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Nevada National Security Site Environmental Report Summary 2013

September 2014

National Nuclear Security Administration

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The information presented in this document is explained in greater detail in the ***Nevada National Security Site Environmental Report 2013*** (DOE/NV/25946--2182). A compact disc of this document is included on the back inside cover. This document can also be downloaded from the U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office at **http://www.nv.energy.gov/library/publications/aser.aspx**.

For more information about the Nevada National Security Site Environmental Report, contact **Pete Sanders** at **(702) 295-1037** or **peter.sanders@nnsa.doe.gov**.

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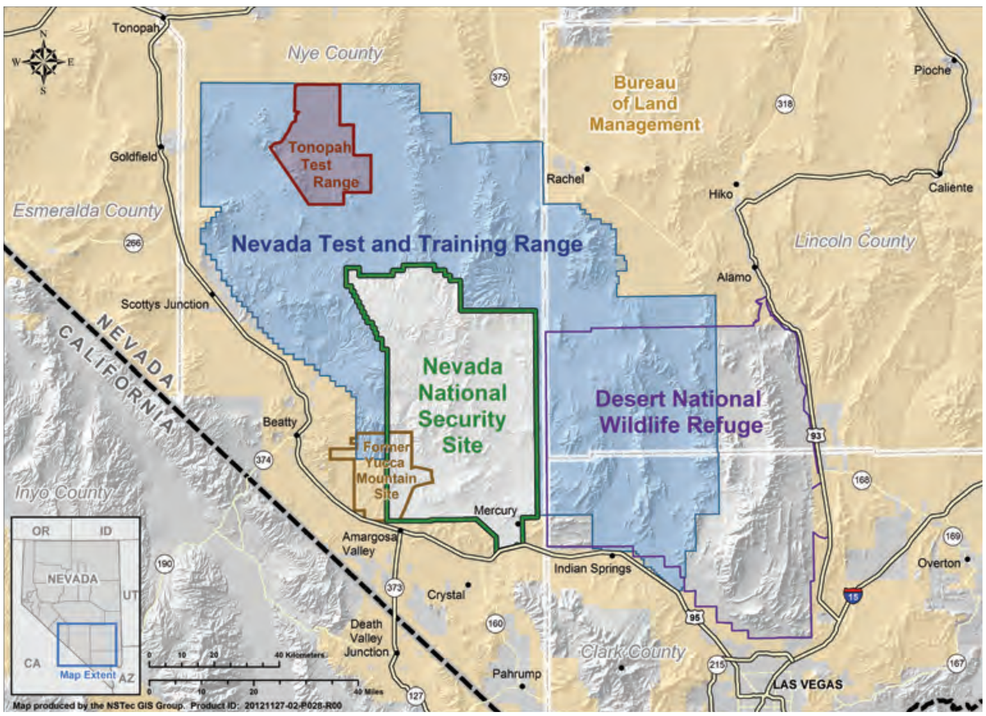
Nevada National Security Site Environmental Report Summary 2013

The U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office (NNSA/NFO), formerly the Nevada Site Office, directs the management and operation of the Nevada National Security Site (NNSS). NNSA/NFO prepares the *Nevada National Security Site Environmental Report* (NNSSER) to provide the public an understanding of the environmental monitoring and compliance activities that are conducted on the NNSS to protect the public and the environment from radiation hazards and from nonradiological impacts.

The NNSSER is a comprehensive report of environmental activities performed at the NNSS and offsite facilities over the previous calendar year. It is prepared annually to meet the requirements and guidelines of the U.S. Department of Energy (DOE) and the information needs of NNSA/NFO stakeholders. This summary provides an abbreviated and more readable version of the NNSSER. It does not contain detailed descriptions or presentations of monitoring designs, data collection methods, data tables, the NNSS environment, or all environmental program activities performed throughout the year.

The reader is provided with an electronic file of the full NNSSER and of *Attachment A: Site Description* (see attached compact disc on the inside back cover). The reader may obtain a hard copy of the full NNSSER as directed on the inside front cover of this summary report.

The NNSS is currently the nation's unique site for ongoing national security–related missions and high-risk operations. The NNSS is located about 65 miles northwest of Las Vegas. The approximately 1,360-square-mile site is one of the largest restricted access areas in the United States. It is surrounded by federal installations with strictly controlled access as well as by lands that are open to public entry.



History of the NNSS

Between 1940 and 1950, the area now known as the NNSS was part of the Las Vegas Bombing and Gunnery Range. In 1950, the NNSS was established as the primary location for testing the nation's nuclear explosive devices. Such testing took place from 1951 to 1992.

Tests conducted through the 1950s were predominantly atmospheric tests. These involved a nuclear explosive device detonated while either on the ground surface, on a steel tower, suspended from tethered balloons, dropped from an aircraft, or placed on a rocket. Several tests were categorized as "safety experiments" and "storage-transportation tests," involving the destruction of a nuclear device with non-nuclear explosives. Some of these tests resulted in dispersion of plutonium in the test vicinity. Some of these test areas are on the Nevada Test and Training Range (NTTR) and on the Tonopah Test Range (TTR).

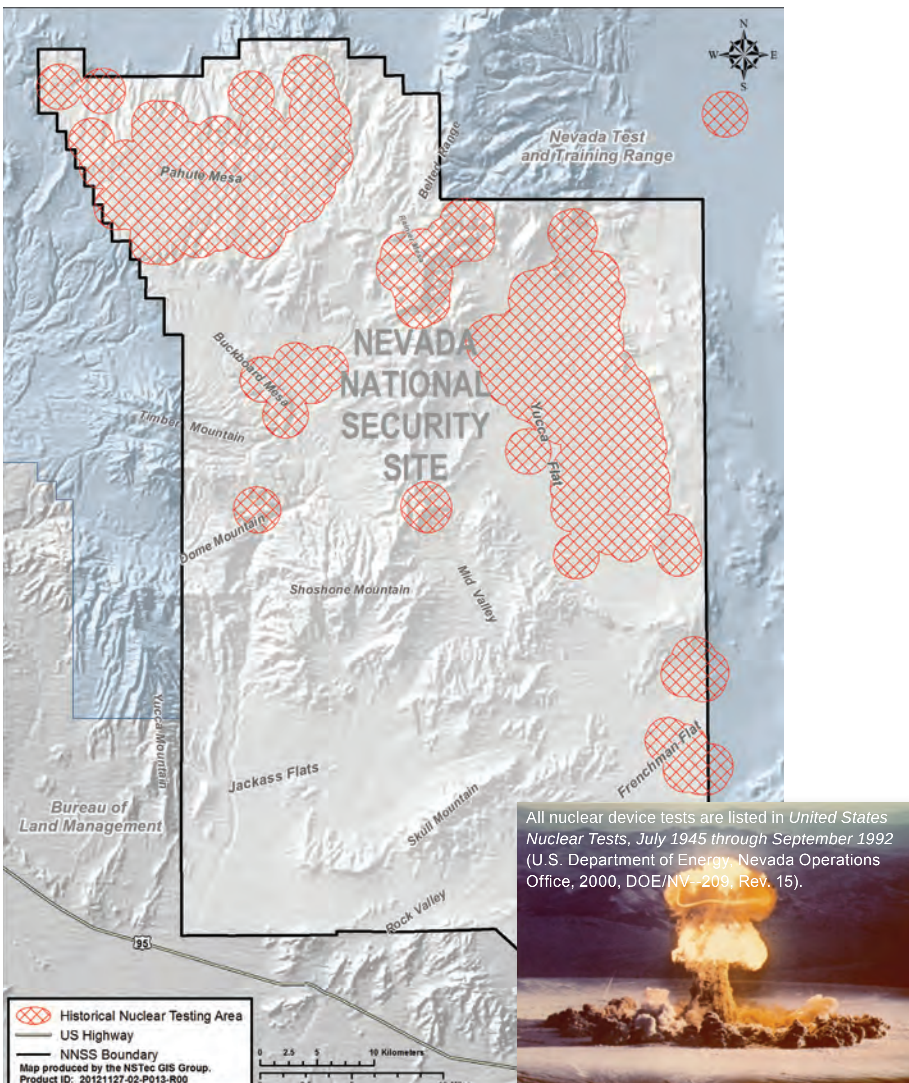
The first underground test, a cratering test, was conducted in 1951. The first fully contained underground nuclear test was conducted in 1957. Testing was discontinued during a moratorium that began October 31, 1958, but was resumed in September 1961 after tests by the Union of Soviet Socialist Republics began. Beginning in late 1962, nearly all tests were conducted in sealed vertical shafts drilled into Yucca Flat and Pahute Mesa or in horizontal tunnels mined into Rainier Mesa. From 1951 to 1992, a total of 828 underground nuclear tests were conducted at the NNSS. Approximately one-third of these tests were detonated near or below the water table.

Continued on Page 2 ...

History of the NNSS ... *continued from Page 1*

Five earth-cratering (shallow-burial) tests were conducted from 1962 to 1968 as part of the Plowshare Program, which explored peaceful uses of nuclear explosives. The first and highest yield Plowshare crater test, Sedan, was detonated at the northern end of Yucca Flat. The second-highest yield crater test was Schooner in the northwest corner of the NNSS. Mixed fission products, tritium, and plutonium from these tests were entrained in the soil, ejected from the craters, and deposited on the ground surrounding the craters.

Other nuclear-related experiments at the NNSS included the Bare Reactor Experiment–Nevada series in the 1960s. These tests were performed with a neutron generator mounted on a 1,527-foot steel tower to study neutron and gamma-ray interactions on various materials and to assess radiation doses experienced by the nuclear bomb survivors of Hiroshima and Nagasaki. From 1959 through 1973, a series of open-air nuclear reactor, engine, and furnace tests were conducted in Area 25, and a series of tests with a nuclear ramjet engine were conducted in Area 26. The tests released mostly gaseous radioactivity (radioiodines, radioxenons, radiokryptons) and some fuel particles that resulted in negligible deposition on the ground.



All nuclear device tests are listed in *United States Nuclear Tests, July 1945 through September 1992* (U.S. Department of Energy, Nevada Operations Office, 2000, DOE/NV--209, Rev. 15).

Historical Nuclear Testing Areas on and adjacent to the NNSS

NNSS – Continental Test Site

After the end of World War II, the United States tested nuclear weapons at Bikini Atoll and Enewetak in the Marshall Islands of the Central Pacific.

In June 1950, with the outbreak of hostilities in Korea and U.S. relations with the Soviet Union continuing to deteriorate, the search began for a continental test site to overcome the difficulties with remoteness and security experienced with testing in the Pacific. The final choices included Dugway Proving Ground–Wendover Bombing Range in western Utah, Alamogordo–White Sands Guided Missile Range in south-central New Mexico, and a North Site and a South Site on the Las Vegas Bombing and Gunnery Range in southern Nevada.

On December 18, 1950, President Truman approved the recommendations of Los Alamos testing officials and the Atomic Energy Commission, christening the South Site on the Las Vegas Bombing and Gunnery Range as the nation's continental test site. It was called the Nevada Proving Ground.

On January 27, 1951, an Air Force B-50D bomber dropped a 1-kiloton yield nuclear bomb over Frenchman Flat. It was the world's tenth nuclear detonation and was the first test at the newly established Nevada Test Site (NTS).

On September 23, 1992, the last underground nuclear test was conducted on the NTS, after which Congress imposed a moratorium on nuclear weapons testing. Since 1951, a total of 100 atmospheric and 828 underground nuclear weapons tests have been conducted at the NTS.

On August 23, 2010, the NTS was renamed the Nevada National Security Site to reflect the diversity of nuclear, energy, and homeland security activities conducted at the site.

Source: T. R. Fehner and F. G. Gosling, 2000. *Origins of the Nevada Test Site*, DOE/MA-0518, History Division, Executive Secretariat, Management and Administration, U.S. Department of Energy.

The NNSS Now

NNSA/NFO conducts three major missions and their programs on the NNSS. Experimental programs are sponsored mainly by Los Alamos, Lawrence Livermore, and Sandia National Laboratories. During the conduct of all missions and their programs, NNSA/NFO complies with applicable environmental and public health protection regulations and strives to manage the land and facilities at the NNSS as a unique and valuable national resource. In 2013, National Security Technologies, LLC (NSTec), was the NNSS Management and Operations Contractor accountable for ensuring work was performed in compliance with environmental regulations.

NNSS activities in 2013 continued to be diverse, with the primary goal to ensure that the existing U.S. stockpile of nuclear weapons remains safe and reliable. Other activities included weapons of mass destruction first responder training; the controlled release of hazardous material at the Nonproliferation Test and Evaluation Complex (NPTEC); remediation of legacy contamination sites; characterization of waste destined for the Waste Isolation Pilot Plant in Carlsbad, New Mexico, or the Idaho National Laboratory in Idaho Falls, Idaho; disposal of low-level and mixed low-level radioactive waste; and environmental research. Facilities and centers that support the National Security/Defense mission include the U1a Facility, Big Explosives Experimental Facility (BEEF), Device Assembly Facility (DAF), Joint Actinide Shock Physics Experimental Research (JASPER) Facility, the National Criticality Experiments Research Center located in the DAF, and the Radiological/Nuclear Countermeasures Test and Evaluation Complex (RNCTEC). Facilities that support the Environmental Management mission include the Area 5 Radioactive Waste Management Complex (RWMC) and the Area 3 Radioactive Waste Management Site (RWMS), which has been in cold standby since 2006.

NNSS Missions and Their Programs

National Security/Defense

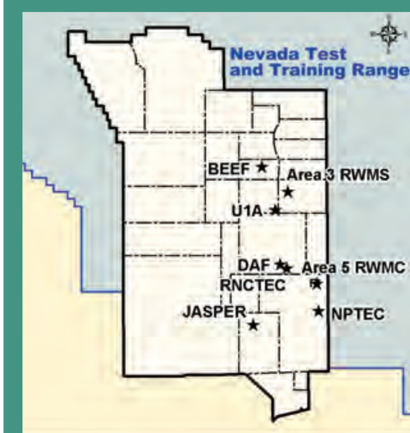
Stockpile Stewardship and Management Program — Conducts high-hazard operations in support of defense-related nuclear and national security experiments.

Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs — Provides support facilities, training facilities, and capabilities for government agencies involved in emergency response, nonproliferation technology development, national security technology development, and counterterrorism activities.

Work for Others Program — Provides support facilities and capabilities for other agencies/organizations involved in defense-related activities.

Environmental Management

Environmental Restoration Program — Characterizes and remediates the environmental legacy of nuclear weapons and other testing at the NNSS and NTTR locations, and develops and deploys technologies that enhance environmental restoration.



Waste Management Program — Manages and safely disposes of low-level waste and mixed low-level waste received from DOE- and U.S. Department of Defense (DoD)-approved facilities throughout the U.S. and wastes generated in Nevada by NNSA/NFO. Safely manages and characterizes hazardous and transuranic wastes for offsite disposal.

Nondefense

General Site Support and Infrastructure Program — Maintains the buildings, roads, utilities, and facilities required to support all NNSS programs and to provide a safe environment for NNSS workers.

Conservation and Renewable Energy Programs — Operates the pollution prevention program and supports renewable energy and conservation initiatives at the NNSS.

Other Research and Development — Provides support facilities and NNSS access to universities and organizations conducting environmental and other research unique to the regional setting.

Environmental Compliance

Activities on the NNSS are subject to federal and state laws intended to protect the environment and public health. These laws define emission limits or prohibit the emission of toxic substances into the air, water, and ground; require plans to prevent spills, unplanned releases, and accidents; and call for programs to monitor, measure, document, and report on compliance to regulatory agencies and the public.

The U.S. Environmental Protection Agency (EPA) and the Nevada Division of Environmental Protection (NDEP) are the principal regulators of NNSS activities.

The following table defines and summarizes 2013 results for a few of the many federal regulations with which NNSA/NFO must comply.

Summary of NNSA/NFO's Compliance with Major Federal Statutes in 2013

Environmental Statute or Order and What It Covers	2013 Status
Atomic Energy Act (through compliance with DOE O 435.1, "Radioactive Waste Management"): Management of low-level waste (LLW) and mixed low-level waste (MLLW) generated or disposed on site	1,124,523 cubic feet of waste was disposed on site in LLW and MLLW disposal cells at the Area 5 RWMC. Some of this volume also included classified low-level and nonradioactive items. Waste volumes were within permit limits; vadose zone and groundwater monitoring continued to verify that disposed LLW and MLLW are not migrating to groundwater or threatening biota or the environment.
Clean Air Act: Air quality and emissions into the air from facility operations	Onsite air sampling stations detected man-made radionuclides at levels comparable to previous years and well below the regulatory dose limit for air emissions to the public of 10 millirem per year (mrem/yr). The estimated dose from all 2013 NNSS air emissions to the maximally exposed individual (MEI) is 0.02 mrem/yr. Nonradiological air emissions from permitted equipment and facilities were all below emission and opacity limits.
Clean Water Act: Water quality and effluent discharges from facility operations	All domestic and industrial wastewater systems and groundwater monitoring well samples were within permit limits for regulated water contaminants and water chemistry parameters.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Superfund Amendments and Reauthorization Act (SARA): Cleanup of waste sites containing hazardous substances	No NNSS cleanup operations are regulated under CERCLA or SARA; they are regulated under the Resource Conservation and Recovery Act (RCRA) instead *(see below)*.
DOE O 458.1, "Radiation Protection of the Public and the Environment": Measuring radioactivity in the environment and estimating radiological dose to the public due to NNSA/NFO activities	Radiological monitoring of air, water, and direct radiation was conducted. The total annual dose to the MEI from all exposure pathways due to NNSA/NFO activities was estimated to be 0.55 mrem/yr, well below the DOE limit of 100 mrem/yr.
Emergency Planning and Community Right to Know Act (EPCRA): The public's right to know about chemicals released into the community	223,828 lb of lead and 1,436 lb of mercury were released as a result of NNSS activities. The majority of lead released was for offsite recycling, and the majority of mercury released was for onsite disposal.
Endangered Species Act (ESA): Threatened or endangered species of plants and animals	Field surveys for 10 projects in desert tortoise habitat and 3 projects in other habitats on the NNSS were conducted; 11.97 acres of tortoise habitat were disturbed, and no tortoises were harmed at or displaced from project sites. Two tortoises were killed by vehicles on paved roads, seven were moved off roads to safety, and seven were captured and fitted with radio transmitters. All actions were in compliance with permit requirements.
Federal Facility Agreement and Consent Order (FFACO): Cleanup of waste sites containing hazardous substances	All 2013 corrective action milestones under the FFACO were met. A total of 32 corrective action sites were closed in accordance with state-approved corrective action plans.
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA): Storage and use of pesticides and herbicides	Only nonrestricted-use pesticides were applied by state-certified personnel. Storage and use of pesticides were in compliance with federal and state regulations.
Migratory Bird Treaty Act (MBTA): Protecting migratory birds, nests, and eggs from harm	During biological surveys for proposed projects, no migratory bird nests, eggs, or young were found in harm's way. However, five accidental bird mortalities were documented.
National Environmental Policy Act (NEPA): Evaluating projects for environmental impacts	NNSA/NFO prepared the final *Site-Wide Environmental Impact Statement for the Nevada National Security Site and Offsite Locations in Nevada*, incorporating public comments. It evaluates current and future NNSA/NFO operations in Nevada during the 10-year period beginning when the Record of Decision is published.
National Historic Preservation Act (NHPA): Identifying and preserving historic properties	Archival research for 40 proposed projects was conducted, and 1,061 acres were surveyed for 10 of the projects; 11 historic sites and 3 historic districts were identified.
Resource Conservation and Recovery Act (RCRA): Generation, management, disposal of hazardous waste (HW) and MLLW and cleanup of inactive, historical waste sites	1,911 tons of MLLW were disposed on site, 2.96 tons of HW and 1.13 tons of polychlorinated biphenyl (PCB) wastes were received for temporary onsite storage and/or treatment, and 2.11 tons of HW and 0.43 tons of PCB waste were shipped off site for disposal, all in accordance with state permits. Groundwater monitoring of wells at the Area 5 RWMS confirmed that buried MLLW remains contained, and vadose zone monitoring and post-closure inspections of historical RCRA closure sites confirmed that buried HW remains contained.
Safe Drinking Water Act: Quality of drinking water	The concentrations of all regulated water contaminants in drinking water from the three permitted public water systems on the NNSS were below state and federal permit limits.
Toxic Substances Control Act (TSCA): Management and disposal of polychlorinated biphenyls (PCBs)	Six drums of PCB-contaminated materials were shipped off site to permitted disposal and treatment facilities.

The Legacy of NNSS Nuclear Testing

Approximately one-third of the 828 underground nuclear tests on the NNSS were detonated near or below the water table, resulting in radioactive contamination of groundwater in some areas. In addition, the 100 atmospheric nuclear tests conducted on the NNSS and numerous nuclear-related experiments resulted in radioactive contamination of surface soils, materials, equipment, and structures, mainly on the NNSS.

The NNSA/NFO Environmental Management mission was established to address this legacy contamination. Within Environmental Management, Environmental Restoration is responsible for remediating contaminated sites, and Waste Management is responsible for safely managing and disposing of radioactive waste.

Continued on Page 6 ...

Aerial view of Yucca Flat showing subsidence craters from historical underground nuclear tests.

Legacy Contamination

Groundwater — The total amount of radiation remaining below the groundwater table is approximately 40 to 60 million Ci, based on the most recent estimate, which incorporates corrections for radioactive decay since the last underground test in 1992. The areas of known and potential groundwater contamination on the NNSS due to underground nuclear testing are called Underground Test Area (UGTA) corrective action units.

Soil — Radioactively contaminated surface soils directly resulting from nuclear weapons testing exist at over 100 locations on and around the NNSS. The soils may contain contaminants including radioactive materials, oils, solvents, and heavy metals, as well as contaminated instruments and test structures used during testing activities.

Air — Airborne radioactive contamination from the resuspension of contaminated soils at legacy sites and from current activities is monitored continuously on and off the NNSS. Airborne concentrations of monitored contaminants have been decreasing at most sample locations on the NNSS over the past decade. Total curies estimated to be released across the entire NNSS fluctuate annually; the highest annual estimates since 1992 have been 2,200 Ci for tritium, 0.40 Ci for plutonium, and 0.049 Ci for americium. In air measured in communities surrounding the NNSS, emissions from the NNSS cannot be distinguished from background airborne radiation.

Structures/Materials — There are approximately 1,850 sites where facilities, equipment, structures, and/or debris were contaminated by historical nuclear research, development, and testing activities. These structures/materials are referred to as Industrial Sites and include disposal wells, inactive tanks, contaminated buildings, contaminated waste sites, inactive ponds, muck piles, spill sites, drains and sumps, and ordnance sites.

Waste Disposal — Low-level and mixed low-level radioactive wastes have been generated by historical nuclear research, development, and testing activities and environmental cleanup activities. From the 1960s, when waste disposal began, through December 31, 2013, nearly 1.7 million cubic yards of waste have been safely disposed at the Area 3 and Area 5 RWMSs. The estimated cumulative radioactivity of all wastes at the time of disposal is 15.7 million Ci. The radioactive content of the waste decays over time, however, at a varied rate depending on the radionuclide.

Curie (Ci) is the traditional measure of radioactivity based on the observed decay rate of 1 gram of radium. One curie of radioactive material will have 37 billion disintegrations in 1 second.

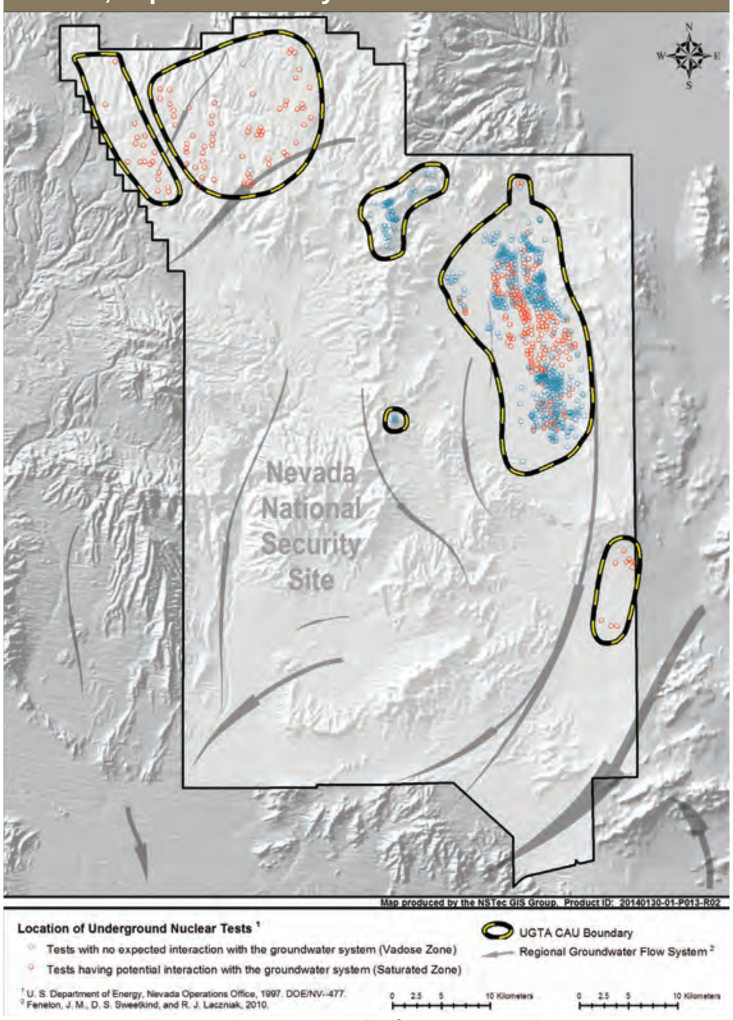
Ci

 ... *continued from Page 5*

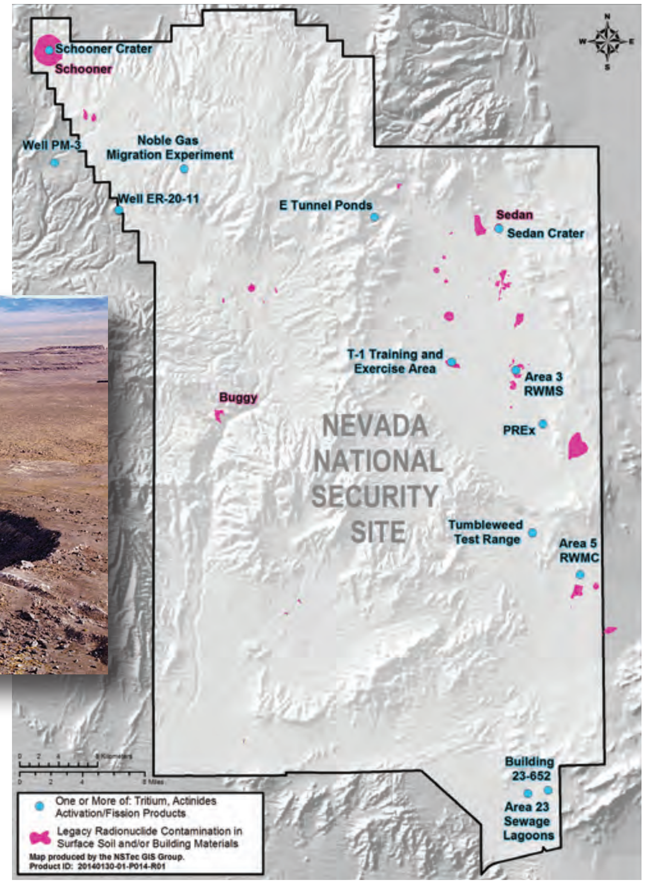
The Federal Facility Agreement and Consent Order (FFACO) between the State of Nevada, DOE, and DoD identifies corrective action units (CAUs), which are groupings of corrective action sites (CASs) that delineate areas of historical contamination. The FFACO establishes corrective actions and schedules for the remediation and closure of CASs. Approximately 3,000 CASs have been identified, the majority of which have already been remediated and/or closed. The public is kept informed of Environmental Management activities through periodic newsletters, exhibits, and fact sheets, and Environmental Management provides the opportunity for public input via the Nevada Site Specific Advisory Board (NSSAB), consisting of 15–20 citizen volunteers from Nevada.


