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Title:	Weapons Engineering Directorate Overview
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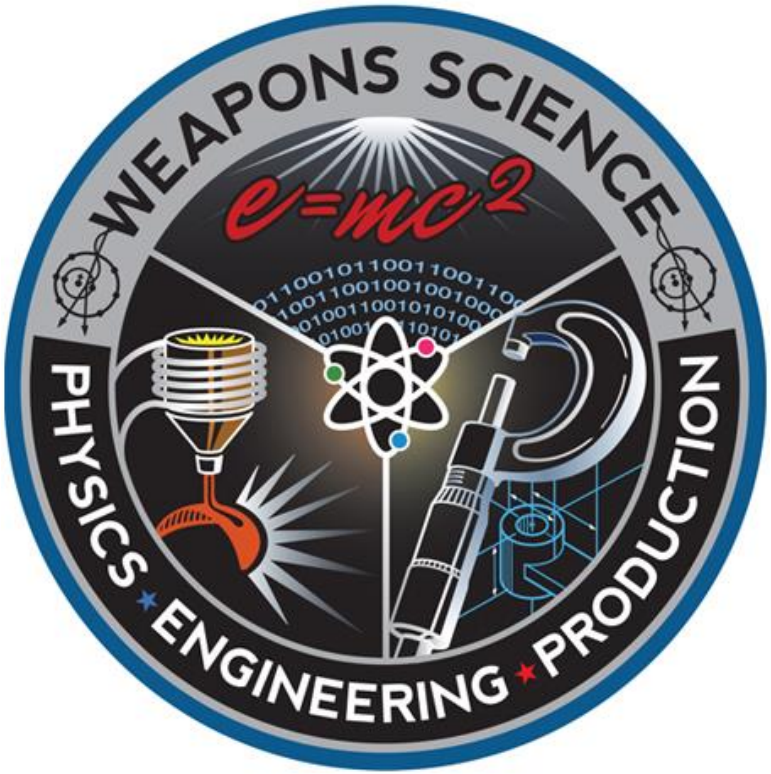
Nuclear Fundamentals Orientation Module 1

Weapons Engineering Directorate Overview

Managed by Triad National Security, LLC for the U.S. Department of Energy's NNSA

Weapons Engineering Directorate Overview



Presentation Overview:

- Lab Agenda
- Organizational Structure
- Key Areas of Focus
- LANL Nuclear Weapon Engineering Elements
- Weapon Systems
- ALDW Divisions – Programs & Capabilities
- References and Recommended Reading
- Summary
- Questions

The 2022 Lab Agenda

- **Mission**

To solve national security challenges through simultaneous excellence.

- **Vision**

To be trusted by our nation, emulated by our peers, and respected by the world.

