

# Nevada National Security Site (NNSS) Tour Booklet



Nevada Site  
Specific Advisory Board  
October 24, 2018



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Prohibited Articles On NNSS Public Tours

**The following items are prohibited within the boundaries of the NNSS public tours.**

**Tour escorts are required to do random checks.**

- Cellular Phones
- Bluetooth Enabled Devices
- PDA, BlackBerry, etc.
- Computers
- Portable Data Storage Devices
- Global Positioning System (GPS)
- Cameras/Camcorders
- Binoculars
- Optical Instruments
- Geiger Counters
- Recording Devices
- Pets and Animals
- Explosives
- Ammunition
- Incendiary Devices
- Chemical Irritants
- Alcoholic Beverages
- Controlled Substances
- Any Item Prohibited by Law

**Possession of these items may delay the tour and prevent your participation.**

**If at any point during the tour these items are discovered, the tour may be terminated.**



**EM Environmental Management**

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# NNSS Tour Agenda\*

- |            |                                                                              |            |                                                            |
|------------|------------------------------------------------------------------------------|------------|------------------------------------------------------------|
| 7:45 a.m.  | Depart for NNSS                                                              | 12:40 p.m. | Depart for Sedan Crater                                    |
| 8:35 a.m.  | Arrive at Mercury Badge Office                                               | 12:55 p.m. | Arrive at Sedan Crater (photo opp)                         |
| 8:55 a.m.  | Depart for USGS Core Library                                                 | 1:25 p.m.  | Depart for T-1/Apple 2 Houses                              |
| 9:00 a.m.  | Arrive at USGS Core Library for Groundwater Briefing ~ Work Plan Items 1 & 2 | 1:45 p.m.  | Arrive at T-1/Apple 2 for Drive-by Briefing                |
| 9:30 a.m.  | Depart for Frenchman Flat                                                    | 2:00 p.m.  | Depart for Area 3 Radioactive Waste Management Site (RWMS) |
| 9:45 a.m.  | Arrive at Frenchman Flat for Drive-Through                                   | 2:05 p.m.  | Arrive Area 3 RWMS for Drive-Through Briefing              |
| 10:05 a.m. | Depart for Area 5 Radioactive Waste Management Complex (RWMC)                | 2:25 p.m.  | Depart for Ice Cap Ground Zero (GZ)                        |
| 10:15 a.m. | Arrive Area 5 RWMC for Briefings ~ Work Plan Items 3, 4, & 5                 | 2:35 p.m.  | Arrive at Ice Cap GZ for Briefing (photo opp)              |
| 11:15 a.m. | Depart for Climax Mine                                                       | 3:05 p.m.  | Depart for Operations Command Center (OCC)                 |
| 12:00 p.m. | Arrive Climax Mine for Groundwater Briefing and Lunch                        | 3:45 p.m.  | Arrive at OCC for rest stop                                |
|            |                                                                              | 4:05 p.m.  | Depart for Gate 100                                        |
|            |                                                                              | 4:10 p.m.  | Drop off at Mercury and return to Las Vegas                |
|            |                                                                              | 5:05 p.m.  | Arrive Centennial Hills Park and Ride, LV                  |

\* *Subject to change*

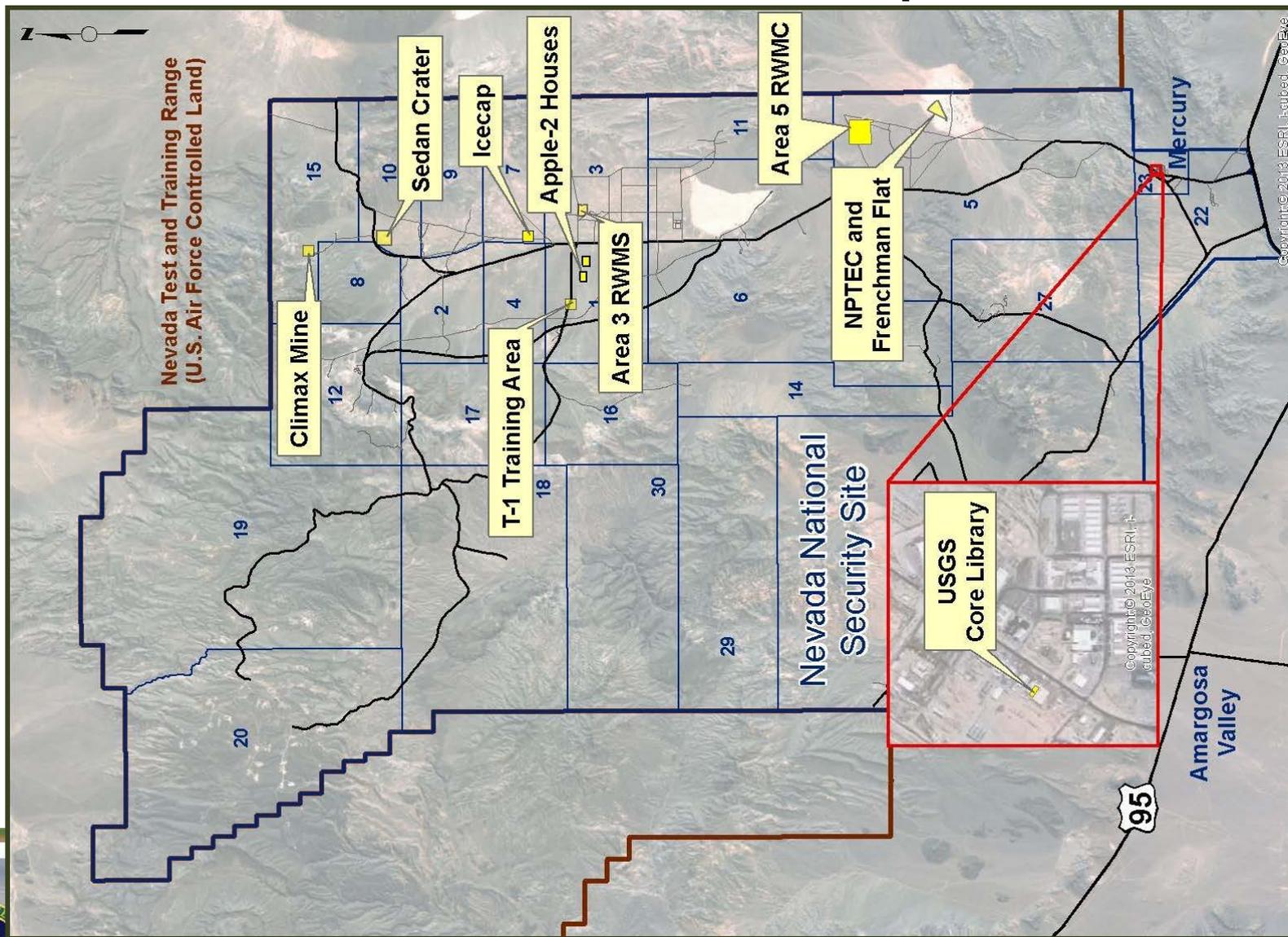


**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

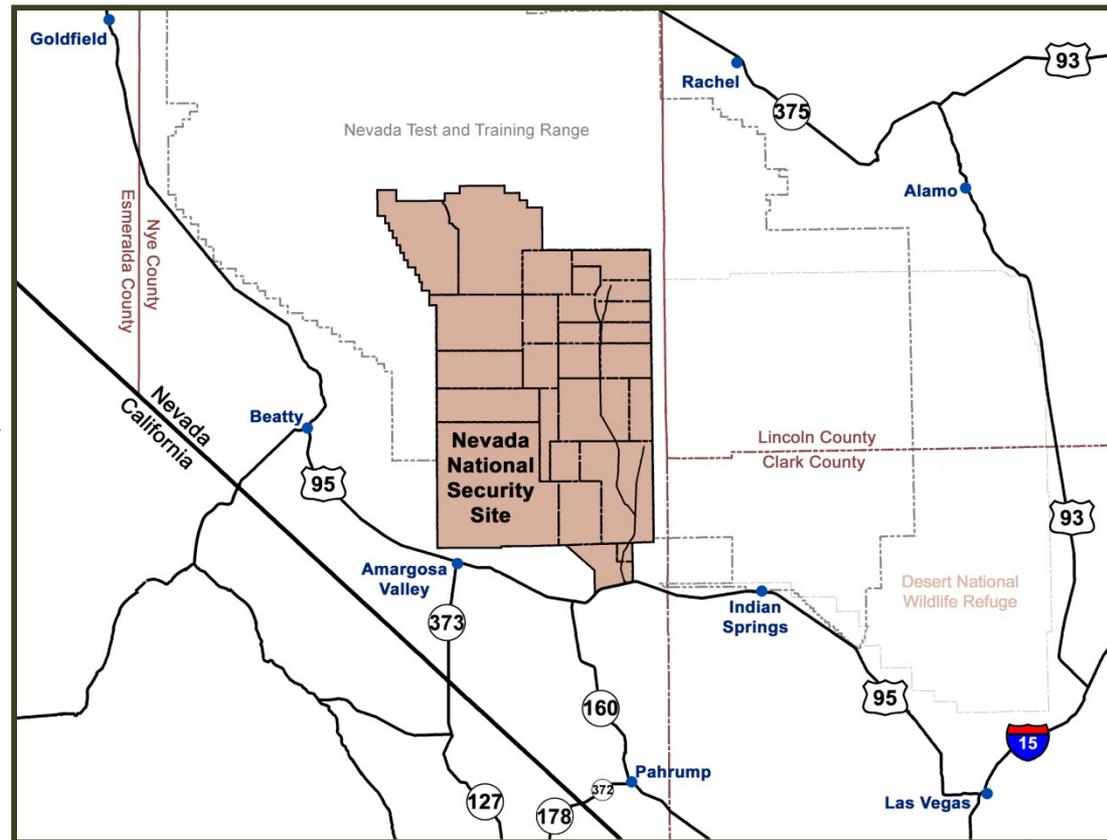
# NNSS Tour Map



safety ❖ performance ❖ cleanup ❖ closure

# NNSS

- Approximately 1,360 square miles of U.S. Department of Energy (DOE)-controlled land
  - Surrounded by approximately 4,500 square miles of federally controlled land
- Located approximately 65 miles northwest of Las Vegas, Nevada



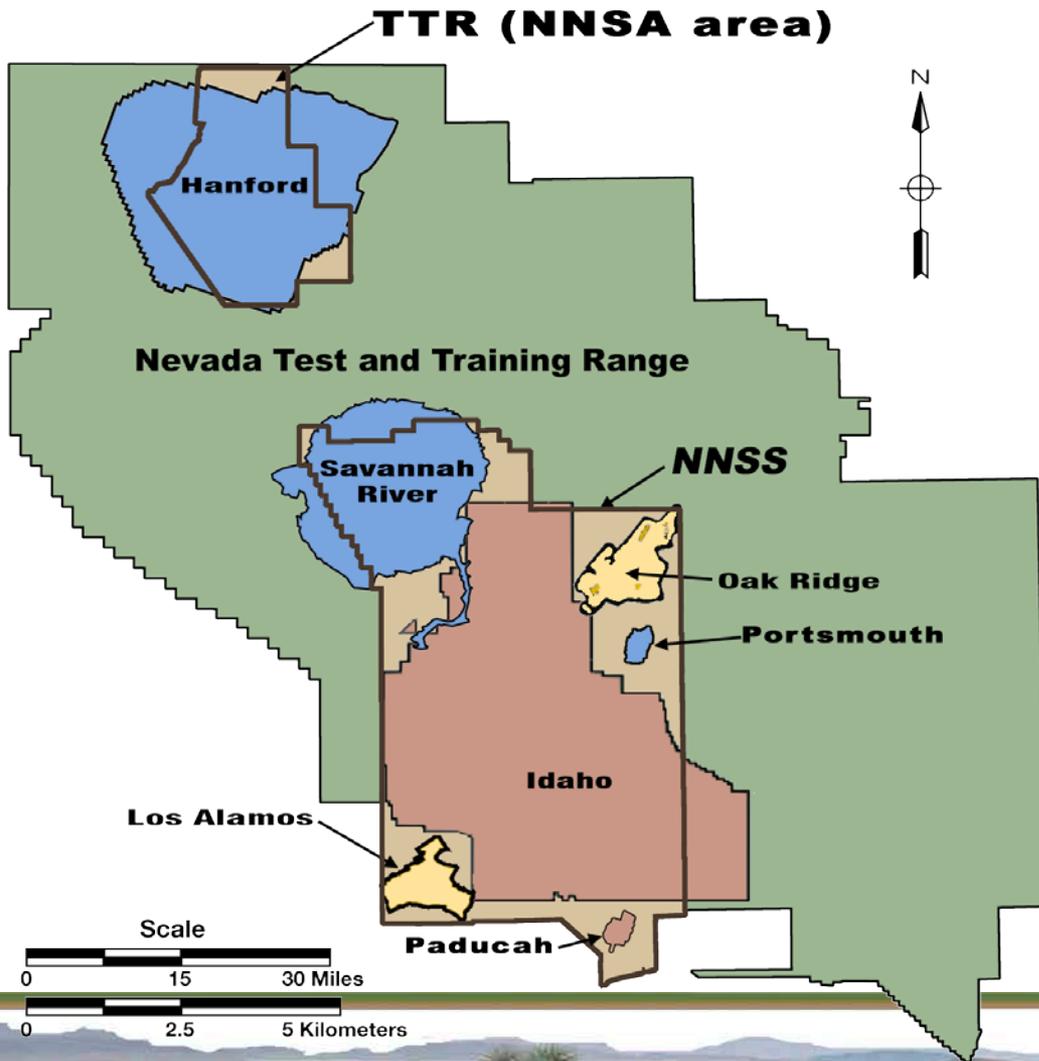
**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 5  
2018-032-EMRP