Schooner Crater in Area 20 formed during a 1968 crater test exploring peaceful uses of nuclear explosives.

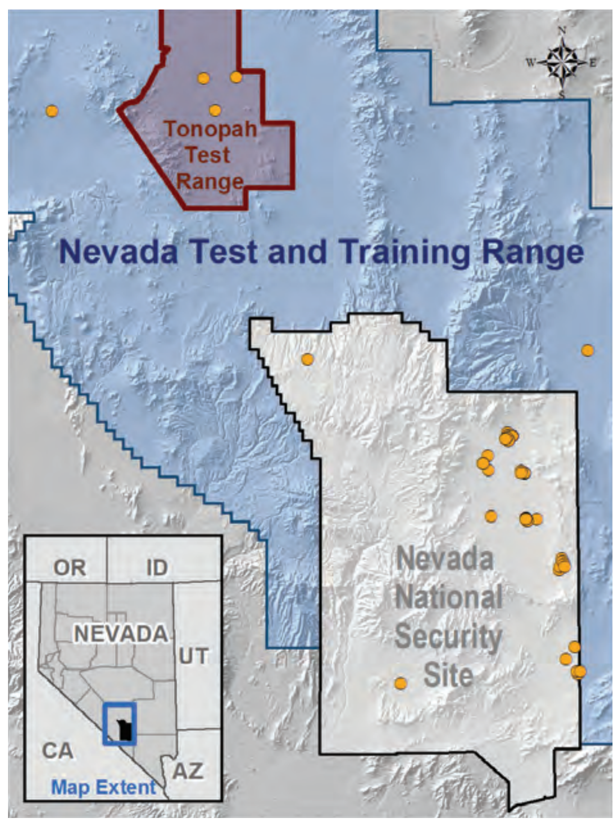
The direction of groundwater flow, shown by the arrows, is predominantly southwest.



Areas of Potential Groundwater Contamination on the NNSS



Sources of Radiological Air Emissions on the NNSS



Locations of Soil Contamination on and off the NNSS That Remain To Be Remediated and/or Closed

The Legacy of NNSS Nuclear Testing

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Numerous man-made and naturally occurring radionuclides occur on the NNSS. The radionuclides produce ionizing radiation in the form of alpha particles, beta particles, and gamma rays, which are emitted from the unstable radionuclides as they decay to form more stable atoms. Almost all human exposure to ionizing radiation (82% in the United States) comes from natural sources that include cosmic radiation from outer space, terrestrial radiation from materials like uranium and radium in the earth, and naturally occurring radionuclides in food, water, and the aerosols and gases in the air we breathe. Man-made sources and applications of ionizing radiation in our everyday life include smoke detectors, X-rays, CT scans, and nuclear medicine procedures. For people living in areas around the NNSS, less than 2% of their total radiation exposure is attributable to past nuclear testing or to current NNSS activities.

Forms of Radiation

Alpha particles are heavy, positively charged particles given off by some decaying atoms. Alpha particles can be blocked by a sheet of paper. Atoms emitting alpha particles are hazardous only if they are swallowed or inhaled.

Beta particles are electrons or positrons (positively charged electrons) ejected from the nucleus of a decaying atom. More penetrating than alpha radiation, beta particles can pass through several millimeters of skin. A sheet of aluminum only a fraction of an inch thick will stop beta radiation. Beta particles can damage skin but are most hazardous if the beta-emitting atoms are swallowed or inhaled.

Gamma rays are waves of pure energy similar to X-rays, light, microwaves, and radio waves. Gamma rays are emitted by certain radionuclides when their nuclei transition from a higher to a lower energy state. They can readily pass into the human body. They can be almost completely blocked by about 40 inches of concrete, 40 feet of water, or a few inches of lead. Gamma rays can be both an external and internal hazard.

X-rays are a more familiar form of electromagnetic radiation, usually with a limited penetrating power, typically used in medical or dental examinations. Television sets, especially color, give off soft (low-energy) X-rays; thus, they are shielded to greatly reduce the risk of radiation exposure.

Neutrons are uncharged heavy particles contained in the nucleus of every atom heavier than ordinary hydrogen. They induce ionization only indirectly in atoms that they strike, but they can damage body tissues. Neutrons are released, for example, during the fission (splitting) of uranium atoms in the fuel of nuclear power plants. They can also be very penetrating. In general, efficient shielding against neutrons can be provided by materials containing hydrogen, such as water. Like gamma rays, neutrons are both an external and internal hazard.

Radionuclides Detected on the NNSS

	Name*	Abbreviation	Primary Type(s) of Radiation	Major NNSS Source
Man-Made	Americium-241	^{241}Am	Alpha, gamma	In soil at and near legacy sites of aboveground nuclear testing. Detected in soil and air.
	Cesium-137	^{137}Cs	Beta, gamma	
	Plutonium-238	^{238}Pu	Alpha	
	Strontium-90	^{90}Sr	Beta	
	Cobalt-60	^{60}Co	Gamma	In soil at and near legacy sites of aboveground nuclear testing. Detected in soil.
	Europium-152	^{152}Eu	Gamma	
	Europium-155	^{155}Eu	Gamma	
	Plutonium-239+240	$^{239+240}Pu$	Alpha	In soil at and near legacy sites of plutonium dispersal experiments. Detected in soil and air.
	Tritium	^{3}H	Beta	In groundwater in areas of underground nuclear tests, in surface ponds used to contain contaminated groundwater, in soil at nuclear test locations, and in waste packages buried in pits at waste management sites. Detected in groundwater and air.
Naturally Occurring	Beryllium-7	^{7}Be	Gamma	Produced by interactions between cosmic radiation from the sun and the earth's upper atmosphere. Detected in air.
	Potassium-40	^{40}K	Beta, gamma	Naturally occurring in the earth's crust. Detected in groundwater, soil, and air.
	Radium-226	^{226}Ra	Alpha, gamma	
	Thorium-232	^{232}Th	Alpha	
	Uranium-234**	^{234}U	Alpha	
	Uranium-235**	^{235}U	Alpha, gamma	
	Uranium-238**	^{238}U	Alpha	

*The number given with the name of the radionuclide is the atomic mass number, which is the total number of protons and neutrons in the nucleus of the atom. Atoms with the same number of protons are the same element; atoms of the same element with different mass numbers are called isotopes of one another.

**These uranium isotopes, though of natural origin, can also be detected at specific NNSS locations where man-made depleted uranium has been released during experiments, resulting in an alteration of the relative amounts of each isotope.

Cleanup and Closure of Corrective Action Sites

UGTA Sites

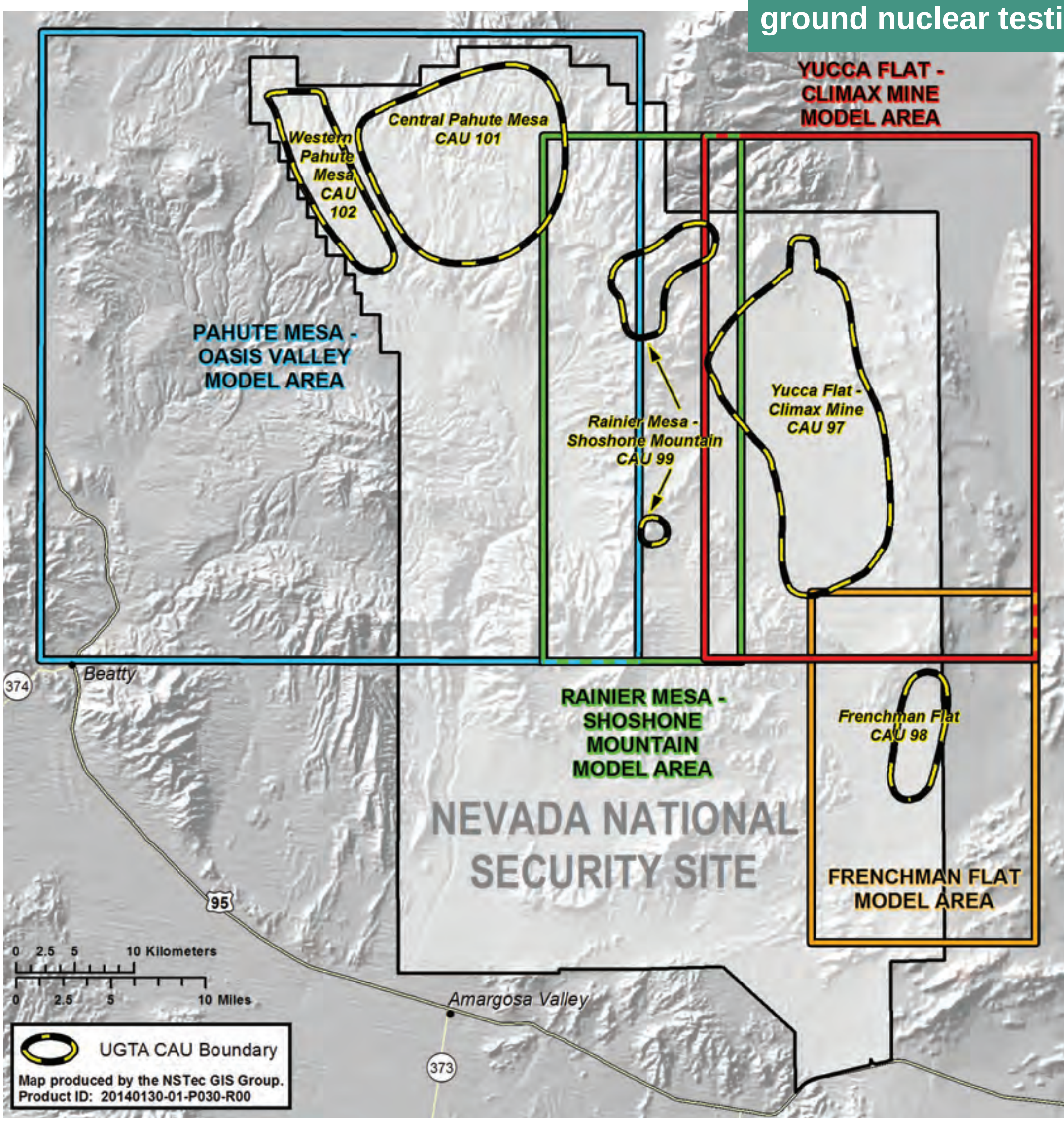
Environmental Restoration gathers data to characterize the groundwater aquifers beneath the NNSS and adjacent lands. The data are used to develop hydrogeologic models for the CAUs and the larger UGTA model areas that will forecast the groundwater movement and transport of radiological contaminants from the CAUs. Closure of the UGTA CAUs under the FFACO will involve long-term groundwater monitoring because cost-effective technologies have not been developed to effectively remove or stabilize the radiological contaminants produced during historical underground nuclear testing. The progress towards closure of each UGTA CAU is summarized below. The design and results to date of all wells in NNSA/NFO's groundwater sampling network are presented on Page 11.

One Environmental Restoration mission is to identify contaminant boundaries for the UGTA CAUs and then implement an effective long-term monitoring system, which will protect the public from exposure to groundwater contaminated by historical underground nuclear testing.

Western and Central Pahute Mesa CAUs – These CAUs are in the middle of the investigation stage of the closure process. The Phase I Central and Western Pahute Mesa Transport Model, completed in 2009, forecasts that tritium in groundwater may migrate off the northwestern boundary of the NNSS within 50 years of the first nuclear detonation (in 1965) and that offsite concentrations of tritium may be above the Safe Drinking Water Act limit of 20,000 picocuries per liter (pCi/L) *(see figure on next page)*.

Consistent with the transport model forecast, tritium was detected in well ER-EC-11 on the NTTR in 2009. ER-EC-11 is located approximately 2,350 feet west of the NNSS boundary and approximately 2 miles from the nearest underground nuclear tests BENHAM and TYBO conducted in 1968 and 1975, respectively. Well ER-EC-11 is the first offsite well in which radionuclides from underground nuclear testing activities at the NNSS have been detected. Well ER-EC-11 was not sampled in 2013.

A Phase II Central and Western Pahute Mesa Corrective Action Investigation Plan was completed in 2009. The plan outlines the field investigation program that is currently being implemented. Ten new wells in these CAUs were drilled from 2009 through 2012 to gather more data for the establishment of these CAUs' long-term groundwater monitoring systems.



Location of UGTA Activity CAUs and Model Areas

Continued on Page 9 ...

New Phase II data from the ten additional characterization wells were used in 2013 to rebuild the hydrostratigraphic framework model for these CAUs.

In 2013, four wells from within the Pahute Mesa–Oasis Valley model area were sampled for tritium.

