



*Managed and operated by  
Mission Support and Test Services*

# Capabilities For Global Security Solutions Resident at the Nevada National Security Site

November 13, 2019



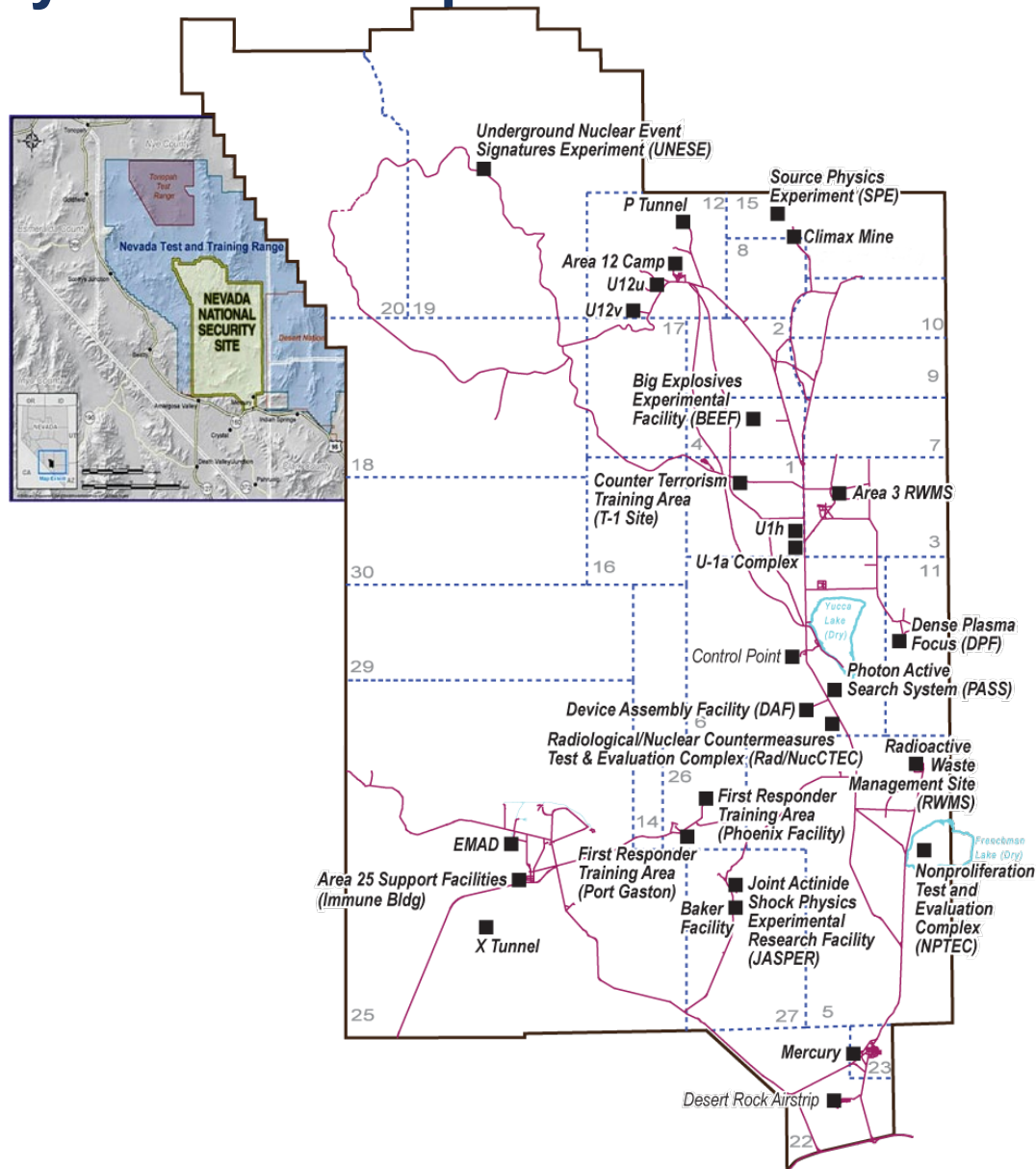
*The Nevada National Security Site is managed and operated by MSTs under contract number DE-NA0003624.*

- 
- NEVADA NATIONAL  
NINSS  
SECURITY SITE



# Nevada National Security Site – A Unique Natural Resource

- Ideal Location
  - Size
  - Remoteness
  - Free from encroachment
  - Safe and Secure
- Large: 1,360 square miles of federally owned land – Size of Rhode Island
- Surrounded by Nevada Test and Training Range
- Safe: Outstanding safety record; VPP Superior Star
- Diverse: Support a wide range of national security missions



