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Radiological NESHAP ANNUAL REPORT
CY 2016

SANDIA NATIONAL LABORATORIES, New Mexico

Albuquerque, New Mexico

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ACRONYMS and ABBREVIATIONS

ACRR	Annular Core Research Reactor
AHCU	Auxiliary Hot Cell Unit
CAP88-PC	Clean Air Act Assessment Package – 1988 Personal Computer
CFR	Code of Federal Regulation
Ci	curie(s)
CY	Calendar Year
DOE	Department of Energy
ECF	Explosive Components Facility
EDE	effective dose equivalent
HERMES	High Energy Radiation Megavolt Electron Source
IBL	Ion Beam Laboratory
KAFB	Kirtland Air Force Base
km	kilometer
m	meter
MEI	maximally exposed individual
mrem	millirem
NGF	Neutron Generator Facility
NM	New Mexico
PRD	Process Research and Development laboratory
RMWMU	Radioactive and Mixed Waste Management Unit
RPICL	Radiation Protection Instrument Calibration Laboratory
SNL	Sandia National Laboratories
START	Sandia Tomography and Radionuclide Transport
TA	Technical Area
U.S.	United States
yr	year

1. INTRODUCTION

This report provides a summary of the radionuclide releases from the United States (U.S.) Department of Energy (DOE) National Nuclear Security Administration facilities at Sandia National Laboratories, New Mexico (SNL/NM) during Calendar Year (CY) 2016, including the data, calculations, and supporting documentation for demonstrating compliance with 40 Code of Federal Regulation (CFR) 61, Subpart H--NATIONAL EMISSION STANDARDS FOR EMISSIONS OF RADIONUCLIDES OTHER THAN RADON FROM DEPARTMENT OF ENERGY FACILITIES (Radiological NESHAP). A description is given of the sources and their contributions to the overall dose assessment. In addition, the maximally exposed individual (MEI) radiological dose calculation and the population dose to local and regional residents are discussed.

2. FACILITY INFORMATION

2.1 Site Description

SNL/NM is located on Kirtland Air Force Base (KAFB) in Albuquerque, NM, at the foot of the Manzanita Mountains. SNL/NM consists of five secured technical areas (TA) where all of the Radiological NESHAP sources are located. In addition to the five secured TAs, SNL/NM has buildings in non-secured areas, and several remote testing areas. These remote test areas are collectively known as the Coyote Test Field and are located in the canyons on the west side of the Manzanita Mountains.

2.2 Point Radiological Sources

Point releases are sources that potentially discharge material to the atmosphere through a facility's exhaust stack or rooftop vent. All releases at SNL/NM are point sources. During CY 2016, the following facilities submitted an inventory of radionuclide releases to the environment and are listed according to location (Figure 1).

- TA-I: Sandia Tomography and Radionuclide Transport Laboratory (START), Radiation Protection Instrument Calibration Laboratory (RPICL), Process Research and Development Laboratory (PRD), Ion Beam Laboratory (IBL), and Neutron Generator Facility (NGF)
- TA-II: Explosive Components Facility (ECF)
- TA-III: Radioactive and Mixed Waste Management Unit (RMWMU)
- TA-IV: High Energy Radiation Megavolt Electron Source (HERMES) and Z Facility
- TA-V: Auxiliary Hot Cell Unit (AHCU), and the Annular Core Research Reactor (ACRR).

