Nevada National Security Site Tour Booklet

Nevada Site Specific Advisory Board

January 22, 2014

Environmental Management

safety ❖ performance ❖ cleanup ❖ closure

www.em.doe.gov

Prohibited Articles On Nevada National Security Site Public Tours

The following items are prohibited within the boundaries of the Nevada National Security Site 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
- 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.

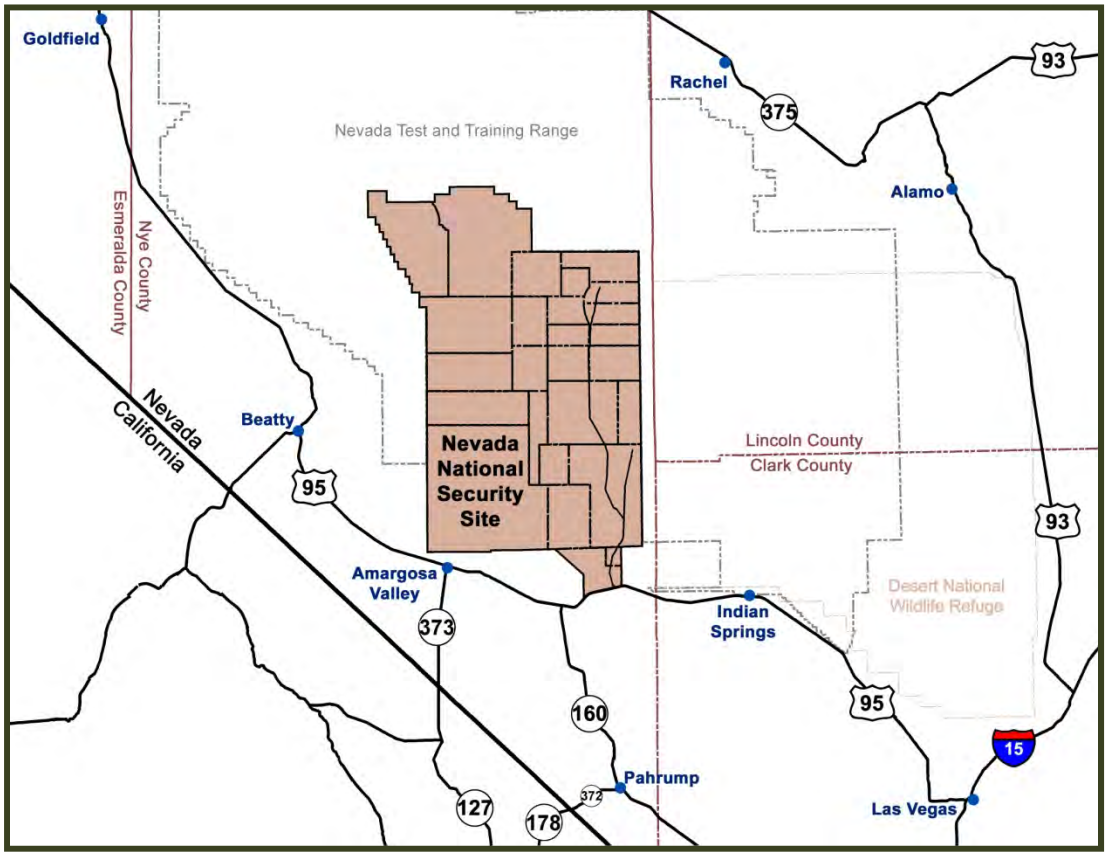
Tour Agenda*

7:30 a.m.	Depart for Mercury from Centennial Hills Transit Center and Park and Ride, Durango and Highway 95, Las Vegas
8:30 a.m.	Arrive at Mercury Badge Office
8:35 a.m.	Depart for Gate 100
8:40 a.m.	Arrive at Gate 100 for badge check
8:45 a.m.	Depart for Frenchman Flat
9:00 a.m.	Arrive at Frenchman Flat. Briefing on Nonproliferation Test and Evaluation Complex (NPTEC) and weapons effects test structures, use restrictions, and long-term monitoring, Work Plan Item 3
9:30 a.m.	Depart for Area 5 Radioactive Waste Management Complex (RWMC)
9:40 a.m.	Arrive at Area 5 RWMC, Work Plan Item 7and 9
10:30 a.m.	Depart for Control Point (CP)
10:45 a.m.	Arrive at CP. Briefing on Yucca Flat Corrective Action Unit (CAU) Work Plan Item 2
11:15 a.m.	Depart for Area 8 Smoky, Ceres, Oberon, and Titania (CAU 550) Work Plan Item 1
11:40 a.m.	Arrive at Smoky
12:00 p.m.	Depart for Sedan Crater
12:05 p.m.	Arrive at Sedan Crater, Work Plan 3
12:30 p.m.	Depart for Stockade Wash Overlook
1:15 p.m.	Arrive at Stockade Wash Overlook. Briefing on Rainier Mesa, Work Plan 8.
2:00 p.m.	Depart for Apple II Houses
2:30 p.m.	Arrive at Apple II Houses
2:45 p.m.	Depart for Mercury
3:30 p.m.	Arrive at Mercury Cafeteria. Rest stop.
4:00 p.m.	Depart for Gate 100
4:05 p.m.	Arrive at Gate 100 for badge check
4:10 p.m.	Depart NNSS
5:00 p.m.	Arrive at Park and Ride in LV

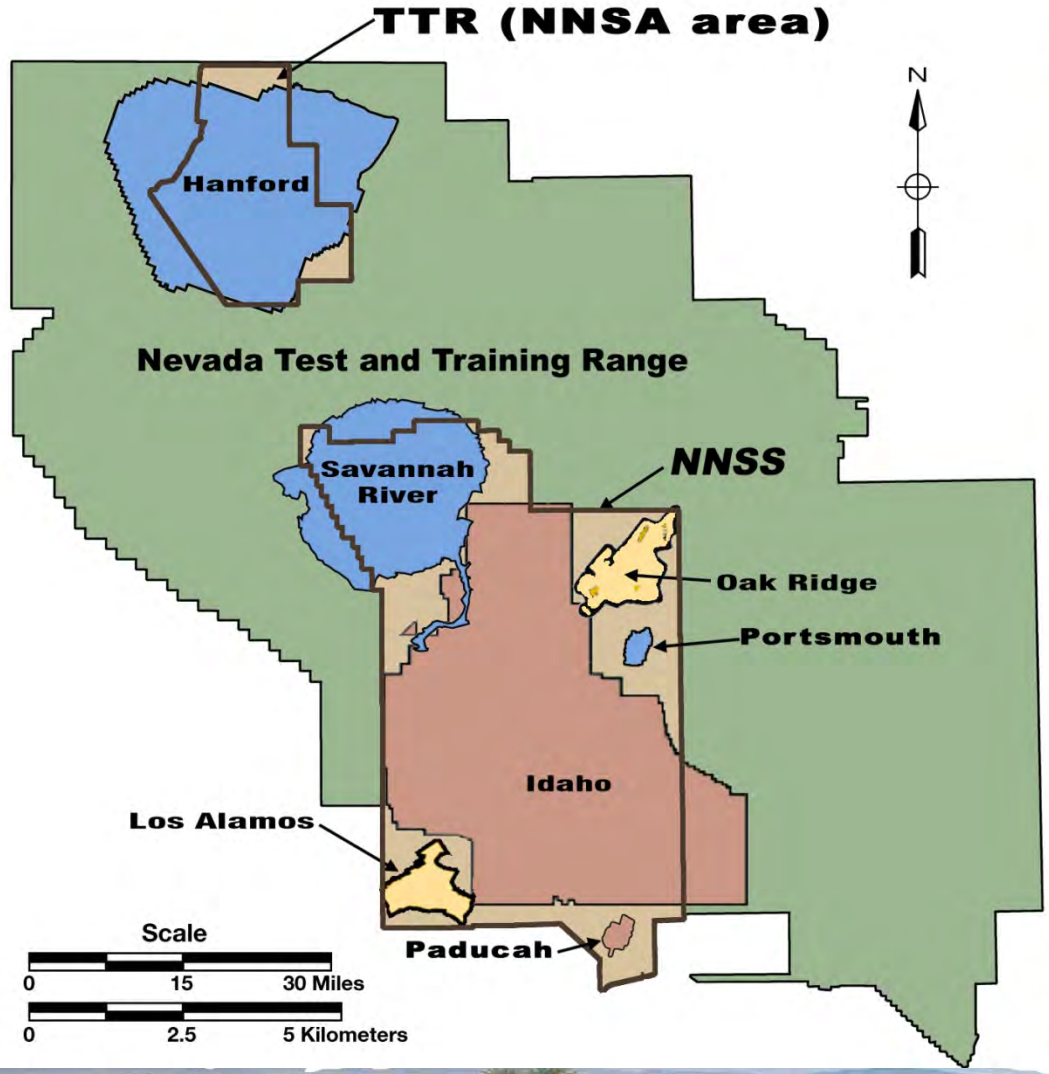
** Subject to change*

Nevada National Security Site (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