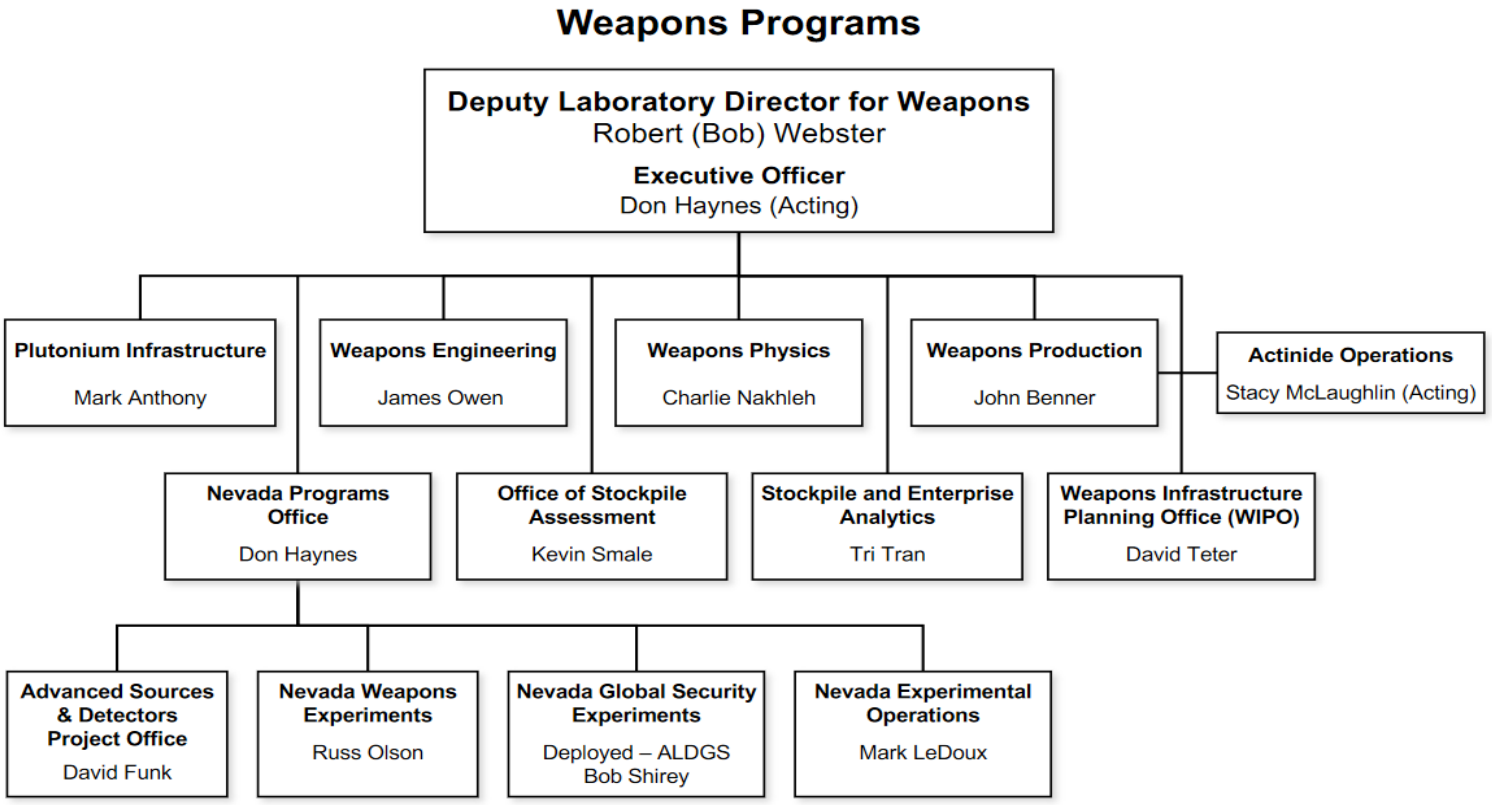
- **Culture**

How we do work is as important as *what* we do.

- **ALDW's Responsibility – Nuclear Deterrent**

Lead the nation in evaluating, developing, and ensuring effectiveness of our nuclear deterrent, including the design, production, and certification of current and future nuclear weapons.