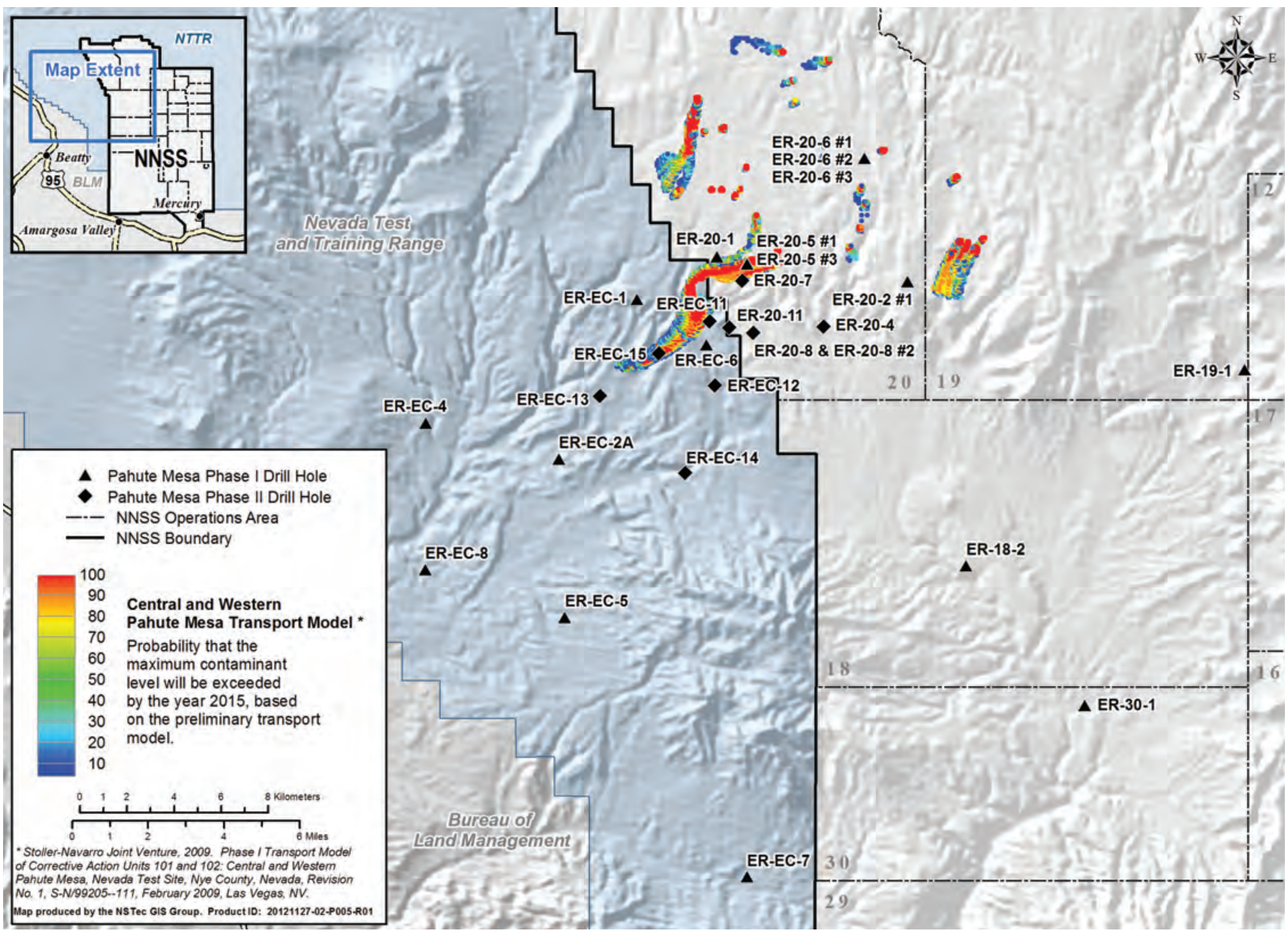
Frenchman Flat CAU – The Frenchman Flat CAU is the first of the five UGTA CAUs at the NNSS to progress to the model-evaluation stage. The flow and transport model for this model area was accepted by the Nevada Division of Environmental Protection (NDEP) in 2010. In 2012, two new model evaluation wells, ER-5-5 and ER-11-2, were drilled, and completion reports for the wells were published in 2013. Well development, hydrologic testing, and sampling of these two wells were performed in 2013. Their data were compared to the existing framework models and modeling forecasts.

Rainier Mesa–Shoshone Mountain CAU – This CAU is in the investigation stage of the closure process. In 2013, the draft groundwater flow and contaminant transport models were completed and subjected to several cycles of internal reviews and presentations to NDEP. Efforts began in 2013 to rebuild the initial hydrostratigraphic framework model in order to develop a more robust conceptual model for the unsaturated zone. The rebuild is scheduled for completion in 2014.

Yucca Flat–Climax Mine CAU – This CAU is in the latter part of the investigation stage of the closure process. All data collection and modeling activities have been completed. The final Phase I Flow and Transport Model report was completed in September 2013. An external peer review of the report is scheduled for 2014.

UGTA Public Outreach – In December 2013, NNSA/NFO held a Fifth Annual Groundwater Open House for the public in Beatty, Nevada. The current status of model development for each CAU and groundwater sampling results were presented.

Continued on Page 10 ...



Results of Phase I Central and Western Pahute Mesa Transport Modeling

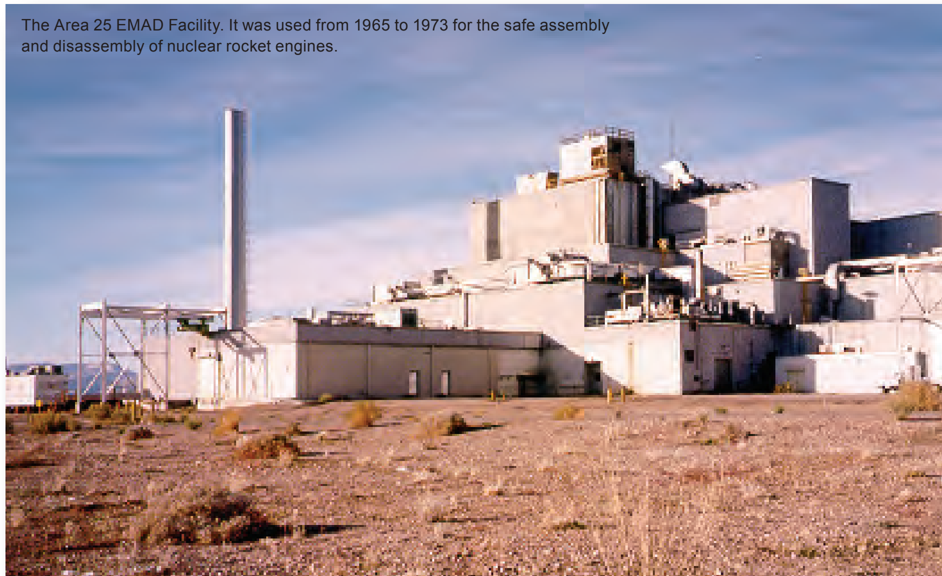
 ... continued from Page 9

Soils Sites

NNSA/NFO has identified 134 Soils CASs for which they are responsible to characterize, manage, and, where necessary, clean up. Some of these sites occur on TTR and NTTR. Corrective actions range from the removal of soil to closure in place with restricted access controls such as fencing and posting. Historical research and the preparation of short summary reports of research findings have been completed for all 134 CASs. In 2013, 32 Soils CASs from 4 CAUs on the NNSS were closed, and work was conducted towards closure at 53 CASs in 11 CAUs on the NNSS. Closure of CASs on the TTR and NTTR require negotiation with the State of Nevada and the U.S. Department of Defense. As of December 31, 2013, the State has approved closure of 79 Soils CASs in accordance with the FFACO. The anticipated date for completing the closure of all Soils CASs is 2027, and 55 Soils CASs remain to be formally closed.

Industrial Sites

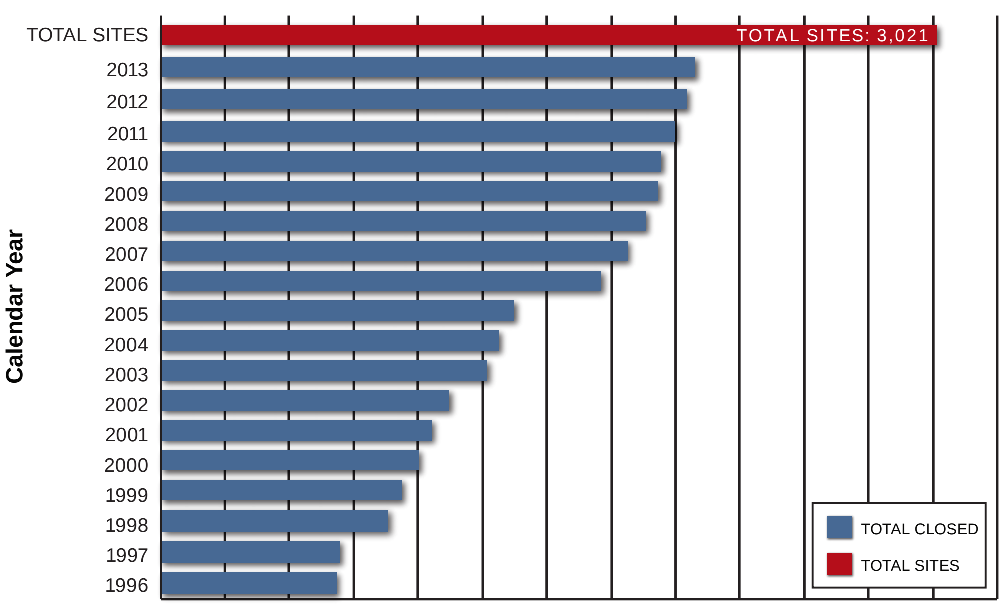
NNSA/NFO is responsible to safely close 1,861 Industrial Sites. Closure strategies have included the removal and disposal of debris, complete excavation of the site, decontamination and decommissioning activities, closure in place, no further action, and subsequent monitoring.


The Area 25 EMAD Facility. It was used from 1965 to 1973 for the safe assembly and disassembly of nuclear rocket engines.

In 2013, no Industrial Sites CASs were closed and no interim work related to closure was conducted. Only two Industrial Sites CAUs remained to be closed at the end of 2013: CAU 114, the Area 25 Engine Maintenance, Assembly, and Disassembly (EMAD) Facility, and CAU 572, the Test Cell C Ancillary Buildings and Structures. They comprise the final eight Industrial Sites CASs to be closed. Their closure will occur prior to the end of the NNSS Environmental Restoration Activity, which is currently planned for 2030. As of December 31, 2013, the State has approved closure of 1,853 CASs in accordance with the FFACO.

Nevada National Security Site

Corrective Action Site Closures



Restoration Progress under FFACO

In 2013, 32 CASs were closed and all 2013 FFACO cleanup and closure activity milestones were met. The majority (878) of the remaining 941 CASs yet to be closed by NNSA/NFO are UGTA CASs for which closure in place with long-term monitoring is the corrective action.

Radiological Monitoring of Groundwater

For decades NNSA/NFO has sampled groundwater from monitoring wells on and off the NNSS to detect radionuclides that may be present due to historical underground nuclear testing. In 2013, NNSA/NFO developed the NNSS Integrated Groundwater Sampling Plan, a comprehensive, integrated approach for collecting and analyzing groundwater samples to to meet the requirements for UGTA CAU closures *(see Page 8)* and for all other compliance and environmental protection objectives. The Plan produced changes to the overall number of groundwater sampling locations, their frequency of sampling, and analytical procedures. The Plan will increase efficiencies and cost savings and standardize sampling methods and analyses performed by numerous organizations, contractors, and subcontractors. Implementation of the Plan began in October 2013.

The water sampling network under the Plan consists of 73 sampling locations categorized into five types: Characterization, Source/Plume, Early Detection, Distal, and Community locations *(see map below)*. An additional four public water system (PWS) wells and three wells/surface waters are sampled to comply with specific federal/state regulations or permits. Tritium is the single contaminant of concern and is analyzed in water samples from all locations at frequencies ranging from once every 3 months to once every 5 years.

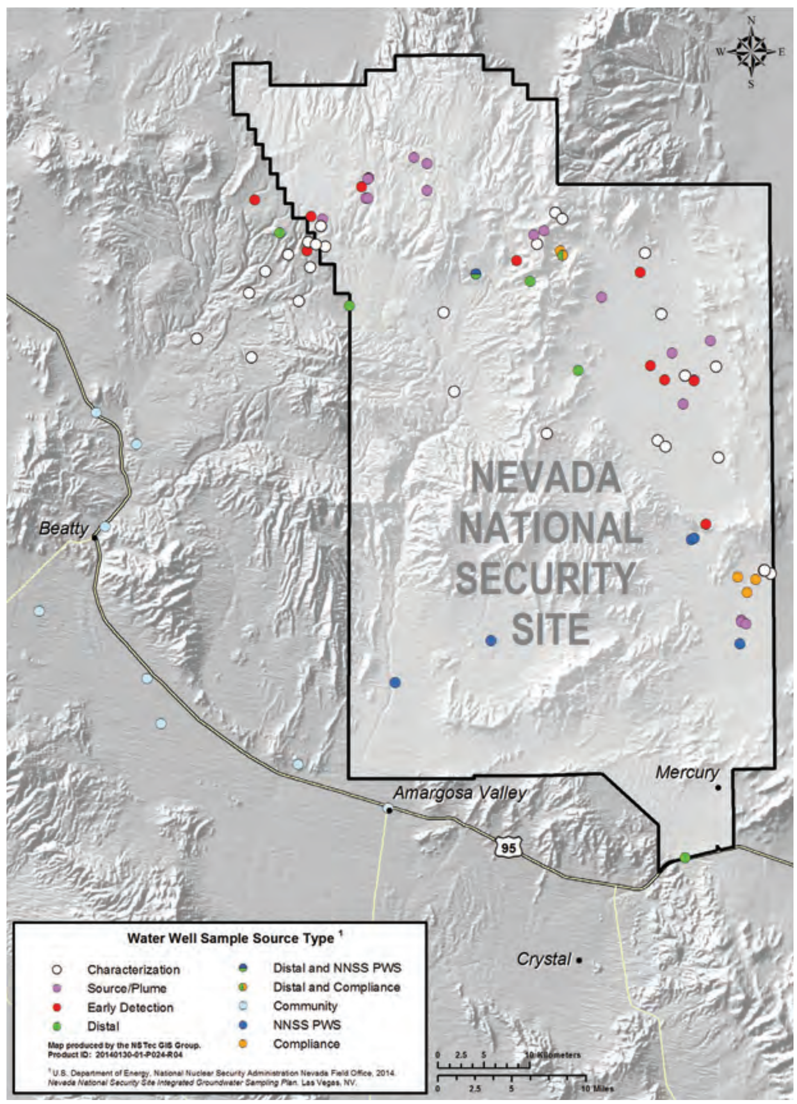
The tritium analysis results for all sampling locations in the network are shown on the map on Page 12. The well sites are color coded based on the tritium concentration of their most recent water sample. The maximum contaminant level (MCL) allowed for tritium in drinking water, set by the EPA under the Safe Drinking Water Act (SDWA), is 20,000 pCi/L. The color codes represent tritium levels expressed as a percentage of this MCL. For example, the 5%–50% category means that tritium was found to be between 5% to 50% of the MCL, or between 1,000 and 10,000 pCi/L.