# DOE Site Comparisons



Site	Sq. Mi.
Hanford	560
Idaho	893
Los Alamos	43
Oak Ridge	53
Paducah	5
Portsmouth	6
Savannah River	310
<b>TOTAL</b>	<b>1,870</b>
NNSS	~1,360
TTR (NNSA area)	~280
<b>TOTAL</b>	<b>~1,640</b>



**EM Environmental Management**

safety ❖ performance ❖ cleanup ❖ closure

# Life in Mercury



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

# Life in Mercury (continued)



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

# Nuclear Testing Road to the NNSS

- U.S. enters World War II in 1941 after Japanese attack Pearl Harbor
- U.S. Manhattan Project begins developing first atomic bomb in 1942 to influence the outcome of the war
- Manhattan Project tests first atomic bomb in New Mexico on July 16, 1945, called “Trinity”
- U.S. drops two atomic bombs on two cities in Japan on August 6 and 9, 1945 – Japan surrenders August 14, 1945
- Nuclear testing begins in the South Pacific Ocean in 1946



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# NNSS Established in 1950

- Atomic testing in the South Pacific presented challenges
  - Logistics
  - Weather
  - Security
  - Safety
- Urgent need for continental test site
  - Top secret feasibility study, code named *Nutmeg*, commenced to search for a continental test site
  - Study concluded arid, southwest section of U.S. as an ideal location
- President Truman officially established Nevada Proving Grounds, now the NNSS, on December 18, 1950



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Historic Activities

- First NNSS atmospheric nuclear test detonated on January 27, 1951
- 928 atmospheric and underground nuclear tests conducted between 1951 and 1992
- Development and testing of nuclear weapons generated radioactive waste



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# U.S. Nuclear Tests

Location	Tests	Detonations
South Atlantic	3	3
Pacific	106	106
Alamogordo, NM	1	1
Amchitka, AK	3	3
Carlsbad, NM	1	1
Central, NV	1	1
Fallon, NV	1	1
Farmington, NM	1	1
Grand Valley, CO	1	1
Hattiesburg, MS	2	2
Nevada Test & Training Range	5	5
Rifle, CO	1	3
NNSS Atmospheric	100	100
NNSS Underground – U.S.	804	
NNSS Underground – U.S./U.K.	24	921
	<b>1,054</b>	<b>1,149</b>

A test is defined in the Threshold Test Ban Treaty as either a *single underground nuclear explosion* (detonation) or *two or more underground nuclear explosions* (detonations) conducted within an area delineated by a circle having a diameter of 2 kilometers and conducted within a total period of time not to exceed 0.1 second.

Source: NV-209 Rev 15



**EM** Environmental Management

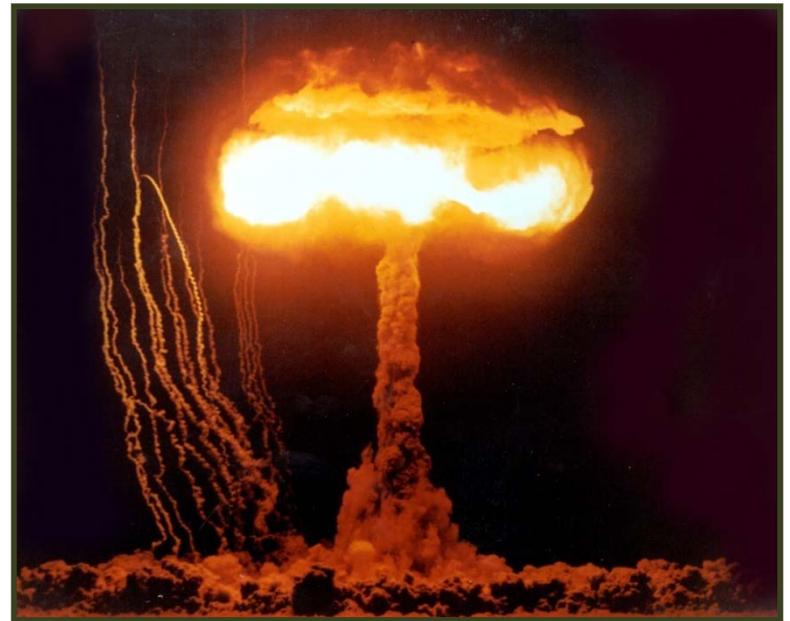
safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Atmospheric Testing at the NNSS

- 100 atmospheric tests conducted at the NNSS from January 1951 through July 1962 to study weapons-related effects, as safety experiments, and to study peaceful effects of nuclear explosions
- Conducted aboveground in the atmosphere
 

– Tower	43
– Balloon	23
– Airdrop	19
– Surface	13
– Rocket	1
– Airburst	1



*Climax* – an airdrop test at the NNSS on June 4, 1953



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

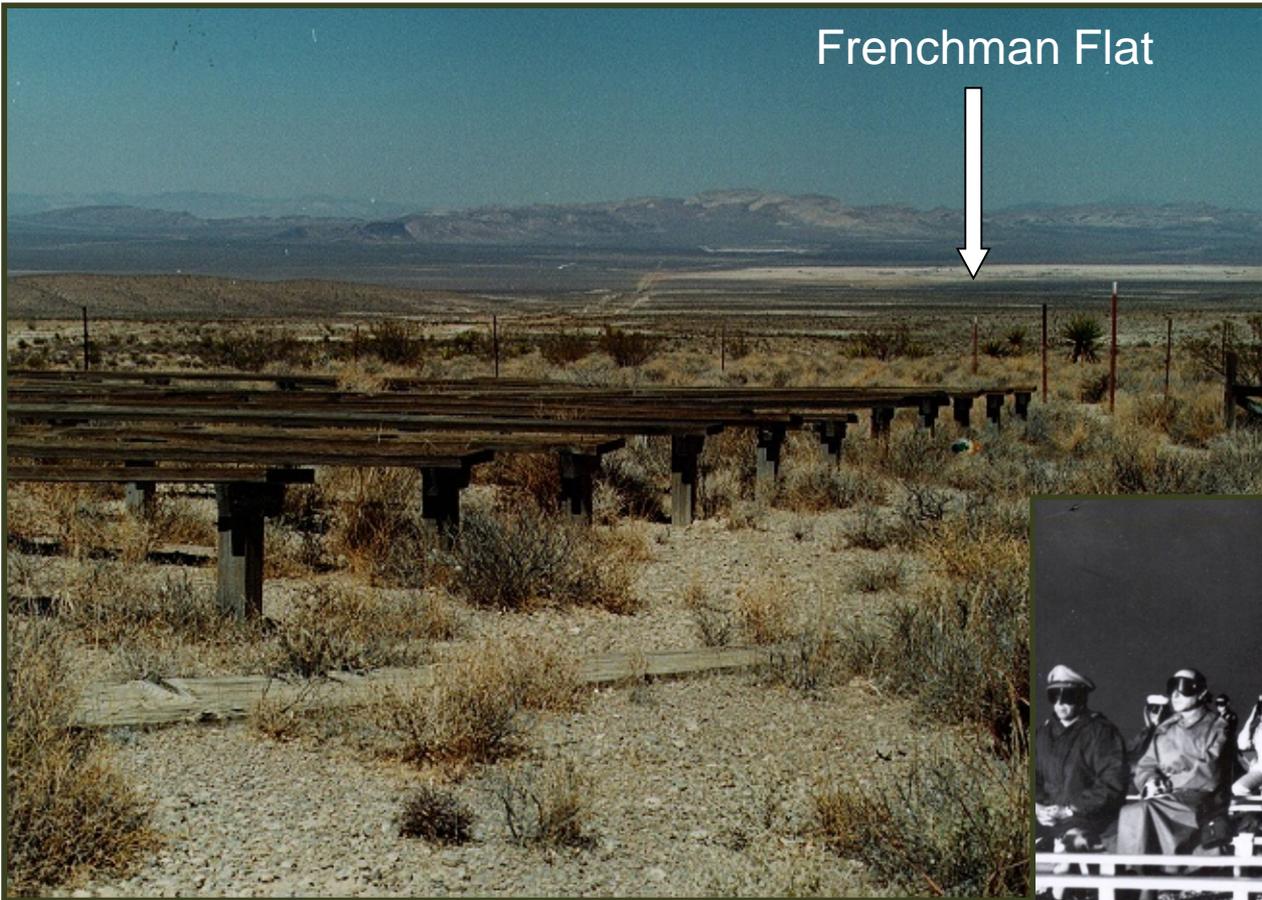
[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 13  
2018-032-EMRP

Frenchman Flat



Seated at these bleachers, located alongside the Mercury Highway, official observers viewed the detonation of 14 atmospheric tests in Frenchman Flat



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

37-kiloton *Priscilla*  
test detonated on  
June 24, 1957 on  
the NNSS  
Frenchman Flat



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 15  
2018-032-EMRP

# Nonproliferation Test and Evaluation Complex (NPTEC)



- Unique 67-acre facility equipped to test sensors using a variety of release methods, including chemical releases, wind tunnel releases, and portable release systems
- Provides sensor arrays for ground truth data, an explosives pad, weather data instrumentation, calibrated release systems, and 24-hour release capability
- Environmental Impact Statement allows release of hazardous materials for training, field-testing of detectors, plume dispersion experimentation, and equipment and materials testing
- Includes activities at various other locations on the NNSA



# Soils



- Atmospheric nuclear weapons tests, nuclear safety experiments, surface releases from underground tests, nuclear testing done in support of nuclear rocket development in Area 25, and evaluation tests for peaceful uses of nuclear explosives conducted at the NNSS and Nevada Test and Training Range (operated by the U.S. Air Force) resulted in the radioactive contamination of surface soils
- Soils Activity includes 148 Corrective Action Sites (~95% closed as of September 30, 2018)
  - Characterizing and remediating surface soil contamination
  - Ensuring appropriate controls (e.g. postings, barriers) are in place at the sites and conducting long-term site monitoring, as needed



