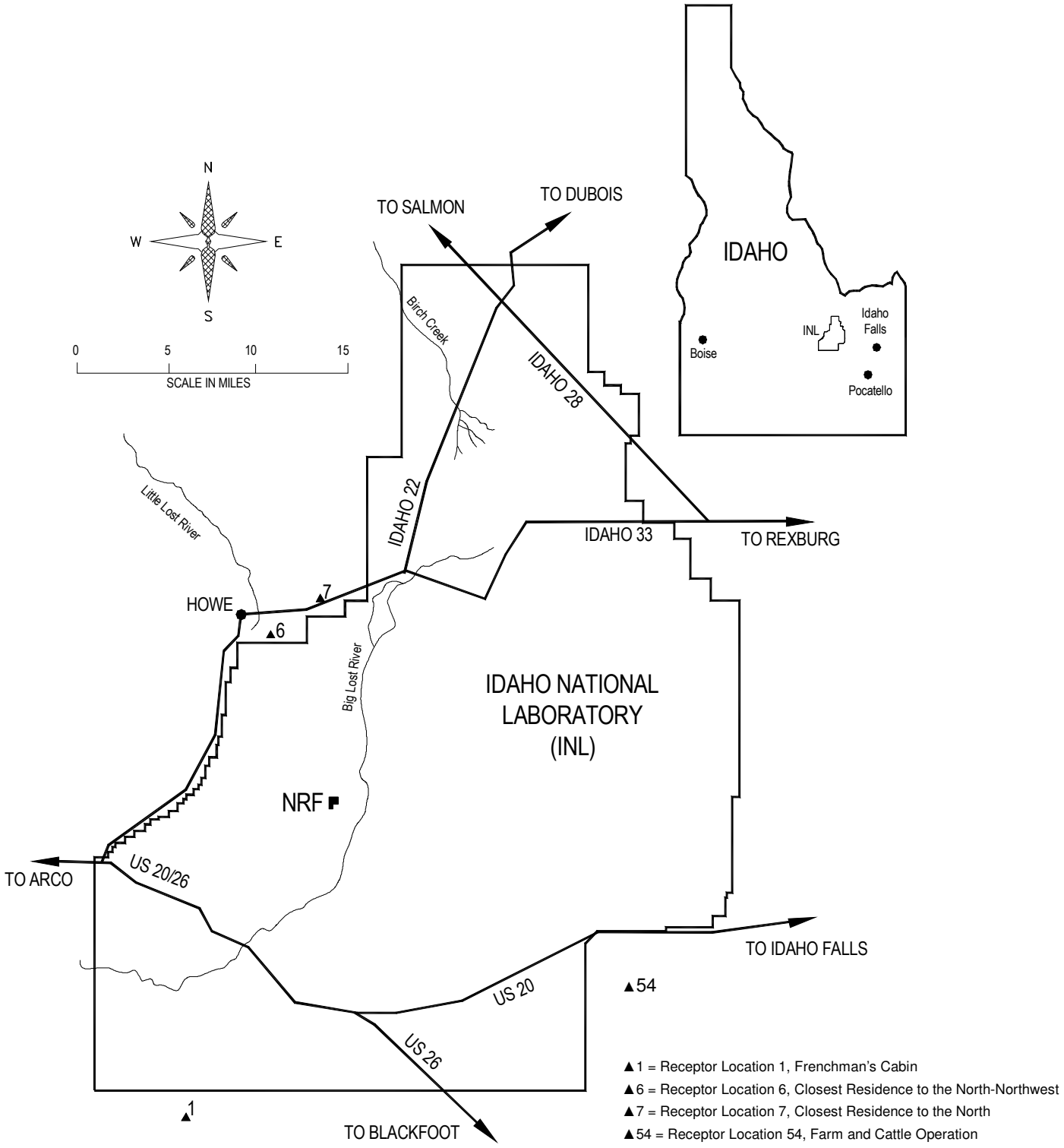

Figure 1. Relation of NRF to INL and the Surrounding Area

Source Descriptions

NRF receives spent fuel and radioactive components from the U.S. Naval Nuclear Propulsion Program, shipped in Department of Energy (DOE)/Nuclear Regulatory Commission approved shipping containers in accordance with Department of Transportation requirements. The shipments are processed and examined at ECF.