# Locations of the NNSS and related facilities



# The NNSS supports many federal and local agencies



Department of Energy  
NNSA



The Intelligence  
Community



Department of Defense



Law Enforcement  
Community



Department of Homeland  
Security



FEMA



# The history of the NNSS.....

- ▶ 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



## 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

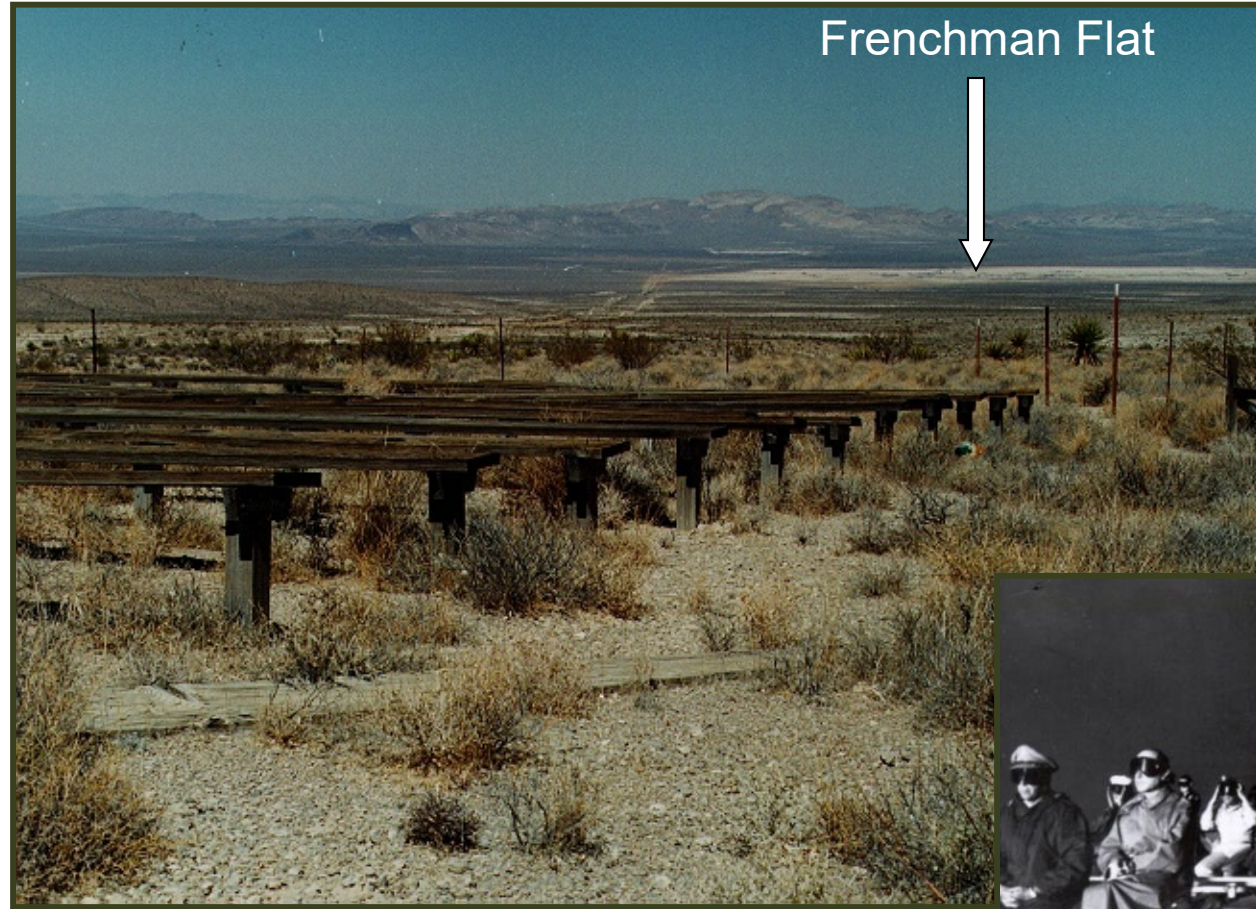


*Climax* – an airdrop test at the NNSS on June 4, 1953

## Frenchman Flat



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





**We protected the nation and advanced nuclear science then...**



**Atmospheric Test Priscilla, June 24, 1957  
detonated in Frenchman Flats**

**...and continue to do so today.**



**Vessel used in today's Sub-Critical  
Experiments**

# Missions of the NNSS

- ▶ The Nevada National Security Site helps ensure the security of the United States and its allies by supporting the stewardship of the nuclear deterrent, providing emergency response capability and training, and contributing to key nonproliferation and arms control initiatives.
- ▶ We execute unique national-level experiments, support national security customers through Strategic Partnership Programs, manage the legacy of the Cold War nuclear deterrent, and provide long-term environmental stewardship for site missions.

## Stockpile Stewardship



## Global Security



## Environmental Management



# Stockpile Stewardship

Ensuring a safe, secure and  
reliable nuclear stockpile





# We ensure the safety, security & effectiveness of the nation's nuclear weapons stockpile



05 Drift in U1a



U1a Breakthrough  
Infrastructure improvement

CYGNUS



# We team with the National Laboratories in national security weapon science

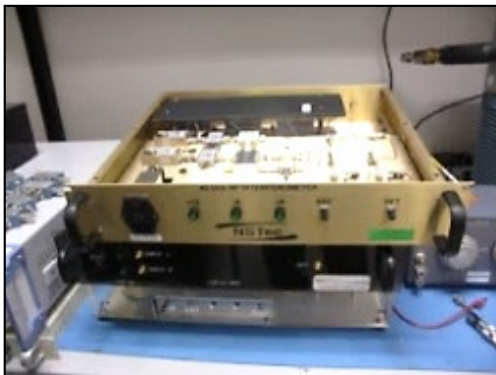
- ▶ **Experiment design and fielding** (including plutonium [Pu], other Actinides, and surrogates) in partnership with the three national laboratories
- ▶ **High-reliability, high-fidelity data capture** from hundreds of high bandwidth signals
- ▶ **Diagnostic research, development, and deployment** of next-generation detectors and instrumentation systems for a suite of weapons science and dynamic materials applications, including characterization and, where applicable, absolute calibration capabilities
- ▶ **Software and algorithm development** for capture and post-processing of data for both legacy underground test and modern experiments
- ▶ **Development of experimental platforms** for optical, X-ray, and neutron science applications





# We are a world leader in diagnostic development, fielding, collection, analysis

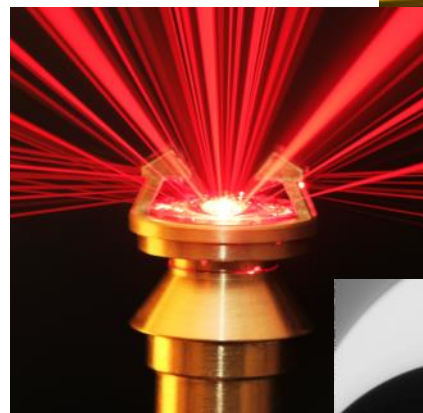
Supports SCE, JASPER, and a full suite of other Laboratories missions and platforms that provide crucial data to support stockpile certification, modernization, and annual assessment processes.



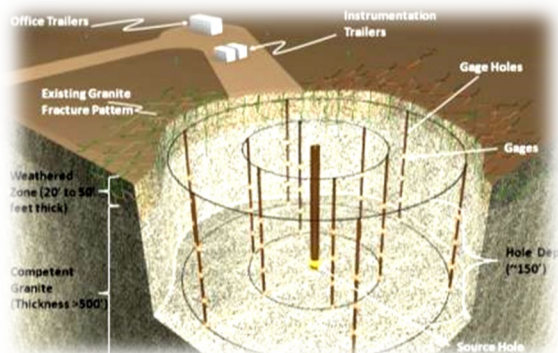
**Microwave Interferometry: RF Velocity Detection**