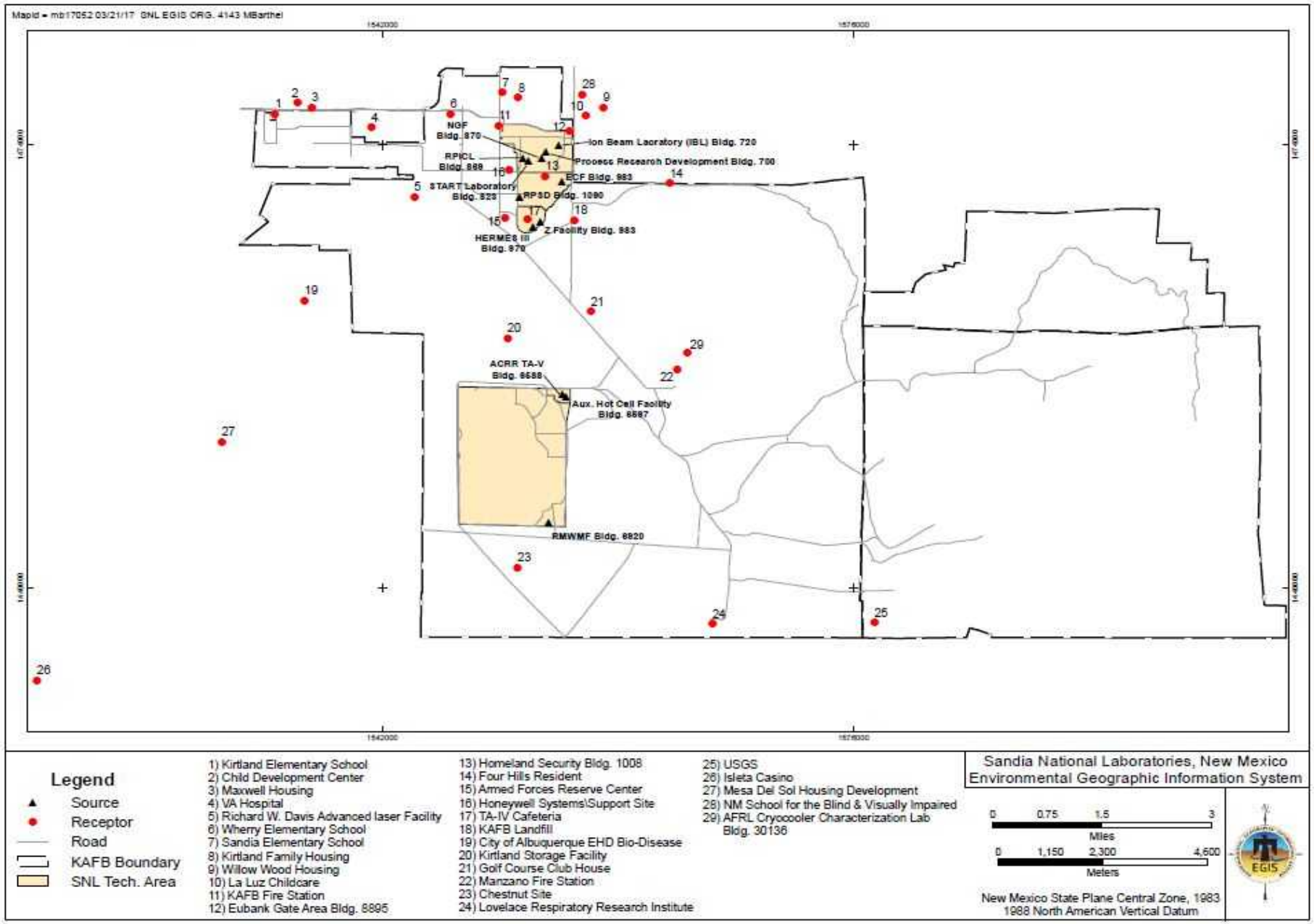

Figure 1. Sources and Receptors

2.3 Radiological Releases During CY 2016

The facilities evaluated for airborne releases are included in the calculation of the total dose to the MEI. **Table 1** summarizes the reported radionuclide releases from the facilities. **Table 2** summarizes the location of each facility and the facility release parameters.

The largest point source releases during CY 2016 were 14.0 curies (Ci) of ^{3}H from the NGF and 17.48 Ci of ^{41}Ar from the ACRR. The release inventories for the remaining sources were negligible. There were no reported emissions from the START laboratory.