The 15 wells that currently exceed the SDWA MCL (coded red on the map) are all located on the NNSS and are either Source/Plume or Characterization wells. All Community sampling locations, which are on Bureau of Land Management (BLM) or private land, have undetectable levels of tritium (coded blue on the map).

Continued on Page 12 ...

Types of Groundwater Sampling Locations

Characterization	Used for groundwater characterization or UGTA CAU model evaluation
Source/Plume	Located within the plume from an underground nuclear test; test-related contamination is currently present
Early Detection	Located downgradient of an underground test; no radioisotopes are detected above standard detection levels
Distal	Located outside the Early Detection area
Community	Located on BLM or private land; used as a water supply source or is near one
NNSS PWS	Potable water supply well that is part of a State-designated non-community public water system (PWS)
Compliance	Monitored to comply with specific regulations or permits



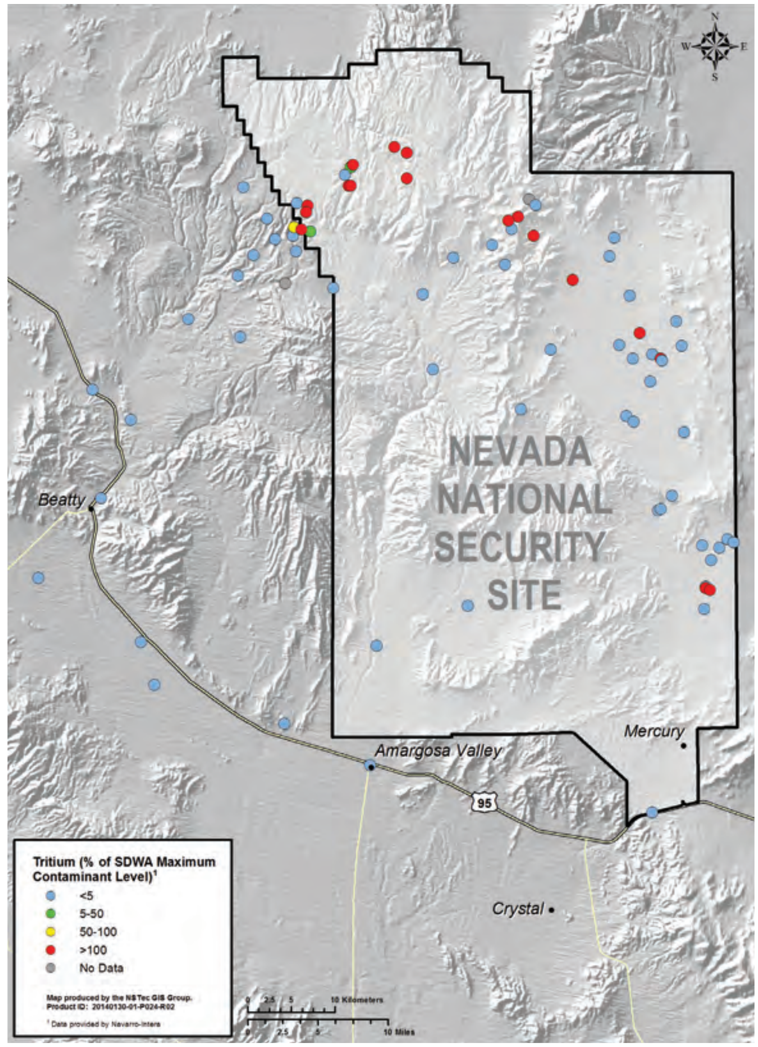
NNSA/NFO Water Sampling Network

Characterization well ER-EC-11 on the NTTR just west of the NNSS is the only offsite well in the network that has tritium concentrations greater than 10,000 pCi/L (coded yellow on the map). Tritum has not been detected in any NNSS PWS wells, and all wells and surface waters monitored to ensure compliance with NNSS permits had either undetectable levels of tritium or tritium levels that were below permit limits.

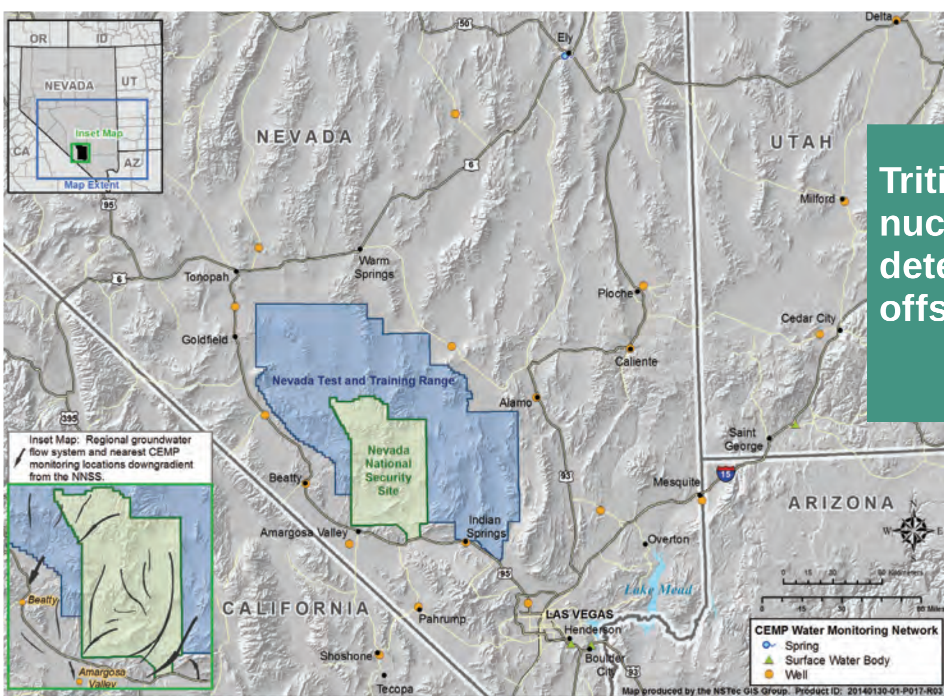
Community Environmental Monitoring Program

Offsite water supply wells and springs are also monitored for the presence of tritium by the independent Community Environmental Monitoring Program (CEMP), which is coordinated by the Desert Research Institute (DRI) of the Nevada System of Higher Education under contract with NNSA/NFO. The CEMP provides the public with these data as part of a non-regulatory public informational and outreach program.

In 2013, the CEMP offsite water sampling locations included 21 wells, 3 surface water supply systems, and 4 springs located in selected towns and communities within 240 miles of the NNSS *(see map below)*. Offsite water supply samples collected by CEMP had levels of tritium either below laboratory background levels or at very low detectable levels (<30 pCi/L). The highest detectable levels (21.9 and 22.5 pCi/L) were in CEMP surface water samples from Boulder City and Henderson, Nevada, respectively, which originated from Lake Mead. The detectable levels represent residual tritium persisting in the environment that originated from global atmospheric nuclear testing.

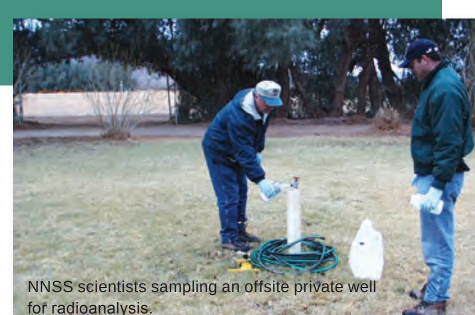


Tritium in NNSA/NFO Groundwater Monitoring Wells



2013 CEMP Water Monitoring Locations

Tritium from underground nuclear testing has not been detected in any onsite or offsite drinking water wells.



NNSS scientists sampling an offsite private well for radioanalysis.

Continued on Page 13 ...

Radiological Monitoring of Air

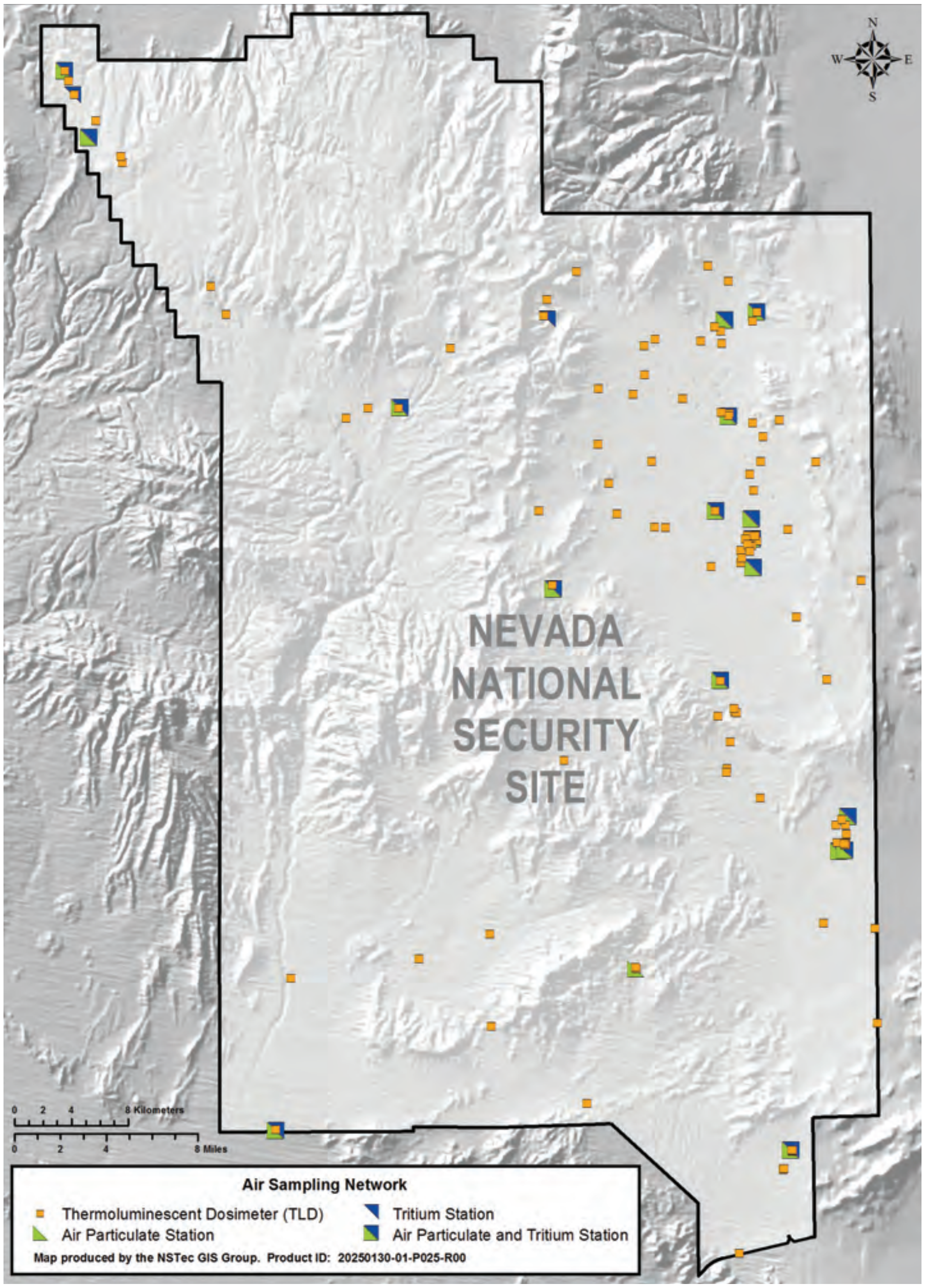
NNSS radioactive emissions are monitored to determine the public dose from inhalation and to ensure compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP) under the Clean Air Act. A network of 17 air sampling stations and a network of 109 thermoluminescent dosimeters (TLDs) are located throughout the NNSS *(see map below)*. NNSS air sampling stations monitor tritium in water vapor, man-made radionuclides, and gross alpha and beta radioactivity in airborne particulates. The TLD stations monitor direct gamma radiation exposure.

Range in Average Concentrations of Man-Made Radionuclides in Air Samples on the NNSS in 2013 Attributable to NNSS Operations

	Concentration (10^{-15} µCi/mL)[a]		
Radionuclide	Limit[b]	Lowest Average	Highest Average
^{241}Am	1.9	0.0004	0.078
^{3}H	1,500,000	40	142,700
^{238}Pu	2.1	−0.003	0.012
$^{239+240}$Pu	2.0	0.003	0.592

(a) The scale of concentration units for radionuclides shown in the table has been standardized to 10^{-15} microcuries per milliliter (µCi/mL). This scale may differ from those reported in detailed radionuclide-specific data tables in the NNSSER.

