NEVADA NATIONAL NNSS SECURITY SITE

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Mission Support and Test Services

Putting the Geo- in the Nevada National Security Site (NNSS)

This work was done by Mission Support and Test Services, LLC, under Contract No. DE-NA0003624 with the U.S. Department of Energy with support from the Office Of Defense Nuclear Nonproliferation Research and Development (NA-22).
DOE/NV/03624--1079

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The questions…

- Who am I?
- How did I get to the NNSS?
- What is the NNSS?
- Who is the NNSS?
- What are the missions of the NNSS?
- How do the geosciences support NNSS missions?

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Who am I?

Cleat Zeiler

- 2003 B.S. Geophysical Engineering from Montana Tech
- 2004 M.S. Geophysical Engineering from Montana Tech
- 2008 PhD Geological Sciences University of Texas at El Paso
- 2008-2019 Air Force Technical Application Center
  - Evaluations Branch Chief
  - Director of the Pinedale Seismic Research Facility
  - Seismic Alert Duty Officer
  - Geophysicist
- 2019-present NNSS
  - User-Centered Remote Testing and Operations Center of Excellence Lead
  - Senior Principal Scientist

How did I get to the NNSS?

2004 – Source Phenomenology Experiment (SPE)

- UTEP Data Coordinator
- Met Jesse Bonner – Geophysicist for Weston Geophysics and SPE Lead

2018 – Explored the job market

- Jesse Bonner had moved to the NNSS
- Expected openings in 1-2 Years
- Position opened in less than 6 months

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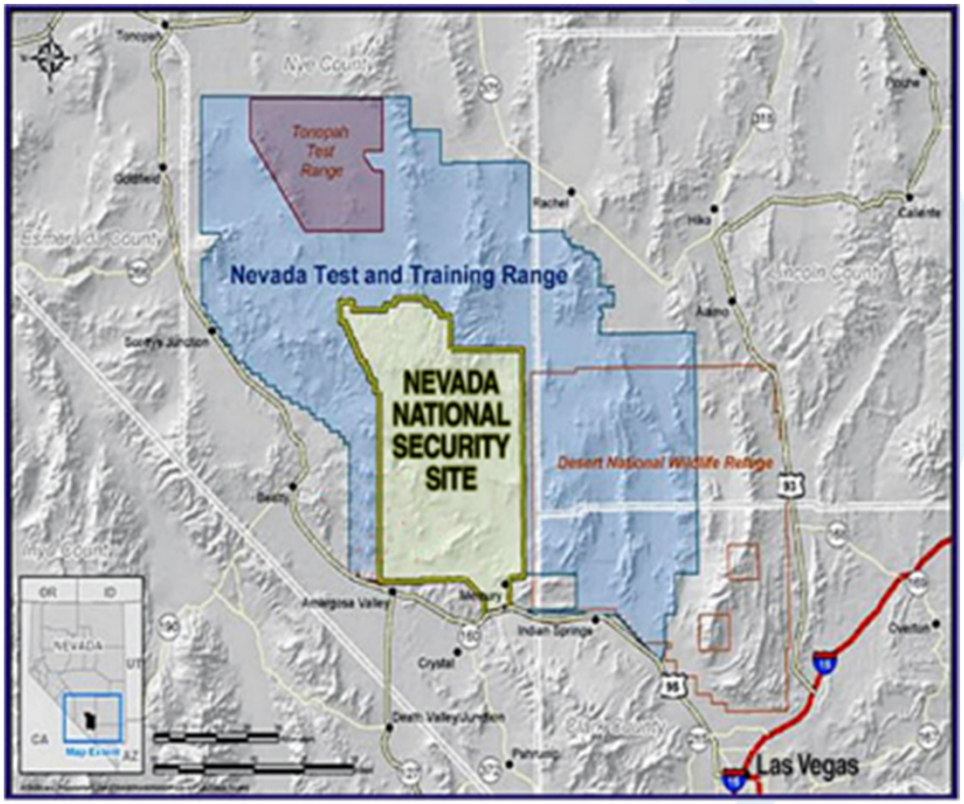
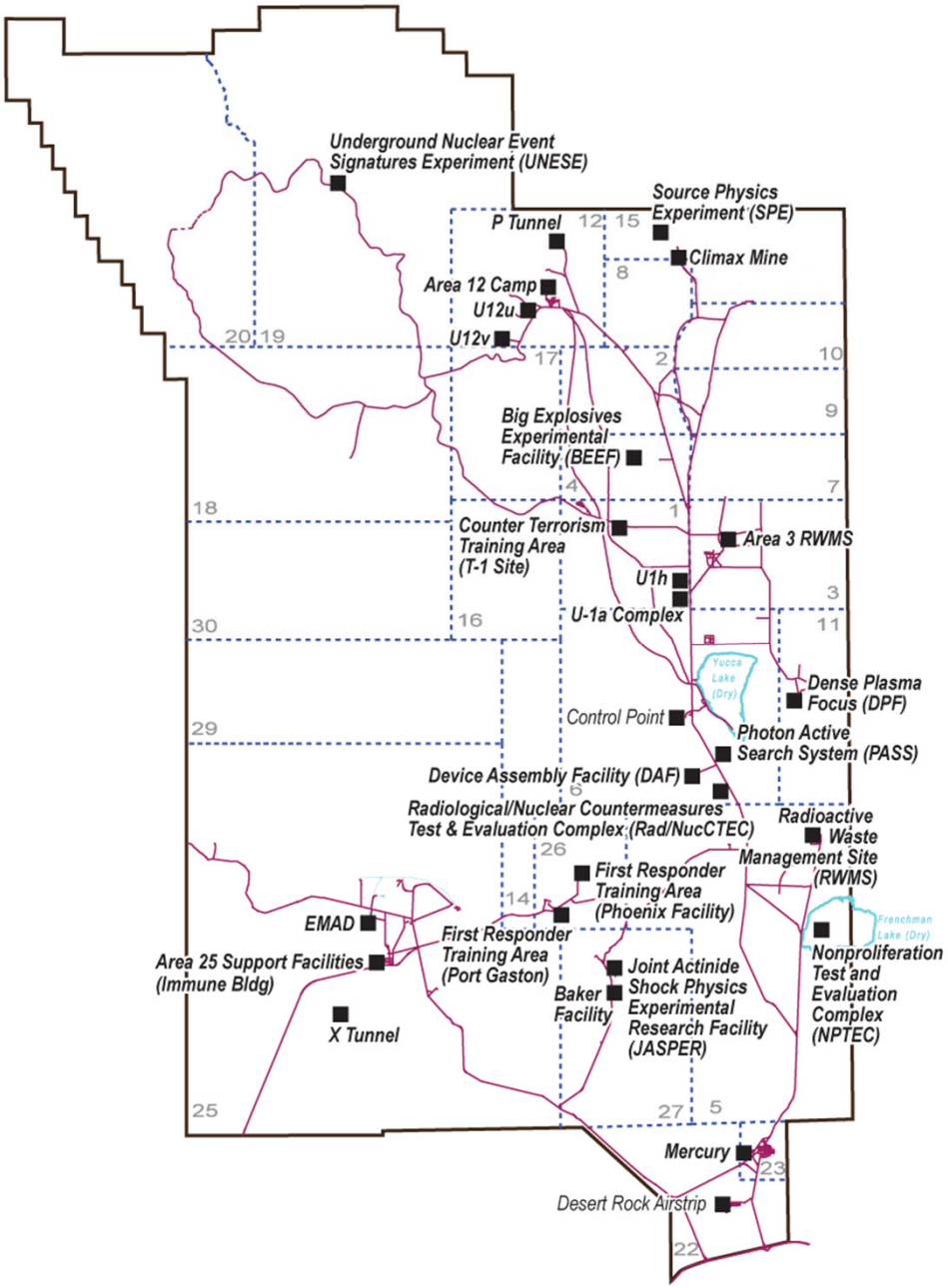
NNSS



- Ideal location based on size, remoteness, lack of encroachments, safety and security
- 1,360 square miles of federally owned land (Size of Rhode Island)
- Surrounded by Nevada Test and Training Range
- Supports a wide range of national security missions



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DOE/NNSA/NNS Organizational Structure

Nevada Field Office

- MSTS contract began Dec. 1, 2017
- Managing partners:

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Supports many federal and local agencies

Department of Energy
NNSA

National Nuclear Security Administration

The Intelligence Community

Department of Defense

Law Enforcement Community

Department of Homeland Security

FEMA

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What are the missions of the NNSS?