2.4 Environmental Monitoring

A detailed description of the ongoing environmental surveillance activities at SNL/NM is published annually in SNL's 2016 *Annual Site Environmental Report, Albuquerque, New Mexico* (SNL 2017).

SNL/NM currently has eight meteorological towers in use at select locations across KAFB. The dose assessment for SNL/NM Radiological NESHAP compliance is performed using on-site meteorological data from three of the eight stations.

There were no environmental restoration activities conducted in CY2016 with the potential to release radionuclide emissions.

2.5 Emission Release Parameters

Point source releases potentially occur from stack exhausts or vents. For those releases, the Clean Air Act Assessment Package –Personal Computer (CAP88-PC) code calculates a momentum-type plume rise. Plume rise is calculated from the stack diameter and exhaust velocity. Stack characteristics for point sources are listed in **Table 2.** Thermally hot exhausts, which lead to much higher plume rises, do not exist at any of the individual SNL/NM facilities considered in this report.

Table 1. Summary of Reported Radionuclide Releases for CY 2016.

Source Name, Location	Description	Source Type	Monitoring Method	Radio-nuclides Emitted	Reported Release Amount (Ci/yr)
ACRR, TA-V	Reactor used to perform in-pile experiments for severe-reactor-accident research projects.	Point	Periodic	^{41}Ar	17.5
AHCU, TA-V	The AHCU is used to identify, sort, characterize, and repackage legacy nuclear materials for permanent removal from the SNL/NM site. Legacy material may include accountable nuclear material, spent nuclear fuel, and radiological material.	Point	Periodic	^{85}Kr ^{90}Sr ^{137}Cs	2.0E-08 1.5E-08 1.0E-08
ECF, TA-II	Facility used for testing neutron-generator design and manufacturing.	Point	Calculation	^{3}H	8.8E-04
HERMES, TA-IV	Gamma simulator used primarily for simulating the effects of prompt radiation from a nuclear burst on electronics.	Point	Periodic	^{13}N ^{15}O	5.43E-04 5.4E-05
IBL, TA-I	Ion solid interaction and defect physics accelerator facility.	Point	Calculation	^{3}H	1.8
NGF, TA-I	Principal production facility for neutron generators.	Point	Continuous	^{3}H	14.0
RMWMU, TA-III	Facility that handles radioactive and mixed waste products.	Point	Continuous & Calculation	^{3}H (oxide) ^{3}H (elemental) ^{90}Sr ^{137}Cs	1.28E-02 1.54E-01 5.02E-06 5.02E-06
RPICL, TA-I	Laboratory that performs radiation detection equipment calibration.	Point	Calculation	^{3}H	2.41E-05
PRD, TA-I	Small-scale laboratory operation involved in the handling and research of sealed and unsealed tritiated materials.	Point	Calculation	^{3}H	8.5E-05
Z Facility, TA-IV	Experimental facility for research on light-ion inertial confinement fusion.	Point	Calculation	^{3}H	2.76E-03

^{41}Ar = Argon 41, ^{85}Kr = Krypton 85, ^{90}Sr = Strontium 90, ^{137}Cs = Cesium 137, ^{3}H = Tritium, ^{151}Sm = Samarium 151, ^{13}N = Nitrogen 13, ^{15}O = Oxygen 15

Table 2. Release Parameters for CY 2016 SNL/NM Facilities

Source Name, Location	Building #	Release Height* meter (m)	Stack Diameter (m)	Release Temperature (°C)	Exhaust Velocity (m/s)
ACRR, TA-V	6588	16.5	0.2	20	18.9
AHCU, TA-V	6591	16.2	0.4	21	14.6
ECF, TA-II	905	7.9	0.5	21	15.4
HERMES, TA-IV	970	13.5	0.05	13	7.8
IBL, TA-I	720	1**	0.025	25	0
NGF, TA-I	870	17.4	1.2	20	16.5
RMWMU, TA-III	6920	16.8	0.6	25	9.4
RPICL, TA-I	819	7.4	0.3	22	7.9
PRD, TA-I	700	10.5	0.6	20	5.0
Z Facility, TA-IV	983	15.8	0.2	21	6.1

*Includes building height.