(b) The concentration established by NESHAP as the compliance limit.



2013 NNSS Air Sampling Network

Radioactive emissions are also monitored at stations in selected towns and communities within 240 miles of the NNSS by the CEMP. A network of 24 CEMP stations is used *(see map on Page 14)*. The CEMP stations monitor gross alpha and beta radioactivity in airborne particulates using low-volume particulate air samplers, penetrating gamma radiation using TLDs, gamma radiation exposure rates using pressurized ion chamber (PIC) detectors, and meteorological (MET) parameters using automated weather instrumentation.

Monitoring NNSS Air Sampling Stations

Several man-made radionuclides were detected at NNSS air sampling stations in 2013: ^{241}Am, ^{3}H, ^{238}Pu, and $^{239+240}$Pu. None, however, exceeded concentration limits established by the Clean Air Act. The highest average levels of ^{241}Am, ^{238}Pu, and $^{239+240}$Pu were detected at Bunker 9-300 in Area 9, located within an area of known soil contamination from past nuclear tests. The highest average level of tritium was detected at Schooner, site of the second-highest yield Plowshare cratering experiment on the NNSS, where tritium-infused ejecta surrounds the crater.

The total amount of man-made radionuclides emitted to the air from

Continued on Page 14 ...

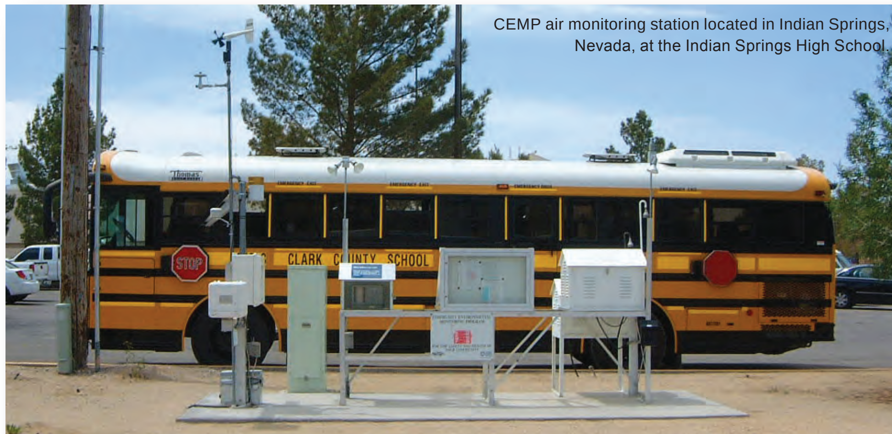
 ... *continued from Page 13*

tritium, americium, and plutonium was estimated to be 42.4 Ci. In 2013, these sources included contaminated soils at Schooner and Sedan craters, Area 3 and Area 5 RWMSs, and legacy sites; contaminated groundwater held in containment ponds or lagoons; and tests at BEEF and NPTEC. A research project in Area 6 released 5,128 Ci of radioactive noble gases and other radionuclides that had half-lives ranging from a few minutes to 53 days. Given their half-lives and release quantities, they were not available to contribute measureable dose to the public at the distances over which they have to travel to reach the public. Over the past 10 years, total emissions have ranged from 42 to 625 Ci for tritium, 0.039 to 0.049 Ci for ^{241}Am, and 0.24 to 0.39 Ci for $^{239+240}$Pu. Emissions of ^{238}Pu are estimated to have remained consistent at about 0.050 Ci over the same time frame.

Estimated Quantity of Man-Made Radionuclides Released into the Air from the NNSS in 2013 (in Curies)

	Tritium (^{3}H)	Americium (^{241}Am)	Plutonium (^{238}Pu)	Plutonium ($^{239+240}$Pu)	Noble Gases	Other Radionuclides	
	42	0.047	0.050	0.29	377	4,749	2.02
Half-life*	12 years	432 years	88 years	>6,500 years	<40 days	<3 hours	>3 hours

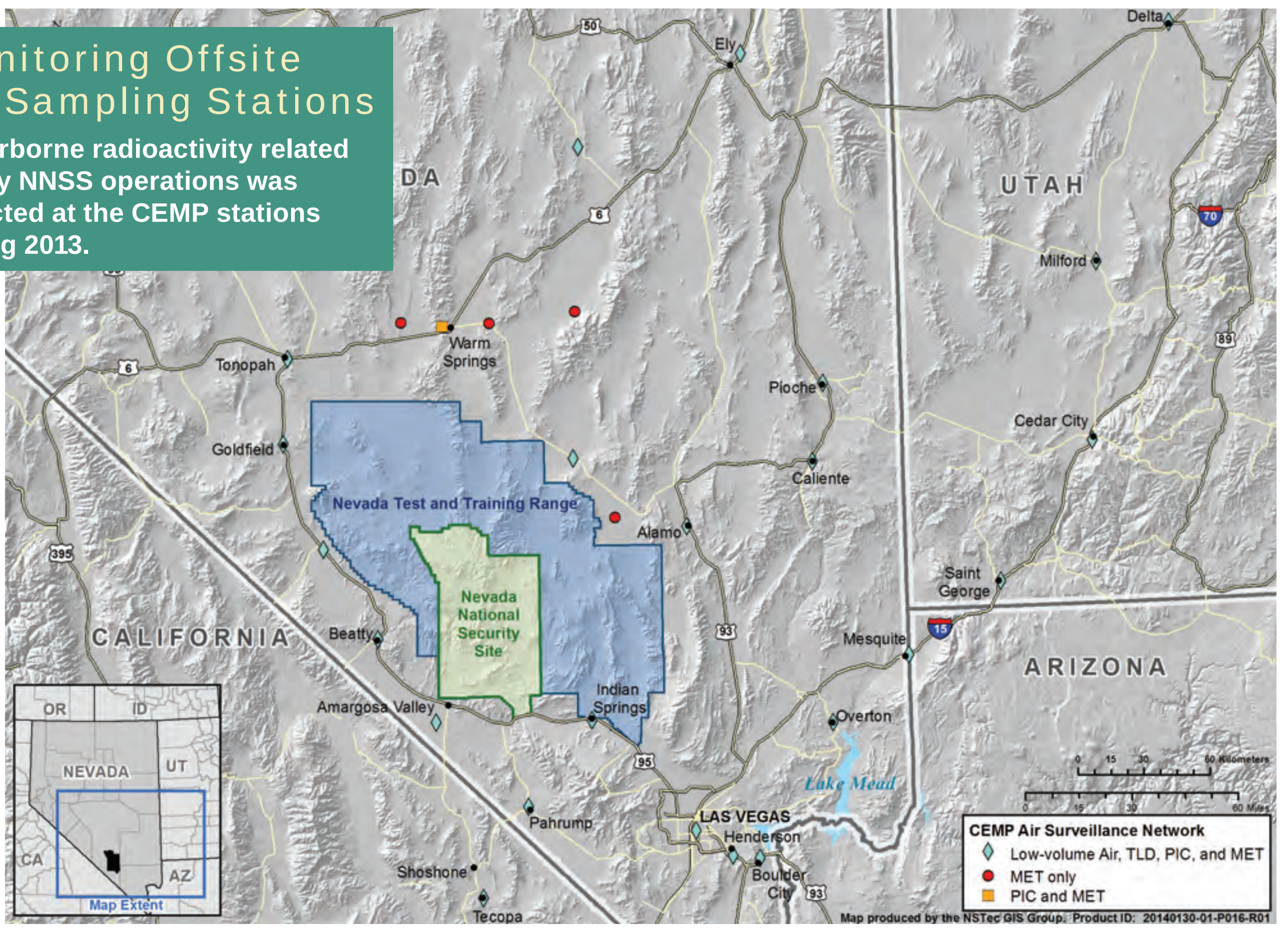
* Half-life is the time required for one-half of the radioactive atoms in a given amount of material to decay.



CEMP air monitoring station located in Indian Springs, Nevada, at the Indian Springs High School.

Monitoring Offsite Air Sampling Stations

No airborne radioactivity related to any NNSS operations was detected at the CEMP stations during 2013.



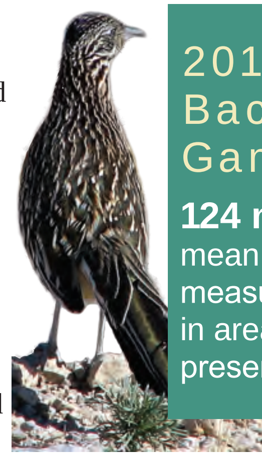
2013 CEMP Air Surveillance Network

Direct Radiation Monitoring

Ten NNSS TLD stations are located where radiation effects from past or present NNSS operations are negligible, and therefore measure only natural background levels of gamma radiation from cosmic and terrestrial sources. In 2013, the mean measured background level from the ten stations was 124 milliroentgens per year (mR/yr). This is well within the range of variation in background levels observed in other parts of the U.S. of similar elevation above sea level. Background radiation varies not only by elevation but by the amounts of natural radioactive materials in soil and rock in different geographic regions.

The highest estimated mean annual gamma exposure measured at a TLD station on the NNSS was 574 mR/yr at Schooner, one of the legacy Plowshare sites on Pahute Mesa. The lowest was 64 mR/yr in Mercury at the fitness track. The mean annual gamma exposure at 17 TLD locations near the Area 3 and Area 5 RWMSs was 140 mR/yr, and at the 35 TLD locations near known legacy sites (including Schooner), it was 231 mR/yr.

The CEMP offsite TLD and PIC results remained consistent with previous years' background radiation levels and are also well within the range of variation in background levels observed in other parts of the U.S. and with the 124 mR/yr level measured on the NNSS. The highest total annual gamma exposure measured off site, based on the PIC detectors, was 173 mR at Warm Springs Summit (at 7,570 feet elevation). The lowest offsite exposure rate, based on the PIC detectors, was 72 mR at Pahrump, Nevada (at 2,639 feet elevation).



Greater Roadrunner *(Geococcyx californianus)*

2013 NNSS Background Gamma Radiation

124 mR/yr — This is the mean background radiation measured at 10 TLD stations in areas isolated from past and present nuclear activities.

Average Background Radiation of Selected U.S. Cities (Excluding Radon)

City	**Elevation Above Sea Level** (feet)	**Radiation** (mR/yr)
Denver, CO	5,280	164.6
Wheeling, WV	656	111.9
Rochester, NY	505	88.1
St. Louis, MO	465	87.9
Portland, OR	39	86.7
Los Angeles, CA	292	73.6
Fort Worth, TX	650	68.7
Richmond, VA	210	64.1
New Orleans, LA	39	63.7
Tampa, FL	0	63.7

Source: http://www.wrcc.dri.edu/cemp/Radiation.html, as accessed on July 16, 2014

Range in Average Direct Radiation Measured in 2013 on and off the NNSS

Location	**Elevation Above Sea Level** (feet)	**Radiation Exposure** (mR/yr)
NNSS - Schooner TLD station	5,660	574
NNSS - 35 Legacy Site TLD stations (includes Schooner)	3,077–5,938	231
Warm Springs Summit, Nevada CEMP PIC station	7,570	173
NNSS - 17 Waste Operation TLD stations	3,176–4,021	140
NNSS - 10 Background TLD stations	2,755–5,938	124
St. George, Utah CEMP PIC station	2,688	89
Pahrump, Nevada CEMP PIC station	2,639	72
NNSS Mercury Fitness Track TLD station	3,769	64

Understanding Radiation Dose

Dose is a generic term to describe the amount of radiation a person receives. The energy deposited indicates the number of molecules disrupted. The energy the radiation deposits in tissue is called the absorbed dose. The units of measure of absorbed dose are the rad or the gray. The biological effect of radiation depends on the type of radiation (alpha, beta, gamma, or X-ray) and the tissues exposed. A measure of the biological risk of the energy deposited is the dose equivalent. The units of dose equivalent are called rems or sieverts. In the NNSSER, the term dose is used to mean dose equivalent measured in rems. A thousandth of a rem is called a millirem (mrem).

An average person in the United States receives about 310 mrem each year from natural sources and an additional 310 mrem from medical procedures and consumer products (Source: http://www.epa.gov/radiation/understand/perspective.html). Whether there is a “safe” radiation dose equivalent is a controversial subject. Because the topic has yet to be settled scientifically, regulators take a conservative approach and assume that there is no such thing as a 100% safe dose equivalent. It is believed that the risk of developing an adverse health effect (such as cancer) is proportionate to the amount of radiation dose received.

Many human activities increase our exposure to radiation over and above the average background radiation dose of 310 mrem per year. These activities include, for example, uranium mining, airline travel, and operating nuclear power plants. Regulators balance the benefit of these activities with the risk of increasing radiation exposures above background and, as a result, set dose limits for the public and workers specific to these activities. DOE has set the dose limit to the public from exposure to DOE-related nuclear activities to 100 mrem/yr. This is the same public dose limit set by the U.S. Nuclear Regulatory Commission (NRC) and recommended by the International Commission on Radiological Protection and the National Commission on Radiological Protection and Measurements. The NRC has set the dose limit for radiation workers to 5,000 mrem/yr. There are no common or agreed-upon dose limits for workers or the public across industries, states, or countries.

Dose — The amount of radiation a person receives.

Absorbed dose — The energy the radiation deposits in tissue, where the energy deposited indicates the number of molecules disrupted. The units of measure of absorbed dose are the rad or the gray.

Dose equivalent — A measure of the biological risk of the energy deposited in tissue, which depends on the type of radiation (alpha, beta, gamma, or X-ray) and the tissues exposed. The units of measure of dose equivalent are called rems or sieverts.