- Since 1951, science, technology and engineering have been the key elements of a mission that helped the United States win the Cold War.
- The Nevada National Security Site continues the tradition of ensuring the security of the U.S. and allies by supporting the stewardship of the nuclear deterrent, providing emergency response capability and training, and contributing key nonproliferation and arms control initiatives.
- Our Core Values
  - We safely and securely achieve common goals
  - We effectively solve problems
  - We build trusting relationships
  - We are a learning organization

Stockpile Stewardship

Global Security

Environmental Management

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Stockpile Stewardship

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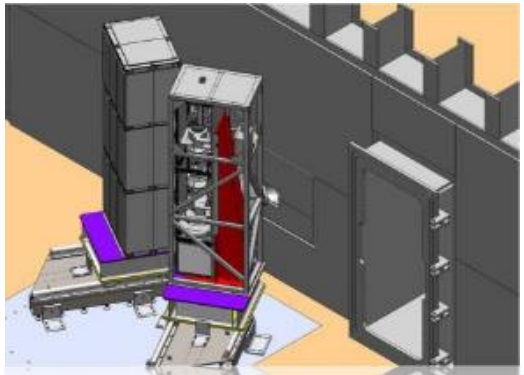
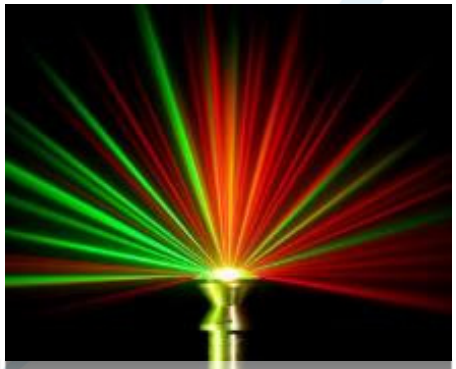
Stockpile Stewardship

- The Stockpile Stewardship Program deploys a wide range of science and engineering technologies to provide venues for dynamic experiments in weapon physics and for studies of materials properties
  - Unique experimental platforms
  - Transformational diagnostics
  - Experiments, data, and results that enhance confidence in assessment and certification

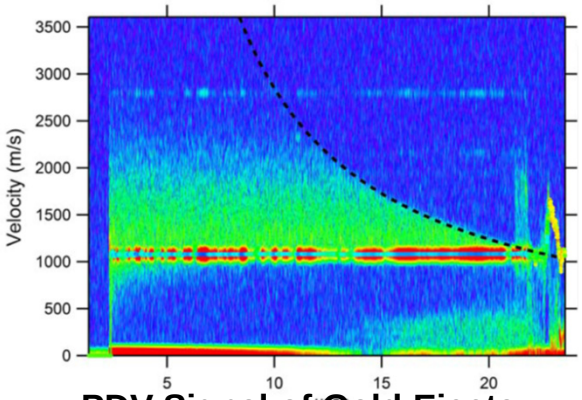


Cygnus Zoom Lens



Next-Gen Optical Probe

Glove Box at DAF



PDV Signal of Gold Ejecta

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Stockpile Stewardship

- Projects are integrated across locations
- Locations support the mission at multiple Laboratories
- Science, Technology & Engineering developed at all locations and on Lab platforms migrates to NNSS platforms (e.g., U1a, BEEF, JASPER)

Weaves unique and common capabilities into a cohesive experimental platform

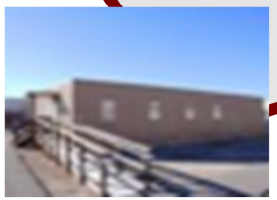
Los Alamos Office
Los Alamos, NM

Special Technologies Laboratory
Santa Barbara, CA

Livermore Operations
Livermore, CA

NNSS High Hazard Experiment Platforms

North Las Vegas Engineering & Infrastructure



Sandia Office
Albuquerque, NM

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DAF is a National Asset well suited to address New National Challenges

Device Assembly Facility (DAF)

- 100,000 sq. ft. Security Category 1, Hazard Category 2 nuclear facility
  - National Criticality Experiments Research Center (NCERC)
  - Nuclear material staging
  - Assembly of subcritical experiments
  - Assembly of JASPER targets
  - Support to stockpile surveillance programs

Radiography Building

JASPER Glovebox

Downdraft Table

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NNSS Conducts Experiments on High Explosives

Big Explosives Experimentation Facility (BEEF)

- Significant role in accumulating data to support the Stockpile Stewardship Program
  - Conduct weapons physics experiments using high-explosives and pulsed laser power to study and investigate impacted materials
  - Exercise design and experimental skills resident in primary groups at the national laboratories

Bunker

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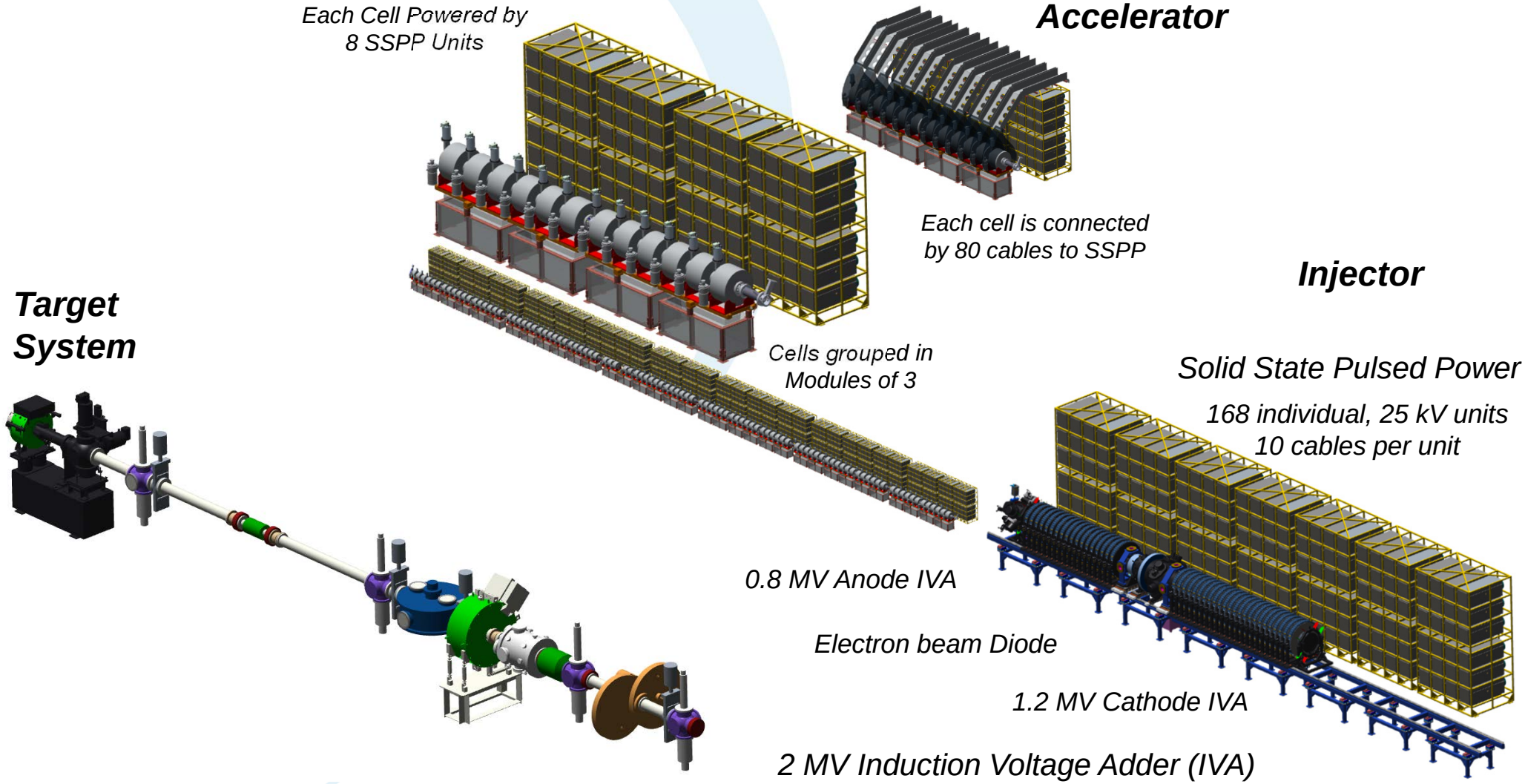
Scorpius – In Progress