DDW Organizational Structure



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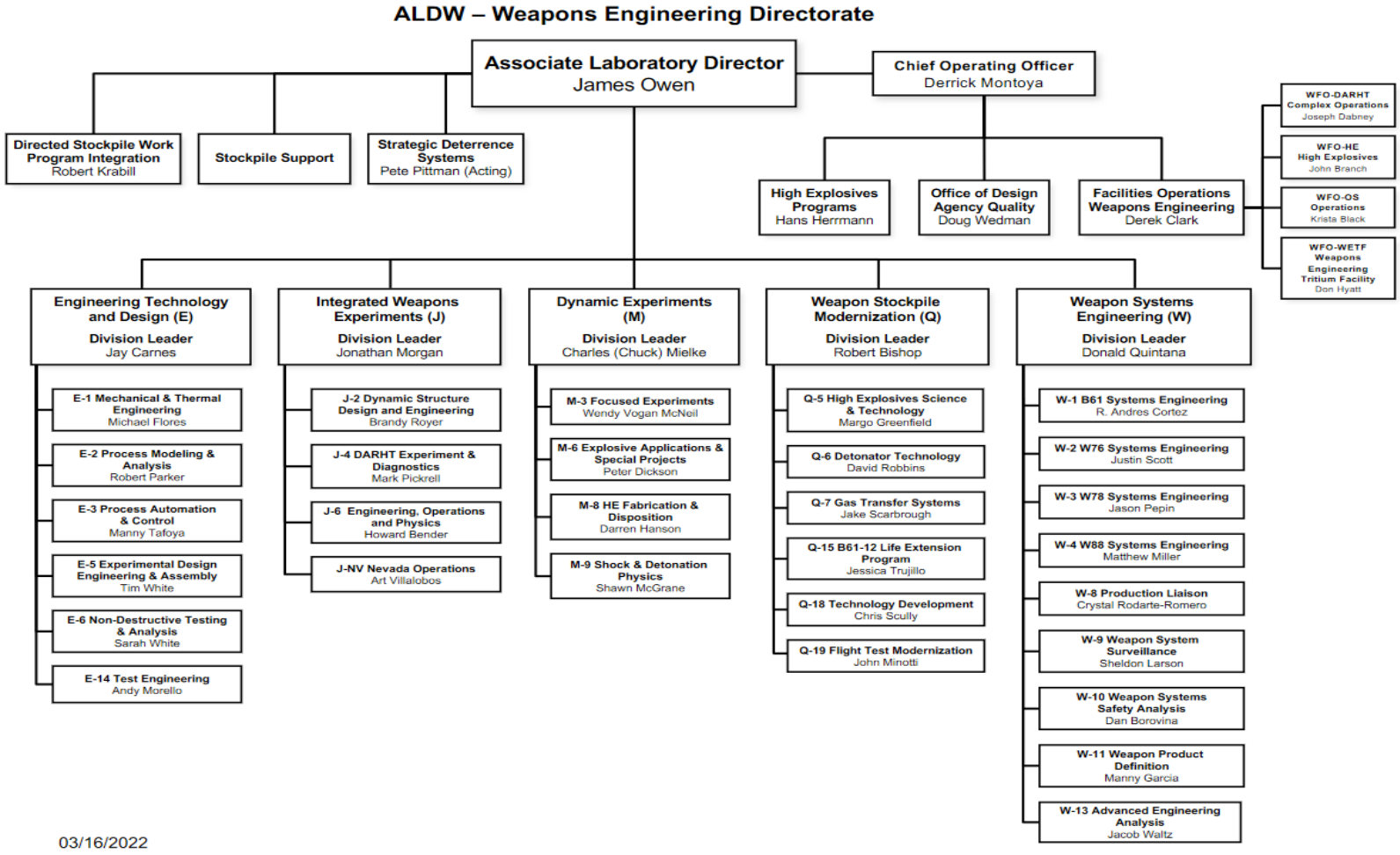
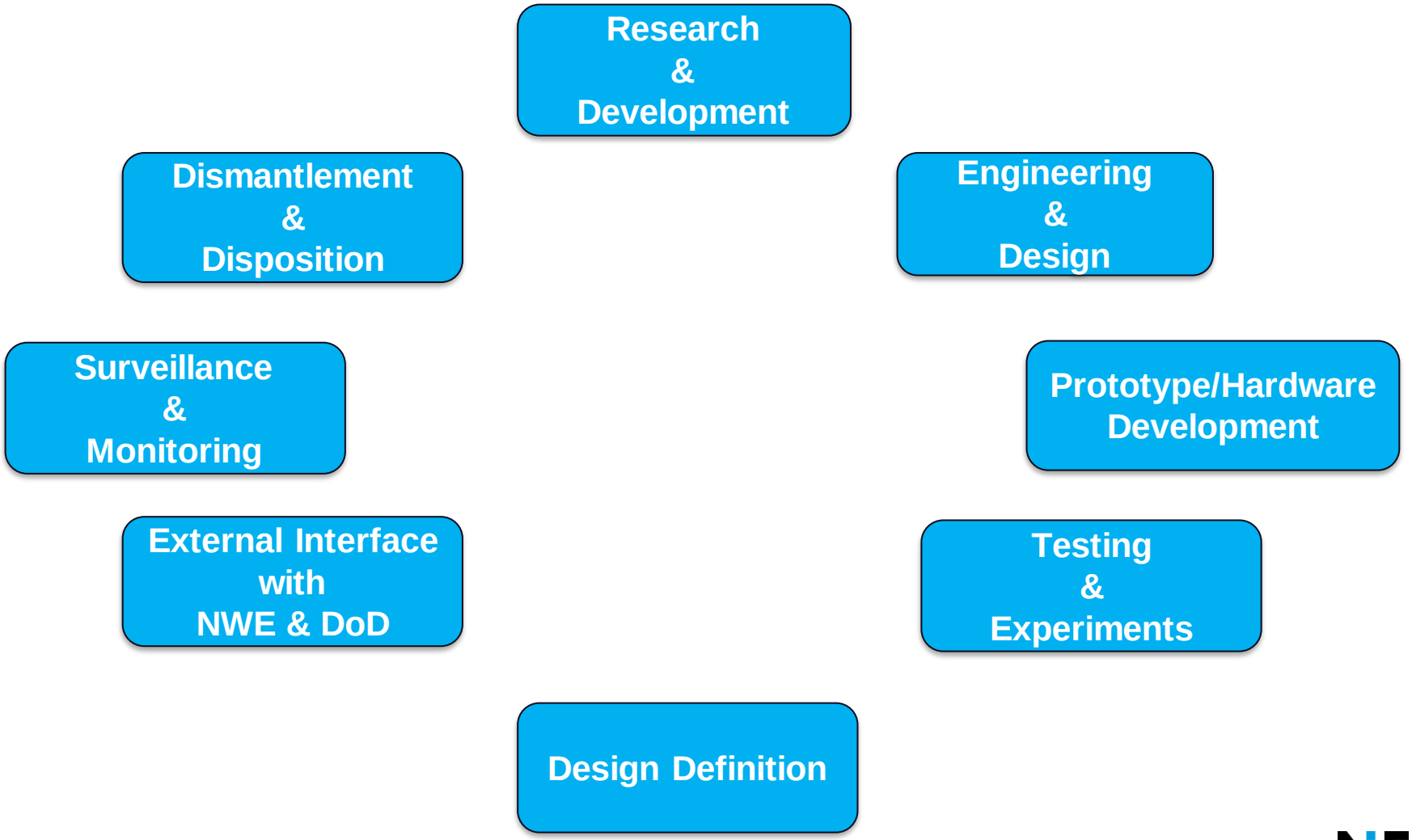
ALDW Organizational Structure