Radioactive materials at NRF include enriched uranium fuel with associated fission products, activation products, and activated corrosion and wear products. Various radiation sources are used for calibrating and checking equipment, and for verifying shielding. Soil with low levels of radioactivity from past releases is also present at NRF.

Radioactive materials are handled and processed in several areas at NRF, including shielded hot cells, chemical and metallurgical laboratories, water pools, and radioactive material storage areas. Physical, chemical, and metallurgical testing of small quantities of highly radioactive material specimens is performed in the ECF shielded hot cells. Radioactive work conducted within the ECF high bay water pools consists of unloading spent naval fuel and radioactive specimens from shipping containers, fuel examinations, removal of non-fuel structural pieces, and storage of fuel. In another part of ECF called the Spent Fuel Packaging Facility, the spent naval fuel is removed from the water pools and packaged for long-term dry storage. Segregation and repackaging of radioactive waste are performed at the S5G prototype building. Decontamination of inactive radiological systems is conducted throughout NRF controlled areas. Radioactive work is performed in appropriate containment. Storage and movement of radioactive materials are under strict control. Special laboratory facilities are available for the chemical analysis of low-level radioactive samples.

Radionuclide emissions to the atmosphere can come from the following sources at NRF:

(1) ECF, where spent fuel from naval reactor cores and contaminated materials such as anti-contamination clothing, tools, and equipment are handled. Spent fuel is handled, stored, and prepared for disposal in the water pools. Radioactive specimens are handled in the shielded hot cells. Spent fuel is unloaded from shipping containers and is packaged for long-term storage at a permanent repository.

(2) S1W, A1W, and S5G Prototype Reactors. Although the reactors have been shut down and defueled, other activities such as routine inspections of the reactor compartments have a small potential to emit radionuclides. At the S5G prototype building, contaminated materials such as anti-contamination clothing, tools, equipment, and contaminated waste are handled. Analyses are performed on radioactive materials in chemistry laboratories in the A1W prototype building.

(3) Fugitive soil emissions from areas surrounding NRF that potentially contain low levels of radioactivity.

(4) Remediation and demolition activities at various buildings and structures with historical radioactive contamination.

II. AIR EMISSIONS DATA

NRF has a number of stacks and vents with the potential to emit low quantities of radionuclides. These emissions are quantified by monitoring and/or by calculations based on production.

Continuous monitoring is required by 40 CFR 61 Subpart H, Section 61.93(b), for emission points that have a potential to emit radionuclides in quantities that could result in an Effective Dose Equivalent (EDE) to a member of the public in excess of 1 percent of the 10 millirem (1×10^{-4} sievert) per year standard, which equates to 0.1 millirem (1×10^{-6} sievert) per year. None of the emission points at NRF qualify for the continuous monitoring requirement; all emission points are below the 0.1 millirem (1×10^{-6} sievert) per year criterion. For emission points whose potential to emit is below this criterion, periodic confirmatory measurements are required to verify the low emissions.

Table II-1 identifies point sources of potential radionuclide air emissions at NRF. Table II-2 identifies potential non-point sources (also called diffuse, or fugitive sources) of radionuclide air emissions. The only non-point source at NRF is windblown soil from areas on NRF property outside of the operations area that contain low levels of radioactivity from past releases to the environment. Table II-3 lists the amount of each radionuclide emitted from point sources and Table II-4 lists the amount from non-point sources. The tables include measured values for those radionuclides that are routinely monitored and calculated values for those radionuclides that are not monitored.