Weapons Radiography requires a very intense pulsed source and an extremely sensitive high-speed detector



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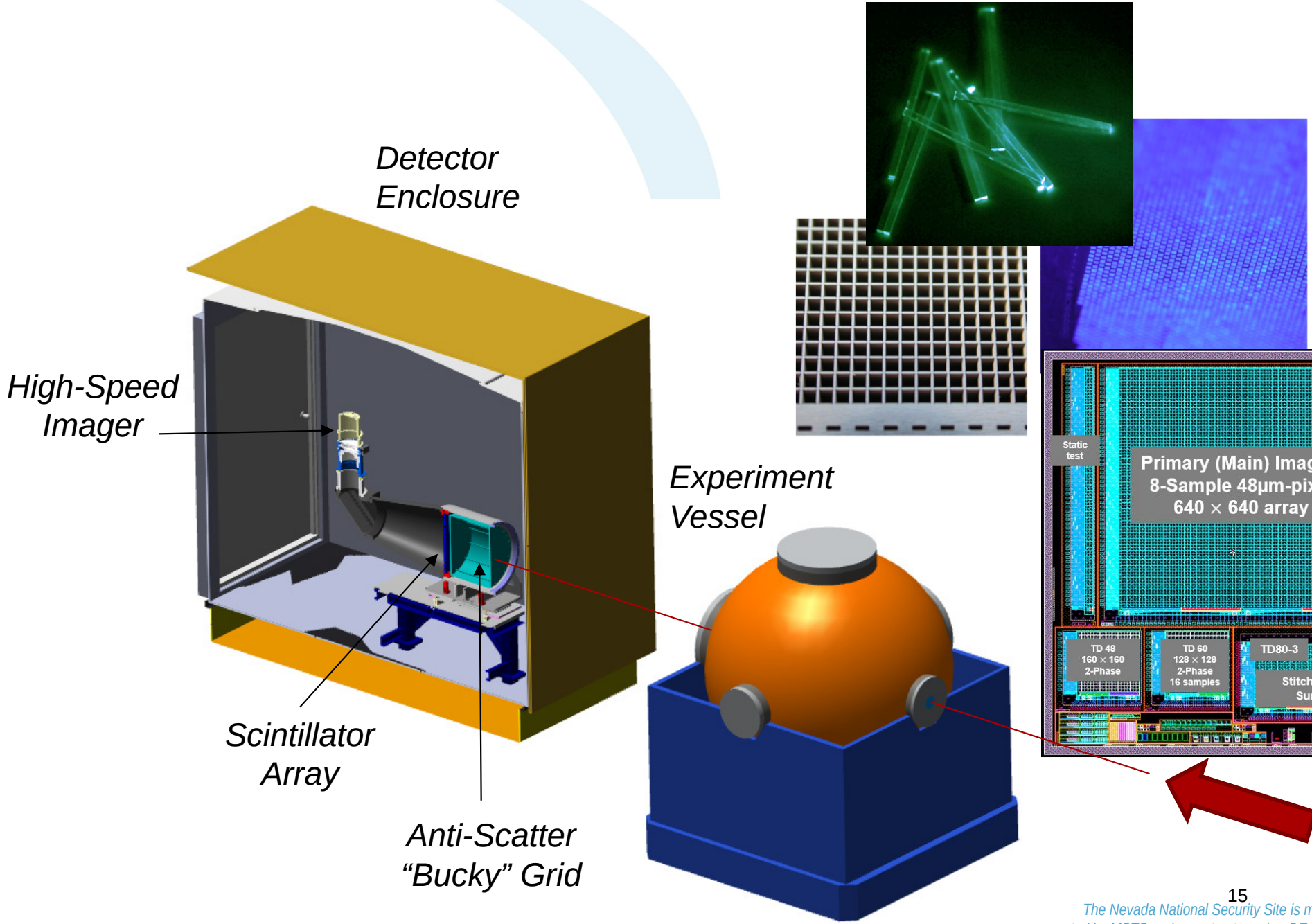
Scorpius – cont.



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Global Security

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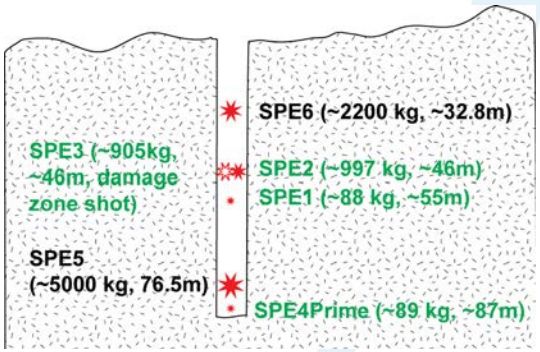
Global Security

- Global Security is dedicated to developing technical solutions; performing test and evaluation; training; deploying; and operating in the following mission areas:
  - Non-proliferation: Technologies for treaty monitoring and compliance
  - Counter-Proliferation/Counter-Terrorism: Full spectrum (CBRNE)
  - Emergency Response: Search and Consequence Management Operations
  - Cyber Security
  - Global Security Autonomous Solutions / Sensor development and Integration – FAA selected site for Unmanned Aerial System (UAS) testing
  - Quick response of Applied Technologies for specialized customers

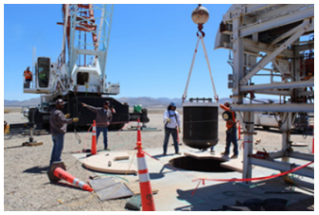
NNSS Conducts Source Physics Experiments

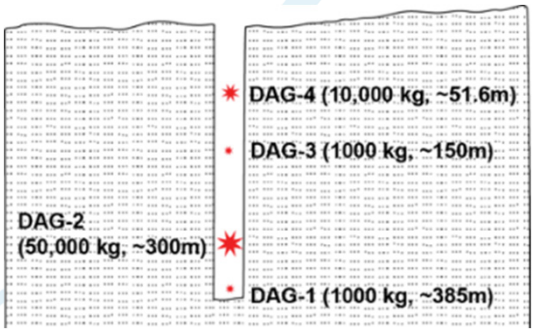
- Underground chemical high explosive detonations of various strengths and depths designed to:
  - Enhance the nation's monitoring & verification capabilities
  - Develop explosive source prediction capability

Phase I
SPE



Phase II
DAG





Aimed at improving arms control and nonproliferation treaty verification

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Non-Proliferation Test and Evaluation Complex (NPTEC)

- **NPTEC provides:**
  - Secure test beds
  - Calibrated release systems
  - High-fidelity weather data
  - Ground-truth instrumentation
  - Assistance with test design and test execution
  - Largest facility for open air testing of hazardous materials, chemicals, and biological simulants in the world

- **Work performed:**
  - Evaluate sensor technologies and ability to identify relevant signatures
  - Identify impact of potential terrorist events and effectiveness of countermeasures

Allows the study of large quantities of toxic material – safely and without damaging the environment