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Atmospheric Test Relics



Concrete shelter domes prior to the 1957 *Priscilla* test



Effect of the test on the concrete shelter dome

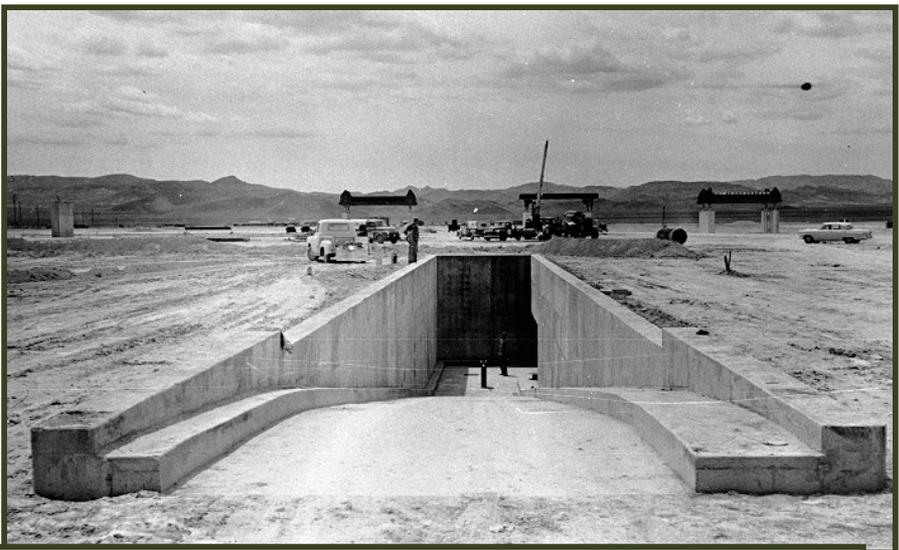


**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

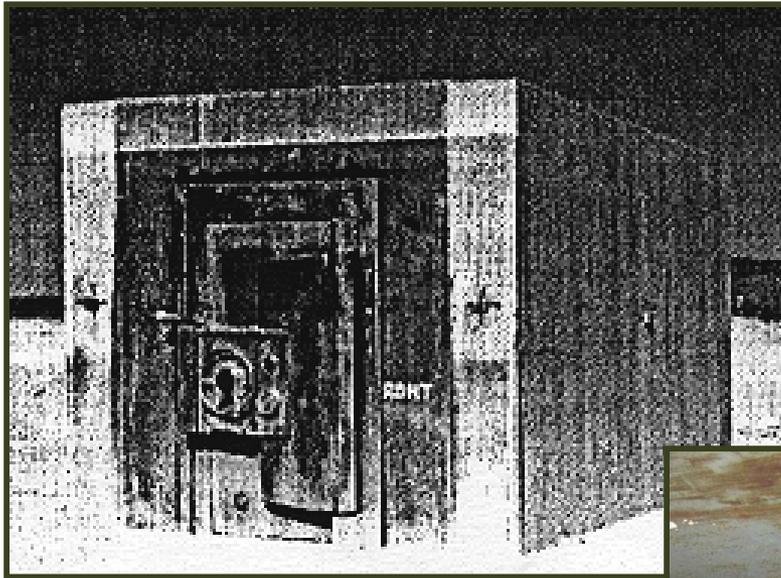
[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 18  
2018-032-EMRP



900-square-foot underground dual purpose garage and mass shelter built and tested for *Priscilla* in 1957





Mosler Safe Company designed a 12-foot-by-8-foot reinforced concrete vault for the *Priscilla* test in 1957; trim on the steel door was loosened by the blast, but the door itself was not damaged – contents placed within the safe remained intact



**EM Environmental Management**

safety ❖ performance ❖ cleanup ❖ closure

Four railroad trestles constructed for *Operation Plumbbob* in 1953 – only one structure remains in place today with visible significant bowing of the steel “I” beams



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

# The End of Atmospheric Testing

- U.S. agreed to observe Limited Test Ban Treaty in October 1963, effectively ending atmospheric testing



*Little Feller I* test location  
46 years after the last  
atmospheric test on the  
NNSS was detonated on  
July 17, 1962



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

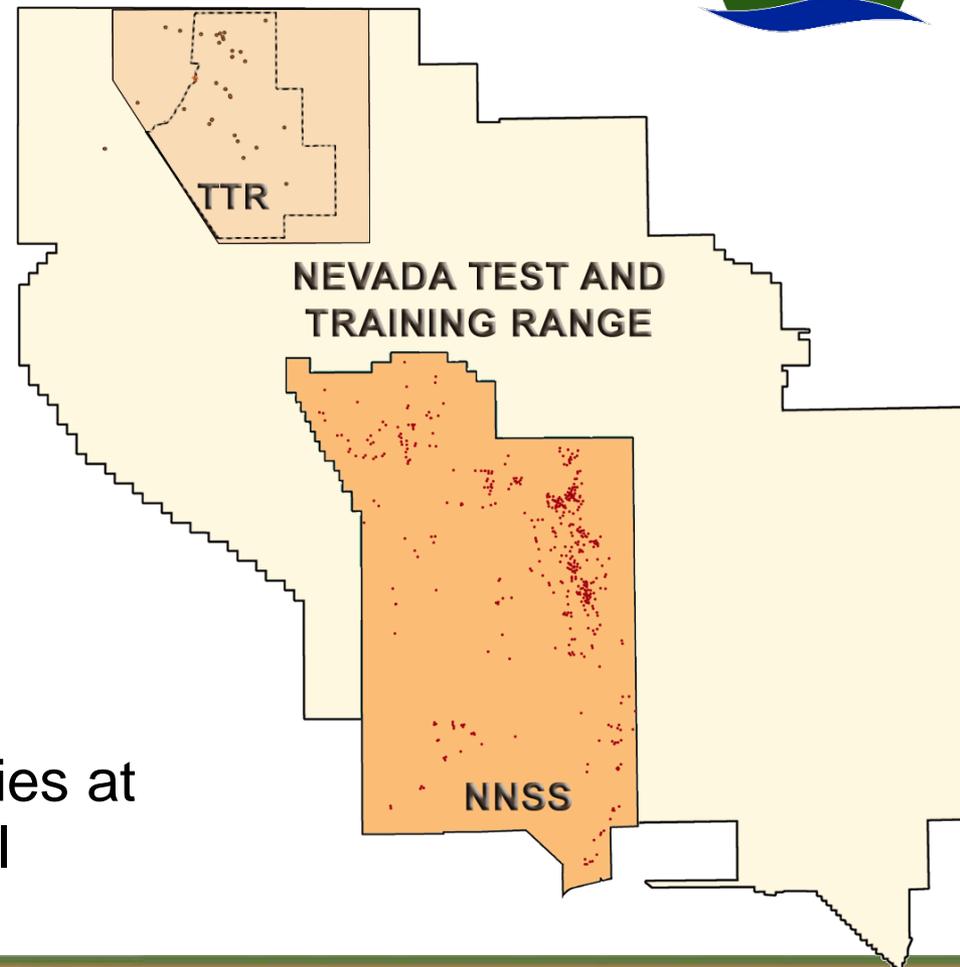
[www.nnss.gov](http://www.nnss.gov)

ID 1818- 10/24/2018 – Page 22  
2018-032-EMRP



# Industrial Sites

- Industrial Sites are facilities and land used in direct support of historic nuclear testing, which resulted in environmental contamination
  - Sites include leach fields, sumps, disposal wells, tanks, contaminated waste piles, and ordnance sites
- 1,126 Corrective Action Sites
  - Completed remediation activities at 1,124 sites with state approval



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Engine Maintenance Assembly and Disassembly (EMAD) Facility

EMAD Facility



- Originally supported Nuclear Rocket Development Station activities on the NNSS in Area 25
- An approximately 165,000 square foot, four-story building that is 80 feet high with walls constructed of either concrete, asbestos-coated corrugated steel, or concrete block
- Building interior is divided among the following functional areas:  
(1) Hot Bay Complex, (2) Operating Galleries and Master Control Room, (3) Cold Bay Complex, (4) Machine and Repair Shops, and (5) Facility Support Areas; includes two train cars



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# EMAD Facility

- No current or future mission
- Scheduled for decontamination and decommissioning starting in fiscal year (FY) 2024 and completed by FY 2027
  - Removes facility from service and demolishes the facility and properly disposes of the generated waste
  - Limits the long-term cost of surveillance and maintenance
  - End state is anticipated to be demolition to slab



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 25  
2018-032-EMRP

# Low-Level Waste (LLW) Disposal at NNSS



**Tom Hergert**

Area 3/5 Nuclear Facility Manager  
Mission Support and Test Services (MSTS)



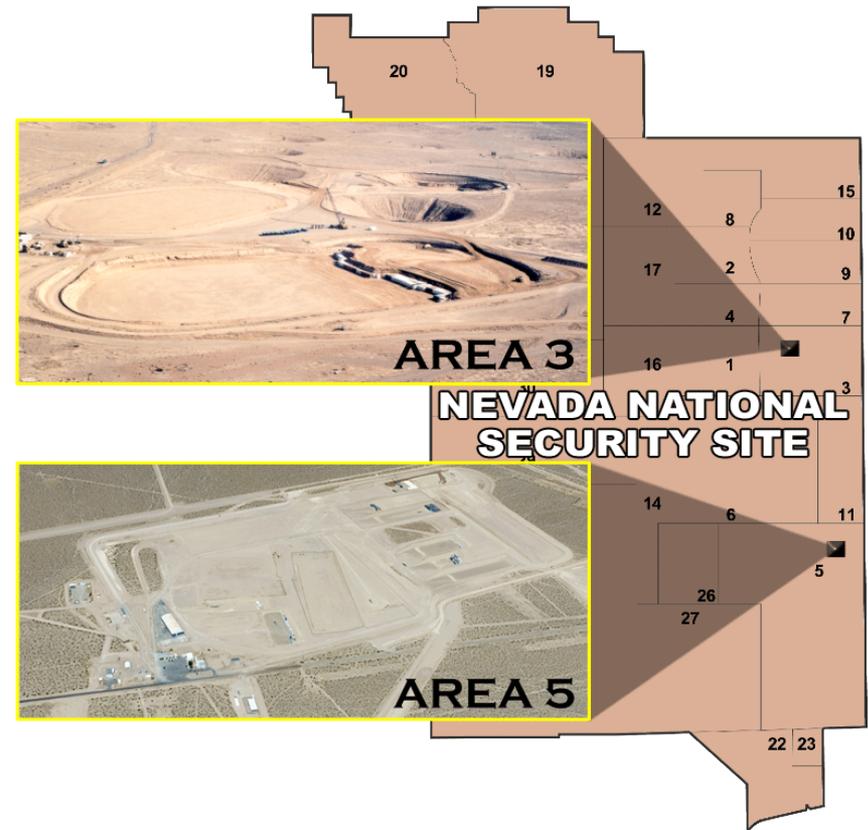
**EM** *Environmental Management*

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# NNSS Waste Disposal Facilities

- LLW can be disposed at two disposal sites at the NNSS
  - Area 3 uses subsidence craters created by past underground nuclear tests to dispose of bulk and containerized waste
  - Area 5 uses engineered shallow-land burial to dispose of containerized waste



**EM Environmental Management**

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 27  
2018-032-EMRP

# Area 5 Radioactive Waste Management Complex (RWMC)

- Located in Frenchman Flat, near first atmospheric nuclear test in Nevada (24 nuclear tests conducted within 4 miles of Area 5 RWMC)
- Arid and isolated disposal facility with no groundwater pathway and deep groundwater
- Supports ongoing cleanup activities at NNSC and across the DOE complex
- Can safely dispose of classified waste that requires additional security



NNSC Area 5 Radioactive Waste Management Site (RWMC)



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Geographic and Geologic Isolation of Disposed Waste

- Protection against intrusion
  - ~740 acres owned by DOE
  - Protected by armed security force and security devices 24/7
  - Surrounded by ~4,500 miles of Air Force controlled land
  - More than 8 feet of soil covers disposal cells
- No groundwater pathway
  - Rainfall either evaporates or is used by plants (evapotranspiration 12 times average precipitation)
  - No recharge of upper aquifer (located ~800 feet deep) in more than 25,000 years
  - Little to no lateral movement of groundwater (estimated at 10 centimeters per year in 2017)



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Geographic and Geologic Isolation of Disposed Waste

(continued)

- No surface pathway
  - Frenchman Flat is a hydrographically closed basin where runoff moves through normally dry washes toward a dry lakebed
    - Any water that accumulates eventually evaporates or is taken up by the native vegetation
  - Depositional basin geology and arid environment provides for a slow accumulation/layering of soil (or other loose, solid rock material) through natural agents, such as wind and gravity
  - Berms around the facility provide protection against storm water events and erosion
    - Most of the alluvial fan surfaces near the Area 5 disposal facility are 3,000 to 128,000 years old



# Ongoing Monitoring to Ensure the Safe Performance of the Disposal Facility

- 30 monitoring locations sample for air, groundwater, meteorology, radon flux, soil moisture and temperature, evapotranspiration, and direct radiation exposure
  - No health risk to the public
  - Potential health risk to workers is minimized through programmatic controls
    - 2018 (1<sup>st</sup> and 2nd Quarters) monitoring results show that the total cumulative dose for all disposal facility workers (43) was less than half of the limit for one worker (205 mRem for entire crew vs. 405 mRem limit for one crew member)



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Ongoing Monitoring to Ensure the Safe Performance of the Disposal Facility

(continued)

- Long-term vadose zone monitoring data indicate no drainage through bottoms of vegetated lysimeters (more than 6 feet deep)
- More than 20 years of groundwater sampling results indicate hydrologic conditions remain stable and there is no contamination in the aquifer from waste disposal activities



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Waste Disposed at NNSS

- Four (4) types of waste accepted: low-level radioactive waste (LLW), mixed low-level radioactive waste (MLLW), classified non-radioactive (CNR) waste and classified non-radioactive hazardous (CNRH) waste
  - LLW not classified as high-level radioactive waste, transuranic waste, spent fuel, by-product material, etc.
  - MLLW is a combination of LLW with a hazardous constituent (i.e., toxic, corrosive, reactive, ignitable or listed by U.S. Environmental Protection Agency as hazardous)
  - CNR consists of classified components that have no radioactive or hazardous contamination but must be securely disposed in the interest of national security
  - CNRH classified components with no radioactive contamination but do contain hazardous constituents