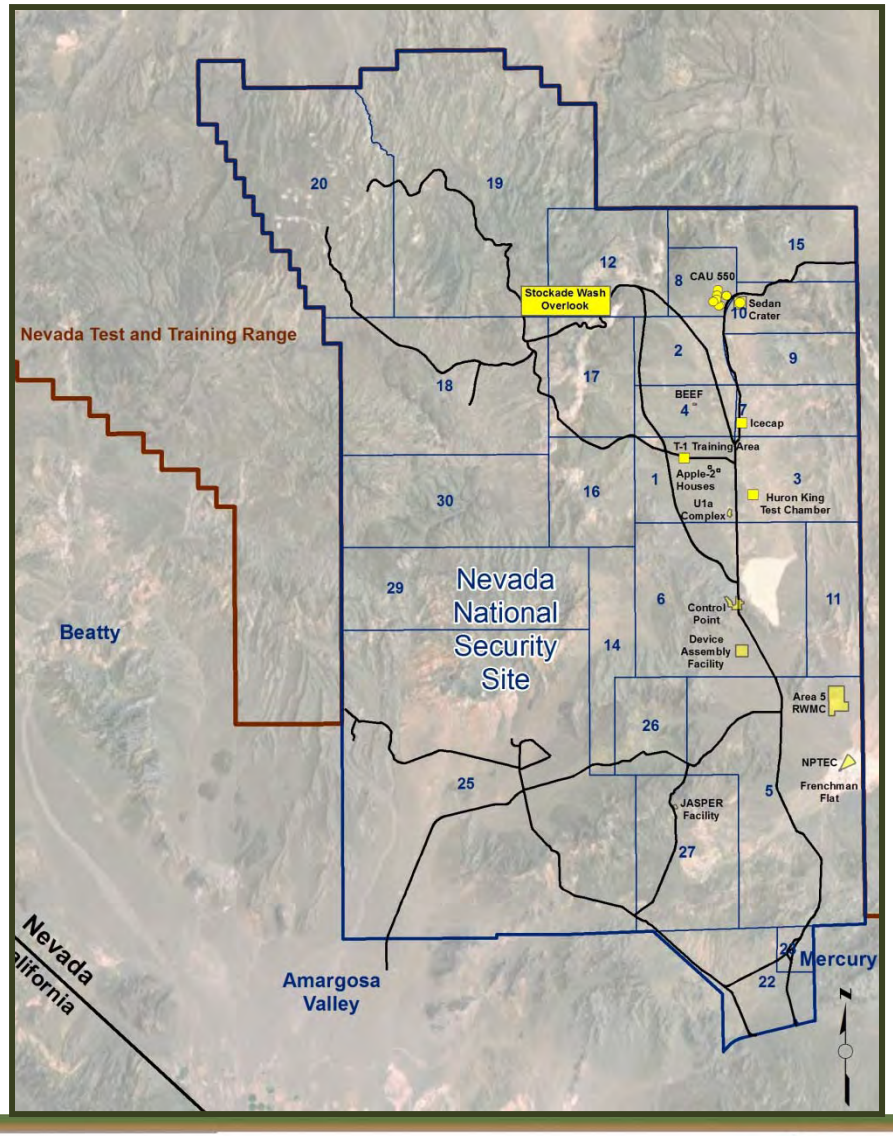


DOE Site Comparisons



Site	Sq. Mi.
Hanford	560
Idaho	893
Los Alamos	43
Oak Ridge	53
Paducah	5
Portsmouth	6
Savannah River	310
TOTAL	**1,870**
NNSS	~1360
TTR (NNSA area)	~280
TOTAL	**~1640**

NNSS Tour Map



Life in Mercury

Life in Mercury

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

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

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

United States 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
Nellis Range	5	5
Rifle, CO	1	3
NNSS Atmospheric	100	100
NNSS Underground – U.S. NNSS Underground – U.S./U.K.	804 24	921
	1,054	1,149

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 two kilometers and conducted within a total period of time not to exceed 0.1 second.

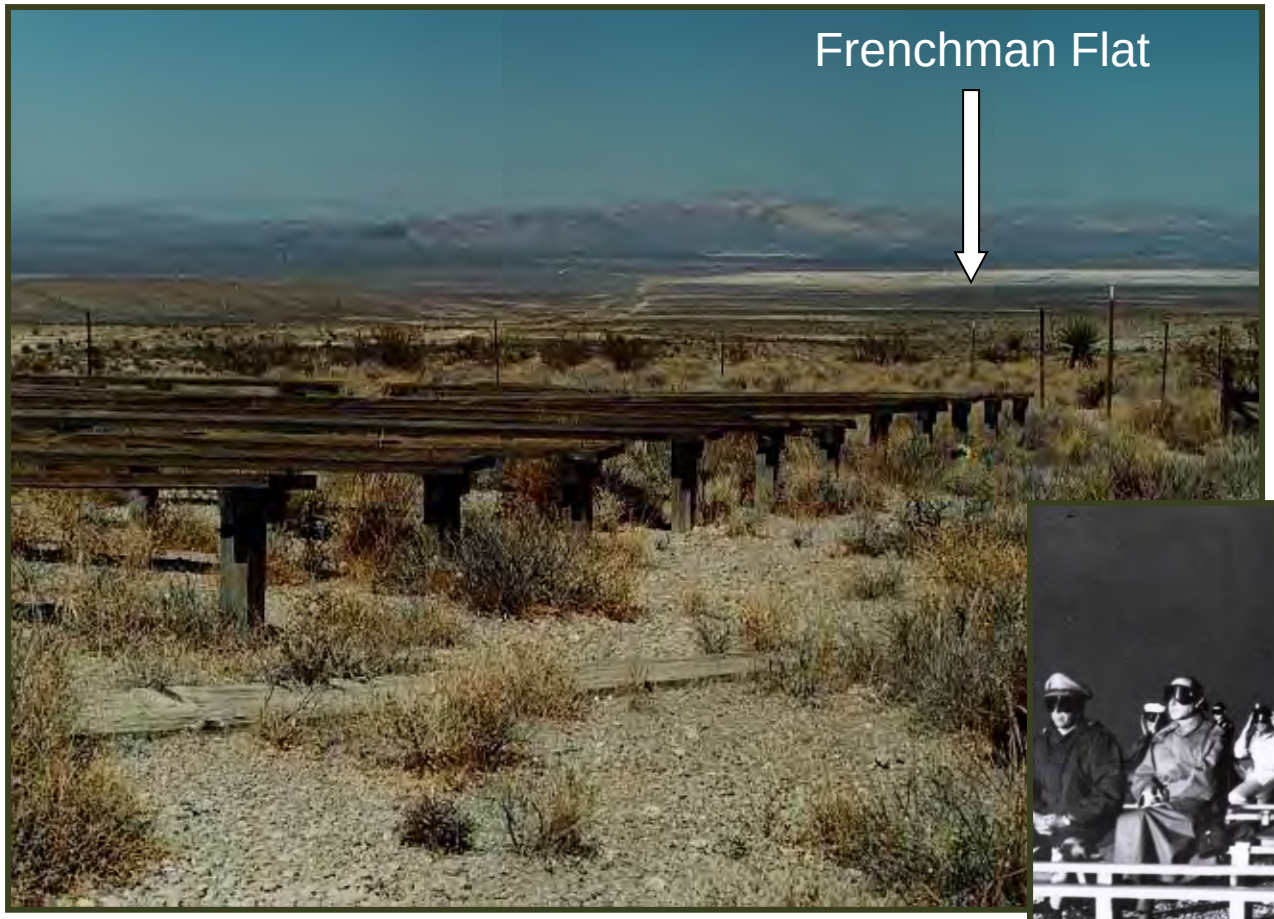
Source: NV-209 Rev 15

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

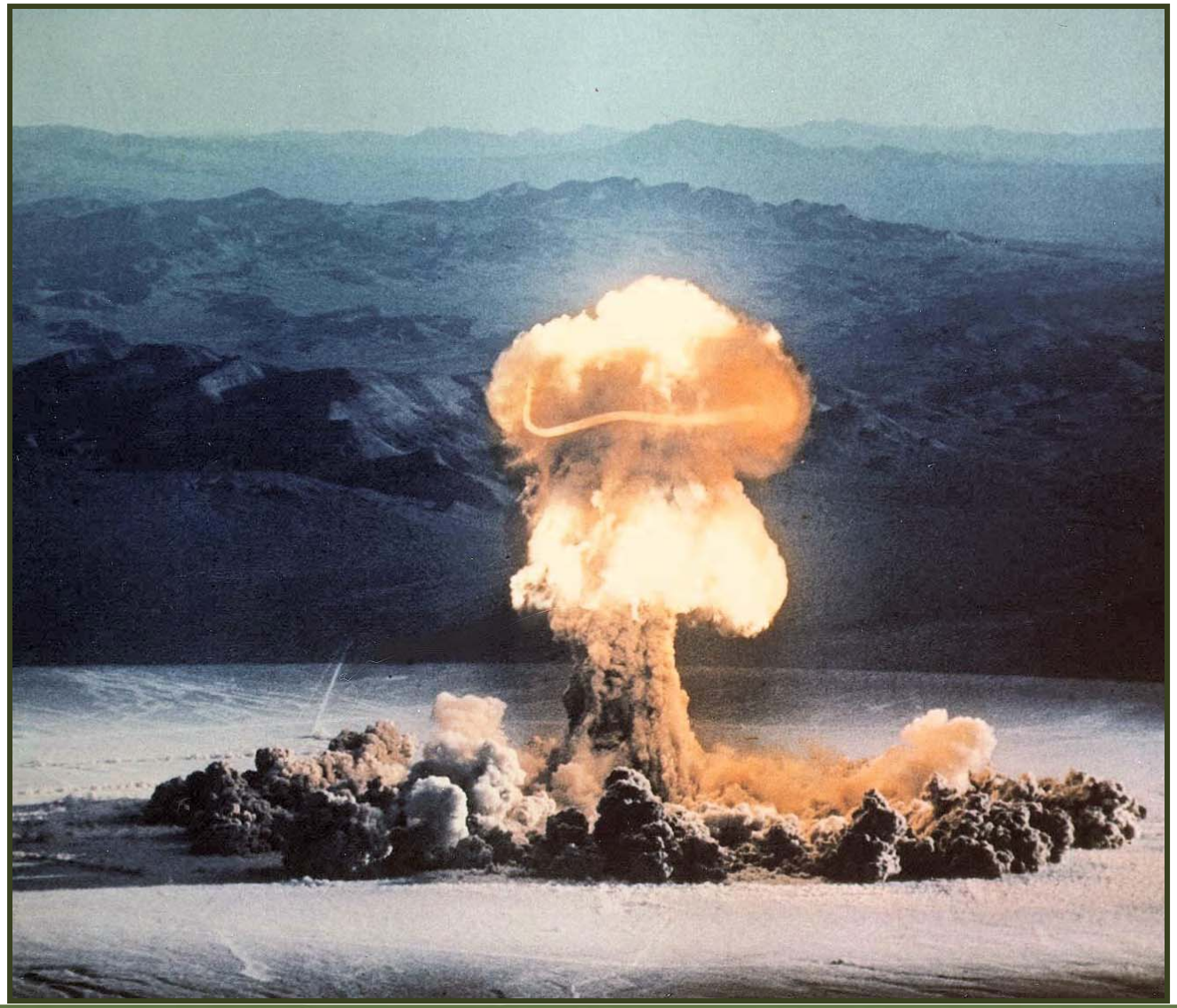
- Conducted aboveground in the atmosphere
  - Tower 43
  - Balloon 23
  - Airdrop 19
  - Surface 13
  - Rocket 1
  - Airburst 1