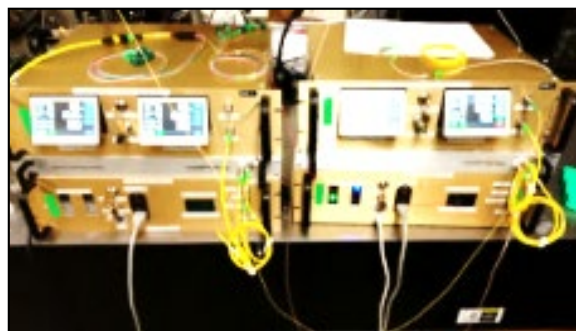
**Kirana Camera Testing**



**Next-Gen MPDV Optical Probes**



**Timing & Firing - Source Physics Experiments (SPE)**



**Optical Ranging System to be fielded on upcoming SCE**



**Cygnus Radiograph of a multi-faceted calibration target**



# Eight time recipient of R&D100 awards in the last decade



## **2009 Winner**

*High-Resolution UV Holography Lens for Particle Size Distribution Measurements*

## **2010 Winner**

*Movies of eXtreme Imaging Experiments*

## **2012 Winner**

*Multiplexed Photonic Doppler Velocimeter*



## **2013 Winner**

*KiloPower (with LANL)*

## **2015 Finalist**

*Argus Fisheye Velocimetry Probe*

## **2017 Winner**

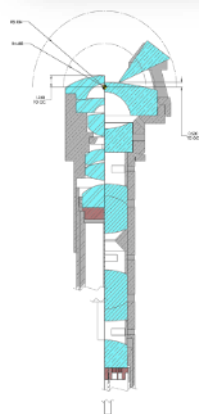
*Geometrically Enhanced Photocathodes*

## **2018 Winner**

*Silicon Strip Muon Detectors*

## **2019 Finalist**

*Man-Portable Dense Plasma Focus for Neutron Interrogation Applications*



# Each of our locations have unique capabilities supporting Stockpile Stewardship

## Core Competencies:



Los Alamos Office  
Los Alamos, NM

- High-speed electro-optical instrumentation
- Optics and fiber-optic systems
- Modeling and data analysis
- Photonics and electronic imaging
- Data Analysis



Livermore Operations  
Livermore, CA

- National Institute of Standards and Technology accredited x-ray, optical, and high energy laser calibration labs supporting High Energy Density (HED) diagnostics
- Sole U.S. capability for custom photomultiplier tube fabrication
- Calibration source development
- Modeling and data analysis



Sandia Office  
Albuquerque, NM

- Radiographic source development
- Mechanical design for Z containment
- Shock physics diagnostic development
- Velocity Interferometer System for Any Reflector (VISAR) and radial Photonic Doppler Velocimetry (PDV) development and fielding

# Each of our locations have unique capabilities supporting Stockpile Stewardship (continued)

## Core Competencies:



Special Technologies  
Laboratory  
Santa Barbara, CA

- Imaging experiments and analysis
- Dynamic shock experiments
- High-band width instrumentation and communication
- X-ray diagnostic development and calibration
- Diagnostics for emissivity and temperature measurements
- Optical Velocimetry development

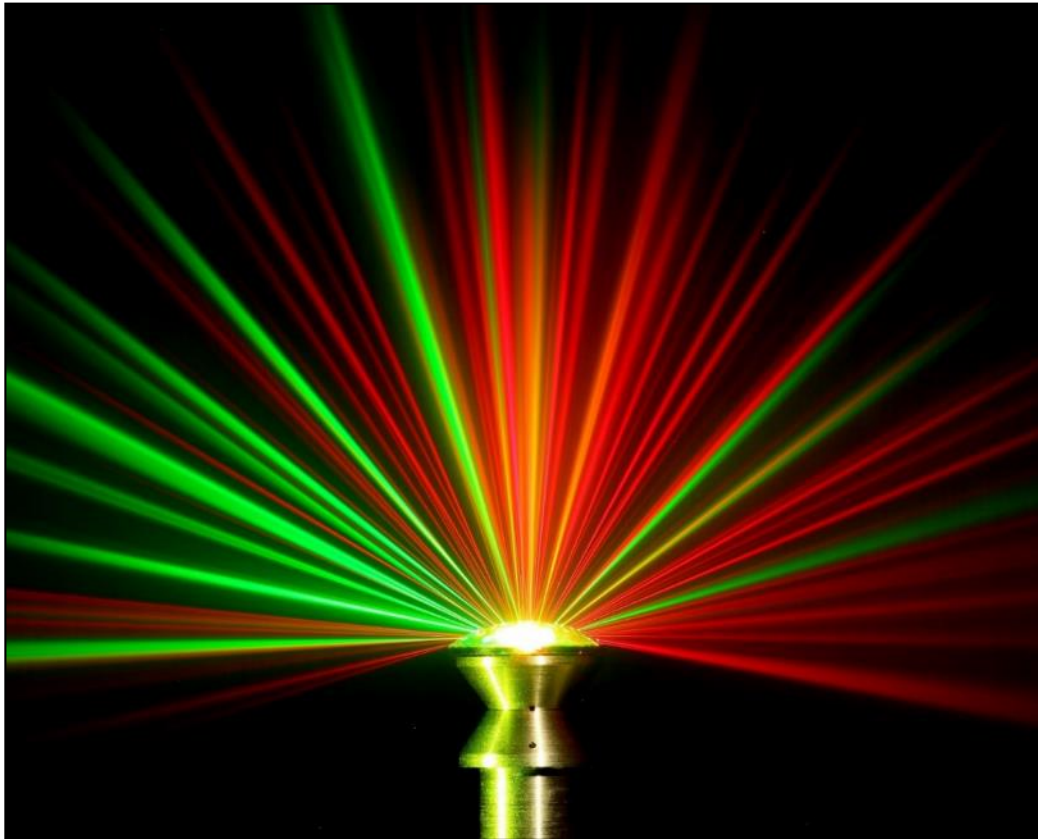


North Las Vegas and  
NNSS

- Timing & Firing / Control Systems Development / Fielding
- Electro-Optics, Fiber Systems, Optical Arrays
- Pulsed Power, Radiography, and Detector Systems
- Photomultiplier Tube and Photodiode (PD) based Detector Development and Characterization
- Feed-through development
- Pulsed Neutron Source (Dense Plasma Focus) User Facility
  - Potential use in reactivity experiment – facility, detector, and experimental geometry
- Platforms & Infrastructure: e.g., U1a, DAF, JASPER, BEEF



# We develop, and use, state-of-the-art diagnostic systems as part of our experimental programs



## ► Argus Probe

- High-speed optical diagnostic tool that captures hundreds of data points simultaneously
- The optical probe is ~1 cm in diameter and has several hundred individual fibers

# Our workforce and infrastructure enables the nation's ability to certify the stockpile

- ▶ An integrated team of engineers, technologists, and scientists from across the Nuclear Security Enterprise
- ▶ All systems functioned as expected, and 100% data was returned
- ▶ Data useful to answer questions related to materials science, future stockpile options, certification and pit reuse program