# Waste Disposed at NNSS

(continued)

- No free liquids allowed for MLLW and no more than 1% by volume for LLW and classified waste
- Must be containerized (i.e., 55-gallon steel drums, cargo containers, burrito wraps, soft-sided containers, and carbon steel boxes)
- Must be generated at a DOE facility or defense-affiliated site or have a clear nexus to a DOE-sponsored program



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 34  
2018-032-EMRP

# Waste Disposed at NNSS

## (continued)

- 1,157,728 cubic feet of waste disposed in fiscal year 2018
- Examples include:
  - Soils and debris (i.e. concrete, piping and building)
  - Equipment, clothing and tools
  - Solidified liquids and sludges
  - Laboratory waste
  - Irradiated metal
  - Depleted uranium
  - Sealed sources (radioisotopes used in equipment for power and medical)
  - Uranium wastes
- MLLW disposed under a state-issued permit



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Area 3 Radioactive Waste Management Site (RWMS) Background

- Subsidence craters created by past underground nuclear tests to dispose of bulk and containerized waste
- 128-acre disposal area with seven craters configured into five disposal cells
- Total disposed volume is over 19 million cubic feet
- Maintained in “cold standby” mode from 2006 – September 2018
- ~ 9.1 million cubic feet of disposal capacity remains



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Area 3 RWMS Today

- In December 2014, the Record of Decision\* (ROD) for the Site-Wide Environmental Impact Statement\* (SWEIS) for the continued Operation of the DOE/National Nuclear Security Administration (NNSA) NNS states:

*In the future and as needed, DOE may use disposal space in Area 3, subject to detailed discussions with the State of Nevada. This space may be needed for disposal of LLW, large onsite remediation debris or soils from cleanup of DOE/NNSA sites within the State of Nevada and would be limited to in-state generated waste.*

- EM Nevada Program began utilizing Area 3 RWMS for Clean Slate III waste disposal from the Tonopah Test Range in October 2018

\*The entire Final SWEIS and ROD available at  
<https://www.nnss.gov/pages/programs/em/EISpage.html>



EM Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# NNSS Waste Acceptance Process

- NNSS uses a structured/stringent waste review and acceptance process that must be met by all on-site and off-site waste generators
  - Rigorous reviews, inspections and certification processes conducted for waste characterization, packaging and transportation
  - Proposed waste streams detail radionuclide action levels to ensure there is no compromise to the safety of the disposal facility
  - NNSS auditors conduct reviews at generator sites to confirm all disposal requirements are met
  - Disposal operations and monitoring activities are factored into the review process



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# NNSS Waste Acceptance Process

(continued)

- Waste streams are approved for disposal at NNSS only after successfully demonstrating compliance with waste acceptance requirements
- At NNSS, State of Nevada participates directly in the waste acceptance review process



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

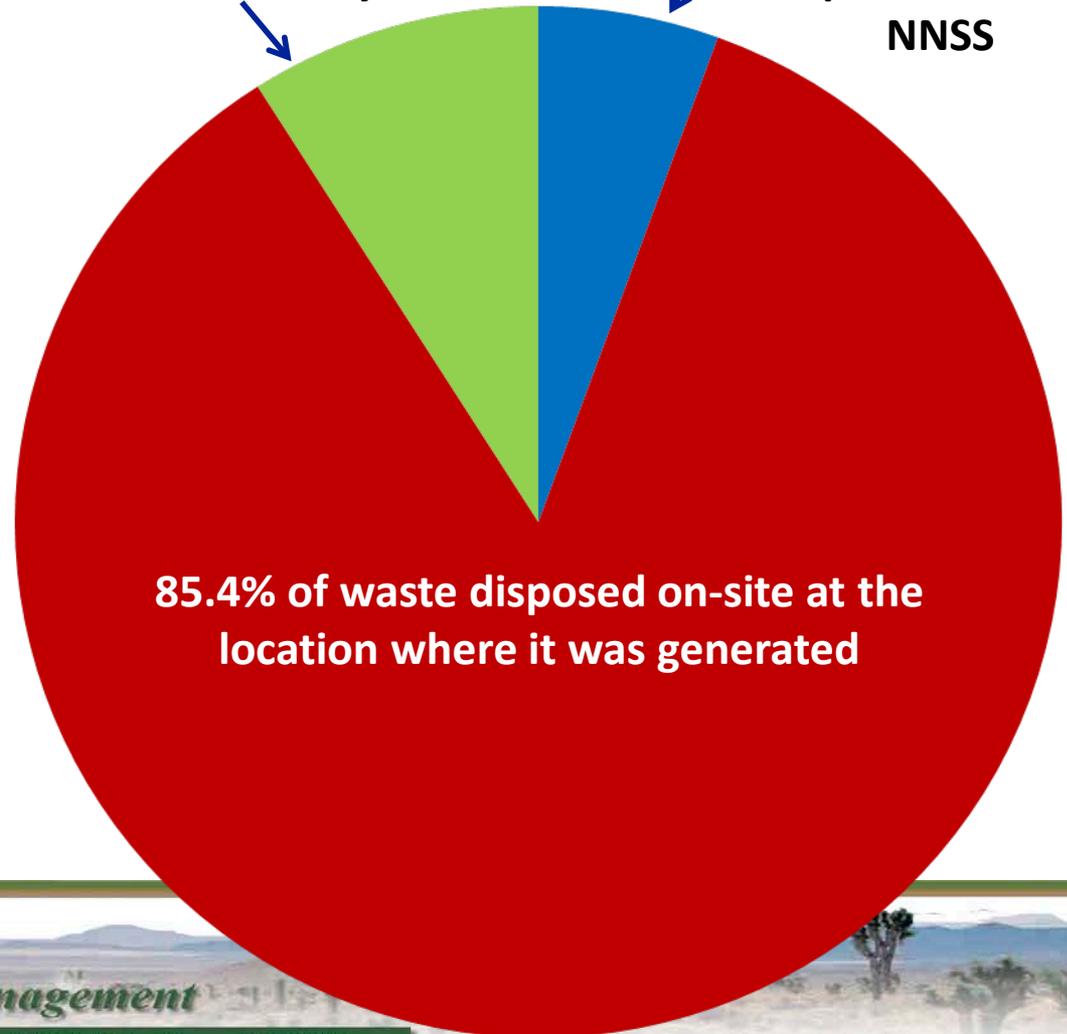
[www.nnss.gov](http://www.nnss.gov)

# Overview of DOE Complex Disposal

- 13.11M cubic feet of LLW disposed throughout the DOE complex in fiscal year 2017

9% of waste disposed at a commercial facility

5.6% of waste disposed at NNSS



85.4% of waste disposed on-site at the location where it was generated



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Transporting Waste to the NNSS

- Packaging and transportation of all radioactive waste must comply with U.S. Department of Transportation (DOT) regulations, including dose limits for worker and public exposure
- Routing includes prohibiting use of the I-15/US-95 interchange and Hoover Dam bypass bridge, preferences for summer and winter months, and CA-127 blackout dates
- Transportation of radioactive waste shipments to/from the NNSS are summarized and reported quarterly
  - Includes maps depicting routes
  - Online at [www.nnss.gov/pages/Programs/RWM/Reports.html](http://www.nnss.gov/pages/Programs/RWM/Reports.html)



**EM Environmental Management**

safety ❖ performance ❖ cleanup ❖ closure

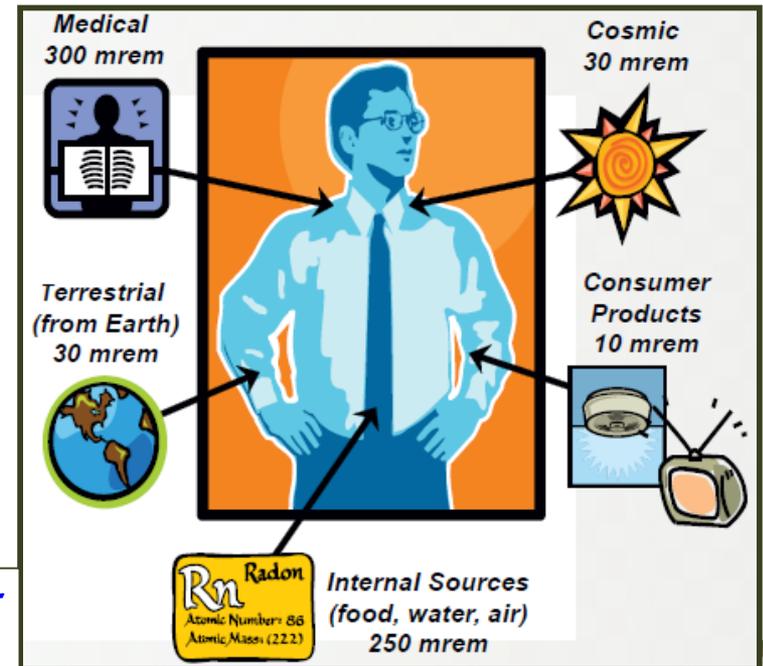
[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 41  
2018-032-EMRP

# As Low As Reasonably Achievable (ALARA)

- ALARA practices (time, distance and shielding) reduces worker dose during LLW disposal operations – DOE annual dose limit for each radiological worker is 500 mRem
- Approximately 8% of shipments require workers to implement additional ALARA procedures and personal protective equipment beyond the standard hard hat, safety boots and glasses, and reflective vest
- Annually, a cumulative radiation dose limit is established for the Disposal Operations crew (42 workers in 2017 and 43 in 2018)
  - 2017 limit was 550 mrem and the cumulative crew dose was 332 mrem
  - Current calculations show workers are at 205 mrem against a reduced goal of 405 mrem through the 2<sup>nd</sup> quarter of 2018

Average Annual Radiation Source and Dose\*



*\*The average person receives ~620 mrem of radiation per year from all sources*



**EM Environmental Management**

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 42  
2018-032-EMRP

# Emergency Management Grant Funding

- Radioactive waste disposal program contributed more than \$15.5M to fund enhancement of emergency response capabilities in Nevada counties (Clark, Elko, Esmeralda, Lincoln, Nye and White Pine)
- Nevada Division of Emergency Management administers the funding, which is needs-based and distributed according to applications submitted by the counties
- Provides for updating/ recalibrating radiological equipment/detectors, communications equipment, emergency operations and hazardous material plans, and more



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Public Outreach Activities

- Opportunities for the public to obtain information on and become involved in Environmental Management activities include:
  - Nevada Site Specific Advisory Board Meetings ([www.nnss.gov/nssab](http://www.nnss.gov/nssab))
  - E-Mail News Subscription over 10,000 subscribers (Articles, Newsletter, Press Releases)
  - Educational Outreach (Operation Clean Desert)
  - Social Media
  - Presentations for Civic Organizations
  - Intergovernmental Meetings
  - Fact Sheets
  - Open Houses/Public Meetings
  - Community Conversations
  - Website [www.nnss.gov](http://www.nnss.gov)
  - Low-level Waste Stakeholder Forum
  - Kiosks
  - Displays
  - Public Reading Rooms



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# LLW Disposal at the NNSS In Summary...