ALDW Key Areas of Focus

- **Serve as design agency for weapons**; ensure design, development, qualification and surveillance processes comply with NNSA Policy Letter NAP-24A, "*Weapon Quality Policy*"
- House explosives research and weapons engineering, assembly, and test infrastructure in 17-square miles dedicated to national security mission
- Six divisions comprised of ~ 1,000 regular employees dedicated to the integrated planning and execution of the stockpile stewardship program
  - Sustain the majority of deployed U.S. nuclear weapons
  - Lead major warhead-modernization efforts (B61-12 LEP, W76-1 LEP, W88 Alt and Refresh Programs)
  - Large scale integrated experimental program is growing with enhanced capabilities at the Nevada National Security Site
- Responsible for Directed Stockpile Work Program Integration, Explosive Safety Program, and Office of Design Agency Quality
- Apply outstanding capabilities to other customer needs and help smooth out the natural fluctuations in large stockpile activities, e.g. LEPs
- Ensure program excellence

LANL Nuclear Weapon Engineering Elements

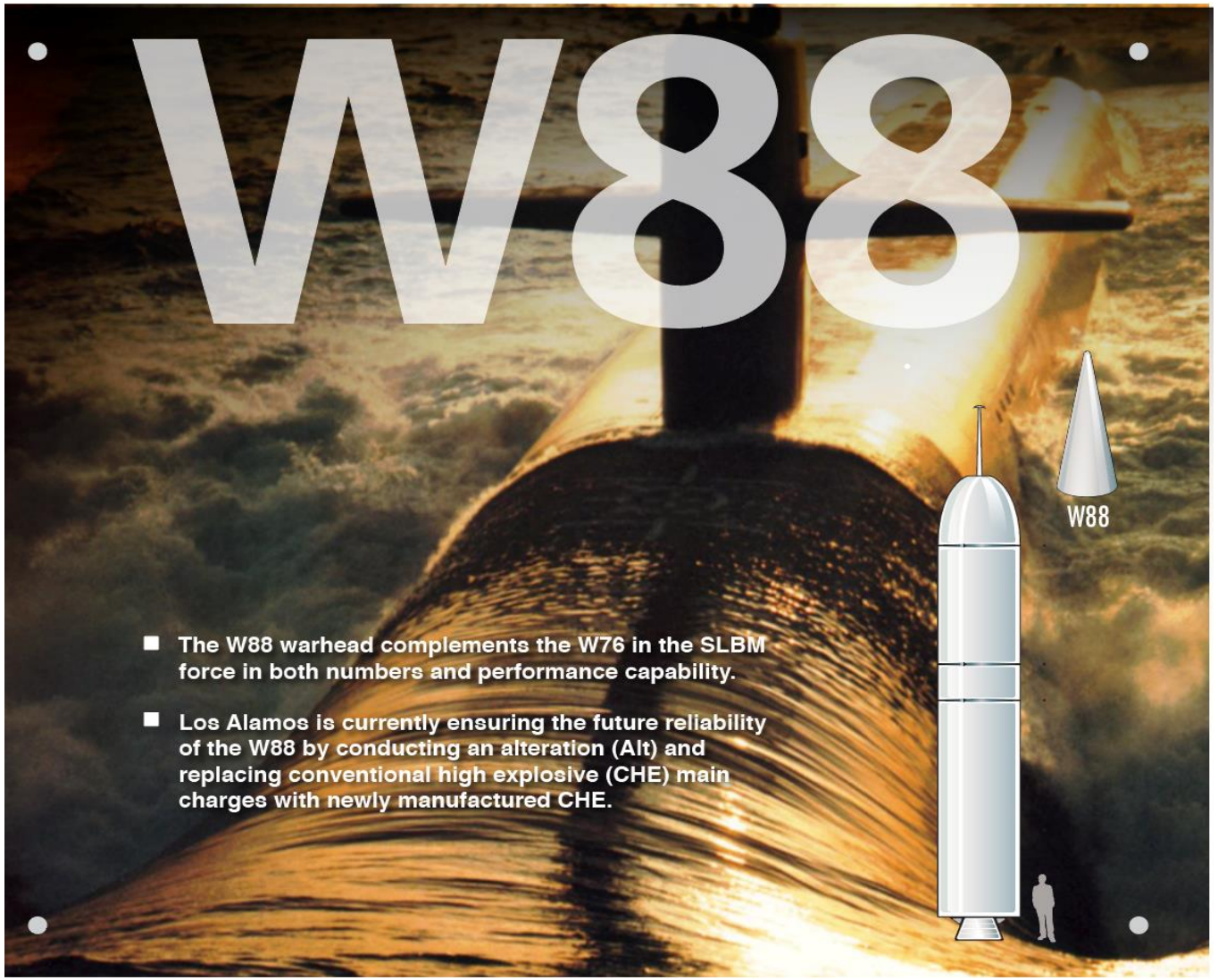


Weapon Systems – W76

Weapon Systems – B61

Weapon Systems – W78

Weapon Systems – W88



Weapon Systems – W93

- The W93 is a future system for the Navy
- It will be carried on both Ohio- and Columbia-class submarines
- According to the NNSA's fiscal year 2021 Stockpile Stewardship and Management Plan, "The W93 will address future Navy ballistic missile requirements. The W93 will incorporate modern technologies to improve safety, security, and flexibility to address future threats and will be designed for ease of manufacturing, maintenance, and certification."
- Expected to enter the stockpile in the mid-2030s

Weapon Systems Engineering – W Division

- **Overview**

  Provides the system engineering and program management necessary to sustain the safety, reliability, and security of the Laboratory's assets in the active U. S. nuclear stockpile – the B61, W76, W78 and W88. The Division generates key certification data for annual assessments supporting the Laboratory director's letter to the president of the United States on the health of those warheads. This role demands ongoing surveillance of the active stockpile and evaluation of the potential impact of any issues through design, engineering, fabrication, and testing using state-of-the-art computational simulation tools, and engineering test facilities.

  Works in close liaison with the production facilities across the nuclear security complex as well as with the customers in the U.S. Navy and U.S. Air Force. The Division continually invests to advance the capabilities underpinning its mission in engineering, explosives safety, and security.

Engineering & Design | **Design Definition** | **External Interface with NWE & DoD** | **Surveillance & Monitoring** | **Dismantlement & Disposition**

W Division

W Division Capabilities

- Advanced engineering analysis
- Designer/drafter
- Engineering
  - Quality
  - Requirements
  - Software
  - Surveillance
  - Systems
  - Test
- Ground, flight, and hydrodynamic qualification testing
- Military liaison
- Nuclear Explosive Package (NEP) design, system engineering, and system integration
- Nuclear explosive safety
- Production liaison
- Use Control
- Weapons Response