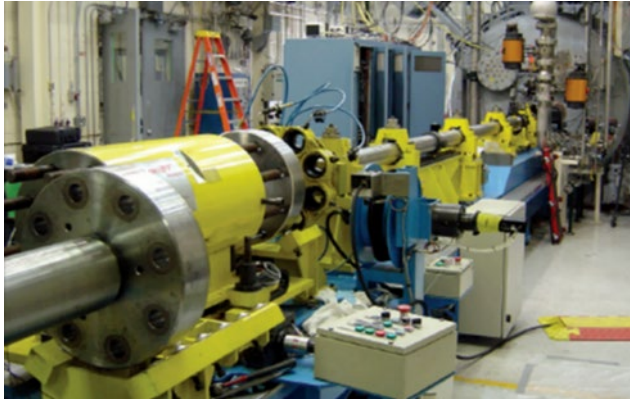


The Vega Subcritical Experiment was successfully executed on December 13, 2017

***“Not all the features in the data are fully understood at this point, and this contributes to the richness of the results.”***

***- Garry Maskaly, LANL Principal Investigator***

# We advance the understanding of materials properties with Joint Actinide Shock Physics Experimental Research facility



JASPER Gas Gun



Breach



JASPER Shot 150 Team

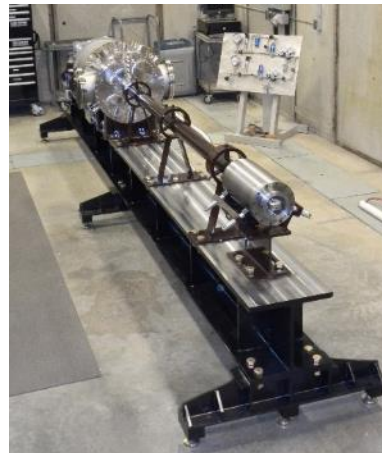


Secondary and Primary  
Containment Chamber



# New small gas launcher has made significant contributions as a training practicum for young scientists and engineers in methods of materials testing

- ▶ The C3 gas launcher has continued to make progress to train early career researchers
  - We have had them design, execute, and analyze simple experiments on iron and certain steel alloys to train them in fundamental shock physics research, and provide new equation of state (EOS) and strength data for these metals.
  - These experiments are important precursors for doing future experiments



3" bore gas launcher

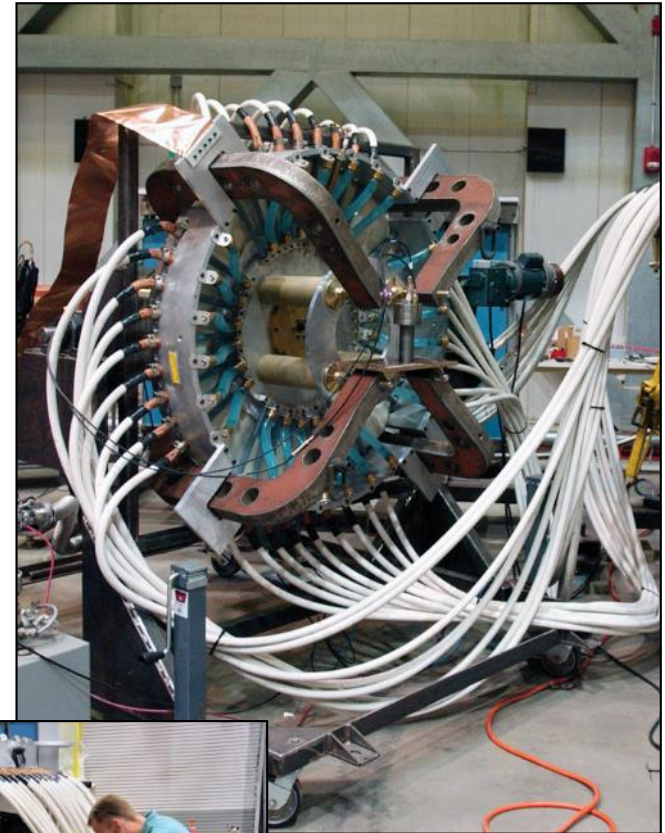


## We develop state of the art diagnostic capabilities science with Dense Plasma Focus (DPF) facility

- ▶ DPF is a pulsed power machine that produces high intensity bursts of neutrons
- ▶ DPF devices can be used as an external neutron diagnostic source during subcritical experiments and other High Energy Density plasma experiments



Dense Plasma Focus tube with close in detectors



DPF Machine





# The Device Assembly Facility (DAF) is a national asset well suited to address new national challenges

- ▶ 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 target
  - Support to stockpile surveillance program with the coring and large-scale capabilities testing projects



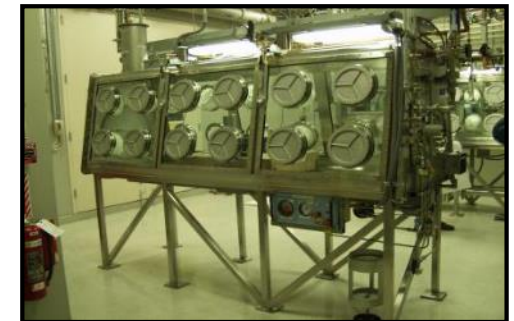
DAF Facility



Downdraft Table



Radiography Building



JASPER Glovebox



# We conduct experiments on high explosives at the 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
  - Exercises design and experimental skills resident in primary groups at the national laboratories



Bunker



# Global Security

# 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: Treaty monitoring and compliance technologies
  - 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



# We conduct Source Physics Experiments aimed at improving arms control and nonproliferation treaty verification

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



Source Physics Experiments Phase I (left) and Phase II (right)