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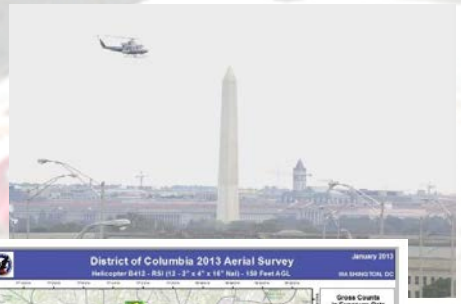
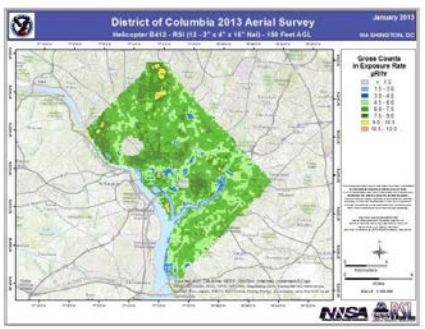
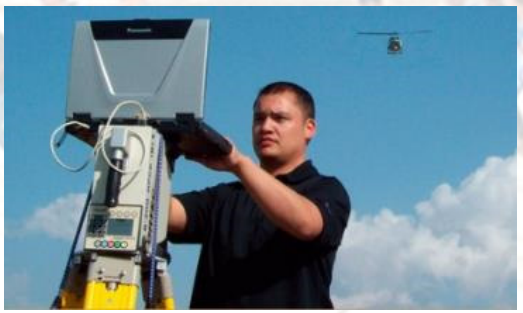
Remote Sensing Laboratory (RSL)

- Nationwide Radiological Emergency Response – East Coast (NCR focus) and West Coast Assets
- On Call Status for Radiological Emergencies
- Deployable Field Teams and Home Team Reach-back
- Aircraft – Unique Aerial Detection Capabilities
- Global Response Capabilities (ex. Fukushima)







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Global Security Autonomous Solutions – Integrating Unmanned Systems

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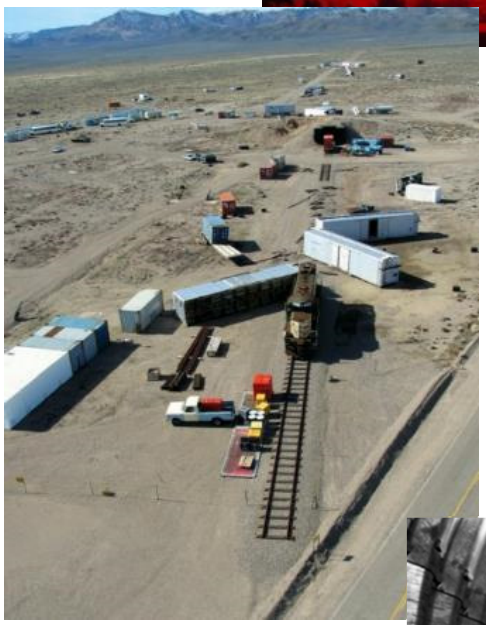
First Responder Training for Radiological and Nuclear Emergencies

T-1 Test in 1955



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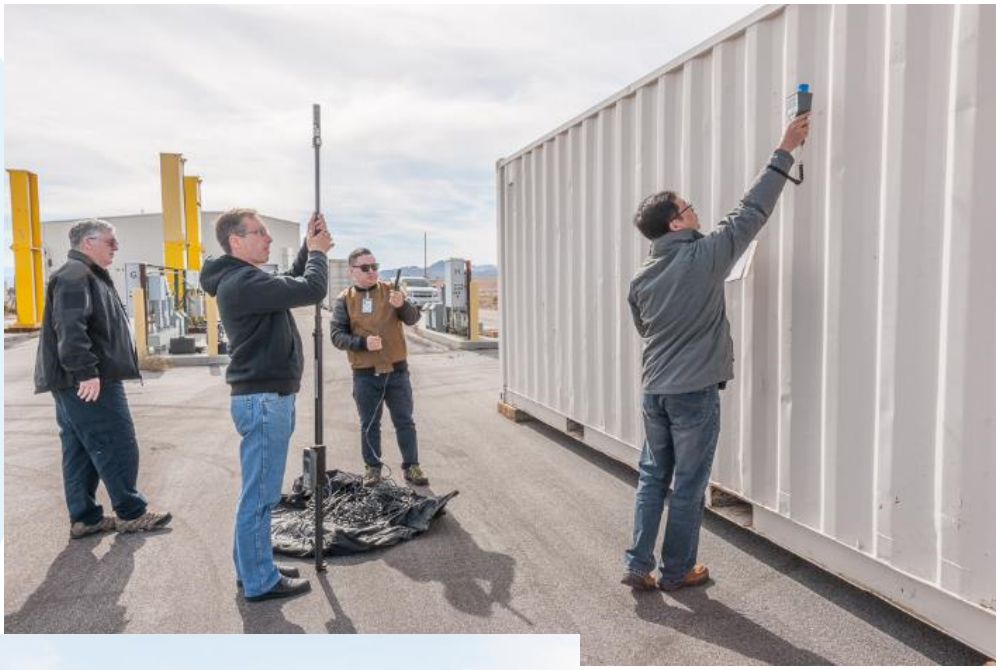
Training at the Radiological/Nuclear Countermeasures Test and Evaluation Complex

- Provides the facilities and capabilities to validate the performance of radiological detectors under development or already deployed in order to protect the U.S. from the threat of a terrorist radiological or nuclear attack



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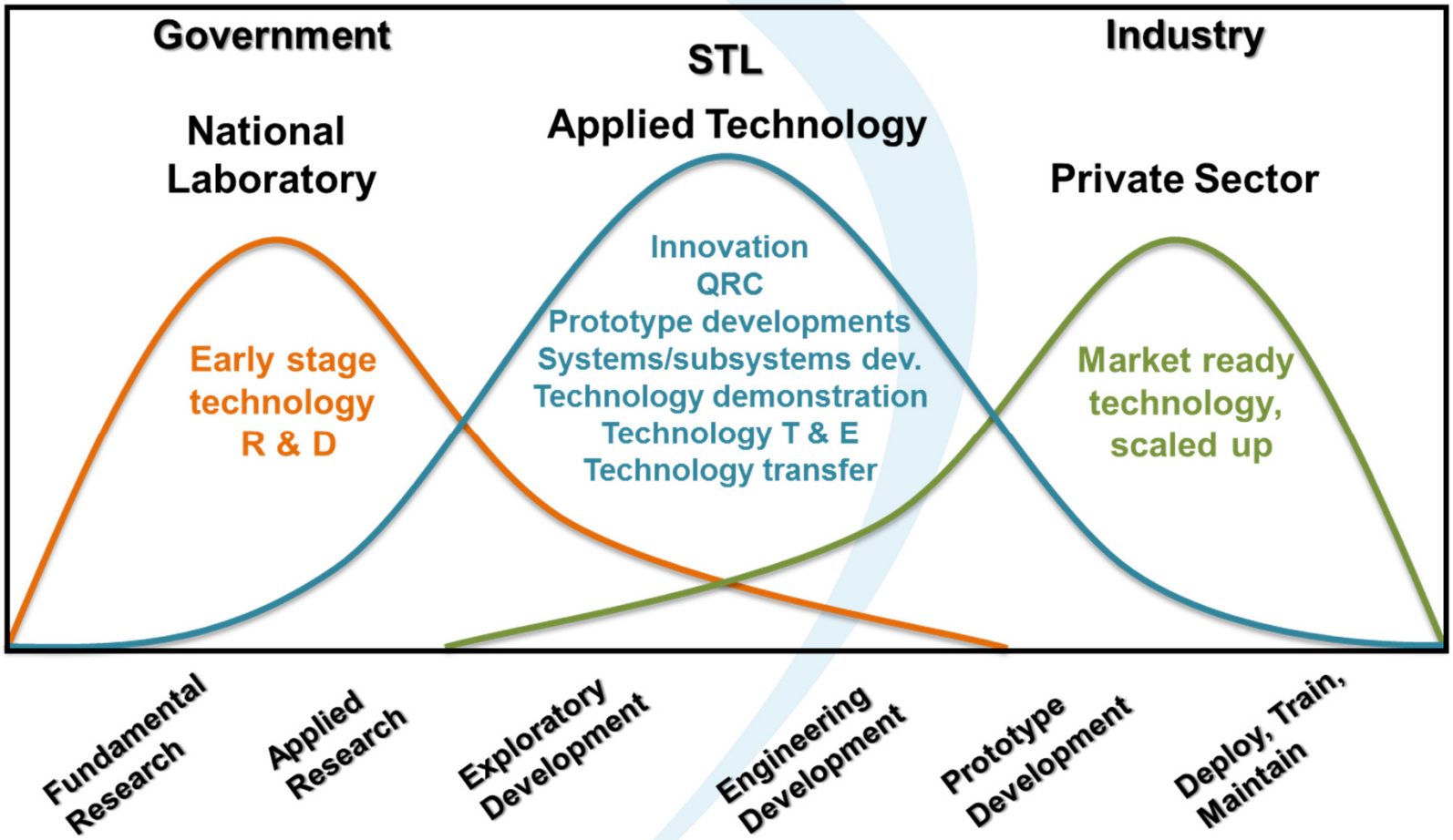
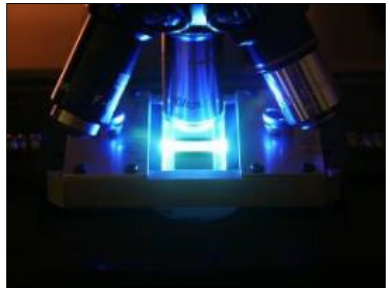
Special Technologies Laboratory