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



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

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



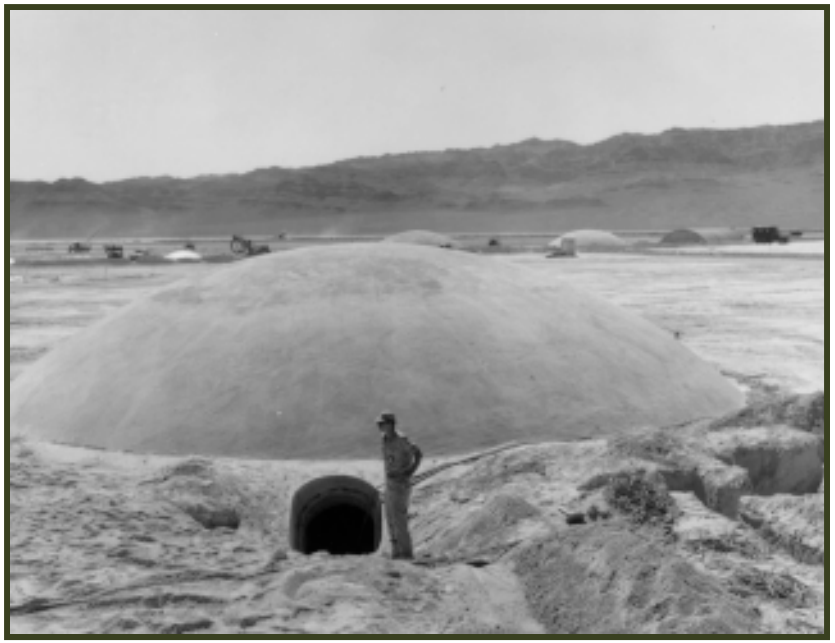
Nonproliferation Test and Evaluation Complex (NPTEC)

- 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 NNSS

Soils

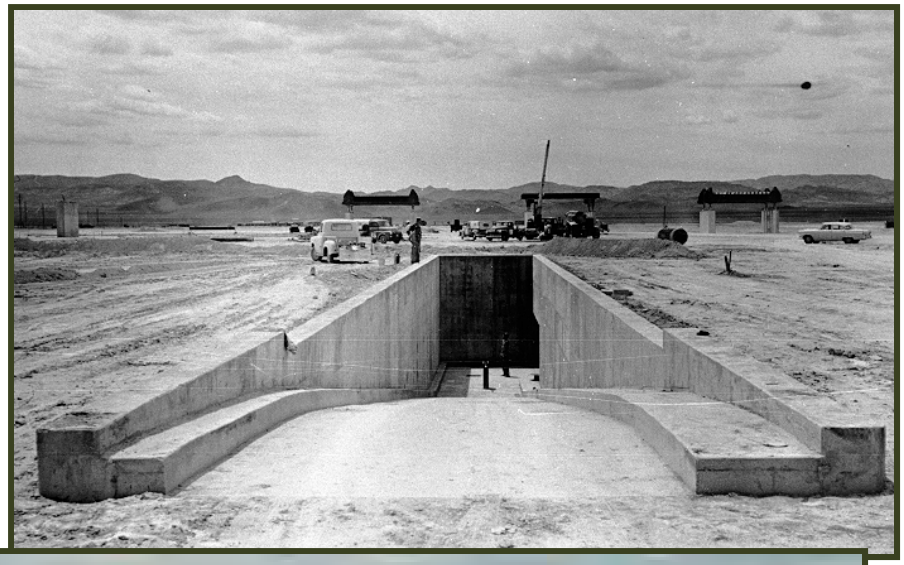
- Atmospheric nuclear weapons tests, nuclear safety experiments, surface releases from underground tests, nuclear testing done in support of nuclear rocket development in Area 25, and evaluation tests for peaceful uses of nuclear explosives conducted at the NNSS and Nevada Test and Training Range (operated by the U.S. Air Force) resulted in the radioactive contamination of surface soils
- Soils responsible for 130 Corrective Action Sites (approximately one-half closed)
  - Characterizing and/or remediating surface soil contamination
  - Ensuring appropriate controls (i.e. postings, barriers, etc.) are in place at the sites and conducting long-term site monitoring, as needed

Atmospheric Test Relics

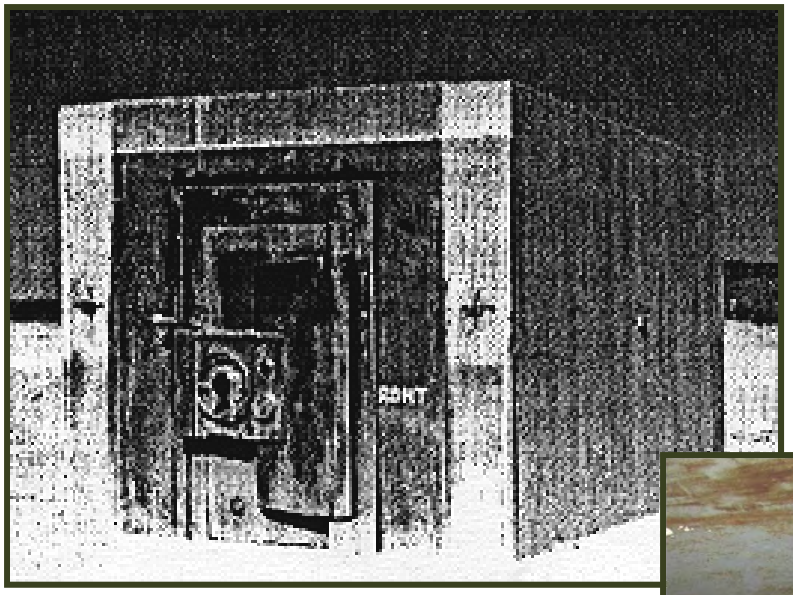


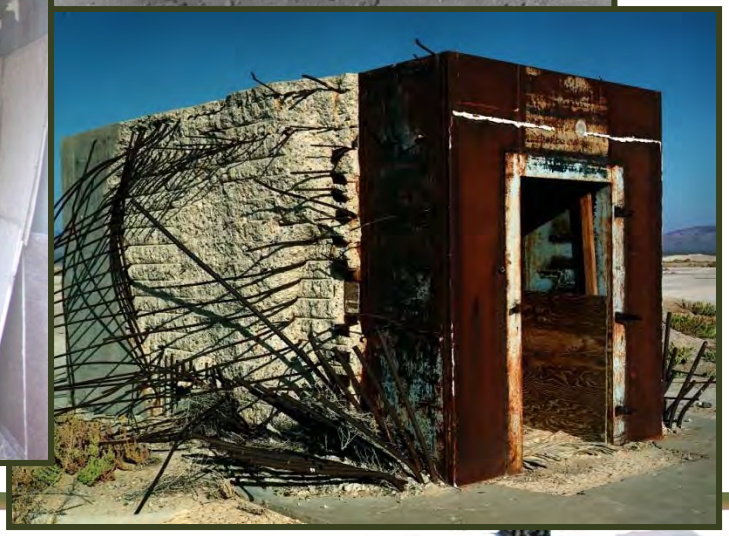
Concrete shelter domes prior to the 1957 *Priscilla* test