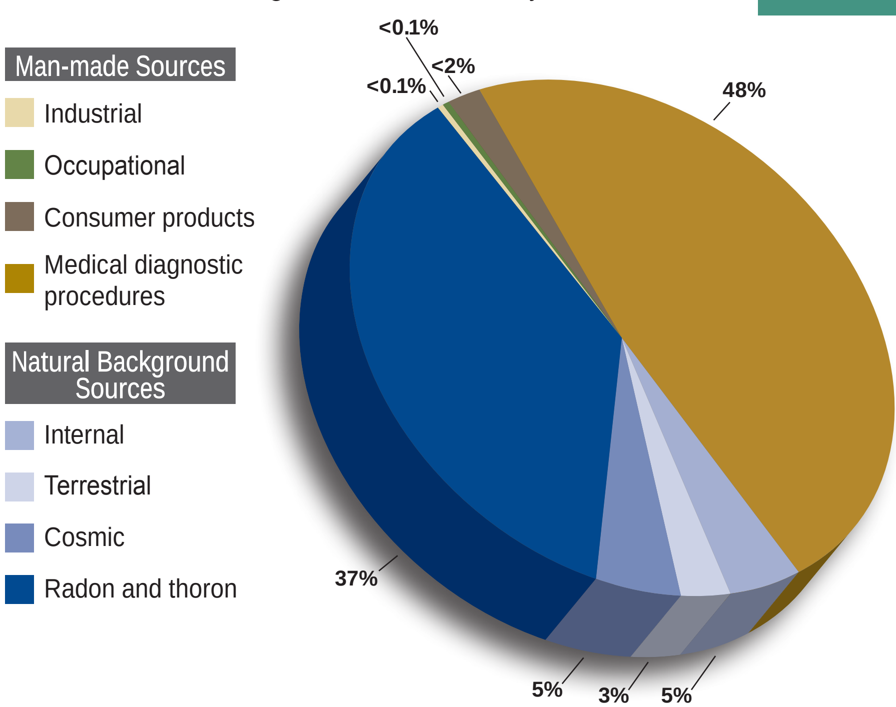
Common Doses to the Average American

Source/Activity	Average Dose/Year (or as noted)
5-hour jet plane ride	3 mrem/5 hours
Building materials	4 mrem
Chest X-ray	8 mrem
Cosmic	30 mrem
Soil	35 mrem
Internal to our body	40 mrem
Mammogram	138 mrem
Radon gas	200 mrem
CT scan	2,500 mrem
Smoking 20 cigarettes/day	5,300 mrem to a smoker’s lung
One cancer treatment	5,000,000 mrem to the tumor

Source: http://hss.energy.gov/HealthSafety/WSHP/radiation/Radiation-final-6-20.pdf, as accessed on June 1, 2013

Sources of Radiation Exposure for the Average Person in the U.S.

Average Dose = 620 mrem/yr



Estimating Dose to the Public from NNSS Operations

The release of man-made radionuclides from the NNSS has been monitored since the first decade of atmospheric testing. After 1962, nuclear tests were conducted only underground, greatly reducing the radiation exposure in the areas surrounding the NNSS. Underground nuclear testing nearly eliminated atmospheric releases of radiation but resulted in the contamination of groundwater in some areas of the NNSS. After the 1992 moratorium on nuclear testing, radiation monitoring focused on detecting airborne radionuclides that are resuspended with historically contaminated soils on the NNSS and on detecting man-made radionuclides in groundwater.

There are three pathways in this dry desert environment by which man-made radionuclides from the NNSS might reach the surrounding public:


Sedan Crater in north Yucca Flat is a source of airborne radionuclides from resuspended soil (e.g., from wind) and from evapotranspiration of tritiated water.

Air Transport Pathway – Members of the public may inhale or ingest radionuclides that are resuspended by the wind from contaminated sites on the NNSS. However, such resuspended radiation measured off and on the NNSS is much lower than natural background radiation in all areas accessible to the public.

Ingestion Pathway – Members of the public may ingest game animals that have been exposed to contaminated soil or water on the NNSS, have moved off the NNSS, and have then been hunted.


Mule deer *(Odocoileus hemionus)* observed by NNSS biologists during a spotlighting census survey on Pahute Mesa.

Groundwater Pathway – Based on monitoring data, drinking contaminated groundwater is currently not a possible pathway for public exposure, given the restricted public access to the NNSS and the location of known contaminated groundwater on and off the NNSS. No man-made radionuclides have been detected in drinking water sources monitored off the NNSS, and no drinking water wells on the NNSS have measurable levels of man-made radionuclides.


NNSS scientists sampling a private water supply site for radioanalysis.

Continued on Page 18 ...

Public Dose Limits for NNSS Radiation

10 mrem/yr — This is the dose limit to the public (above natural background) from just the air transport pathway, as specified by the Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAP).

100 mrem/yr — This is the dose limit to the public (above natural background) from all possible pathways combined, as specified by DOE O 458.1, "Radiation Protection of the Public and the Environment."

 ... continued from Page 17

Estimated 2013 Inhalation Dose to the Public

Compliance with radiation dose limits to the general public from the air transport pathway is demonstrated using air sampling results from six onsite "critical receptor" sampling stations, which were approved by the EPA in 2001. The radionuclides detected at four or more of the NNSS critical receptor samplers were ^{241}Am, ^{238}Pu, and $^{239+240}$Pu.

As in previous years, the 2013 data from the six critical receptor samplers show that the NESHAP dose limit to the public of 10 mrem/yr was not exceeded. The Schooner critical receptor station, in the far northwest corner of the NNSS, had the highest concentrations of radioactive air emissions; an individual residing at this station would experience a dose from air emissions of 1.01 mrem/yr. A more realistic estimate of the maximum dose to a member of the offsite public would be to use the air sampling results from the Gate 510 sampling station in the far southwest corner of the NNSS, which is closest to the nearest populated place, Amargosa Valley. A person residing at the Gate 510 station would experience a dose from air emissions of 0.02 mrem/yr.

Estimated 2013 Ingestion Dose to the Public

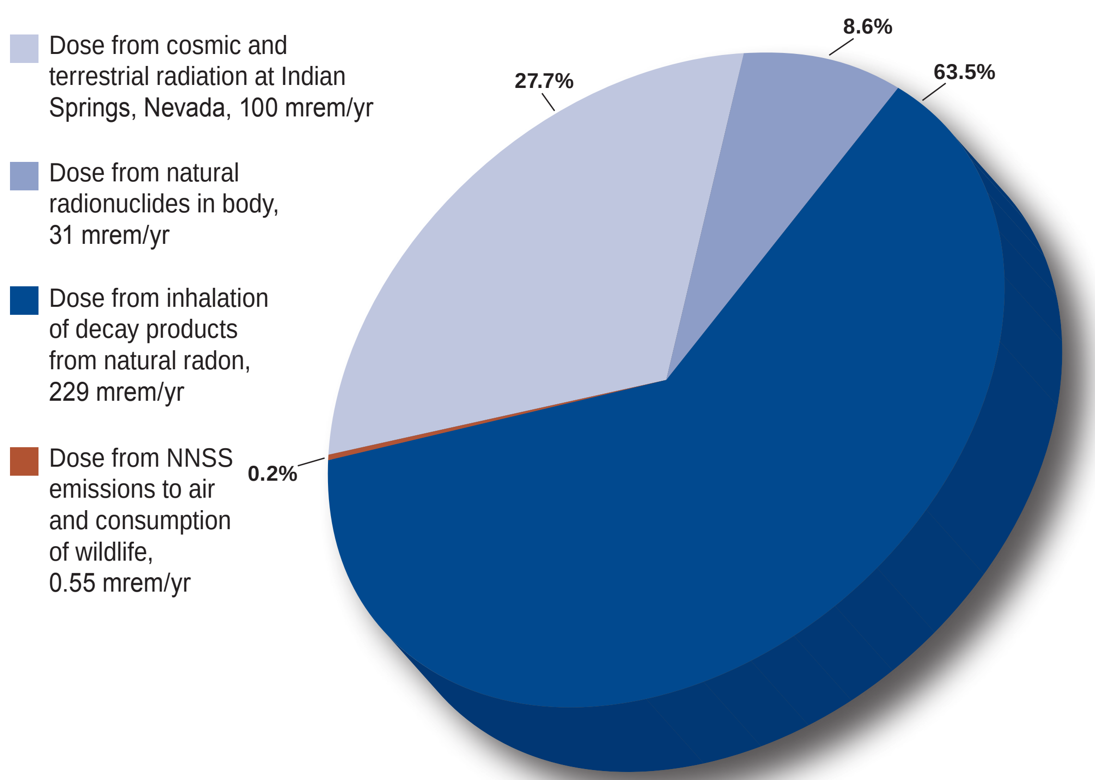
NNSS game animals include pronghorn antelope, mule deer, chukar, Gambel's quail, mourning doves, cottontail rabbits, and jackrabbits. Small game animals from different contaminated NNSS sites are trapped each year and analyzed for their radionuclide content. These results are used to construct worst-case scenarios for the dose to hunters who might consume these animals if the animals moved off the NNSS.

In 2013, tissue samples from a total of six cottontail rabbits, two from each of the Palanquin and Schooner historical Plowshare sites and their control site, and one jackrabbit from the Palanquin site were collected. In addition, opportunistic tissue samples from the carcasses of two pronghorn antelope killed by vehicles and three bighorn sheep and nine mule deer killed by a mountain lion were collected. The estimated dose to an individual who consumes one animal of each of these game species sampled on the NNSS in 2013 was 0.53 mrem/yr.

Direct Exposure

No members of the public are expected to receive direct gamma radiation that is above background levels as a result of NNSS operations. Areas accessible to the public, such as the main entrance gate, had direct gamma radiation exposure rates comparable to natural background rates from cosmic and terrestrial radiation.

Dose to the Public from Natural Background Sources and from the NNSS



2013 Dose to the Public from All Pathways

0.55 mrem/yr — This is the maximum dose to the public from inhalation, ingestion, and direct exposure pathways that is attributable to NNSS operations. It is well below the dose limit of 100 mrem/yr established by DOE O 458.1 for radiation exposure to the public from all pathways combined. This total dose estimate is indistinguishable from natural background radiation experienced by the public residing in communities near the NNSS.

Nonradiological Monitoring of Air and Water

Nonradioactive Air Emissions

The release of air pollutants is regulated on the NNSS under a Class II air quality operating permit. Class II permits are issued for "minor" sources where annual emissions must not exceed 100 tons of any one "criteria pollutant," or 10 tons of any one of the 189 "hazardous air pollutants" (HAPs), or 25 tons of any combination of HAPs. Common sources of such air pollutants on the NNSS include particulates from construction, aggregate production, surface disturbances, fugitive dust from driving on unpaved roads, fuel-burning equipment, open burning, fuel storage facilities, and chemical release and detonation tests.

An estimated 10.29 tons of criteria air pollutants and 0.23 tons of HAPS were released on the NNSS in 2013. The majority of the emissions were nitrogen oxides from diesel generators. No emission limits for any air pollutants were exceeded.

Estimated Quantity of Pollutants Released into the Air from NNSS Operations in 2013

Criteria Air Pollutants:	Tons
Particulate Matter[a]	0.45
Carbon Monoxide	1.54
Nitrogen Oxides	6.38
Sulfur Dioxide	0.23
Volatile Organic Compounds	1.69
Hazardous Air Pollutants (HAPs)	0.23

(a) Particulate matter equal to or less than 10 microns in diameter

Nonradiological Monitoring of Drinking Water and Wastewater

NNSA/NFO operates a network of seven permitted wells that comprise three permitted public water systems on the NNSS that supply the drinking water needs of NNSS workers and visitors. NNSA/NFO also hauls potable water to work locations at the NNSS that are not part of a public water system. Monitoring results for 2013 indicated that water samples from the three public water systems and from the potable water hauling trucks met the National Primary and Secondary Drinking Water Standards.

Industrial discharges on the NNSS are limited to the two operating sewage lagoon systems, Area 6 Yucca and Area 23 Mercury. Under the requirements of the state operating permit, liquid discharges to these sewage lagoons were tested quarterly in 2013 for biological oxygen demand, pH, and total suspended solids. All sewage lagoon water measurements were within permit limits.

The discharge water from the E-Tunnel complex is sampled annually under a state water pollution control permit for 14 nonradiological contaminants, which are mainly metals. In 2013, none of these contaminants were detected at levels that exceeded permit limits.

NNSS Drinking Water

The public water systems that supply drinking water to NNSS workers and visitors meet all Safe Drinking Water Act standards.

Sampling well water

Managing Cultural Resources

The historical landscape of the NNSS contains archaeological sites, buildings, structures, and places of importance to American Indians and others. These are referred to as "cultural resources." NNSA/NFO requires that NNSS activities and programs comply with all applicable cultural resources regulations and that such resources on the NNSS be monitored. The Cultural Resources Management program is implemented by DRI to meet this requirement.

DRI archaeologists conducted archival research for 40 proposed NNSA/NFO projects that had the potential to impact cultural resources, which led archeologists to conduct six field inventories and two historical evaluations. A total of 1,061.4 acres were surveyed, and 11 historic sites and three historic histricts were identified.

The historical evaluations were for the U15 Complex in Area 15 and the Shasta atmospheric test location in Areas 2, 4, and 8. The U15 Complex was in operation from 1959 to 1967 for the Hard Hat, Tiny Tot, and Pile Driver underground nuclear tests conducted to monitor the response

Continued on Page 20 ...

of various structure types to a nuclear explosion in order to design underground facilities that would be impervious to a direct nuclear attack. The Shasta location was used in 1957 as one of the mid-series tests of Operation Plumbbob.

No mitigation actions to protect historic properties on the NNSS were required. DRI continued to maintain and manage the NNSS Archaeological Collection, which contains over 400,000 artifacts.