# Phase II of SPE involves shots in Dry Alluvium Geology (DAG) shots are bigger, deeper, shot in rapid succession!

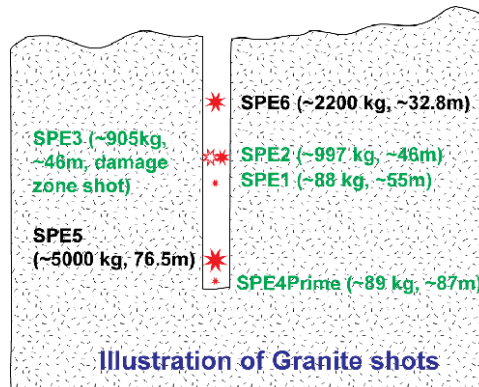


**Bigger**

**Deeper**

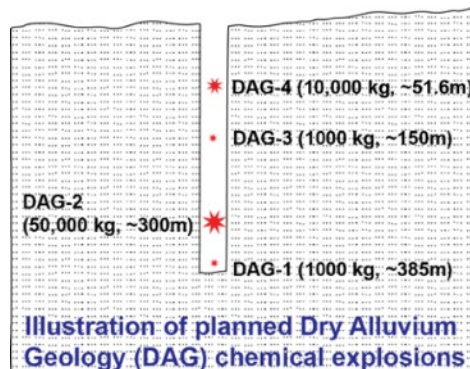
**Faster**

**Phase I  
SPE**



SPE Phase I	
Num. of shots	Time window
6	FY10-FY16

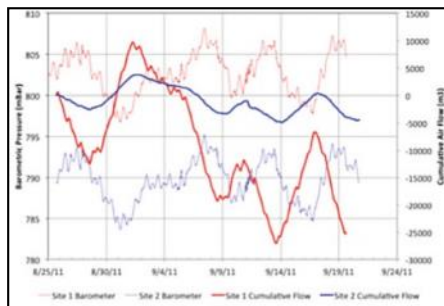
**Phase II  
DAG**



SPE Phase II (DAG)	
Num. of shots	Time window
4	FY18-FY19

# Underground Nuclear Explosion Signatures Experiment (UNESE) will be focused on post-detonation signatures

- ▶ Multi year R&D project
- ▶ Address scientific knowledge gaps associated with nuclear explosion verification and nuclear nonproliferation
- ▶ Scientific knowledge and capabilities developed during UNESE will help to better detect, locate, and identify underground nuclear explosions
- ▶ R&D results will be applicable in current and future verification and nonproliferation contexts and as a deterrent factor for potential proliferant nations



UNESE monitoring



UNESE automated surface samplers



# Non-Proliferation Test and Evaluation Complex (NPTEC) allows the study of large quantities of toxic material – safely and without damaging the environment

## ► 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

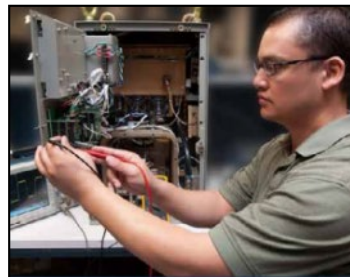


## ► Work performed:

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



# Deployable national assets with the mission of detecting and locating nuclear and radiological sources



# Remote Sensing Laboratory (RSL-N and RSL-A)

## *Nellis Air Force Base and Andrews Joint Base*



**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**

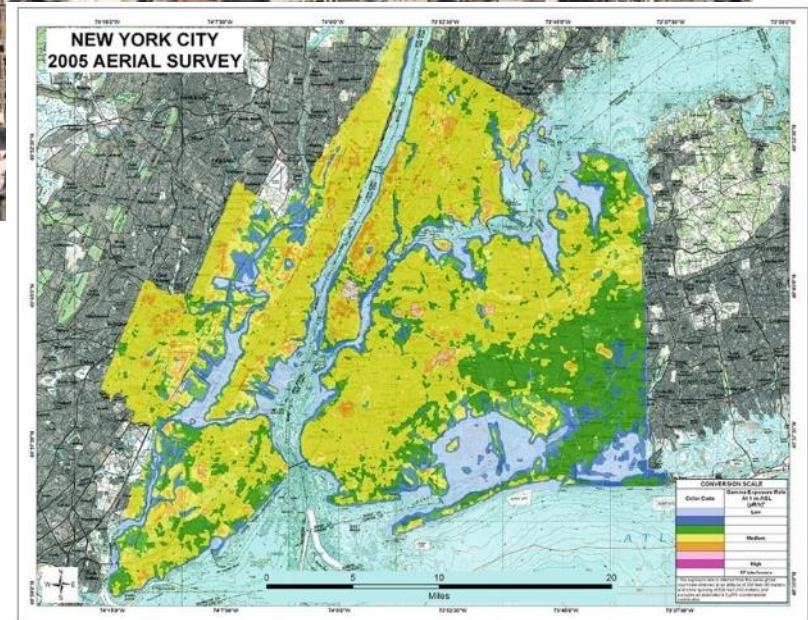


**Aircraft – Unique Aerial Detection Capabilities**

**Global Response Capabilities (ex. Fukushima)**









# First responder training for radiological and nuclear emergencies

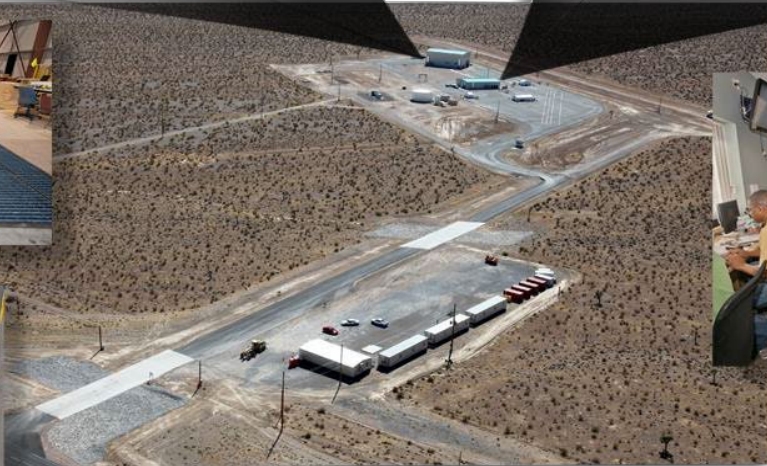


T-1 Test  
in 1955



# We advance radiological and nuclear sensor technology at the Radiological/Nuclear Test and Evaluation Complex

State-of-the-art facility for evaluating detection technologies in a realistic environment against realistic materials