- Waste acceptance, transportation and disposal at the NNSS is conducted responsibly and safely to protect workers, the public and environment
- NNSS infrastructure and environmental conditions provide for the long-term protection of disposed waste
- DOE is committed to conducting its LLW disposal activities in an open and transparent manner



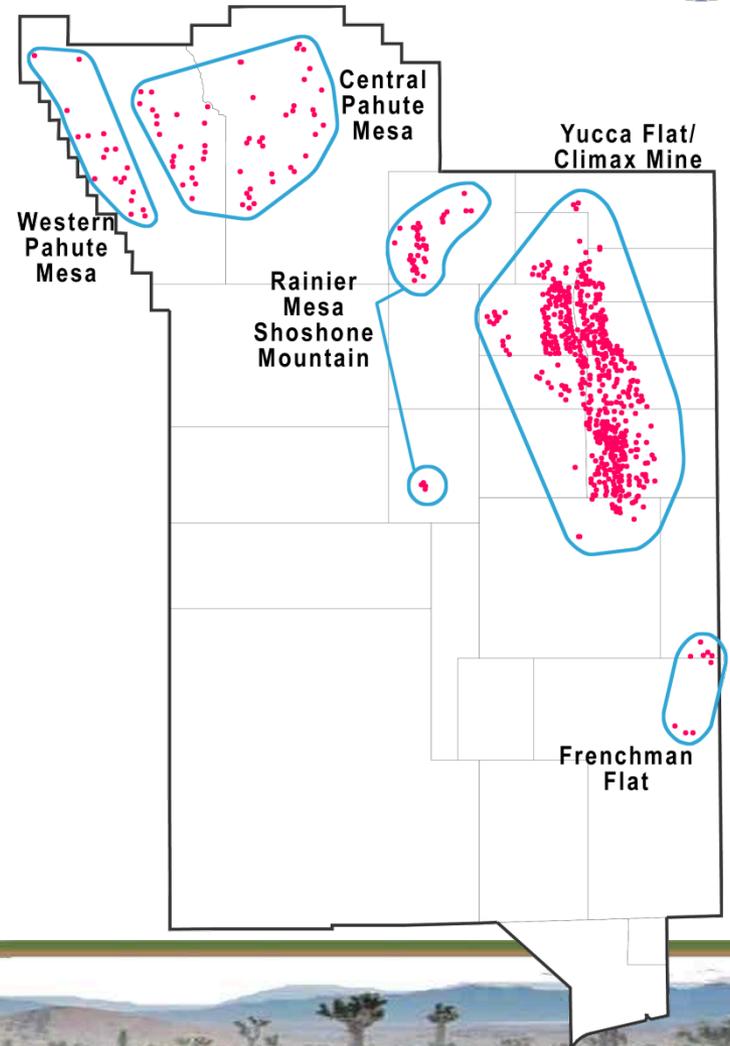
**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure



# Underground Test Area (UGTA)

- 828 underground nuclear tests conducted at depths ranging from approximately 100 to 4,800 feet below the ground surface
- About one-third of tests occurred in, near, or below the water table, which resulted in some groundwater contamination



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 46  
2018-032-EMRP



# Underground Testing at the NNSS

- First underground nuclear test was *Uncle* on November 29, 1951
- Last underground nuclear test, *Divider*, detonated on September 23, 1992



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 47  
2018-032-EMRP

# Underground Testing at the NNSS (continued)



- Holes were 3 to 12 feet in diameter
- A large hole required the removal of more than 4,280 cubic yards of soil
- If the depths of holes drilled for underground nuclear tests since 1961 were combined, it would total about 280 miles
- Drilling techniques developed at the NNSS continue to be used throughout the world



**EM** Environmental Management

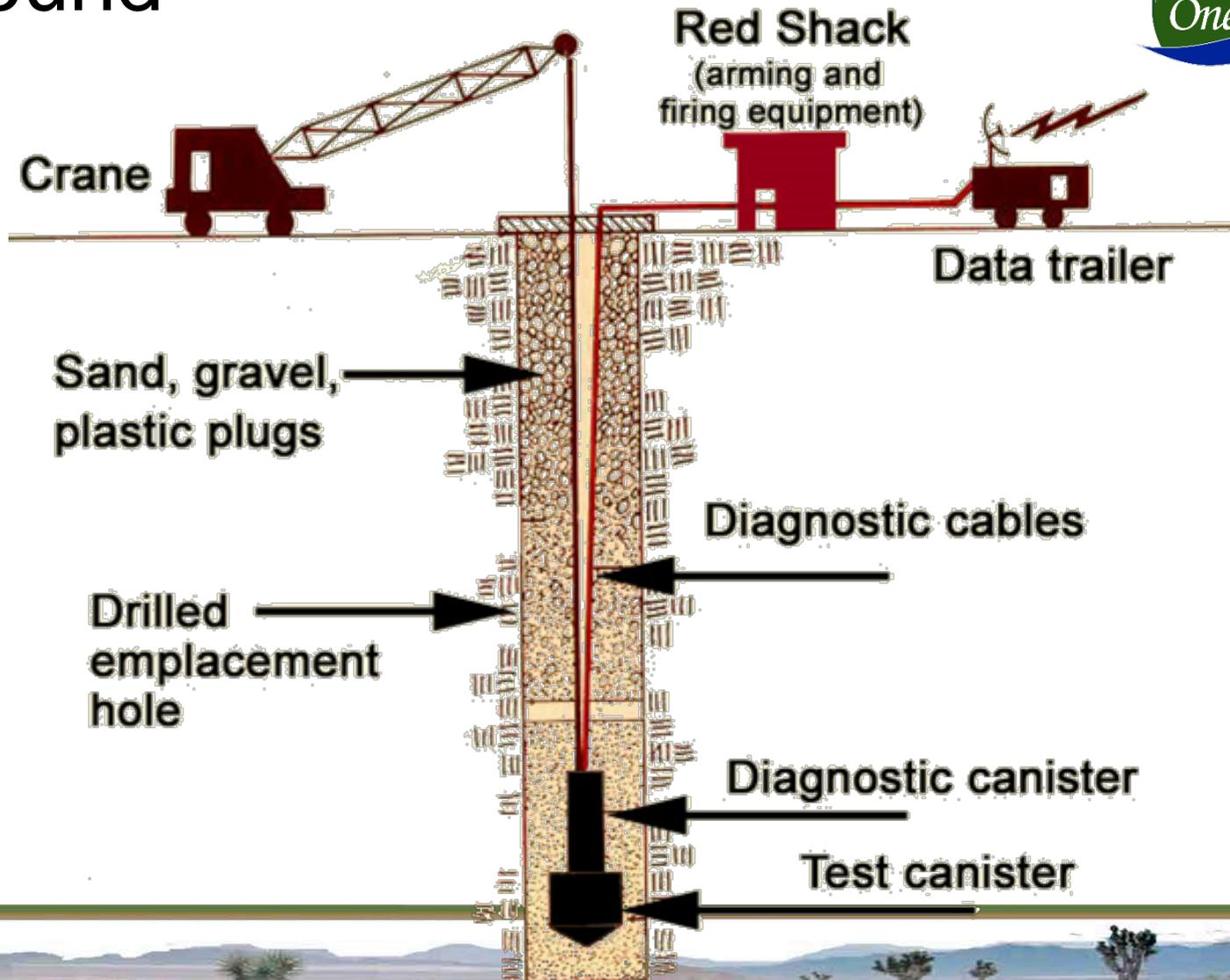
safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 48  
2018-032-EMRP



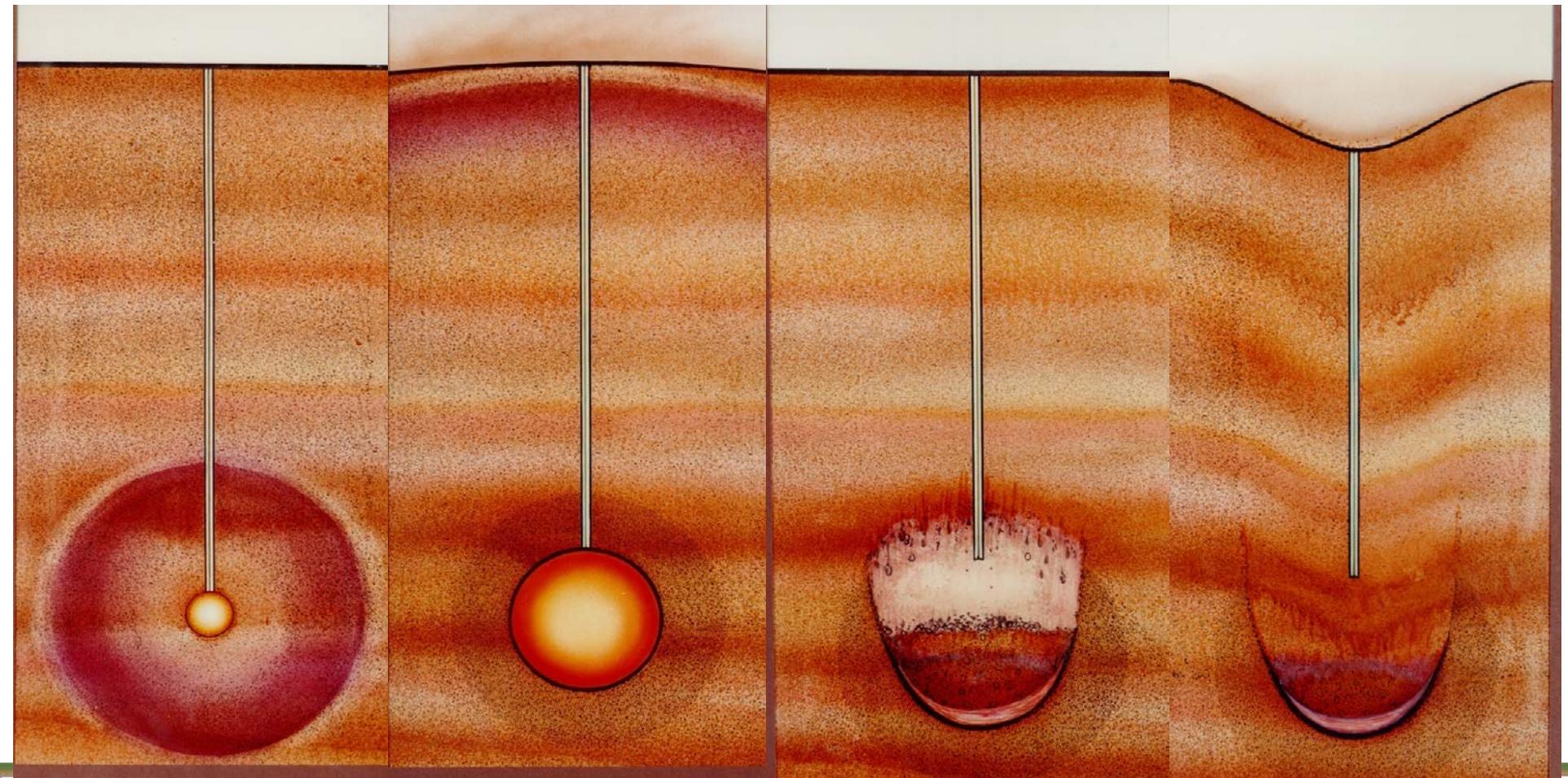
# Underground Test



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

# Underground Testing at the NNSS – Subsidence Crater Formation



**EM** Environmental Management

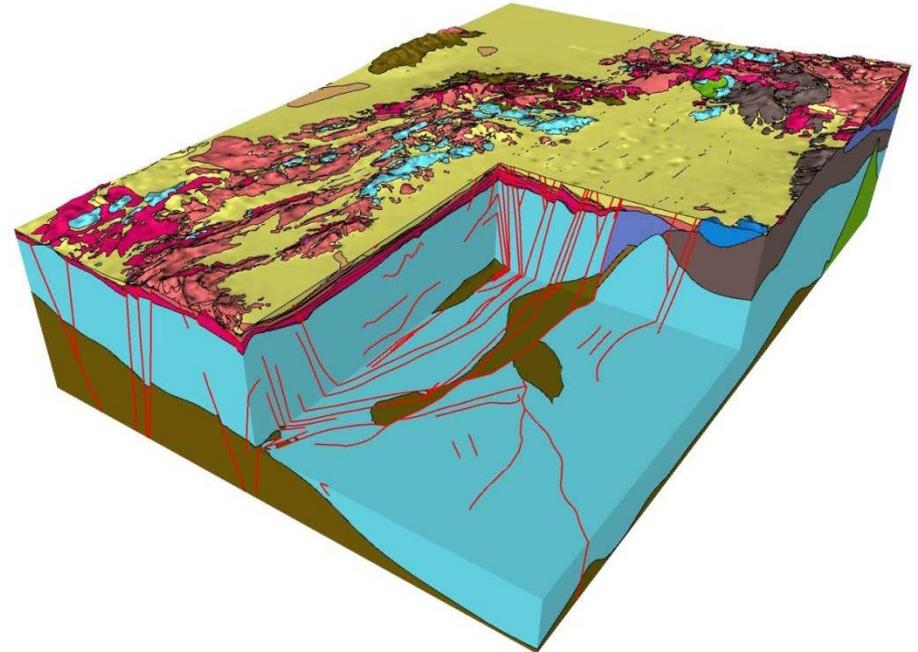
safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)



# UGTA Groundwater Characterization

- UGTA evaluates historic testing impacts on groundwater resources and studies the extent of contaminant migration
- Groundwater characterization scope includes collection of multiple sources of field data in order to create 3-D computer models
  - Models include groundwater, flow and transport parameters
- Models will be used to aid in the selection of monitoring well locations



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 51  
2018-032-EMRP



# Groundwater at the NNSS

- Finnegan Inventory records more than 40 million curies of radionuclides released during testing (decay corrected to September 30, 2012)
- No proven, cost-effective technology to remove or stabilize the radiological contaminants
- Current scientific data available show there is no risk to the public from contaminated groundwater at the NNSS
- UGTA works with the State of Nevada to identify contaminant boundaries and implement an effective long-term monitoring system