Weapon Stockpile Modernization – Q Division

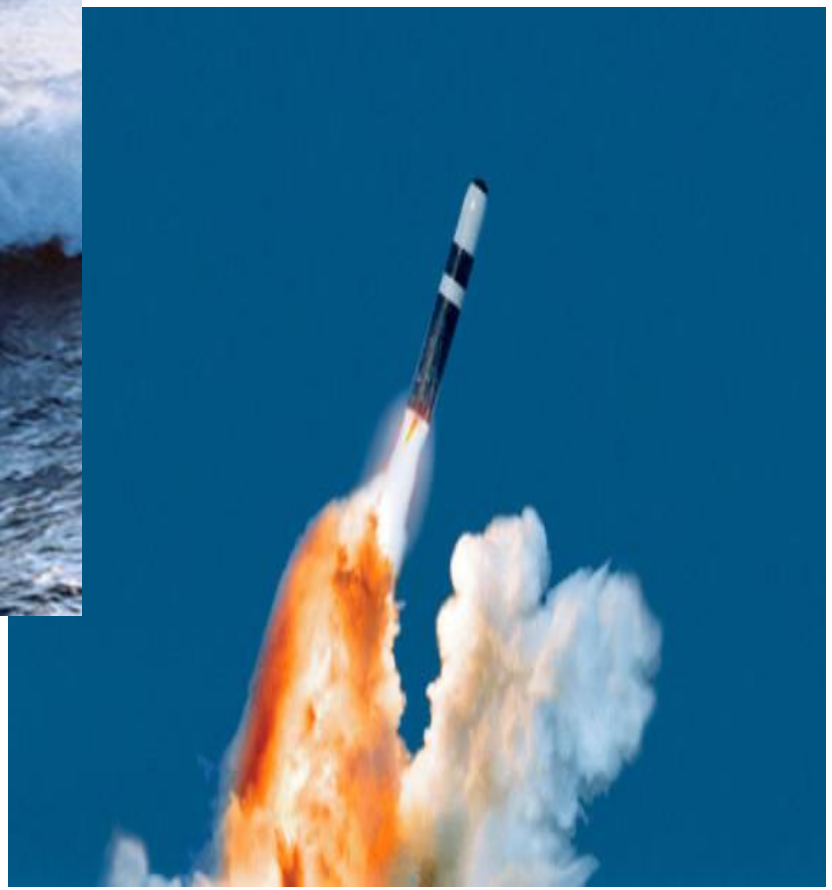
Overview

Brings its system engineering and program management expertise and state-of-the-art simulation and experimental capabilities to roles ranging from basic and applied research and development; component technology conceptualization and maturation; through to sub-system and system testing of flight and integrated performance. These are applied to:

1. Modernization of the stockpile through support of the current programs of record; the B61-12 and W88 ALT 370/940.
2. Stockpile and component surveillance and associated testing and analysis as well as the resulting technology development to extend the life of the current stockpile.
3. Support of development of future DOD programs by broadly anticipating the scope of possible future modernizations and advancing/maturing relevant science and technologies.

To execute these roles the Division efforts are divided into several major activity areas: High Explosive Science Technology; Detonator Powder Production; Initiation System and Detonator Science, Design and Engineering; Gas Transfer and Advanced Surety Science, Design and Engineering; Weapon System Engineering; Advanced Nuclear Explosive Package Design; and Flight and Integrated Testing. The Division works in close liaison with NNSA and particularly with the several production facilities across the nuclear security complex as well as with the major mission customers in the US Navy and Air Force.

Q Division



Q Division Capabilities

- Advanced surety and safety systems
- Analytical chemistry
- Data processing, environmental analysis, and requirements development
- Development of Safety and Surety Architectures and Assessment Methodologies
- Firing system, detonator, and actuator design
- Gas transfer system (GTS) and GTS related design
- Ground, flight, and hydrodynamic qualification testing
- High Explosive (HE) Science
- NNSA business practice execution
- Nuclear Explosive Package (NEP) design, system engineering, and system integration
- Processing, characterizing, and examining new and traditional HE
- Small-scale safety, sensitivity, & performance testing of energetic materials