Effect of the test on the concrete shelter dome



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

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

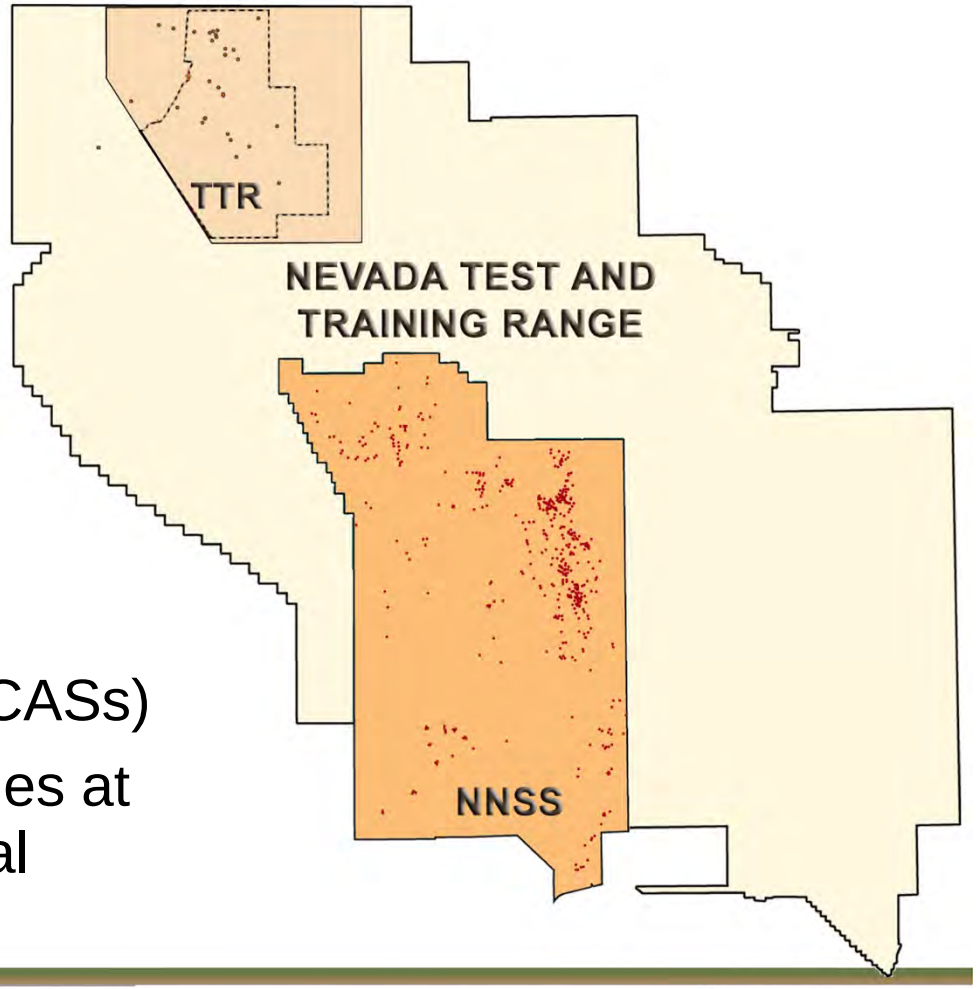
The End of Atmospheric Testing

- 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

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, ordnance sites, etc.
- 1,126* Corrective Action Sites (CASs)
  - Completed remediation activities at 1,124* sites with state approval



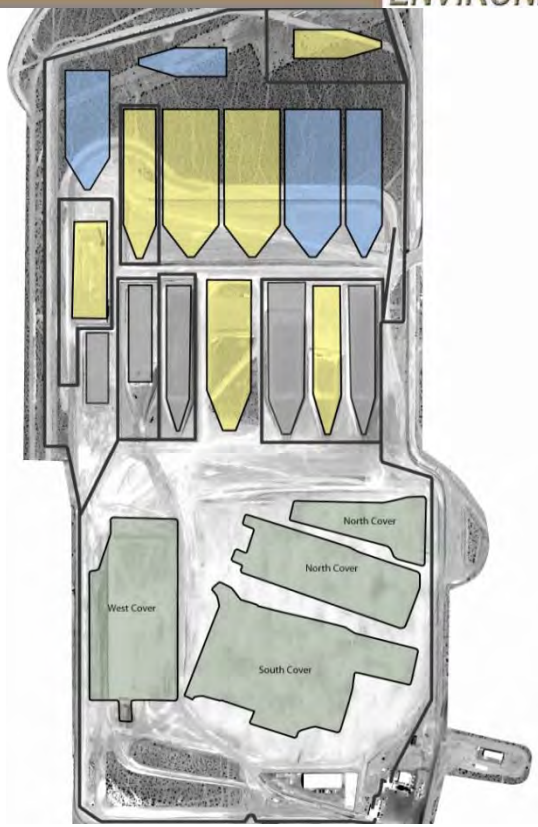
* Does not include Defense Program funded sites

Area 5 Radioactive Waste Management Complex (RWMC)

- Low-level radioactive waste disposal began in 1961
- DOE and Department of Defense waste generator sites across the complex ship packaged low-level and mixed low-level waste (MLLW) for disposal
- In addition to disposal, MLLW may be stored at the RWMC in accordance with a Resource Conservation and Recovery Act permit

Area 5 RWMC
(continued)

- Total disposed volume since inception is more than 24 million cubic feet
- Available capacity in existing cells is greater than 5 million cubic feet
- Disposal Cell 21 was completed in April 2013 and added ~ 2.3 million cubic feet of disposal capacity



Yellow = active cells
Blue = future cells
Gray = operationally closed cells
Green = 92 acre is permanently closed

Seven (7) active disposal cells (yellow)

Thirty (30) closed disposal cells

Cover completed in 2012; however vegetation died. Test plots were reseeded in October 2013. Based on results, remaining cover will be reseeded with best performing test process in FY 2015.

Area 5 RWMC
(continued)

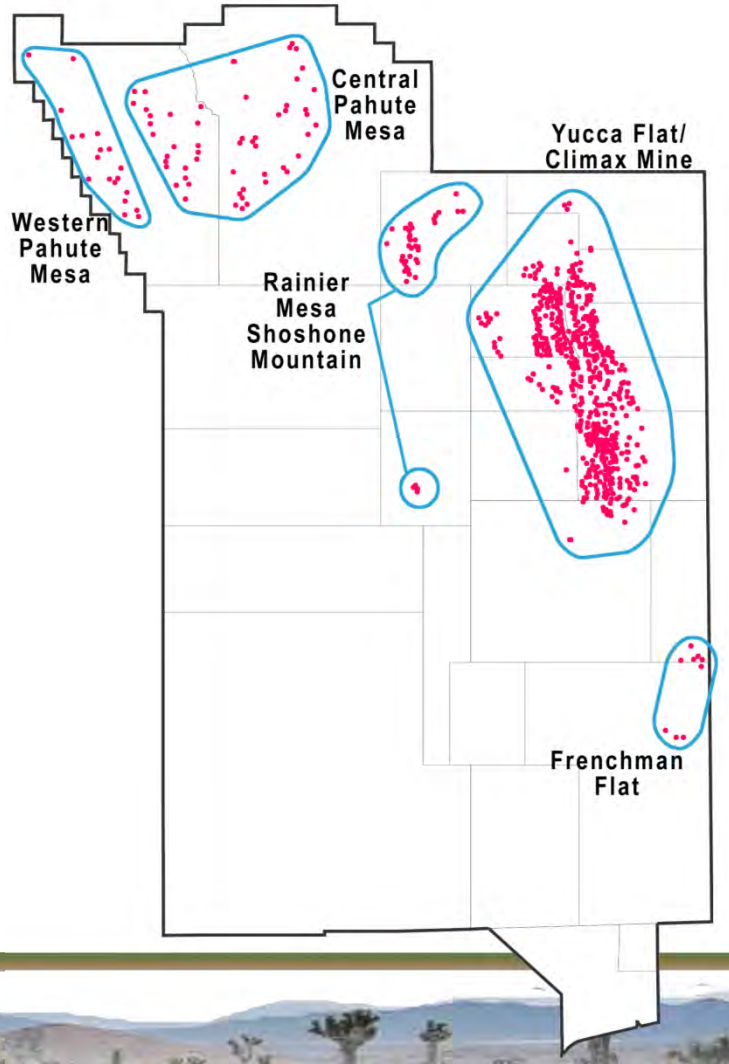
Monitoring Locations

- Air (2)
- Groundwater (3)
- Meteorology (1)
- Radon Flux (1)
- Evapotranspiration(2)
- Soil Moisture (6)
- Soil Temperature (7)
- Thermoluminescent Dosimeters (12)