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

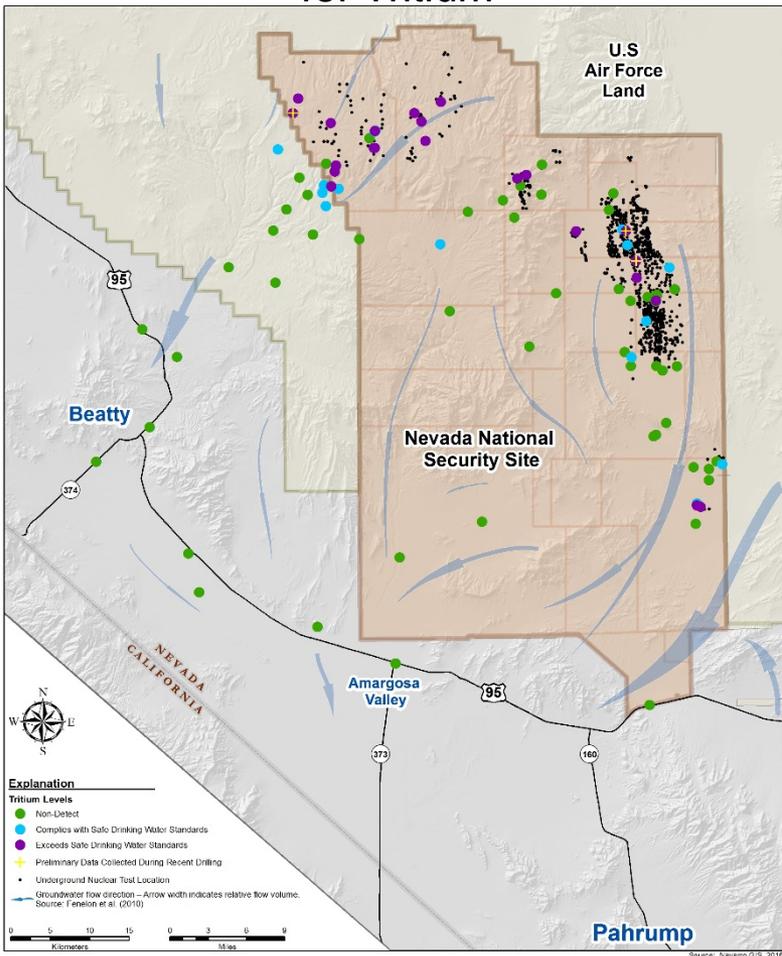
[www.nnss.gov](http://www.nnss.gov)



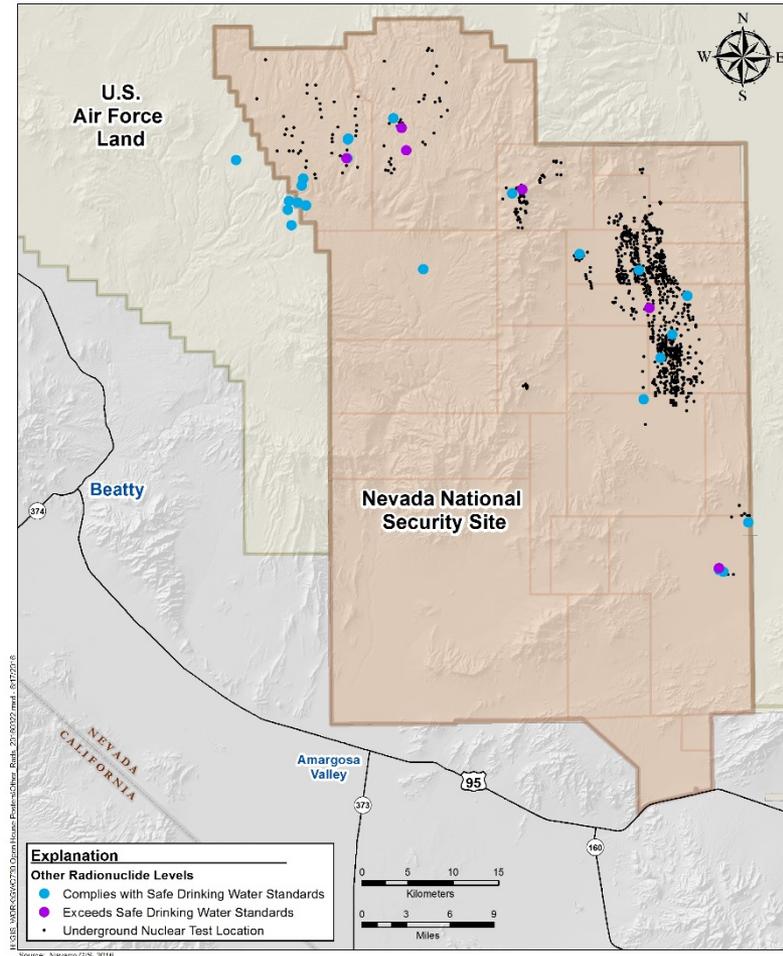
# Locations of Groundwater Contaminants

## Groundwater Sample Results for Tritium

## Groundwater Sample Results for Other Radionuclides



Contamination from historic underground nuclear testing has not been found in any wells beyond the U.S. Air Force land surrounding the NNSS



Environmental Management

safety ❖ performance ❖ cleanup ❖ closure



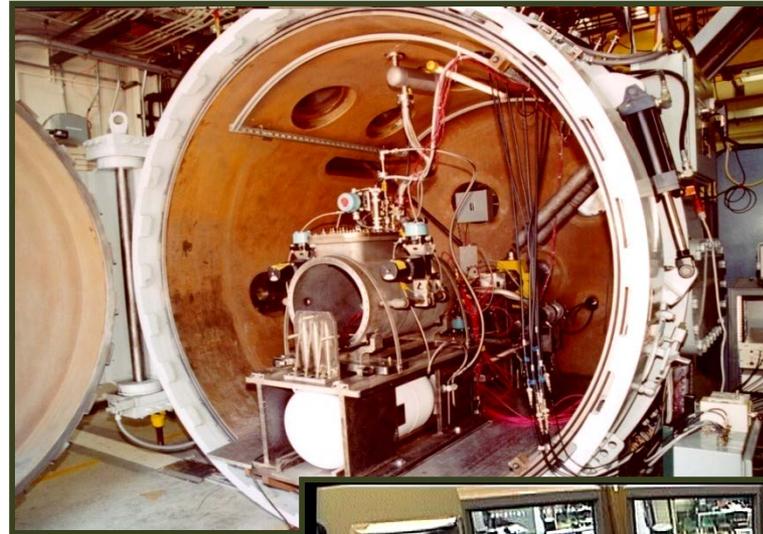
# Movement of Contaminants

- Many of the radionuclides produced by nuclear tests are relatively immobile:
  - 29 radionuclides are trapped in the melt glass formed by the detonation of the underground nuclear device
  - Tritium, carbon, iodine, chlorine, technetium are mobile in most subsurface environments
  - Cesium and strontium are mobile in some subsurface environments
  - Plutonium is transported a limited distance on small particles
  - Samples are analyzed for other radionuclides once tritium has been detected through standard analyses



# Joint Actinide Shock Physics Experimental Research (JASPER)

- Study properties and responses of special nuclear materials under high pressure
- 169 shots to date (68 plutonium shots)\*
  - First shot: JAS001  
March 19, 2001
  - First plutonium shot:  
JAS021 July 8, 2003



\*as of August 23, 2018



EM Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 55  
2018-032-EMRP

# Homeland Security Increasing Activity at the NNSS



- Radiological Nuclear Countermeasures Test and Evaluation Complex
  - National test bed for radiation detectors/sensors
  - Realistic operational environment allows use of significant quantities of nuclear material
- Advanced Spectroscopic Portal (ASP monitoring)
- Aerial radiological surveys



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 56  
2018-032-EMRP

# Device Assembly Facility (DAF)

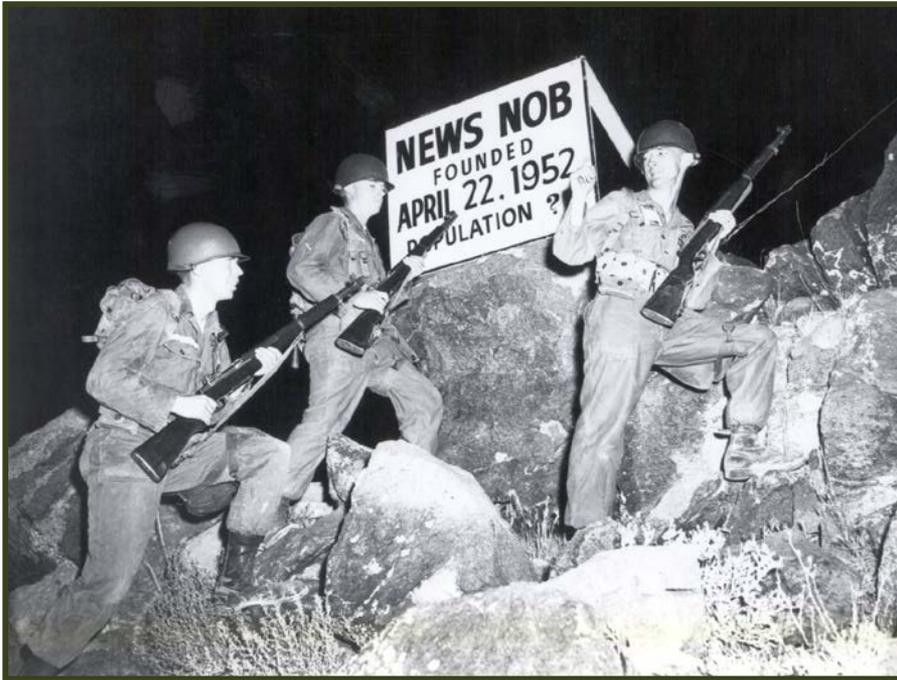
- 100,000-square-foot facility
- Assembly cells designed to withstand effects of explosions
- Glovebox for JASPER and U1a target assembly
- Current location for National Criticality Experiments Research Center



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

# News Nob



Soldiers pose by News Nob, a vantage point for atmospheric tests established for the media



Journalists set up on News Nob to witness an atmospheric test in March 1953



**EM** Environmental Management

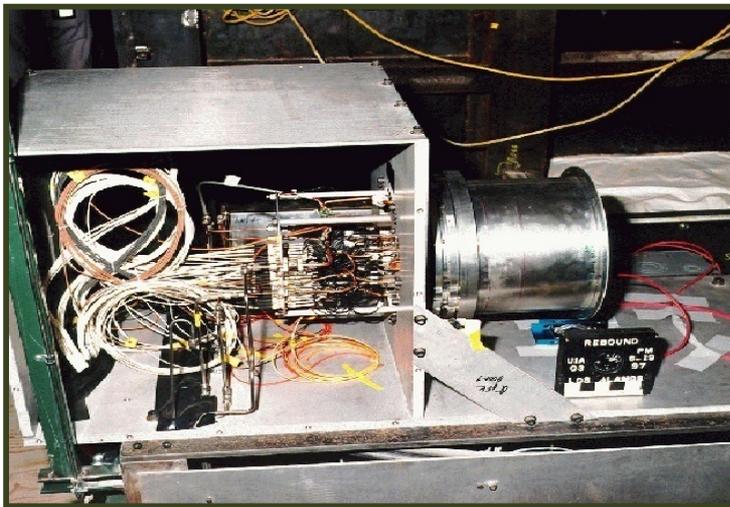
safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 58  
2018-032-EMRP

# U1a

- Underground laboratory for subcritical experiments
- Data for National Laboratories
- Safety and reliability of stockpile
- 51 experiments conducted at U1a\*



\*as of August 23, 2018



EM Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 59  
2018-032-EMRP

# Huron King Test Chamber

- Visual line of sight underground nuclear test (yield less than 20 kilotons) conducted June 24, 1980
- Tested effects of a system generated electromagnetic pulse on a full-scale operating military Defense Satellite Communications System



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 60  
2018-032-EMRP

# Icecap Ground Zero

- Location for underground nuclear test scheduled for Spring 1993
  - Moratorium on nuclear weapons testing on September 23, 1992
- Planned test range was 20 - 150 kilotons and would have been conducted 1,550 feet underground
- Tower is 157 feet tall
- Inside is a 300,000-pound diagnostic canister suspended from the top of the tower