The nearest residence, school, business, or office to NRF is a residence 13.3 kilometers (8.3 miles) to the north-northwest. The nearest cultivated land is 11.6 kilometers (7.2 miles) to the north. This area is typically planted in wheat, barley, or alfalfa. The nearest farm producing milk is 20.9 kilometers (13.0 miles) to the north-northwest. The nearest feedlot producing meat is 15.6 kilometers (9.7 miles) to the north-northwest. However, cattle are grazed on private and public land throughout the area. Cattle are allowed to graze as close as 3.4 kilometers (2.1 miles) to the north of NRF. These distances are from the northern-most emission point at NRF. The distances are greater from other NRF emission points. These distance values may differ from those stated in the overall INL report since that report may use a different origination point at NRF for calculating distances.

Table II-1. Radiological Air Emission Point Sources at NRF During 2021

AREA-BLDG-VENT	SOURCE DESCRIPTION	EFFLUENT CONTROL	EFFICIENCY	MONI-TORED [2]
NRF-601-HBRV	S1W High Bay Roof Vents (6 individual emission points)	None	NA	Yes
NRF-601-132	S1W Deep Pit Area Ventilation	HEPA Filter	99.95% [1]	Yes
NRF-616-012, 021	A1W Operations Building and Site Chemistry	None	NA	Yes
NRF-617-013	A1W Reactor Compartment 3A	HEPA Filter	99.95% [1]	Yes
NRF-617-020	A1W Reactor Compartment 3B	HEPA Filter	99.95% [1]	Yes
NRF-618-099	ECF Stack Number 1	HEPA Filter Carbon Filter	99.95% [1] 90–99.9% [3]	Yes+
NRF-618-103	ECF Stack Number 2	HEPA Filter	99.95% [1]	Yes+
NRF-618-237	ECF Stack Number 3	HEPA Filter	99.95% [1]	Yes+
NRF-618-HBRV	ECF High Bay Roof Vents (16 individual emission points)	None	NA	Yes+
NRF-633A-057	S5G Radioactive Area Ventilation (RAV) System	HEPA Filter	99.95% [1]	Yes
NRF-633A-HBRV	S5G High Bay Roof Vents (7 individual emission points)	None	NA	Yes

Table II-1 Notes:

1. High Efficiency Particulate Air (HEPA) filters are tested by the manufacturer prior to delivery to NRF and by NRF during the life of the filter. The manufacturer tests the efficiency for 0.3-micron monodispersed dioctylphthalate (DOP) particles to a minimum of 99.97 percent. NRF tests the efficiency for 0.7-micron polydispersed DOP particles to a minimum of 99.95 percent.
2. "Yes" indicates that the source was monitored, and the measured emissions are included in this report. "Yes+" indicates that the source was monitored, and both measured and calculated emissions are included in this report. Because some gaseous radionuclides could not be measured, the amounts of these radionuclides were calculated based on process production rate.
3. The carbon filters have an efficiency of 99.9 percent for the removal of radioactive iodine when new. Their efficiency lessens with use, as the carbon adsorbent depletes. The carbon filters are replaced every 3 years, before efficiency drops to 90 percent.

Table II-2. Radiological Air Emission Non-Point Sources at NRF During 2021

AREA-BLDG-VENT	SOURCE DESCRIPTION	EFFLUENT CONTROL	EFFICIENCY	MONI-TORED
NA	Fugitive Soil	None	NA	No

Table II-3. Point Source Releases from NRF During 2021

Radionuclide	Release (curies)	Release (becquerels)[1]
Gross alpha activity (modeled as plutonium-239)	3.8E-06	1.4E+05
Gross beta activity (modeled as strontium-90)	6.9E-05	2.6E+06
Carbon-14	5.5E-01	2.0E+10
Hydrogen-3 (Tritium)	1.1E-02	4.1E+08
Iodine-129	1.2E-05	4.4E+05
Iodine-131	5.2E-06	1.9E+05
Krypton-85	5.3E-03	2.0E+08
Total	5.7E-01	2.1E+10

Table II-3 Note:

1. One curie equals 3.7E+10 becquerels.

Table II-4. Non-Point Source Releases from NRF During 2021

Radionuclide	Release (curies)	Release (becquerels)[1]
Cesium-137	6.3E-05	2.3E+06
Total	6.3E-05	2.3E+06

Table II-4 Notes:

1. One curie equals 3.7E+10 becquerels.
2. In 2021, there was no measurable or calculated release of cobalt-60.

III. DOSE ASSESSMENT

Description of Dose Model and Summary of Input Parameters

The CAP88 computer code (CAP88-PC Version 4.0) was used to calculate the EDE from NRF releases. CAP88 is approved for use by the Environmental Protection Agency (EPA) for demonstrating compliance with 40 CFR 61 Subpart H. The output from CAP88 is the EDE, which includes the 50-year committed EDE from internal exposure through the ingestion and inhalation pathways, and the external EDE from ground deposition and air immersion.

Site-specific 2021 wind data was used, supplied by the National Oceanic and Atmospheric Administration (NOAA). The emissions from all NRF sources were totaled and modeled as a single emission point; individual emission points were not modeled separately. The emissions were modeled as ground level releases with no plume rise. Other user-supplied input parameters are as follows:

Wind Data File: NRFL21.STR provided by NOAA
Annual Average Temperature: 7.8°C average in 2021 per NOAA
Annual Rainfall: 19.2 cm in 2021 per NOAA
Humidity: 4 g/m^3 long-term INL average calculated from NOAA data
Lid Height: 800 m standard value for INL, provided by NOAA
Agricultural Class: Rural

For determining the EDE, the gross alpha radioactivity was conservatively modeled as plutonium-239 and the gross beta radioactivity was conservatively modeled as strontium-90. The dose from radioactive daughter progeny is included in the dose determined by the CAP88 program.

Table III-1 summarizes the EDE results for point sources, non-point sources, and both combined.

Table III-1. Effective Dose Equivalents from Sources at NRF During 2021

Release Type	EDE [1] (mrem)	EDE [1] (Sv) [2]
Point Sources	2.0E-04	2.0E-09
Non-Point Sources	3.7E-06	3.7E-11
Total:	2.0E-04	2.0E-09

Table III-1 Notes:

1. The EDE shown is for the NRF Maximally Exposed Individual (Figure 1, Location 7).
2. One millirem (mrem) equals 1.0E-05 sievert (Sv).

Compliance Assessment

40 CFR 61 Subpart H requires that emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive an EDE of 10 millirem (1×10^{-4} sievert) per year. "Member of the public" is any offsite point where there is a residence, school, business, or office. The CAP88 program determined the dose from NRF emissions at various locations around the INL where there is a residence, school, business, or

office. The highest dose occurred at a residence 15.4 kilometers (9.6 miles) to the north of NRF (Figure 1, Location 7). This location is not the closest residence to NRF. The closest residence, school, business, or office is a residence 13.3 kilometers (8.3 miles) to the north-northwest (Figure 1, Location 6). However, the direction of winds throughout the year caused Location 7 to be more affected by NRF emissions than Location 6. The location numbers come from a list of residences around the INL boundary created by INL for dose modeling.

The EDE from NRF emissions is provided for information only. For compliance purposes, the EDE from all INL emissions combined must comply with the 40 CFR 61.92 standard of 10 millirem per year. NRF emissions are combined with emissions from other INL facilities to determine the overall EDE for INL. The highest EDE from all INL facilities combined typically occurs at a location south of INL referred to as Frenchman's Cabin (Figure 1, Location 1). Due to the variability of work conducted at the Materials and Fuels Complex in the last two years, the highest EDE from all INL facilities shifted to Receptor 54, a farm and cattle operation located approximately 2.3 kilometers (1.4 miles) south of the INL border and northeast of East Butte (Figure 1, Receptor Location 54).

IV. ADDITIONAL INFORMATION

40 CFR 61 Subpart H requires this report to include a brief description of all construction and modifications that were completed in the calendar year for which the report is prepared, but for which the requirement to apply for approval to construct or modify was waived.