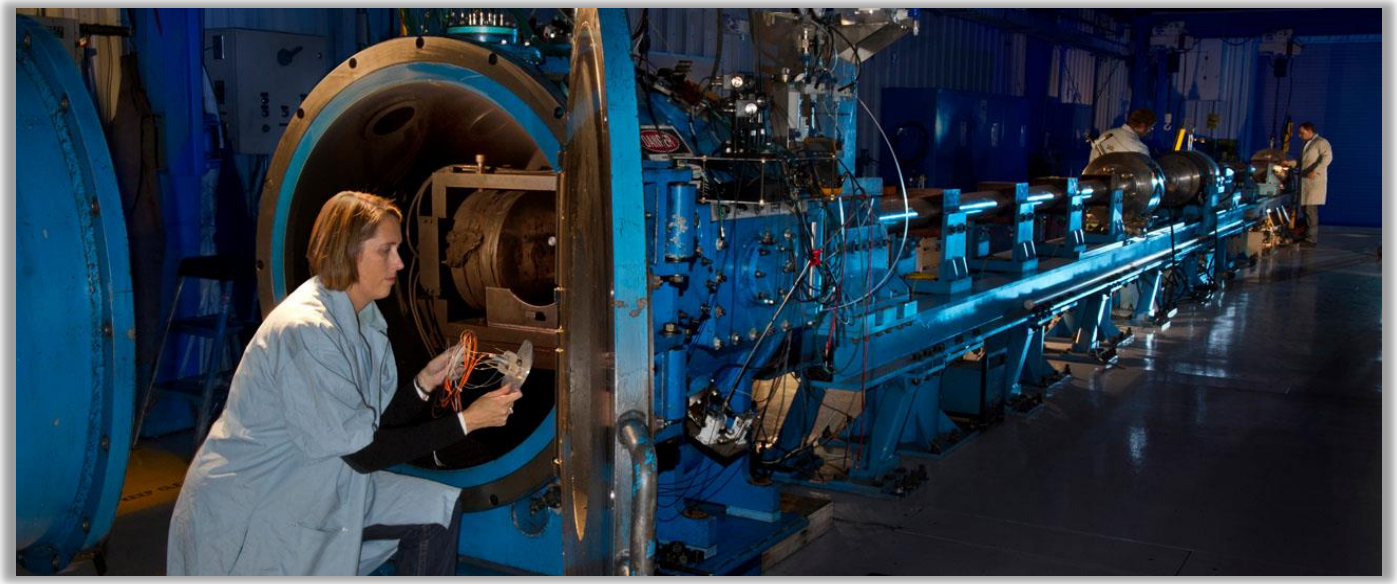
Dynamic Experiments – M Division

Overview

Dynamic Experiments (M) Division is responsible for current and evolving explosive science and shock physics efforts as well as High Explosive fabrication, disposition and execution of hydrodynamic experiments. We support National Security through the characterization and application of energetic materials and understanding material response at extreme conditions to address conventional, nuclear, and homeland defense needs. The Division has a diverse portfolio of research, development, and application projects involving the dynamic properties of inert and reactive weapons materials. Competencies include the physics of shock waves in inert and energetic materials (EM), pressing, machining and inspection of EM into research and development (R&D) weapon system test components as well as R&D of EM, the shock initiation and detonation physics of explosives, the response of explosives to stimuli including electrical, chemical, mechanical, thermal, impact, shock and laser interactions, and the diverse application of high-explosive driven pulsed-power.

Research & Development | Prototype/ Hardware Development | Testing & Experiments | Surveillance & Monitoring | Dismantlement & Disposition

Dynamic Equation-of-State (DEOS) Facility



Firing Sites

M Division Capabilities

- Dynamic properties of materials
- Explosives detection
- Gas and powder gun
- HE crystal growth
- HE fabrication and disposal
  - HE waste treatment
  - Inspection
  - Machining
  - Pressing
  - Sawing
- HE operations
- HE-pulsed power
- Investigations of reacting energetic materials
- Materials synthesis and formulation
- Reactive flow modeling
- Shockwave initiation and detonation physics
- Shockwave compression of organics and shock-induced chemistry

Integrated Weapons Experiments – J Division

Overview

Addresses national security challenges by executing mission-driven, large-scale, integrated experiments, emphasizing subcritical experiments, hydrodynamic tests, focused experiments, and tests of engineered systems. Develops the workforce, facilities, technologies, and systems necessary to generate, analyze, and disseminate unique, high-quality data with integrity and scientific excellence.

Utilizes professional engineering management, and Formality of Operations and Conduct of Engineering processes, to effectively integrate high-fidelity test objects, multiple diagnostic technologies, sophisticated experiment design, and multi-disciplinary teams assembled across organizational boundaries. Executes its responsibilities in a sustainable, safe, secure, reliable, and environmentally responsible manner. Operates the Dual-Axis Radiographic Hydrodynamic Test (DARHT) facility. Collaborates to execute sub-critical and other integrated experiments at the Nevada National Security Site (NNSS) and NNSA, DOE, and partner organization facilities as needed.