Depth to groundwater is over 770 feet

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

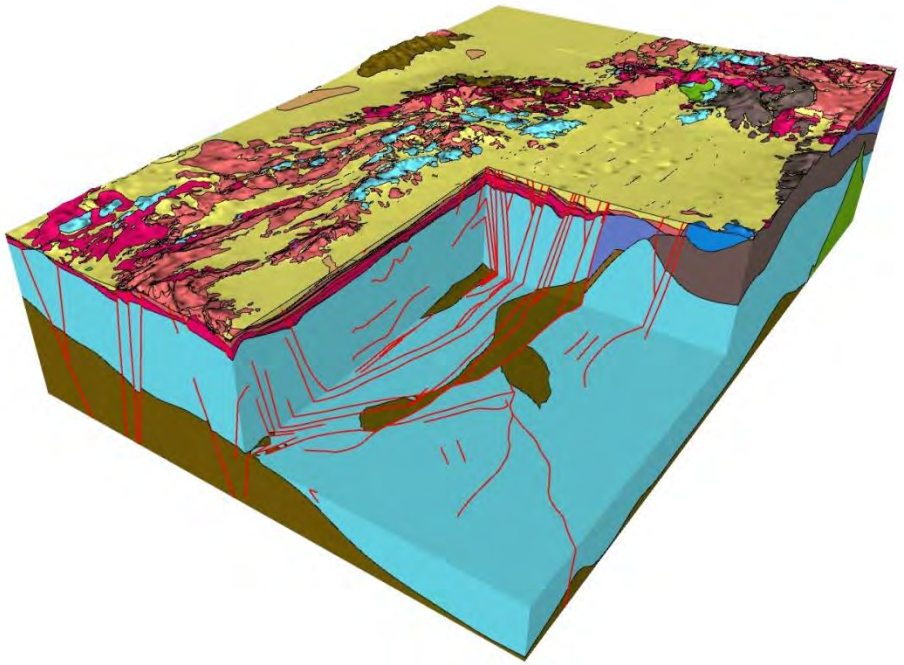


Underground Testing at the NNSS

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

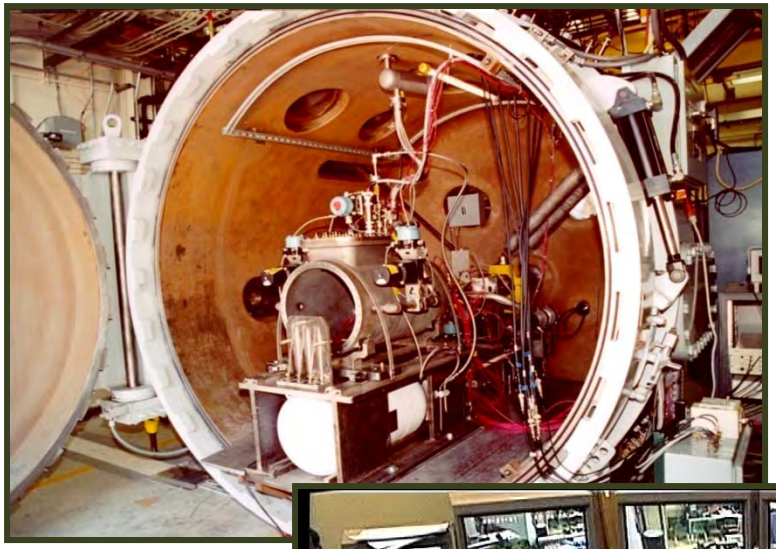
UGTA Groundwater Characterization

- 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



Joint Actinide Shock Physics Experimental Research (JASPER)

- Study properties and responses of special nuclear materials under high pressure
- 116 shots to date (49 plutonium [Pu] shots)*
  - First shot: JAS001 March 19, 2001
  - First Pu shot: JAS021 July 8, 2003



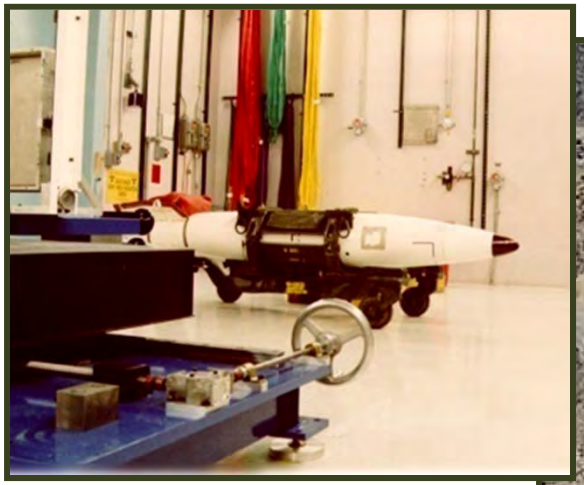
*as of December 9, 2013

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

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



Control Point-1 (CP-1)

- Command post used for conducting nuclear tests

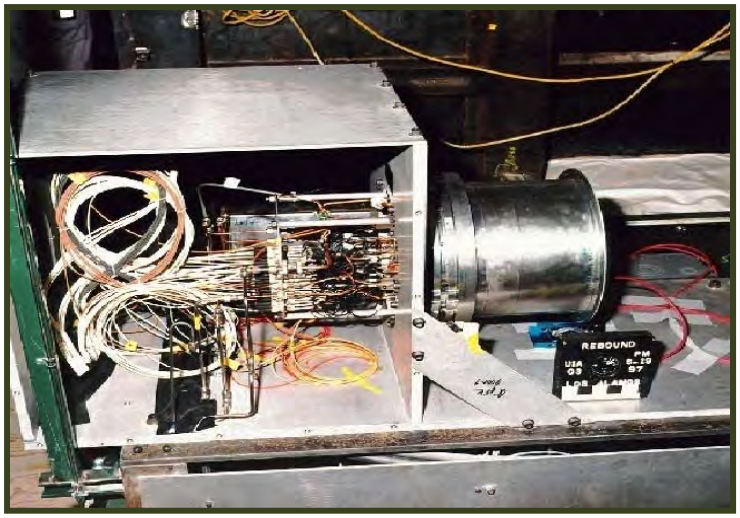
News Nob

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

U1a

- Underground laboratory for subcritical experiments
- Data for National Laboratories
- Safety and reliability of stockpile