** Does not include building height

3. DOSE ASSESSMENT

3.1 Description of Model Used

This section summarizes the CAP88-PC computer code for air dispersion and radionuclide dose assessment.

3.1.1 CAP88-PC

Compliance procedures for DOE facilities [40 CFR 61.93(a)] require the use of CAP88-PC or other approved procedures to calculate effective dose equivalents (EDE) to members of the public. All dose assessments presented in this report were calculated using CAP88-PC Windows Version 4.

3.1.2 Summary of CAP88-PC Input Data

Radionuclide-specific parameters such as dose conversion factors, decay constants, and dry deposition velocity are provided as part of the CAP88-PC computer code. However, several types of site-specific and user-supplied data are required by the CAP88-PC code. These include meteorological, demographic, radiological inventories, receptor location, and facility release parameters. This section summarizes the required user-supplied data for running the CAP88-PC code.

3.1.2.1 Meteorological Data

Meteorological data used in the CY 2016 dose assessment were obtained from on-site meteorological stations located near the emission sources. These data collectively consist of hourly meteorological observations of wind direction, wind speed, and stability class (inferred from wind and solar insolence data) that formed a normalized distribution from which all wind and stability frequency-of-occurrence data was derived. The CY 2016 SNL/NM meteorological station data were used to create stability array data files that, once converted to wind files (WND), could be incorporated into the CAP88-PC code to perform the dose assessment.

Data from three SNL/NM meteorological tower stations -- A21 (TA-II), A36 (North East end of TA-III), and CW1(South East end of TA-III) – were used for the dose assessment (Table 3). These stations were selected based on distance from radiological source locations, tower height (all meteorological data were obtained at a height of 10 m), and data availability.

Table 3. Weather Data for CY 2016

Tower	Temperature (°C)	Relative Humidity (%)	Precipitation (cm)	Absolute Humidity
A21	14.95	38.6	20.37	5.12
A36	14.43	39.7	21.39	5.04
CW1	14.69	43.0	20.90	5.63

*Average precipitation calculation

3.1.2.2 Facilities Modeled

By regulation, continuous monitoring is required of radionuclide sources that have a potential EDE to the MEI of > 0.1 millirem per year (mrem/yr). There are no facilities at SNL/NM

requiring continuous stack monitoring according to the regulation. However, several facilities report emissions based on either stack monitoring or calculations based on measured parameters. While not required by the regulation, stack monitoring and calculations based on measured parameters are performed as part of SNL/NM's best management practices.

The sources identified at SNL/NM are the NGF, the IBL, the PRD, the START Laboratory, and the RPICL located in TA-I; the ECF located in TA-II; the RMWMU located in TA-III; Z Facility and the HERMES Facility located in TA-IV; and the ACRR and AHCU located in TA-V.

No emissions were reported from the START Laboratory.

3.1.2.3 Receptor Locations

Numerous receptor locations were evaluated as potential locations of maximum exposure. These locations are either on-site areas (within the KAFB Boundary) or off-site areas where members of the public are known to reside for varying lengths of time. **Figure 1** of this document illustrates the receptor locations.

3.1.2.4 Demographic Data for Modeling

Demographic data relevant to Rad NESHAP reporting include population, beef cattle, dairy cattle, and the utilized food crop area fraction. The CAP88-PC code has demographic data available for the Albuquerque area that is based on state-wide demographic averages. The estimated State of New Mexico urban and county population data obtained from the U.S. Census Bureau (www.census.gov) data were used to calculate the population distribution within each of the eighty CAP88-PC analysis zones (16 wind direction sectors subtended by 5 concentric, equally spaced rings to an 80-kilometer (km) radius). A total of 909,953 people were estimated to live within the 80-km-radius study area.