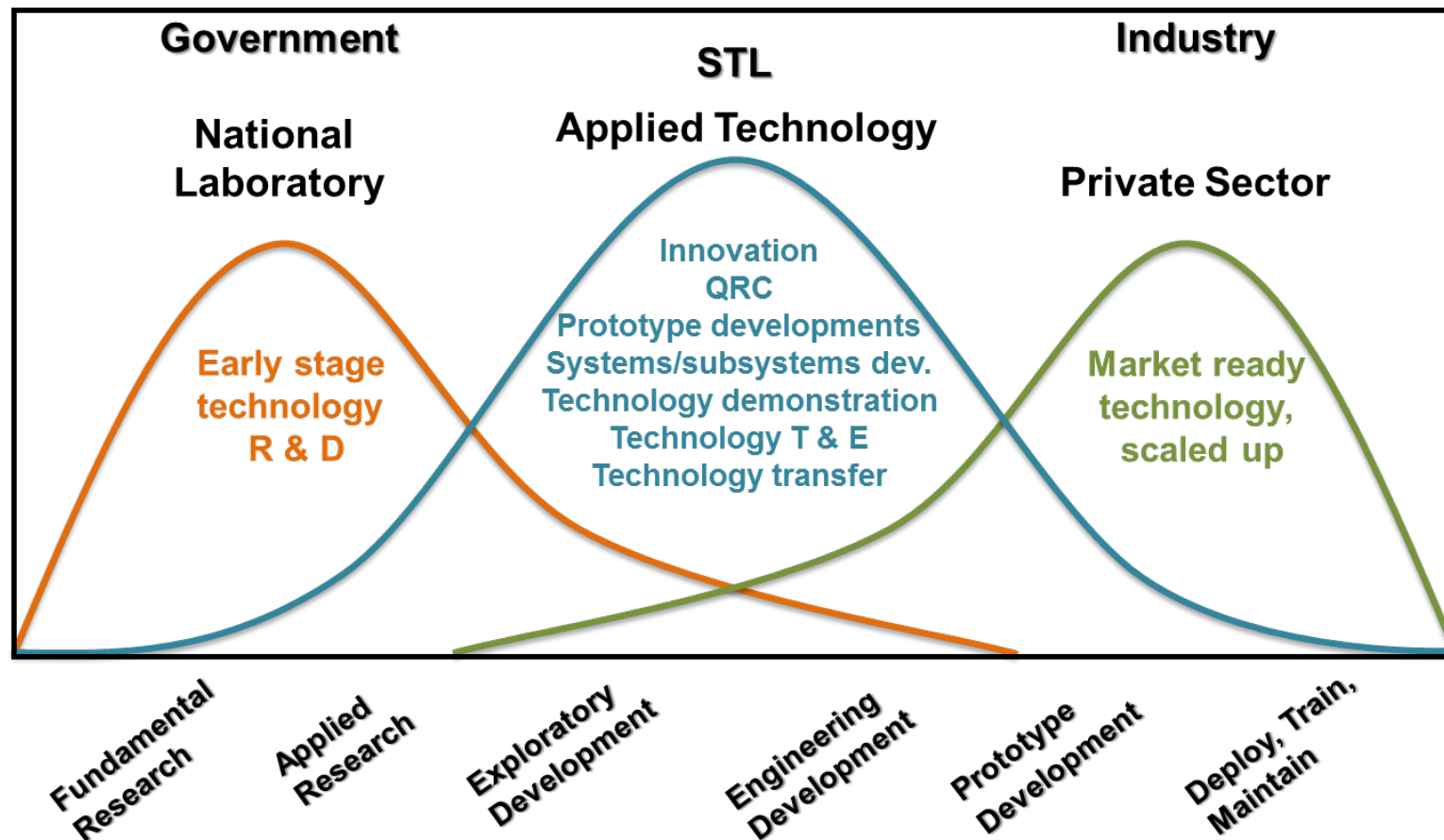


# Training at the Radiological/Nuclear Countermeasures Test and Evaluation Complex (RNCTEC)

- 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

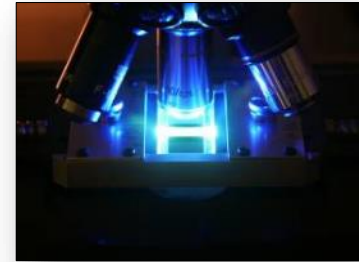


# Special Technologies Laboratory – An Incubator of Technology



# STL – capabilities supporting National Security missions

- ▶ Bridges the gap between national laboratory R&D and private industry deployment through:
  - Applied Engineering
    - Sensors; communications & RF; software systems; unmanned aerial systems
  - Integrated Device and Systems Solutions
    - System Integration Development; Rapid Development Cycles; Field Support
  - Non-Proliferation Research and Development – Research then develop diagnostics, sensors and systems supporting National Security missions
  - Experimental Physics – helping the national laboratories make better measurements
  - Electronic & Mechanical Prototype Fabrication
    - Complete in-house electronic design and development



Material Identification



Electronic Prototype

**Multi-disciplinary teams specialize in focused development of special-purpose devices, measurement instruments, and analysis methods tailored to the needs of the end-user**



# Global Security Autonomous Solutions – Integrating Unmanned Systems



# MSTS Environmental Waste Program



# Waste Management

- ▶ MSTS operates the RWMC, disposes low-level radioactive, mixed low-level radioactive, and classified waste from on-site activities, and various DOE and Department of Defense related activities





## We are able to dispose of classified components for the complex at the RWMC

- ▶ The classified component disposal program at the RWMC is for components that have been declared excess to national security requirements
- ▶ The NNSS has the only approved disposal site that accepts classified matter without sanitization



Items being inventoried prior to packaging



Packaged Spent JTA  
Center Sections

# Supporting Site Services

## Our North Las Vegas Machine Shop contributes significantly to the Experimental Program

- ▶ The A-1 Machine Shop provides services for classified and unclassified components in support of a broad spectrum of missions
- ▶ Maintain the capabilities/resources for precision machine fabrication, dimensional inspection, welding, assembly and perform acceptance pressure testing as a national security manufacturing asset
- ▶ Aging machines will continue to be evaluated for upgrade or replacement needs and future investment
- ▶ Evaluating long-term business model, capabilities and location to support future missions



SCE vessel (assembly parts support)



PTC loaded at JASPER (PTC fabrication)



## MSTS's Site Services Organization:

- ▶ Provides quality, efficient services to programs and operations at the Nevada National Security Site in the areas of:
  - Housing, Feeding, and Custodial services
  - Power Operations
  - A-1 Machine Shop
  - Bus Services
  - Fleet, Fuel and Heavy equipment
  - Inspection Services (Hoisting and Rigging)
  - Roads, Grounds, Water and Waste Services
  - Asset & Material Management