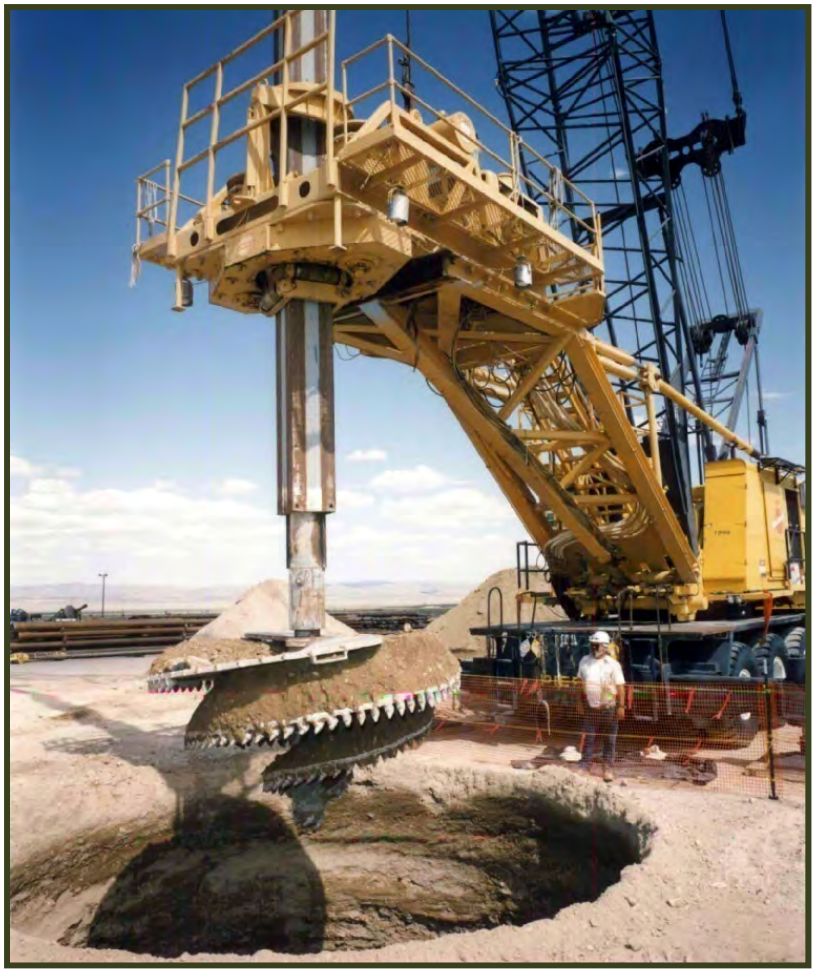


Huron King Test Chamber

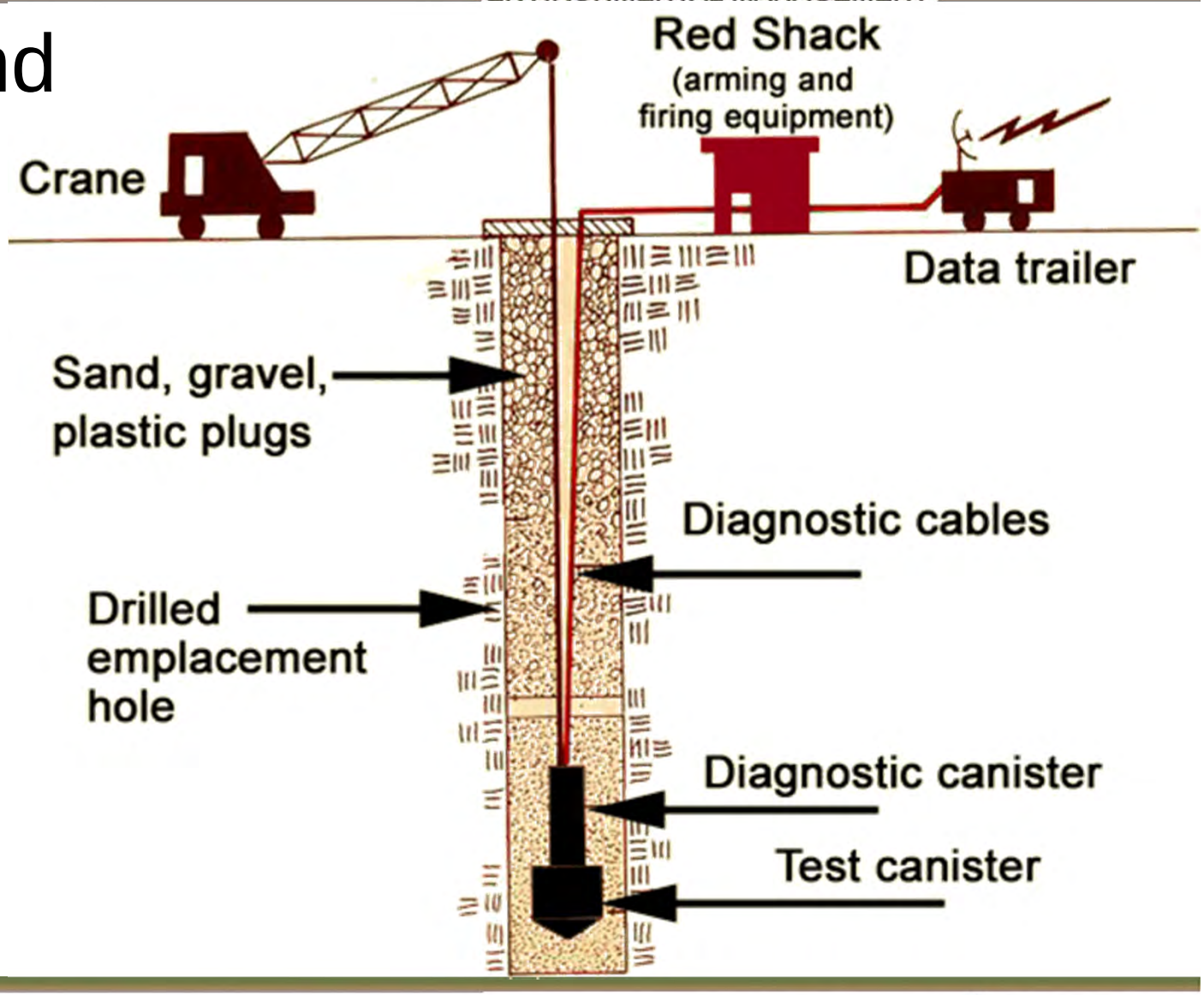
- Visual line of sight underground nuclear test (yield less than 20 kilotons) conducted June 24, 1980
- Tested effects of a system generated electromagnetic pulse on a full-scale operating military Defense Satellite Communications System

Underground Testing at the NNSS

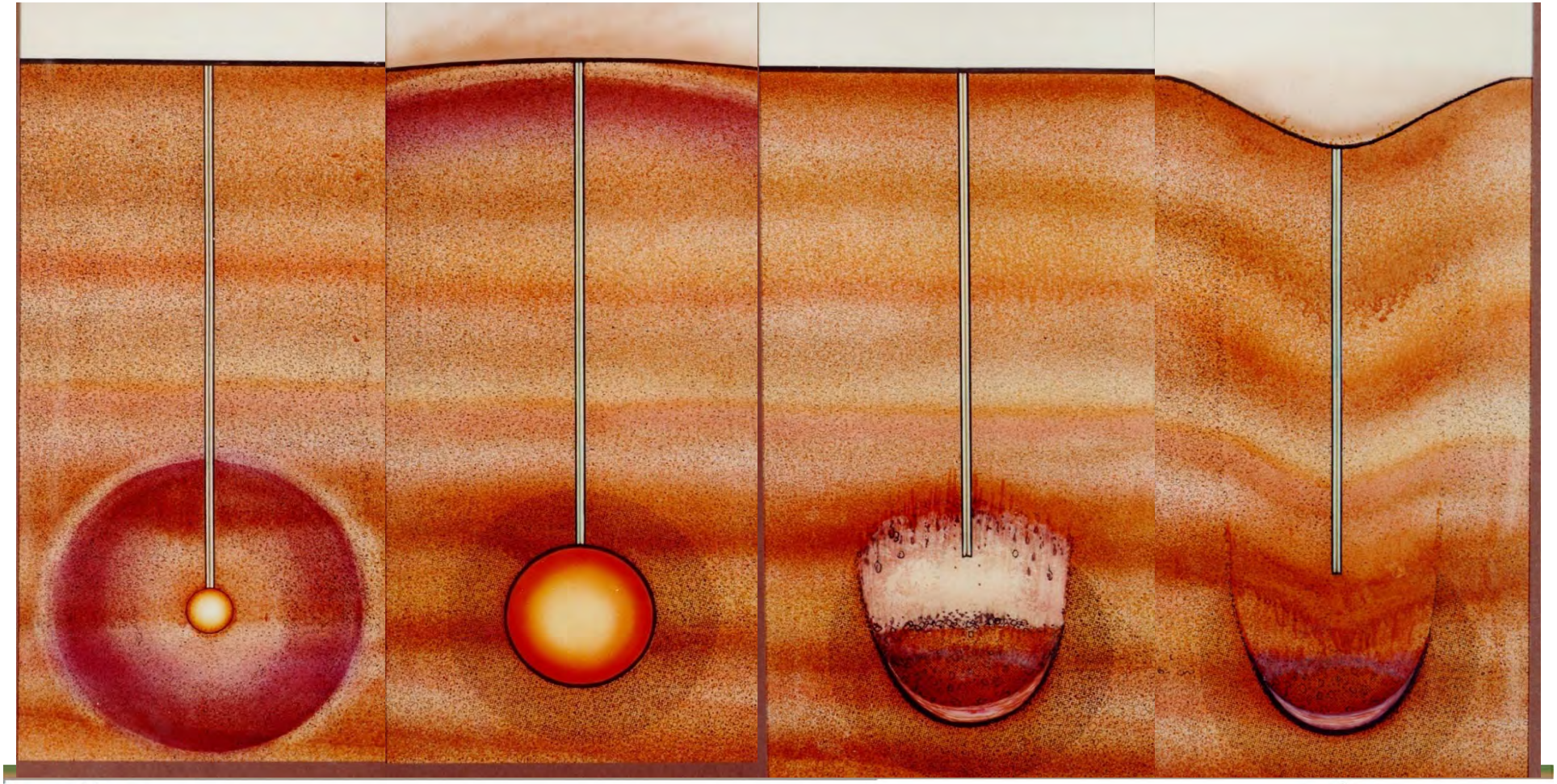
- Holes were three to 12 feet in diameter
- A large hole required the removal of more than 4,280 cubic yards of soil
- If the depths of holes drilled for underground nuclear tests since 1961 were combined, it would total about 280 miles
- Drilling techniques developed at the NNSS continue to be used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



Underground Test



Underground Testing at the NNSS – Subsidence Crater Formation



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

Big Explosive Experimental Facility (BEEF)

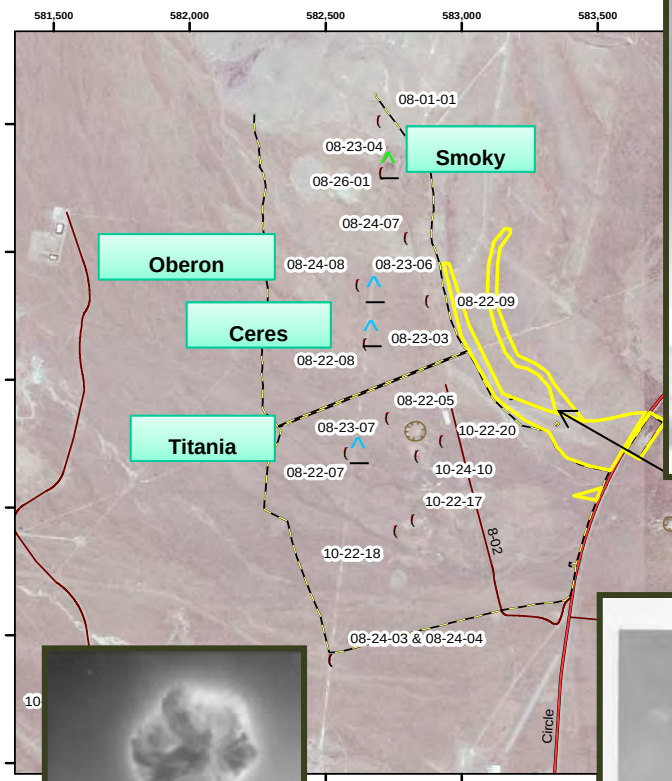
- Non-nuclear high- explosive tests
- Capable of 70,000 pounds of explosives

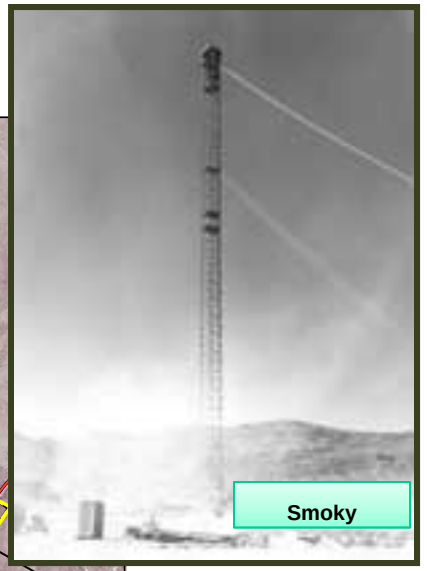
Tower Test Example

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

Corrective Action Unit (CAU) 550 Overview

- One weapons-related atmospheric test (Smoky)
- Three safety experiments (Ceres, Oberon, and Titania)
- Washes/drainage channels, including a depositional area located south of Circle Road
- Debris locations (15 sites)
- NSSAB provided recommendation for Corrective Action Alternative of Closure in Place ~ November 2013