Additional demographic data includes:

- beef cattle density of 0.58 per km^2,
- dairy cattle density of 0.93 per km^2, and
- a food crop area fraction of 6.2E-04

3.2 Dose to the Maximum Exposed Individual

The calculation of the MEI of the public is required annually under Radiological NESHAP regulations, 40 CFR 61, Subpart H. The regulation requires that the cumulative EDE from exposure to all site-wide airborne radionuclide releases not exceed the 10 mrem/yr standard. The dose contribution from each of the sources was combined to yield the overall dose to the MEI. Release amounts from individual facilities at SNL/NM were determined from either calculations based on actual measurements, measured stack parameters, or from calculations based on radionuclide inventory.

The on-site MEI was determined to be located at the Kirtland Storage Facility. The EDE calculated for the MEI was estimated to be 2.53E-03 mrem/yr, primarily from exposure to ^{3}H released from the NGF and ^{41}Ar from the ACRR. The off-site MEI dose was 1.10E-03 mrem/yr at the Eubank Gate. The MEI doses are well below the Radiological NESHAP standard of 10 mrem/yr.

3.3 Dose to the Regional Population

A population dose was calculated by the CAP88-PC code for the 80-km radius surrounding the SNL/NM site using a single common grid analysis (i.e., single release point) for all SNL/NM sources. Because the analysis area is so large, the relatively small distances between sources have a minimal impact on the resulting 80-km-radius regional population dose. The population dose contribution from each Radiological NESHAP source was estimated and then summed to obtain the regional population dose. The local regional population distributions were derived from this population data and input to CAP88-PC.

The population dose from CY 2016 SNL/NM operations was calculated to be 9.66E-02 person-rem/yr for the surrounding population residing outside Kirtland AFB. The population dose is well below the Radiological NESHAP standard of 10 mrem/yr.

3.4 Dose to Kirtland Air Force Base Residents

A population dose was calculated for KAFB residents resulting from exposure to all SNL/NM routine radiological emissions. Because there are only a few residential neighborhoods on KAFB, the KAFB population dose was determined based on the maximum individual dose calculated for each of the KAFB housing compounds.

The population dose for each KAFB housing unit was calculated as the product of the housing unit population and the housing unit individual dose (calculated by the CAP88-PC code). The housing unit population doses were then summed to obtain a composite KAFB population dose. An annual composite population dose of 1.45E-03 person-rem/yr was estimated for KAFB. The population dose for KAFB is well below the Radiological NESHAP standard of 10 mrem/yr.

4. OTHER Radiological NESHAP COMPLIANCE CRITERIA

In addition to the MEI dose criterion imposed under Radiological NESHAP, there are a number of other criteria. These criteria are addressed below.

4.1 Continuous and Periodic Confirmatory Air Monitoring

Under the Radiological NESHAP regulation, monitoring is required for any source that has the potential to contribute 0.1 mrem/yr or more to the MEI. However, after a programmatic review of the SNL/NM Radiological NESHAP program in 1997, SNL/NM personnel determined that under routine and normal operations, there are currently no sources at SNL/NM that require stack monitoring. This remains unchanged. However, as part of SNL/NM's best management practice, the NGF main stack and the RMWMU are continuously monitored for discharges of radionuclides to the environment.

4.2 New or Modified Radiological Sources

During CY 2016, The IBL laboratory reported emissions.

4.3 NESHAP Subparts Q and T

During CY 2016, no radon emissions occurred from any SNL/NM facilities.

4.4 Unplanned Radiological Releases

There were no unplanned radiological releases in CY 2016.

5. REFERENCES

EPA 1989 U.S. Environmental Protection Agency, 40 CFR 61, Subpart H, *National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy (DOE) Facilities*, December 15, 1989.

SNL 2017 *2016 Annual Site Environmental Report for Sandia National Laboratories/NM,* 2016.