During 2021, work started on the Northeast Boundary Area project, which will extend power and communication equipment to the wall around the north and east sides of NRF. Part of the excavation will be done in soil that is potentially contaminated with low levels of radioactivity. Using conservative methods, the potential EDE to the Maximally Exposed Individual was determined to be 2.32E-05 millirem per year, which is less than 0.1 millirem per year so an application for approval was not required per 40 CFR 61.96(b).

NRF did not have any unplanned releases of radionuclides to the atmosphere in 2021.

A dose assessment of the diffuse (non-point) emissions from NRF is presented in Section III. As shown in Table III-1, the EDE from diffuse sources does not significantly add to the overall EDE from NRF emissions. The only diffuse source of air emissions from NRF is soil with low levels of radioactivity from historical releases that is exposed to the wind. The amount of this diffuse emission is determined based on the measured activity in the soil and a conservative calculation of the amount of soil that leaves the NRF site as windblown dust.

V. SUPPLEMENTAL INFORMATION

A March 25, 1993, memorandum from the DOE Office of Environmental Guidance requested that the following supplemental information be included in the annual report. This information is not required by the reporting requirements of 40 CFR 61.94.

REQUEST: Provide an estimate of the collective effective dose equivalent (person-rem per year) for 2021 releases.
An estimate of the collective effective dose equivalent for the population within 50 miles (80 kilometers) of NRF for 2021 is 1.1E-02 person-rem per year (1.1E-04 person-sievert per year).

REQUEST: Provide information on the status of compliance with Subparts Q and T of 40 CFR Part 61 if pertinent.
Subpart Q of 40 CFR Part 61, "National Emission Standards for Radon Emissions from Department of Energy Facilities," is applicable to the design and operation of storage and disposal facilities for radium-containing material that emit radon-222 into the air. Subpart Q is not applicable to NRF. Subpart T of 40 CFR Part 61, "National Emission Standards for Radon Emissions from the Disposal of Uranium Mill Tailings," is not applicable to NRF.

REQUEST: Provide information on radon-220 emissions from sources containing uranium-232 and thorium-232 where emissions potentially can exceed 0.1 millirem (1×10^{-6} sievert) per year to the public or 10 percent of the non-radon dose to the public.
NRF does not have any sources of uranium-232 or thorium-232 emissions that potentially can exceed 0.1 millirem (1×10^{-6} sievert) per year to the public or 10 percent of the non-radon dose to the public.

REQUEST: Provide information on non-disposal and non-storage sources of radon-222 emissions where emissions potentially can exceed 0.1 millirem (1×10^{-6} sievert) per year to the public or 10 percent of the non-radon dose to the public.
NRF does not have any non-disposal or non-storage sources of radon-222 emissions that potentially can exceed 0.1 millirem (1×10^{-6} sievert) per year to the public or 10 percent of the non-radon dose to the public.

REQUEST: For the purpose of assessing facility compliance with the National Emission Standards for Hazardous Air Pollutants effluent monitoring requirements of Subpart H under Section 61.93(b), give the number of emission points subject to the continuous monitoring requirements, the number of these emission points that do not comply with the Section 61.93(b) requirements, and if possible, the cost for upgrades. Describe site periodic confirmatory measurement plans. Indicate the status of the quality assurance program described by Appendix B, Method 114.
NRF does not have any emission points that require continuous monitoring under Section 61.93(b), and therefore does not have any emission points that do not comply, and no upgrades are necessary. Periodic confirmatory measurements were made using a combination of sampling and calculation. Particulate radionuclides were sampled on a continuous basis. Iodine-131 was sampled on a continuous basis from two stacks. Other gaseous radionuclide emissions were calculated based on process knowledge and production rate. The Appendix B Method 114 quality assurance program is not required since no NRF emission points require continuous monitoring. However, a quality assurance program is followed which incorporates many of the same features, such as equipment calibration, the use of blanks and known standards, and the annual review and validation of data by peer reviewers.