Washes/Drainages

Smoky Detonation

Ceres, Oberon, and Titania all conducted from similar 20' tall wooden towers

CAU 550 Field Activities

- Field Activities
  - Sampling and radiological dose measurements conducted intermittently between August 2012 through October 2013, including:
    - Soil Sampling (chemical and radiological)
    - Terrestrial radiological surveys
    - Characterization and removal of potential source material

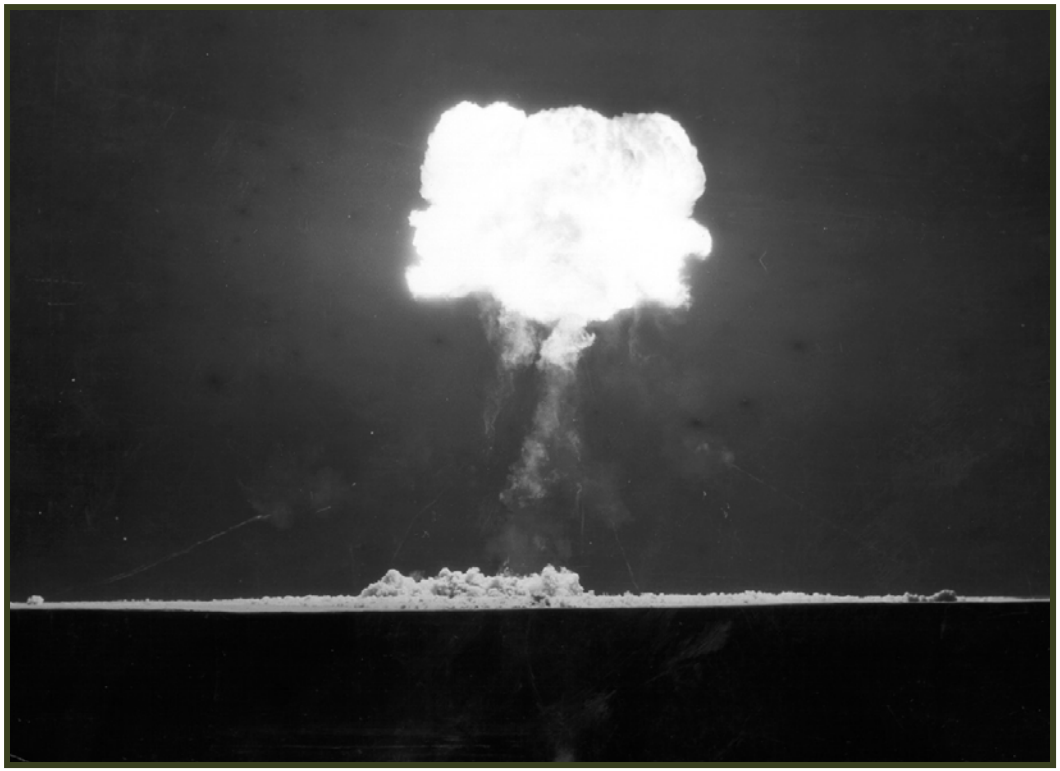
CAU 550 Results

- Corrective Actions are required for:
  - The area surrounding the safety experiments (CASs 08-23-03, 08-23-06, and 08-23-07 exceed action level for transferable radiological contamination)
  - Debris CASs 08-26-01 (lead bricks) and 08-24-08 (batteries) exceed action level for lead

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



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
- Listed on the National Register for Historic Places on April 1, 1994

Sedan Crater
(continued)

- Completion of remediation activities and implementation of a closure in place with a use restriction and posting, approved by the State in July 2011
- NSSAB Work Plan Item to provide recommendation on improvements or enhancements to Radionuclide Decay at Use-Restricted Soil Sites report and what DOE's actions should be when radionuclides in use-restricted areas have decayed

Use Restrictions

- Use restrictions consist of contaminant boundaries that are entered into the site-wide geographic information system (GIS)
- Use restrictions are put in place to warn site workers of the presence of contamination at levels of potential concern

Use Restrictions
(continued)

- FFACO use restrictions are implemented where dose could exceed 25 millirem/year (mrem/yr) based on current and projected land use – these require a higher level of control to include warning signs
- Administrative use restrictions are implemented where dose could exceed 25 mrem/yr if the site were to be used for industrial activities – this is a lower level of control and do not require signage
- Both use restriction types are controlled administratively

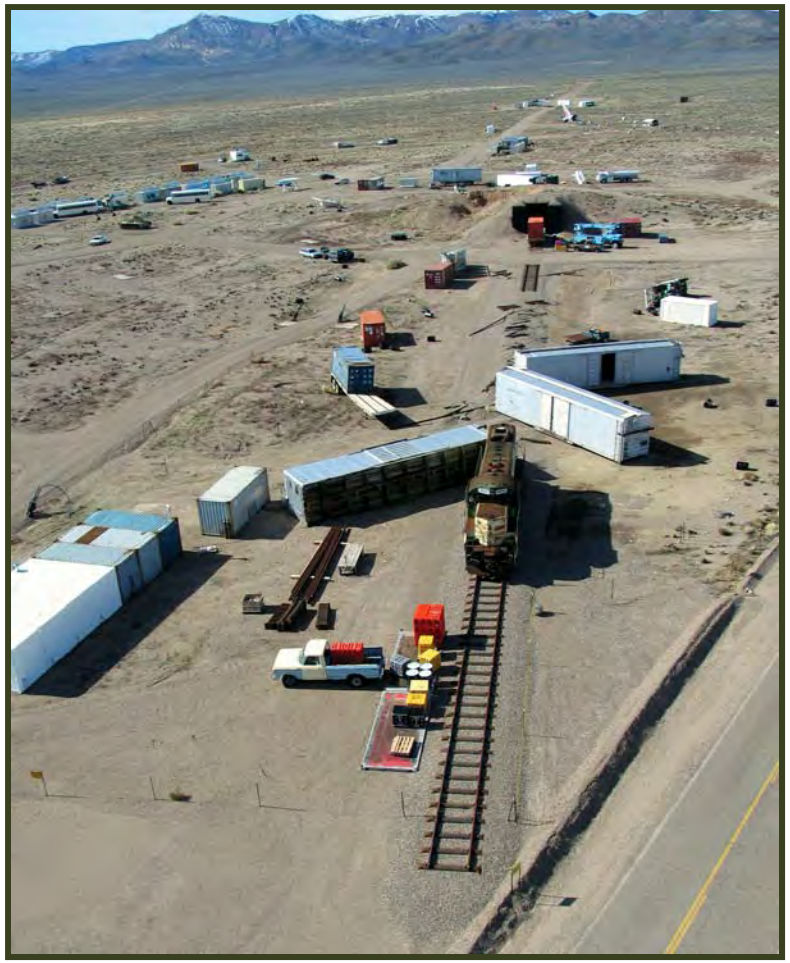
EPA Farm

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

AEC had its own brand

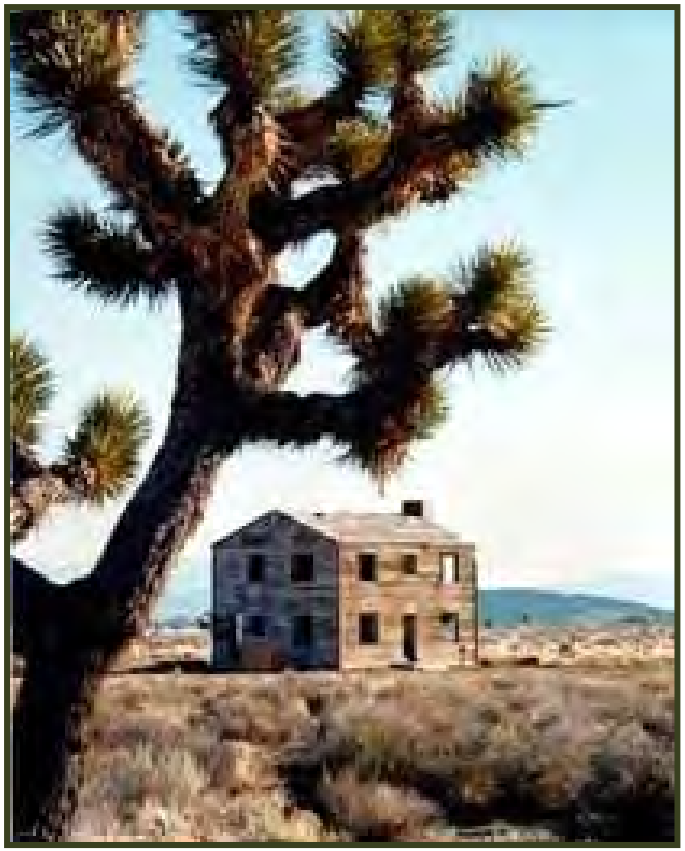
T-1 Training Area

- Counter Terrorism Operations Support (CTOS)/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
- More than 140,000 first responders trained since 1999