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 61  
2018-032-EMRP

# Big Explosive Experimental Facility (BEEF)



- Non-nuclear high-explosive tests
- Capable of 70,000 pounds of explosives



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

# Tower Test Example

*Smoky* – tower soars 700 feet into the air above Yucca Flat at the NNSS; first atomic tower test of this height (*Smoky* detonation below) on August 31, 1957



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

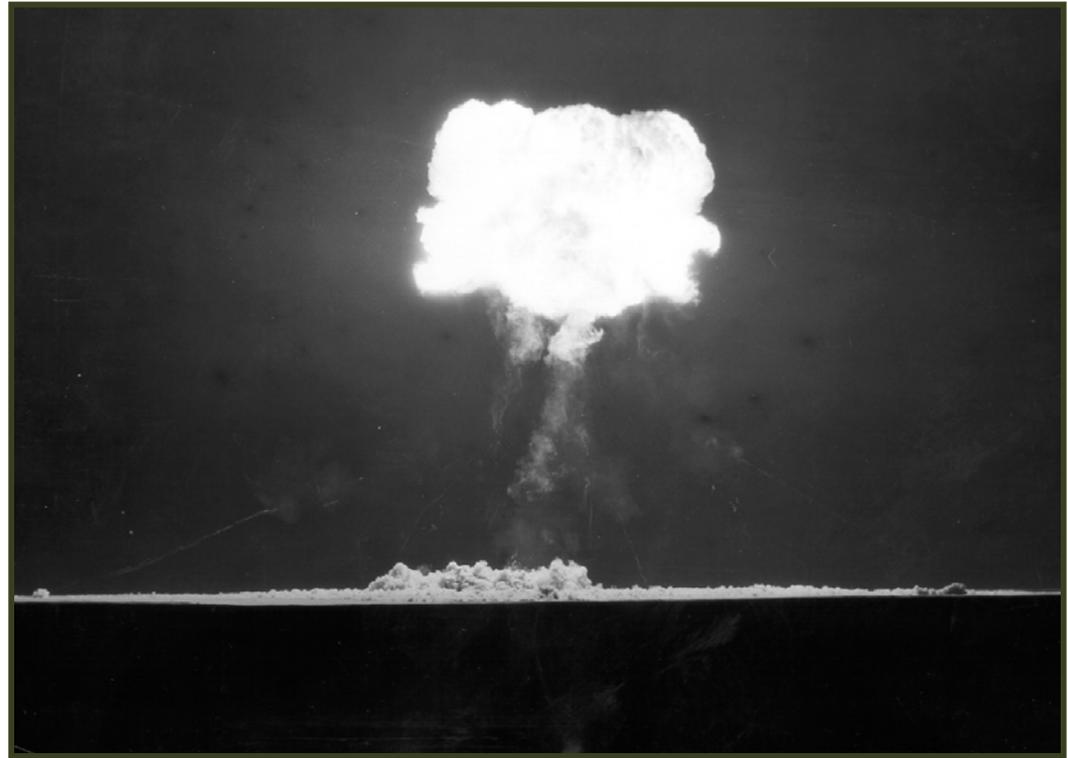
[www.nnss.gov](http://www.nnss.gov)

# Balloon Test Examples



Balloon used in the detonation of *Charleston* on September 28, 1957

Fireball of *Charleston* lights Yucca Flat at the NNSS; 12-kiloton device was suspended by a balloon at a height of 1,500 feet



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

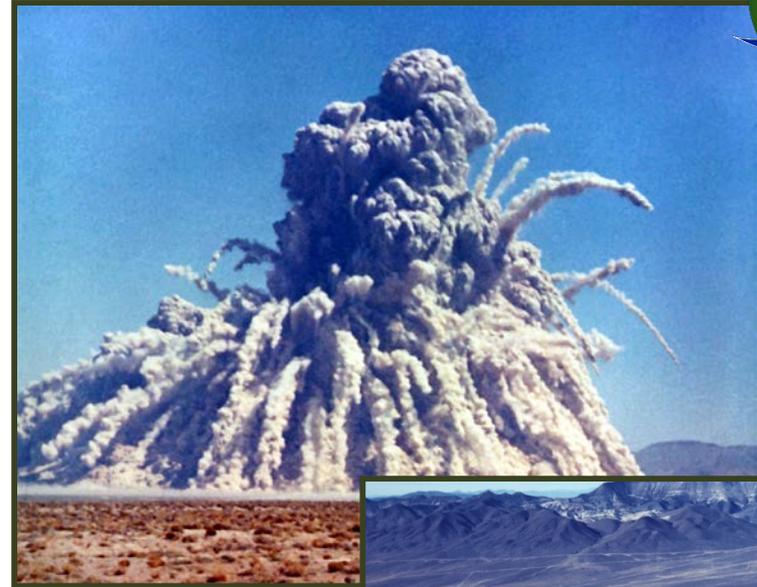
[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 64  
2018-032-EMRP

# Sedan Crater



- Excavation experiment using a 104-kiloton thermonuclear device (part of the Plowshare Program)
- Conducted July 6, 1962
- Detonated 635 feet underground
- Displaced 12 million tons of earth
- Crater is 1,280 feet in diameter and 320 feet deep
- Released seismic energy equivalent to a 4.75 magnitude earthquake



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 65  
2018-032-EMRP



# Sedan Crater

(continued)

- Listed on the National Register for Historic Places on April 1, 1994
- Completion of remediation activities and implementation of a closure in place with a use restriction and posting, approved by the State of Nevada in July 2011



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 66  
2018-032-EMRP

# EPA Farm

- Operated 16 years
- Studied radionuclide uptake in cows, horses, pigs, goats, chickens, and crops
- Closed in December 1981



Atomic Energy Commission  
had its own brand



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 67  
2018-032-EMRP



**EM Environmental Management**

safety ❖ performance ❖ cleanup ❖ closure

# T-1 Training Area

- Counter Terrorism Operations Support/ Center for Radiological Nuclear Training
- Includes more than 10 acres with more than 20 separate training venues
- First-responder training to take action in preventing or mitigating terrorist use of radiological or nuclear devices
- Since 1999, ~ 220,000 first responders trained (includes the training of 1,165 emergency responders from Nevada representing 33 different organizations since 2008)



**EM** Environmental Management

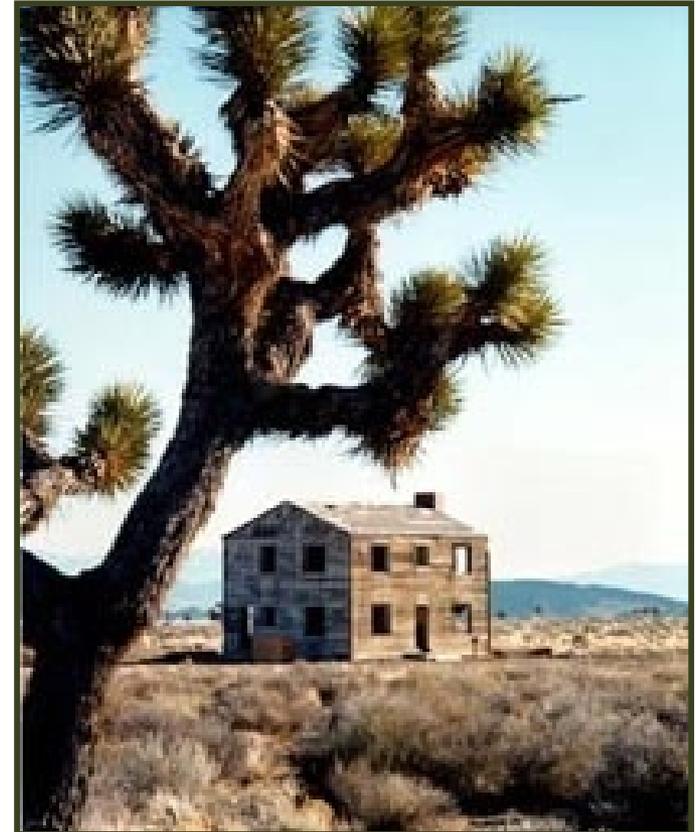
safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 69  
2018-032-EMRP

# Apple-2 Houses

- 29-kiloton test was detonated from a 500-foot tower on May 5, 1955
- 7,800 feet to the east of the tower are the remains of a wooden two-story house
- Part of a Civil Defense exercise



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 70  
2018-032-EMRP



Located 7,800 feet from *Apple-2* ground zero, this existing two-story wooden house was one of two identical structures erected for civil effects tests; the other one, located 5,500 feet from ground zero, was severely damaged



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 71  
2018-032-EMRP



Located 10,500 feet from *Apple-2* ground zero, this existing two-story brick house was one of two identical structures erected for civil effects tests; the other house located 4,700 feet from ground zero was demolished beyond repair



**EM** Environmental Management

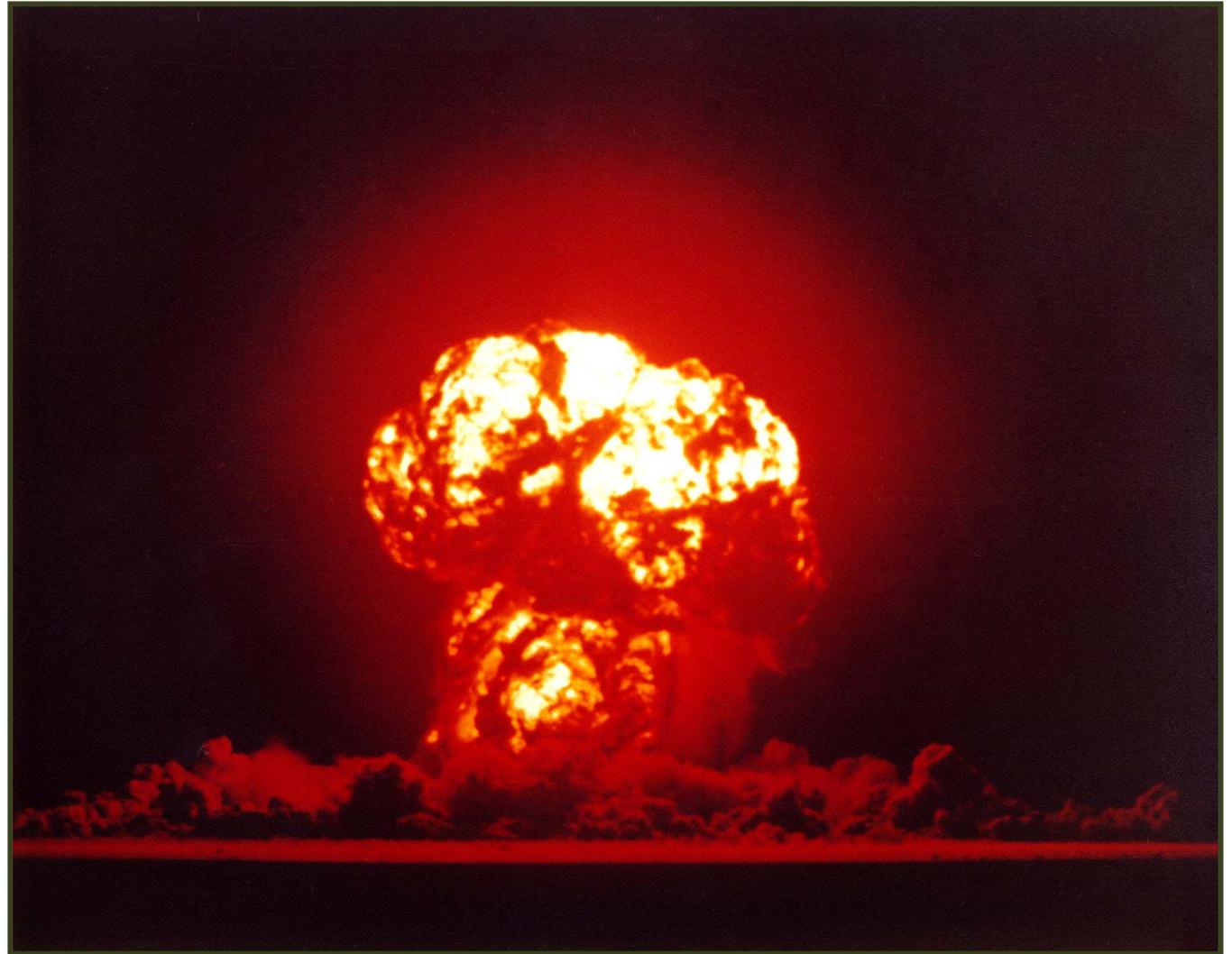
safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 72  
2018-032-EMRP

*Apple-2* – 29-kiloton nuclear test detonated from the top of a 500-foot tower at the NNSS on May 5, 1955

65 associated experiments conducted at various distances from ground zero, including 48 civil effects tests on different types of typical American homes