# Infrastructure

# NNSS Realities – the challenges



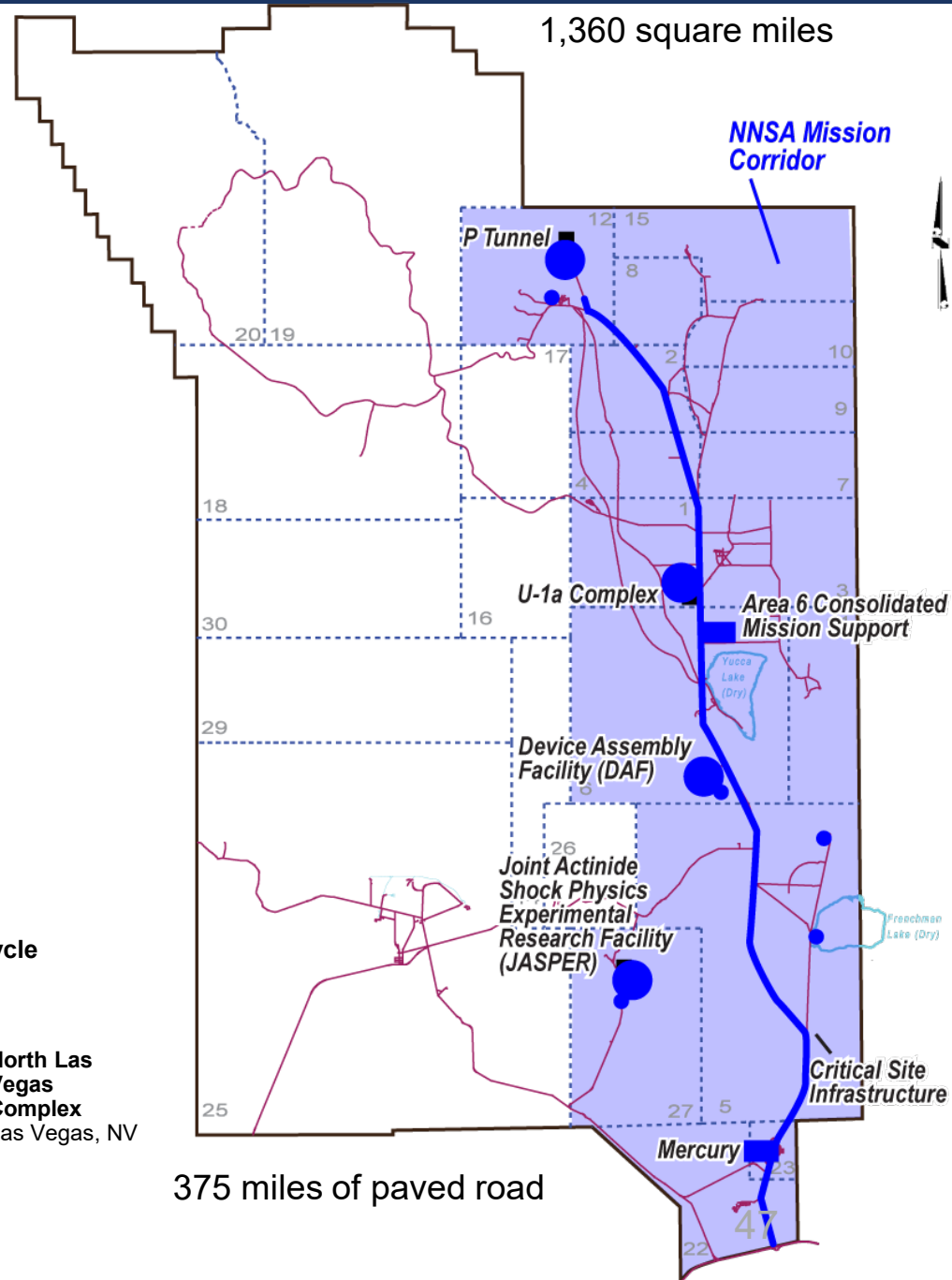
433 Buildings, including 4 major nuclear facilities  
DAF – ARGUS/PECOS



\$254M in Deferred Maintenance  
Communication system past supportable life-cycle



North Las Vegas Complex  
Las Vegas, NV





# NNSS Infrastructure Strategy/Plan is a Site Imperative

NNSS is leveraging our unique capabilities and modernizing to a smaller, more efficient and capable infrastructure that reduces risk and cost, saves energy, enables current and future missions, and enables a 21<sup>st</sup> Century workforce



Management  
Processes

- Integrate and optimize infrastructure resources by centralizing prioritization, planning and budgeting
- Align with/support sponsor initiatives
- Invest in tools and resources to dramatically upgrade planning capabilities



Workforce

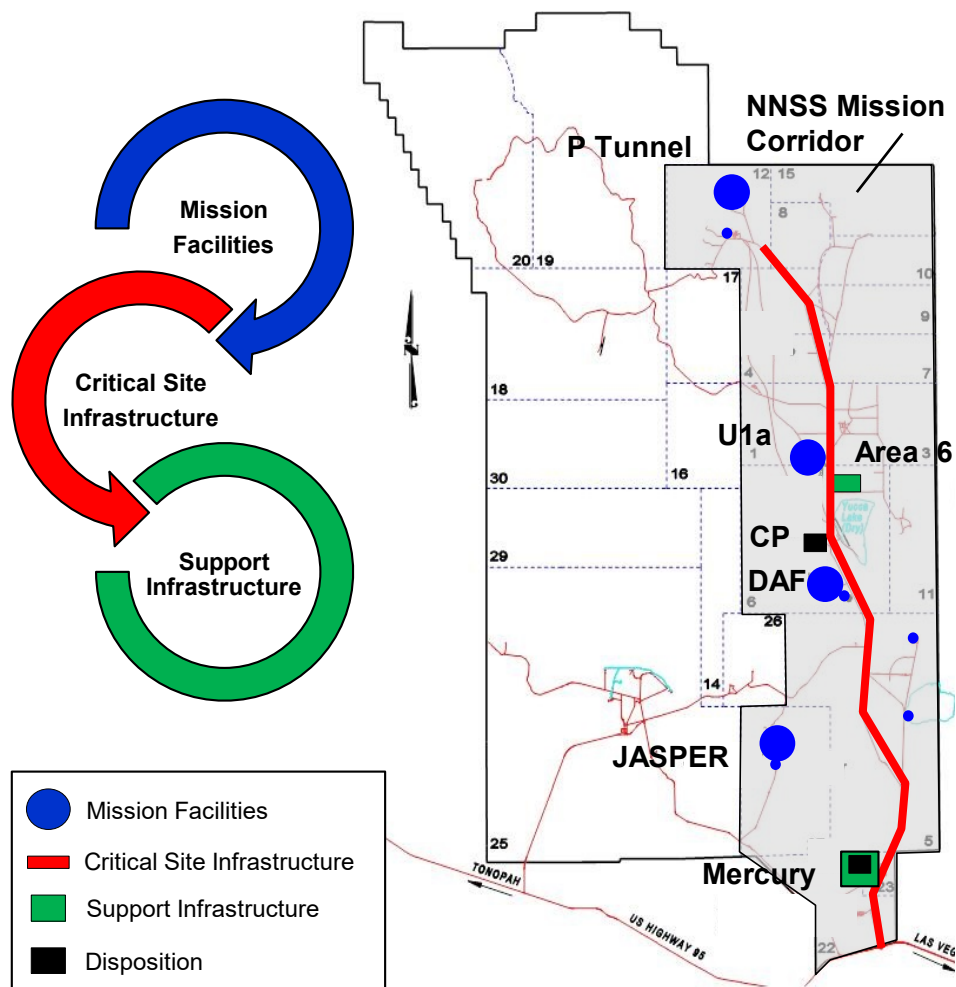
- Recognize our people are our most precious asset
- Provide an environment that fosters productivity and innovative thinking to enable professional growth
- Ensure workforce has required knowledge, training and tools to effectively manage our infrastructure