Apple II Houses

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

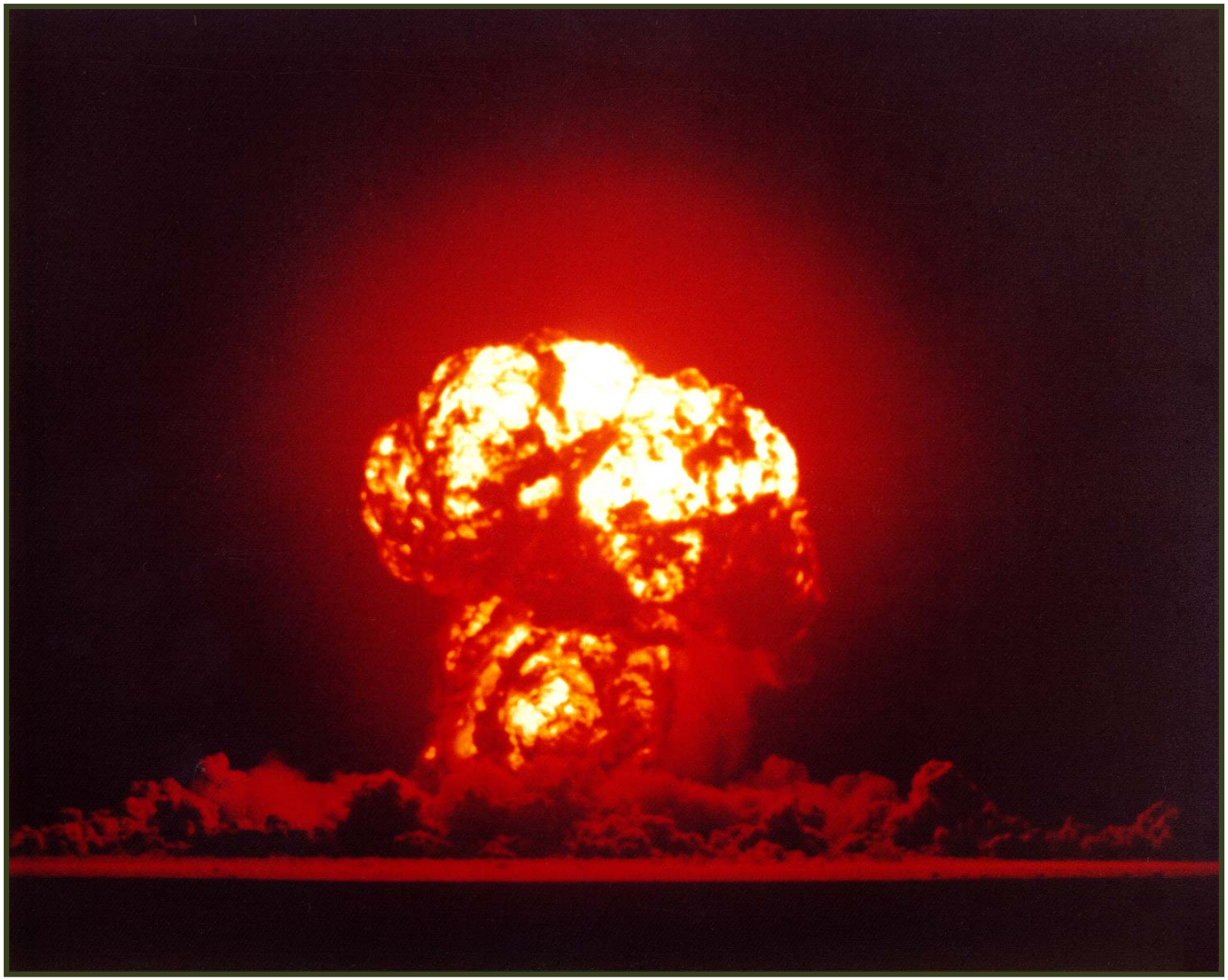


Located 7,800 feet from *Apple-2* ground zero, this existing two-story wooden house was one of two identical structures erected for civil effects tests; the other one, located 5,500 feet from ground zero, was severely damaged

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

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

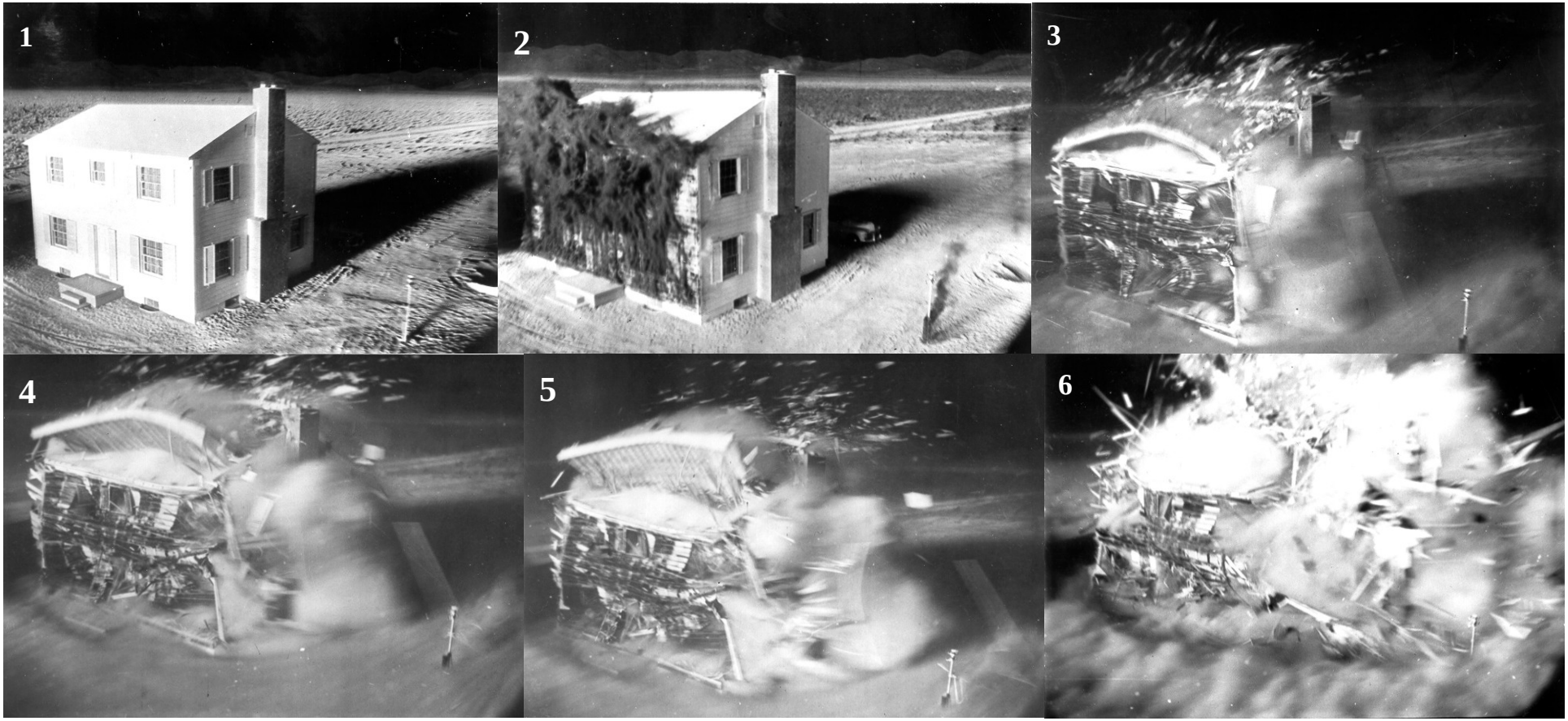
65 associated experiments conducted at various distances from ground zero, including 48 civil effects tests on different types of typical American homes



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



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

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

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

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; and
- 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

March 1963

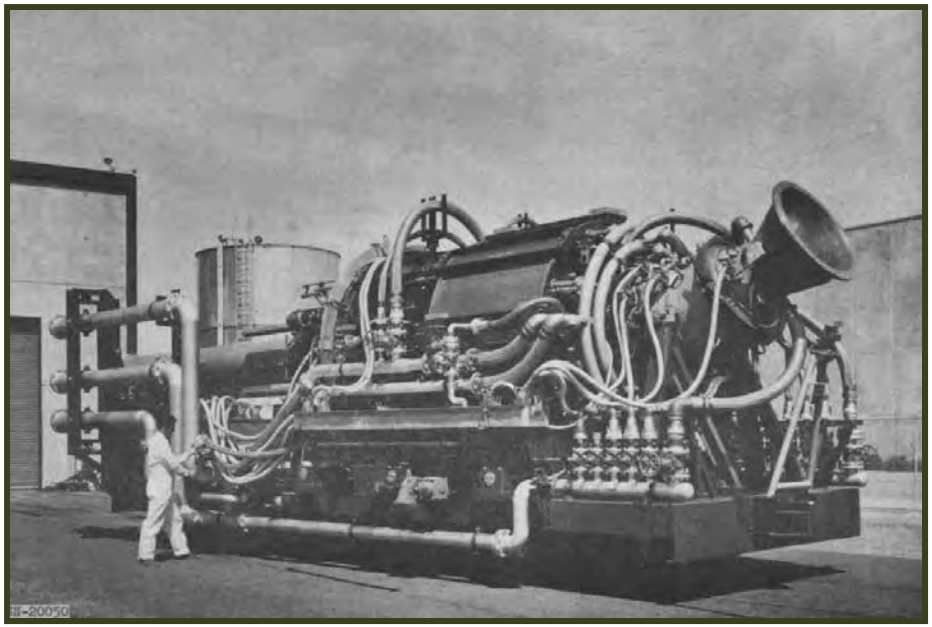
President Kennedy visits Nuclear Rocket Development Station in Area 25

Engine Test Stand 1

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

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.

Homeland Security and Defense

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

COUNTER TERRORISM
OPERATIONS SUPPORT

U.S. DEPARTMENT OF HOMELAND SECURITY

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

For More Information

For more information on

U.S. Department of Energy,

National Nuclear Security Administration

Nevada Field Office programs and activities:

visit our website at www.nv.energy.gov

or call the

Office of Public Affairs at

(702) 295-3521