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

Two colonial,  
two-story  
homes were  
erected at  
3,500 feet and  
7,500 feet  
from *Annie*  
ground zero

House at  
3,500 feet was  
completely  
destroyed

House at  
7,500 feet was  
badly  
damaged

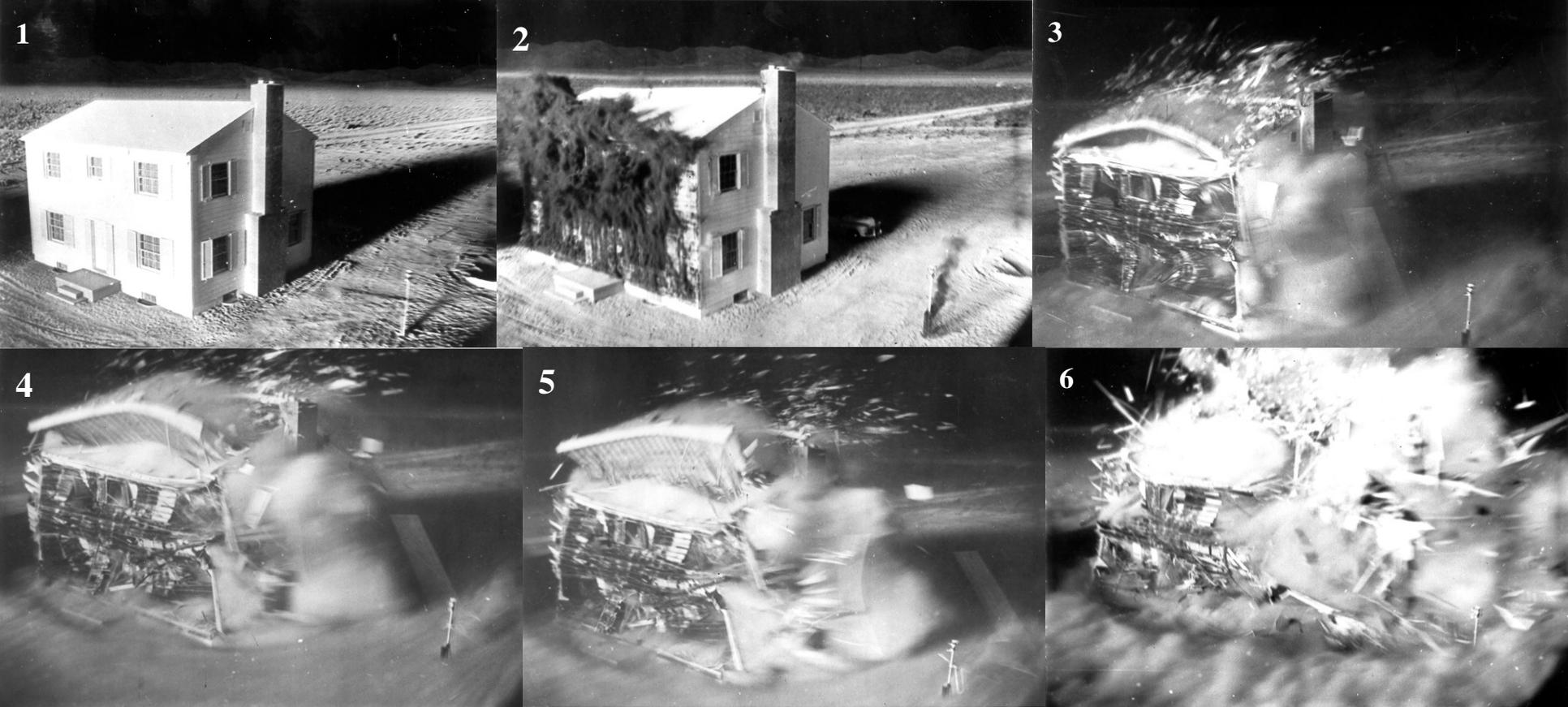


**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 18- 10/24/2018 – Page 74  
2018-032-EMRP



Sequential photos show the complete destruction of the colonial style house located 3,500 feet from *Annie* ground zero



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 75  
2018-032-EMRP

# Nuclear Rocket Development at the NNSS – Project Rover

- U.S. launched nuclear rocket development program in 1955
- Ground tests conducted at facilities in southwest corner of NNSS
- Four basic segments:
  - KIWI tested non-flyable nuclear test reactors
  - PHOEBUS Extension of KIWI, designed to produce higher power levels and longer duration operations than KIWI reactors



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# Nuclear Rocket Development at the NNSS – Project Rover

(continued)



- PHOEBUS 2A was the most powerful, non-flyable nuclear rocket reactor ever built
- Reactor operated for about 32 minutes; 12 minutes at power levels more than a million watts



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 77  
2018-032-EMRP

# Nuclear Rocket Development at the NNSS – Project Rover

(continued)

- NERVA (Nuclear Engine for Rocket Vehicle Applications) developed the first nuclear rocket engine suitable for space flight
- RIFT (Reactor In-Flight Test) objectives were to design, develop, and flight-test a NERVA-powered vehicle as an upper stage for a Saturn V launch vehicle

Project Rover, a technical success, terminated in 1973 as a result of the cancellation of Saturn V launch vehicle program in 1969



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

March 1963

President Kennedy visits Nuclear  
Rocket Development Station in  
Area 25

Engine Test Stand 1



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

# Nuclear Rocket Development at the NNSS – Project Pluto

- Code name for the project to develop a nuclear powered ramjet for a Supersonic Low-Altitude Missile (SLAM)
- Principle was to draw in air at the front of the vehicle under ram (great pressure), heat it to make it expand, and then exhaust it out the back, providing thrust
- Reactor designed for experiment named *Tory* and was capable of 35,000 pounds of thrust
- Testing conducted at the Pluto Facility in NNSS Area 26

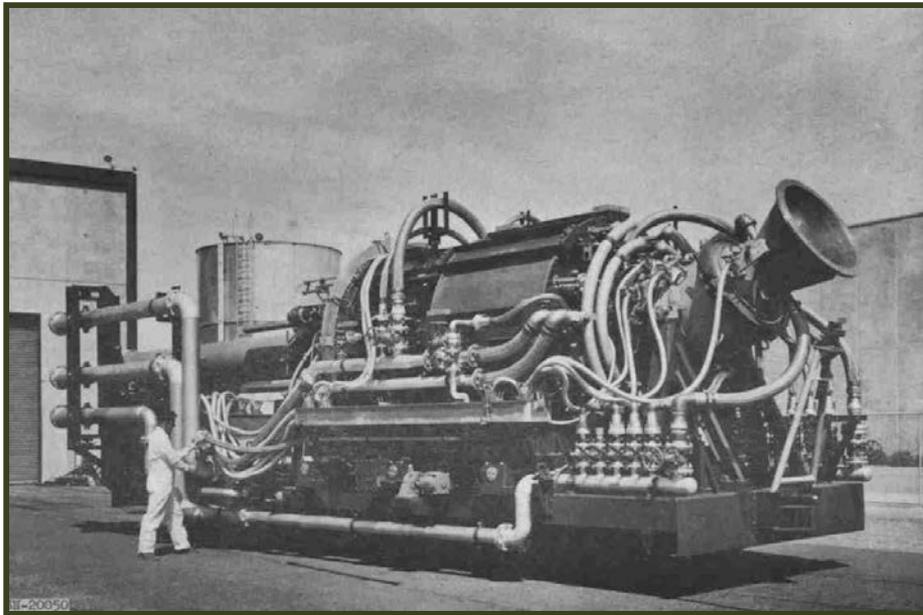


**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

On May 14, 1961, the world's first nuclear ramjet engine, Tory II-A, mounted on a railroad car, roared to life for just a few seconds



Three years later, Tory II-C was tested for 5 minutes. Despite its success, the Pentagon and Pluto sponsors had second thoughts about the project and on July 1, 1964, seven years after its inception, Project Pluto was cancelled.



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

ID 2018- 10/24/2018 – Page 81  
2018-032-EMRP

# Homeland Security and Defense



- Train responders in prevention/ response to terrorist radiological/ nuclear material
- Unique NNSA training complexes and capabilities simulate realistic scenarios in radiation and chemical environment



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# NNSS Plays Central Role in National Emergency Response



- Remote Sensing Laboratory (RSL) provides technologies, equipment, and national response teams to search for improvised nuclear devices and radiation dispersal devices (“dirty bombs”)
  - RSL-Andrews provides the national capital region response
  - RSL-Nellis provides other national response
- Also provides consequence management teams if a device were to detonate
- Provides support during other emergencies including response to the Nuclear Power Plant disaster in Fukushima, Japan



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# NSSAB FY 2019 Work Plan

Item 1	Work Plan Item:	<i>Pahute Mesa Groundwater Sampling Well Prioritization</i>
	Deadline for Recommendation:	July 2019
	Description:	<p>Background: Environmental Management (EM) NV plans to drill additional groundwater wells on/near Pahute Mesa. In support of this, the EM NV contractor will develop a white paper outlining the proposed well locations. The white paper will be presented to the NSSAB.</p> <p>NSSAB Scope: From a community perspective, provide a recommendation to EM NV that prioritizes the factors used by EM NV to prioritize proposed well locations.</p>
Item 2	Work Plan Item:	<i>Changes to Approach for Pahute Mesa Completion</i>
	Deadline for Recommendation:	April 2019
	Description:	<p>Background: EM NV is considering a more pragmatic approach for the closure of the Pahute Mesa Corrective Action Unit (CAU).</p> <p>NSSAB Scope: From a community perspective, provide a recommendation on if the more pragmatic approach is supported by the NSSAB and how it could be improved.</p>



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# NSSAB FY 2019 Work Plan (continued)

<b>Item 3</b>	<b>Work Plan Item:</b>	<b><i>Waste Verification Strategy</i></b>
	Deadline for Recommendation:	July 2019
	Description:	<p>Background: In FY 2019, EM NV will identify existing and potential verification strategies regarding verification of waste sent to the Nevada National Security Site (NNSS) for disposal. This information will be used to determine if the existing verification strategy can be improved.</p> <p>NSSAB Scope: From a community perspective, provide a recommendation if the NSSAB thinks further waste verification is needed and provide feedback on the potential verification strategies identified and/or how these strategies may be implemented.</p>
<b>Item 4</b>	<b>Work Plan Item:</b>	<b><i>Evaluation of the Audit Determination Process</i></b>
	Deadline for Recommendation:	March 2019
	Description:	<p>Background: The Radioactive Waste Acceptance Program (RWAP) develops a schedule for audits of waste generators in the next fiscal year using a risk-informed selection process and other subject criteria.</p> <p>NSSAB Scope: From a community perspective, provide a recommendation on if the existing selection process is supported and how it could be improved.</p>



**EM Environmental Management**

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# NSSAB FY 2019 Work Plan (continued)

Item 5	Work Plan Item:	<b><i>Low-Level Waste (LLW) Visual Verification</i></b>
	Deadline for Recommendation:	July 2019
	Description:	<p>Background: RWAP conducts LLW visual verification at generator sites throughout the country. These verifications are in addition to the audits identified in the NNSS Waste Acceptance Criteria (WAC) and focus on the packaging of waste into the shipping containers to ensure the waste is consistent with the waste profile and meets the NNSS WAC. Representatives from the NSSAB will be invited to observe RWAP conducting a LLW visual verification.</p> <p>NSSAB Scope: From a community perspective, provide recommendations for how RWAP's visual verifications could be enhanced.</p>
Item 6	Work Plan Item:	<b><i>Offsite Groundwater Contamination Communication Plan</i></b>
	Deadline for Recommendation:	March 2019
	Description:	<p>Background: EM NV has developed an Offsite Groundwater Communication Plan that identifies what sampling results would trigger the need for stakeholder communication and how the communication would be completed.</p> <p>NSSAB Scope: From a community perspective, provide a recommendation on if the communication plan is supported by the NSSAB and/or how it could be improved.</p>



**EM Environmental Management**

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# NSSAB FY 2019 Work Plan (continued)

Item 7	Work Plan Item:	<i>FY 2021 Baseline Prioritization</i>
	Deadline for Recommendation:	April 2019
	Description:	<p>Background: As part of the federal budget process, the EM NV Program must provide funding request information to HQ as it relates to planned FY 2021 activities. The request is based on planned baseline activities.</p> <p>NSSAB Scope: From a community perspective, the NSSAB will provide a recommendation ranking the baseline activities.</p>



**EM** Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)

# For More Information

For more information on  
U.S. Department of Energy

[www.nnss.gov](http://www.nnss.gov)

(702) 295-3521



*EM* Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

[www.nnss.gov](http://www.nnss.gov)