Material Identification

Electronic Prototype

An incubator of technology with multi-disciplinary teams specialize in focused development of special-purpose devices, measurement instruments, and analysis methods tailored to the needs of the end-user

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Geosciences at the NNSS

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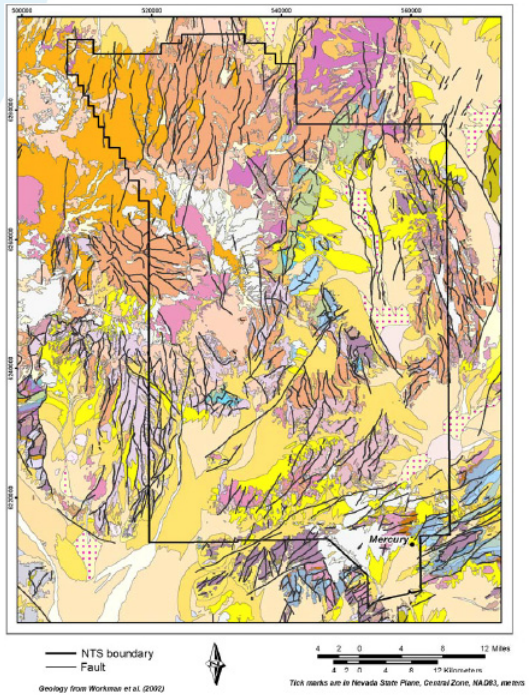
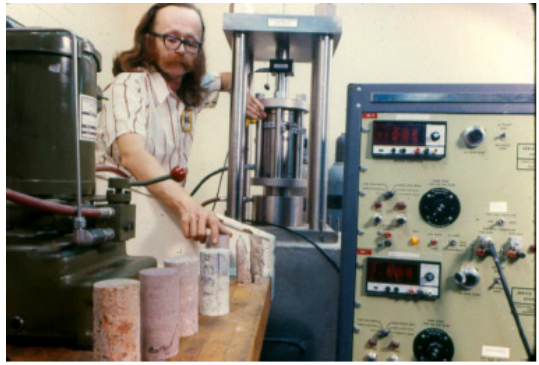
What Geosciences do at the NNSS

- Historically the containment of nuclear tests was a primary concern
  - Determine location suitability for mining and/or drilling
  - Learning on the fly, BANEBERRY
  - Conservatism/Predictive Modeling/Environmental Protection (groundwater)
- USGS and Contractor Geologists
  - Groundwater studies
  - Surface and underground geologic mapping
  - Physical properties measurements
  - Geophysical measurements
  - Core Library





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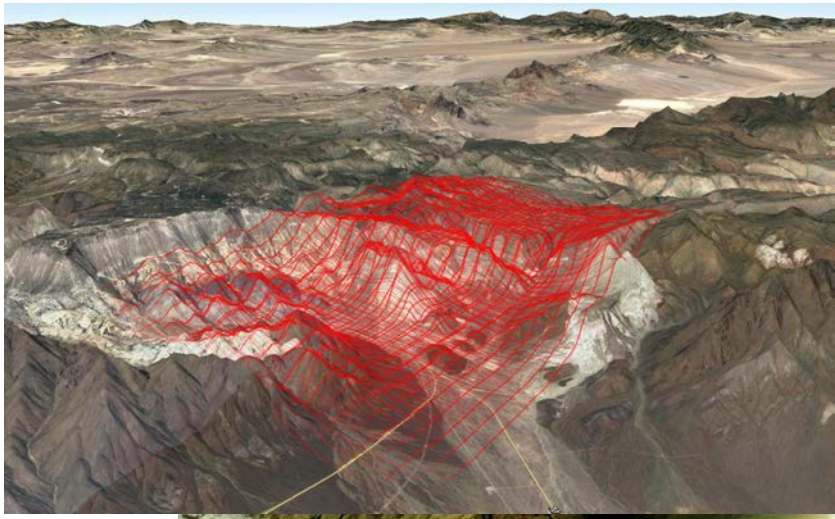
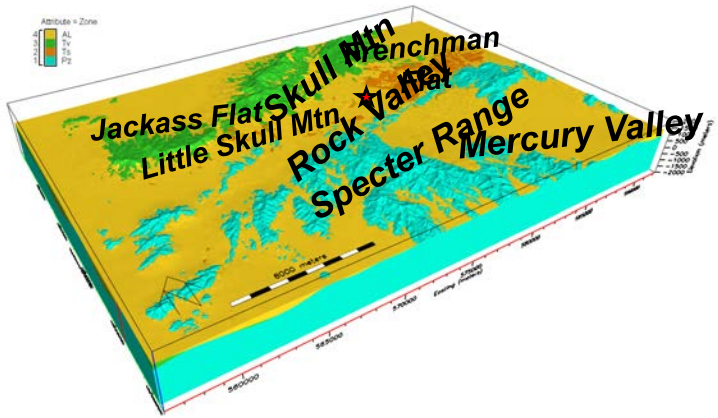
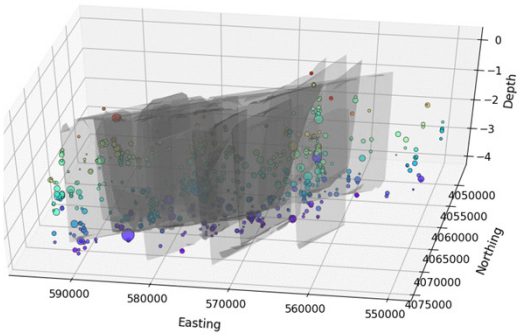
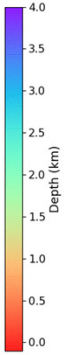
What Geosciences do at the NNSS

- Test Bed Construction
- Mapping/Field support
- Remote Sensing/Photogrammetry
- Mining/Drilling Support
- Borehole/Core Characterization/Logging
- Geologic Framework Modeling (GFM)
- Geohazard modeling
- Earthquake Relocations
- Diagnostic Fielding/Testing
- Drone Pilots
- Data Management