Physical  
Infrastructure

- Ensure safe, secure and compliant operations to execute program deliverables
- Reduce unneeded assets and recapitalize enduring infrastructure and facilities
- Integrate, balance and optimize within and across mission facilities, critical site and support infrastructure

# NNSS Infrastructure Strategy and Plan addresses three physical infrastructure elements



## Mission Facilities:

- Nuclear
- Radiological
- High-Security
- High-Hazard
- Experimental



## Critical Site Infrastructure:

- Power
- Water
- Transportation
- Communication / IT
- Land

[Depicted here as primary utilities running along Mercury Highway]



## Support Infrastructure:

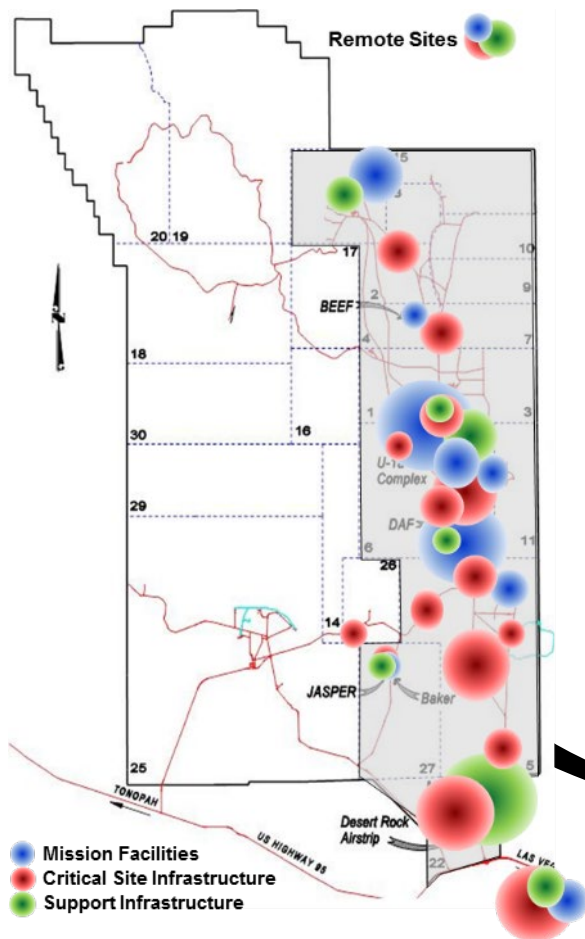
- Offices
- Warehouses
- Support Facilities
- Industrial
- Balance of Plant



## NNSS Infrastructure employs an integrated management approach to optimize our assets and funding

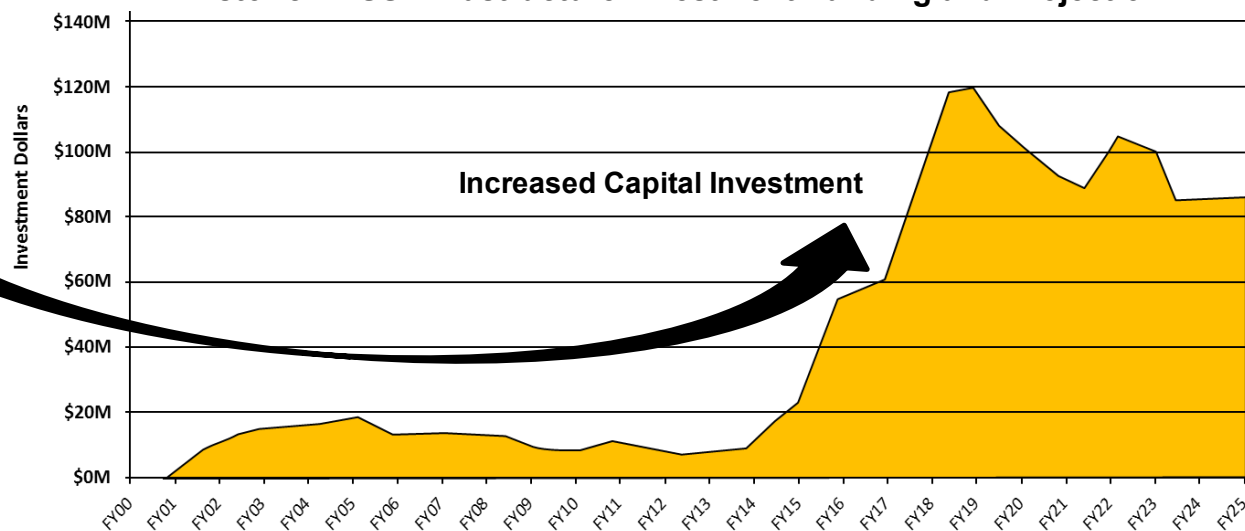
# Capital Investment Planning and Execution are growing significantly

## “Heat Map” of Mission and Infrastructure Investments



- ▶ Long awaited Infrastructure investments are critical to NNSS mission execution and site sustainability
- ▶ Represent a major challenge and opportunity for the site
- ▶ NNSS management, planning, integration and execution systems and processes must be improved to enable this work which is critical for our missions and site sustainability
- ▶ Must be balanced and optimized based on priority, access/readiness and resource availability

Historic NNSS Infrastructure Investment Funding and Projection





# Informational Materials

# Find us at NNSS.GOV and other media below



## Reference Materials

Link to NNSS.gov Fact Sheets

<http://www.nnss.gov/pages/resources/library/FactSheets.html>