NNSA/NFO's American Indian Consultation Program conducts consultations with NNSS-affiliated American Indian tribes through the Consolidated Group of Tribes and Organizations (CGTO). The CGTO Spokesperson was appointed to the State Tribal Government Working Group (STGWG), joining 10 other tribes currently serving from New Mexico, Idaho, Washington, Oregon, and New York. The STGWG works closely with various DOE sites throughout the U.S. The CGTO Spokesperson attended six meetings in 2013, each supported by NNSA/NFO to encourage increased tribal involvement and understanding about DOE's role in national activities. They included DOE's National Transportation Stakeholders Forum, two STGWG meetings, and meetings with the Western Interstate Energy Board, and the Midwestern Council of State Governments. A special meeting, the 1st Tribal Leaders Dialogue, provided an opportunity for the CGTO Spokesperson and other tribal leaders to engage in discussions with the Assistant Secretary of Nuclear Energy and develop methods for increasing tribal involvement through expanded communications on a national level.

The CGTO Spokesperson was formally appointed to the NSSAB to serve as a liaison giving advisory insight into activities conducted on the NNSS.

NNSA/NFO is committed to working collaboratively with other agencies to provide research opportunities on the NNSS that benefit ecological and conservation science.

Endangered Species Protection and Ecological Monitoring

The Ecological Monitoring and Compliance (EMAC) Program provides ecological support for activities and programs conducted on the NNSS. Important species known to occur on the NNSS include 18 sensitive plants, 1 mollusk, 2 reptiles, over 250 birds, and 27 mammals. They are classified as important due to their sensitive, protected, and/or regulatory status with state or federal agencies.

The desert tortoise is the only resident species on the NNSS that is protected under the Endangered Species Act and that can be adversely affected by NNSS activities. It is designated as a threatened species under the Act. Habitat of the desert tortoise is in the southern third of the NNSS. Activities conducted in desert tortoise habitat must comply with the terms and conditions of a Biological Opinion issued to NNSA/NFO by the U.S. Fish and Wildlife Service (FWS). In 2013, no desert tortoises were accidentally injured or killed at a project site, nor were any found, captured, or displaced from project sites. Two desert tortoises were accidentally killed by vehicles on paved roads in separate events in 2013, and seven were moved out of harm's way off roads.


Desert tortoise *(Gopherus agassizii)*

Seven desert tortoises were captured and fitted with radio transmitters for a study approved by the FWS. The study will collect movement data through 2014 from up to 20 tortoises found near NNSS roads for the purpose of developing a strategy to minimize road mortalities.

Two additional studies on the NNSS have been approved by the FWS and are being conducted solely, or in part, by NNSS biologists. They include:

- A study of the fate of 60 juvenile tortoises, which were translocated in 2012 from captivity at the Desert Tortoise Conservation Center located near Las Vegas to undisturbed tortoise habitat in Area 22 of the NNSS. The study was begun by staff biologists of the San Diego Zoo Institute for Conservation Research (ICR) and was transferred to NNSS biologists in the fall of 2013.
- A collaborative behavioral/ health study of up to 20 translocated tortoises within each of three existing fenced enclosures in Rock Valley (Area 25). The study is led by the USGS in collaboration with the FWS, the San Diego Zoo ICR, and Pennsylvania State University. NNSS biologists provide support to the U.S. Geological Survey (USGS) as requested.

Continued on Page 21 ...

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In 2013, biologists continued to monitor important species and biological resources on the NNSS, including sensitive plants, migratory birds, wild horses, mule deer, sensitive bats, the western red-tailed skink, and natural and man-made water sources. The collaborative effort with Dr. David Mattson of the USGS continued in 2013 to study the movements, habitat use, and food habits of pumas (mountain lions) on and around the NNSS. Of the four pumas radio-collared in 2012, two died of apparent natural causes, and the collar on one stopped working. The remaining collared puma (NNSS7) was recaptured in 2013, fitted with a new radiocollar, and tracked throughout 2013. No new pumas were successfully captured to add to the study.

The adult male puma, NNSS7, first captured in 2012, was recaptured on June 1, 2013, and fitted with a new radiocollar. Biologists visited abandoned kill sites, revealing that NNSS7 had consumed 30 mule deer, 12 desert bighorn sheep, and 1 badger during 2013.

Environmental Stewardship

NNSA/NFO's Environmental Management System (EMS) is a business management practice that incorporates concern for environmental performance throughout the NNSS and its support facilities. The goal of the EMS is continual reduction of NNSA/NFO's impact on the environment. The EMS is designed to meet the requirements of the globally recognized International Organization for Standardization (ISO) 14001:2004 Environmental Management Standard. In 2008, the EMS obtained ISO 14001:2004 certification. Annual audits are required to maintain an EMS registration, and recertification audits of the entire EMS occur every 3 years. In 2012, an EMS recertification audit determined that NNSA/NFO remains in conformance with the ISO 14001:2004 Standard.

Site-specific EMS objectives and targets are developed on a fiscal year (FY) schedule (October 1 through September 30). In FY 2013, the EMS objectives included:

- Reduce energy use.
- Decrease use of petroleum-based fuels.
- Purchase products that meet environmentally preferable purchasing standards.
- Meet site remediation corrective action schedule deadlines established under the FFACO.
- Help NNSA meet DOE complex-wide site sustainability goals.

The Energy Management Program was formed specifically to reduce the use of energy and water in NNSA/NFO facilities and to advance the use of solar and other renewable energy sources.

In December 2013, the Energy Management Program completed the FY 2014 NNSA/NFO Site Sustainability Plan, which reports the current status and planned actions toward meeting DOE's sustainability goals. Thus far, the Energy Management Program is on track to meet the majority of the DOE long-term goals *(see Pages 22 and 23)*.

The Pollution Prevention and Waste Minimization Program helps to reduce the volume and toxicity of waste that must be disposed. In 2013, an estimated 1,105 tons of waste were diverted from NNSS landfills and disposal facilities, all through recycling and reuse.

Energy Efficiency and Management

- Energy intensity (energy use per square foot of building space) was 31% below the FY 2003 baseline – the goal is 29.5% reduction by FY 2015.
- 94% of buildings or processes are metered for electricity – exceeds the goal of 90% by October 2012.
- 76% of buildings or processes are metered for natural gas; 0% are metered for chilled water – the goal is 90% for both by October 2015.
- Two roofs were replaced with cool roofs (solar reflective/thermal resistant). Cool roofs currently cover 23% of the gsf of all NNSA/NFO buildings.
- 77 energy and water assessments were conducted – meeting the goal to ensure that all eligible facilities under Section 432 of the Energy Independence and Security Act are assessed once every 4 years. The assessments identified energy conservation measures for several buildings at the NNSS and the NLVF.

Water Efficiency and Management

- Water intensity (gallons used per total gross square feet [gsf] of facility space) was 57% below the FY 2007 baseline – exceeds the goal of 26% reduction by FY 2020.
- Non-potable water production (used to estimate consumption) was 80% below the FY 2010 baseline as a result of repairing end point leaks, closing unneeded well sumps, and replacing the sumps with metal wildlife watering troughs – exceeds the goal of a 20% reduction by FY 2020.

Wildlife watering trough that replaced Well 5b sump closed in 2012.

Fleet Management

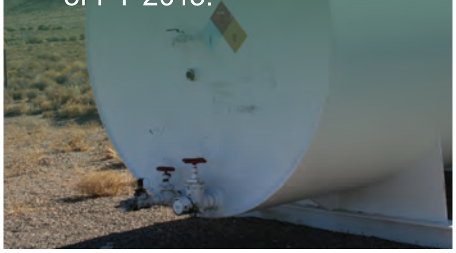
- Use of alternative fuel was 195% above the FY 2005 baseline – exceeds the goal of a 70% increase above the FY 2005 baseline for 2012.
- Use of petroleum was 60% less than the FY 2005 baseline – exceeds the goal of a 16% decrease from the FY 2005 baseline for 2013.
- 100% of light duty vehicle acquisitions were alternative fuel vehicles – exceeds the goal of 75%.
- Fleet inventory is 13% less than the FY 2005 baseline – the goal is a 15% reduction by FY 2015.

High Performance Sustainable Buildings (HPSBs)

- 3.3% of buildings larger than 5,000 gsf are compliant with the Guiding Principles (GPs) for Federal Leadership in HPSB design, and 14 buildings (11.7% of applicable buildings) range from 69% to 86% complete toward meeting the GPs – the goal is to have 15% of such buildings compliant by FY 2015.

Pollution Prevention and Waste Minimization

- 35% of non-hazardous solid waste generated at NNSA/NFO facilities was diverted from landfills through recycling – the goal is 50% by the end of FY 2015.
- 43% of construction materials were recycled and diverted from the landfill – the goal is 55% by the end of FY 2015.



Electronic Stewardship and Data Centers

- All data centers have been metered in order to measure their monthly Power Utilization Effectiveness (PUE), where an ideal PUE is 1.0 – meets the goal to have all centers metered by FY 2015.
- PUE for the Building C-1 data center at the NLVF was 1.5; PUE for the data center in Building 23-725 at Mercury was 1.1 – the goal is a maximum annual weighted PUE of 1.4 for each data center by FY 2015.
- All leased computers are Electronic Product Environmental Assessment Tool registered and Energy Star qualified.
- All leased computers and monitors have power management capabilities that are used.

Greenhouse Gas (GHG) Emissions

- FY 2013 Scope 1 and 2 GHG emissions were 2% greater than those of the FY 2008 baseline – the goal is a 28% reduction by FY 2020.
- FY 2013 Scope 3 GHG emissions were 54% less than those of the FY 2008 baseline – exceeds the goal of 13% reduction by FY 2020.

GHG emissions targeted for reduction are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (SF_6) and are classified depending on their source:

Scope 1 — from sources owned or controlled by a federal agency.

Scope 2 — resulting from the generation of electricity, heat, or steam purchased by a federal agency.

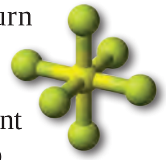
Scope 3 — from sources not owned or directly controlled by a federal agency but related to agency activities.

Climate Change Resilience

- Regional risks to NNSA/NFO facilities are drought and flooding. Program and site evaluations will continue to ensure they are resilient to climate change in accordance with the goals of DOE's Climate Change Adaptation Plan.

NNSA 2013 Sustainability Awards

Environmental Stewardship Award for GHG Scope 1 and 2 Reduction of SF_6

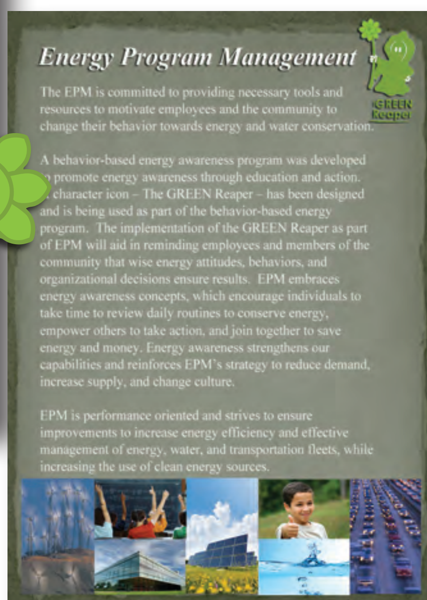


- NSTec initiated a program to return dozens of excess bottles of SF_6 gas to their vendors, and new methods for monitoring equipment containing SF_6 were developed to reduce fugitive emissions of this GHG.

The National Nuclear Security Administration awarded 18 Sustainability Awards for innovation and excellence to its national laboratories and sites in 2013. Of these 18, the NNSS received two Best in Class Awards and two Environmental Stewardship Awards.

Environmental Stewardship Award for the Green Reaper

- NSTec Energy Program Manager Dawn Starrett received this award for her creation of the Green Reaper cartoon character used in announcements, newsletters, and other literature to encourage workers to conserve energy. In 2013, the Green Reaper character was translated into a costume for use during community outreach presentations to local elementary school children.



Energy Program Management

GREEN Reaper

The EPM is committed to providing necessary tools and resources to motivate employees and the community to change their behavior towards energy and water conservation.

A behavior-based energy awareness program was developed to promote energy awareness through education and action. A character icon – The GREEN Reaper – has been designed and is being used as part of the behavior-based energy program. The implementation of the GREEN Reaper as part of EPM will aid in reminding employees and members of the community that wise energy attitudes, behaviors, and organizational decisions ensure results. EPM embraces energy awareness concepts, which encourage individuals to take time to review daily routines to conserve energy, empower others to take action, and join together to save energy and money. Energy awareness strengthens our capabilities and reinforces EPM's strategy to reduce demand, increase supply, and change culture.

EPM is performance oriented and strives to ensure improvements to increase energy efficiency and effective management of energy, water, and transportation fleets, while increasing the use of clean energy sources.

Best in Class Award for Water Loss Mitigation

- Four earthen sumps on the NNSS that stored pumped groundwater for use in construction projects were closed in 2012 and replaced with aboveground water storage containers. Water losses due to soil infiltration were eliminated, resulting in a 20% reduction in water use on the NNSS.

Best in Class Award for NNSS Fleet Management Initiatives

- NNSA/NFO implemented a Plug-in Electric Vehicle (PEV) Pilot Program to demonstrate PEV technology for possible wider use in federal fleets nationwide. NSTec has 11 Chevy Volts, 5 plug-in stations at the NLVF, and 10 at the NNSS, 2 of which were installed in 2013.
- Two Closed Loop Vehicle Oil Change Machines were purchased and installed, which will protect the environment from oil spills and reduce the time taken to change oil in NNSS fleet vehicles.
- Two dispensers for E-85 fuel (an ethanol-gasoline fuel blend) were installed at the Area 6 Service Station on the NNSS, providing E-85 availability at the station, which did not exist before.
- NNSA/NFO adopted the use of synthetic motor oil and periodic oil analysis for the premier NNSS security vehicles, increasing their mileage interval between oil changes by 50%.

National Nuclear Security Administration

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