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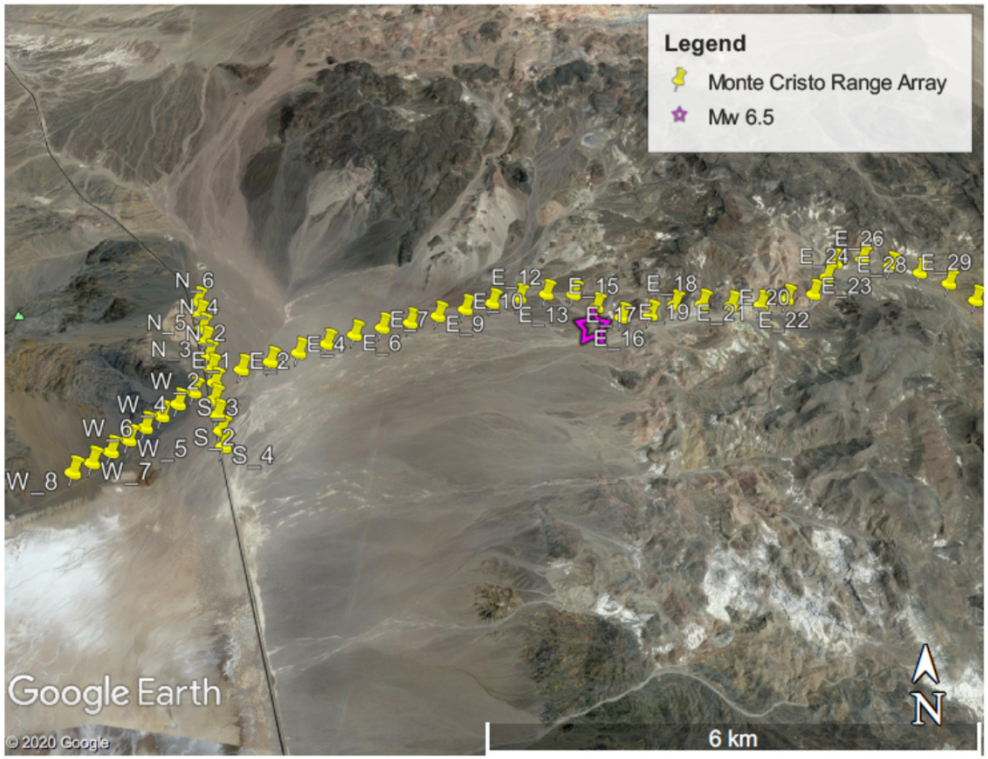
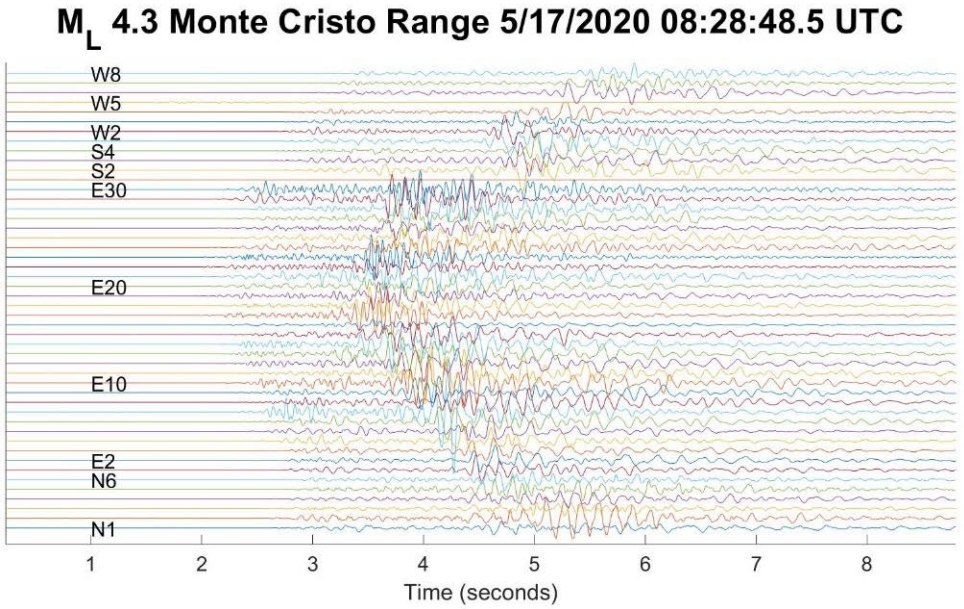
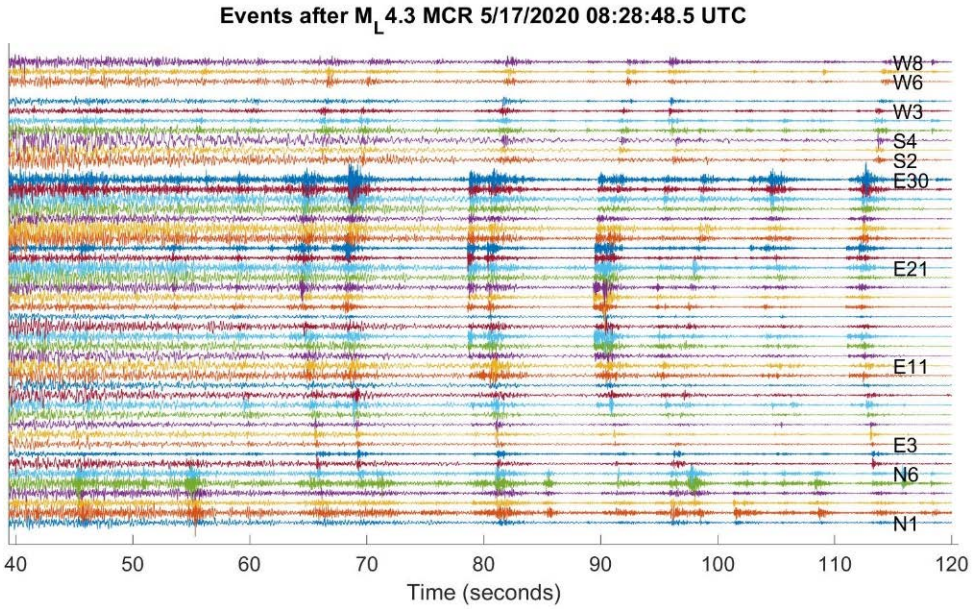
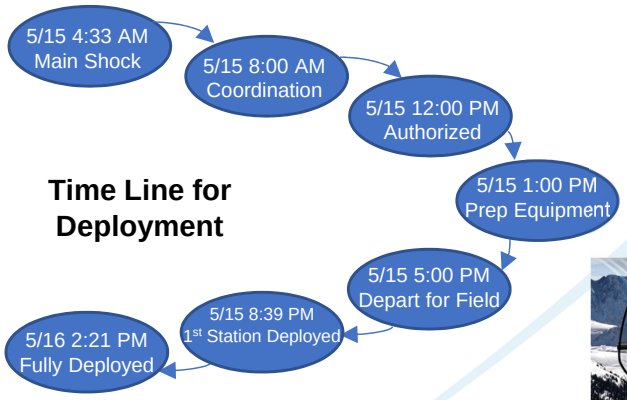
Monte Cristo Range Mw 6.5 Nodal Geophone Rapid Deployment









Time Line for Deployment

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NNSS Contributes to Nevada and the Communities Served

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What NNSS Does for Nevada

- Employ ~**3,000 people;** approximately 2,700 in Nevada
- Represent a nearly $1 billion economic impact in Nevada
- **$41.5 million** – total procurement expenditures in Nevada in FY20
- **$3.55 billion** – total replacement value of infrastructure (road and building) at the NNSS
- **$15 million** to Nevada counties in the last two decade to support emergency response capabilities
- Fire & Rescue paramedics provide Nye County ongoing life safety response with in-kind contribution of **$300,000** annually
- **$1.3 million** to Nevada for oversight of low-level radioactive waste disposal program
- **$530,000** to Nevada for oversight of NNSS environmental restoration activities
- **$665,000** to the Nevada Division of Emergency Management through waste fees

NNSS is the Largest High-Tech Employer in Southern Nevada

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Outreach Program

- Strategy Focus Areas
  - Community Leadership
    - Nevada Test Site Historical Foundation
    - UNLV Committee Members: Science & Business
    - Vegas Chamber
    - Las Vegas Global Economic Alliance
  - Economic Development
    - Small Businesses: Disadvantaged, Veteran-owned, Service-disabled, Women-owned, etc.
  - Education Outreach: STEM
    - Nevada Science Bowl
    - FIRST Nevada
    - CCSD, UNLV, and others
  - Community Outreach
    - American Red Cross
    - Rebuilding Together Southern Nevada
    - Three Square Food Bank, and others

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NNSS History

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NNSS History

- President Truman established the Nevada Proving Grounds in 1950, later to become the Nevada Test Site, and then to be renamed the Nevada National Security Site in 2010
- January, 1951 – First atmospheric nuclear test detonated at the NNSS
  - Tests continued until 1962
  - 100 atmospheric tests were conducted
- August 1963 – Limited Test Ban Treaty – led to underground testing
- 828 underground tests conducted from 1962-1992 when the Comprehensive Test Ban Treaty was signed in 1992
- 1994 – Stockpile Stewardship Program was established
- In order to maintain the safety and reliability of the nation's nuclear weapons stockpile, "subcritical testing" was initiated at the NNSS
- Subcritical experiments provide careful measurement as to how nuclear weapons materials interact and age, enabling scientists to predict changes in the safety, reliability and performance of the nuclear stockpile, without testing.
- Additional national security missions have grown:
  - Nonproliferation
  - Criticality Experimental Capability
  - Strategic Partnership Projects
  - Environmental Programs

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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

Source: NV-209 Rev 16

A test is defined in the Threshold Test Ban Treaty as either a *single underground nuclear explosion* (detonation) at a test site, 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.

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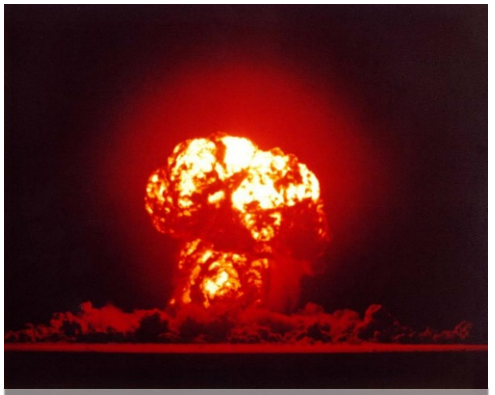
Atmospheric Testing

- 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 – airdrop
June 4, 1953

Atmospheric Test Priscilla - balloon June 24, 1957



Apple II – Tower
May 5, 1955

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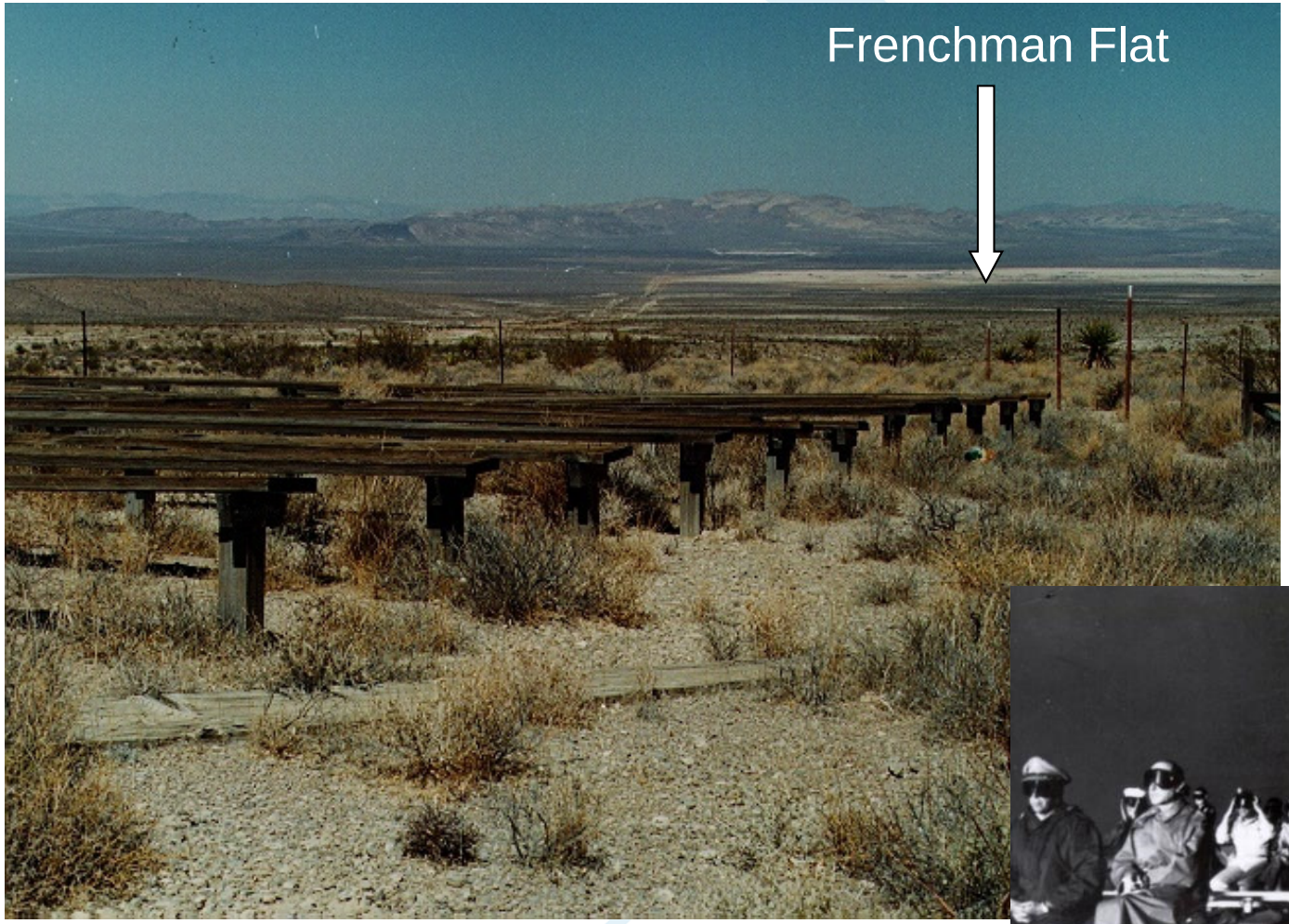

Seated at these bleachers, located alongside the Mercury Highway, official observers viewed the detonation of 14 atmospheric tests in Frenchman Flat

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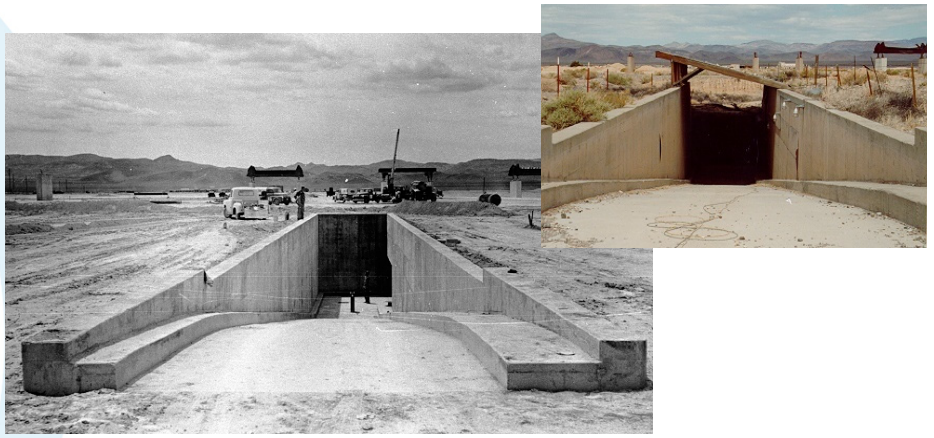
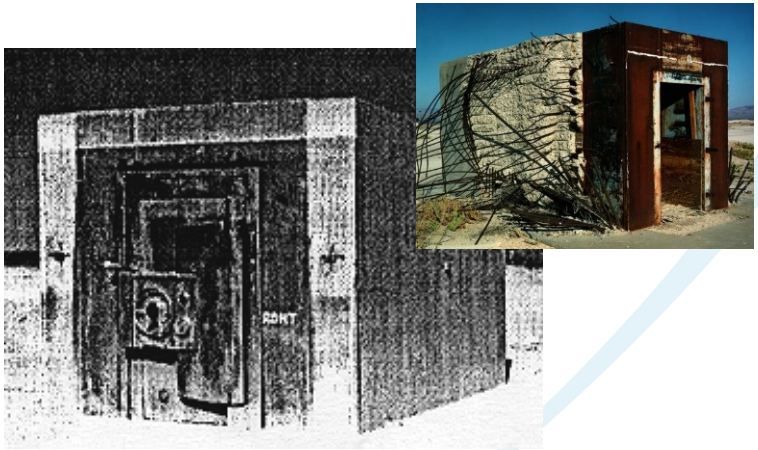
Atmospheric Test Relics

Concrete shelter domes prior to the 1957 *Priscilla* test



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

Four railroad trestles constructed for *Operation Plumbbob* in 1953

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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

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A Rich History

President Kennedy visits in 1962

NASA astronauts trained - 1965

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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

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Huron King Test Chamber

- Vertical 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

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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

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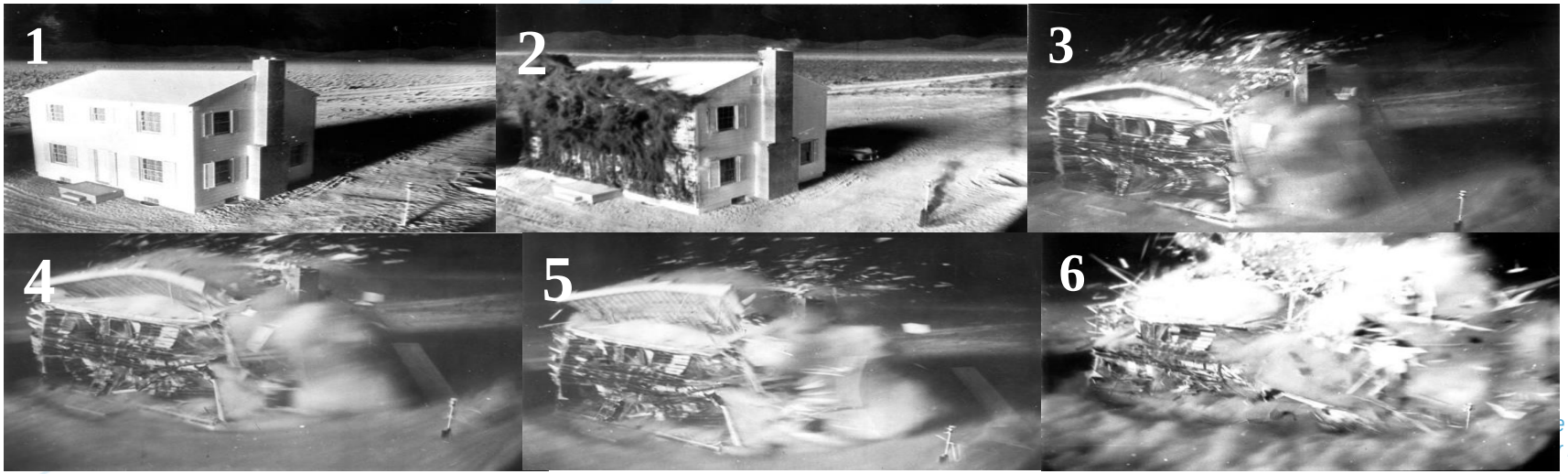
Apple II Houses

- 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



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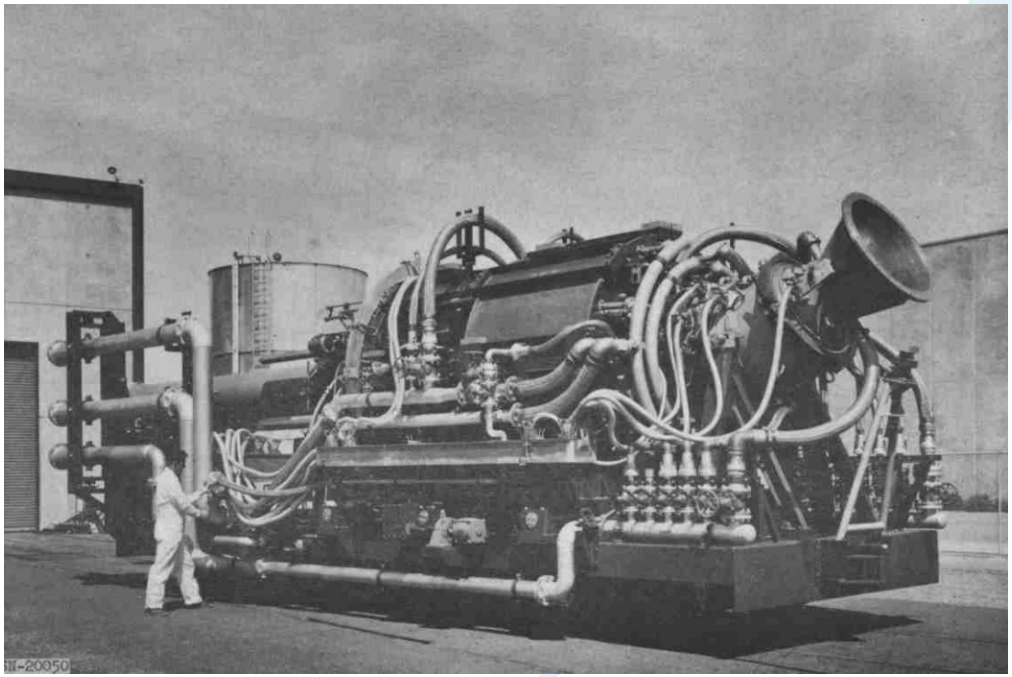
Nuclear Rocket Dev. – Project Rover

- U.S. launched nuclear rocket development program in 1955
- Ground tests conducted at facilities in southwest corner of NNSS
- Four basic segments:
  1. KIWI - tested non-flyable nuclear test reactors
  2. PHOEBUS - Extension of KIWI, designed to produce higher power levels and longer duration operations than KIWI reactors
  3. NERVA (Nuclear Engine for Rocket Vehicle Applications) developed the first nuclear rocket engine suitable for space flight; and
  4. 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

PHOEBUS 2A was the most powerful, non-flyable nuclear rocket reactor ever built

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.

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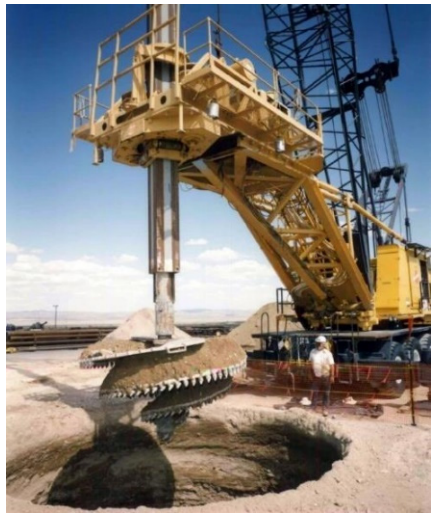
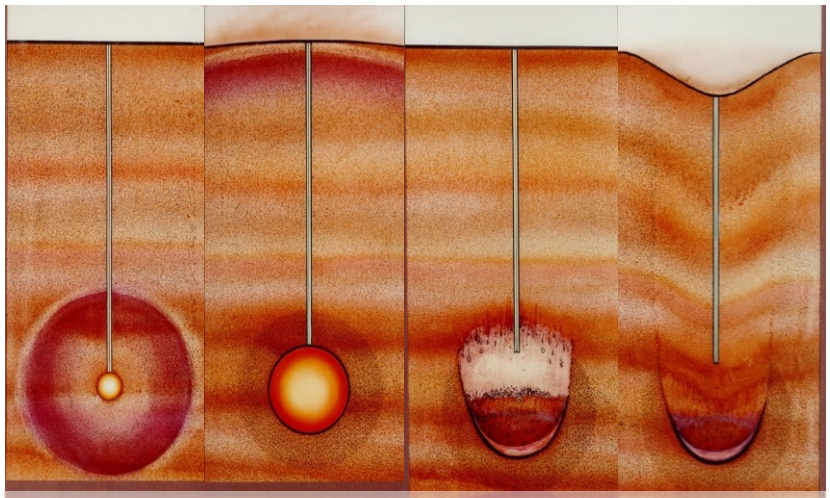
Underground Testing

- First underground nuclear test was *Uncle* on November 29, 1951
- Last underground nuclear test, *Divider*, detonated on September 23, 1992
- 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 Testing – Subsidence Crater Formation

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Thank You!

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