Research & Development

Testing & Experiments

DARHT

J Division Capabilities

- Accelerator operations
- Accelerator and beam physics
- Data analysis
- Develop and field x-ray and related diagnostics
- Dynamic structure R&D
- Experiment and diagnostic probe design and construction
- Experiment integration to include designing, modeling, and conducting integrated experiments
- Mechanical engineering and maintenance
- Technical and operational expertise in planning and executing complex and hazardous system/ subsystem tests
- Variable Field of View (at DARHT)
- Vessel operations: fielding, cleanout, repair, and procurement

Engineering Technology and Design – E Division

ENGINEERING TECHNOLOGY AND DESIGN

- **Overview**

  E Division solves today's national security challenges through innovative application of engineering principles, while stewarding and expanding capabilities to ensure answers for tomorrow's evolving threats. We partner with programs and innovators to deliver a diverse and unique set of applied R&D engineering solutions for national security and scientific challenges. E Division maintains the most diverse set of engineering capabilities in ALDW. The Division gets involved in every phase of the engineering process: requirements definition, design, analysis, fabrication, and assembly, as well as testing and evaluation. Although the Weapons Program and Pu sustainment are E's core focus, a diverse portfolio of programs including basic science, global security, and energy security are also supported.

E Division at Work …

Experimental Device Engineering and Assembly Facility

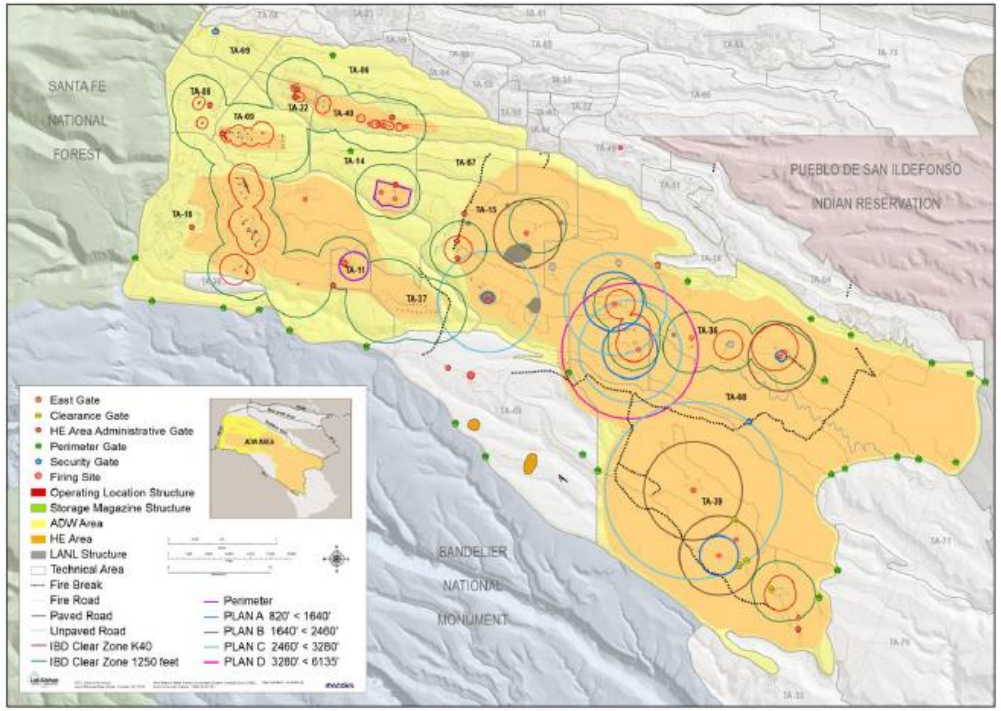
E Division Capabilities

- Assembly engineering
- Cryogenics
- Glovebox design and integration
- Industrial engineering
- Instrumentation and control development
- Mechanical design, fabrication, and testing
- Nondestructive testing and evaluation
- Nuclear process design
- Process automation and robotics
- Process Modeling
- Radiography - static
- Risk analysis
- Systems engineering
- Thermal design, analysis, and testing
- Weapon assembly
- Weapon environmental testing

Weapons Facilities Operations – WFO Division

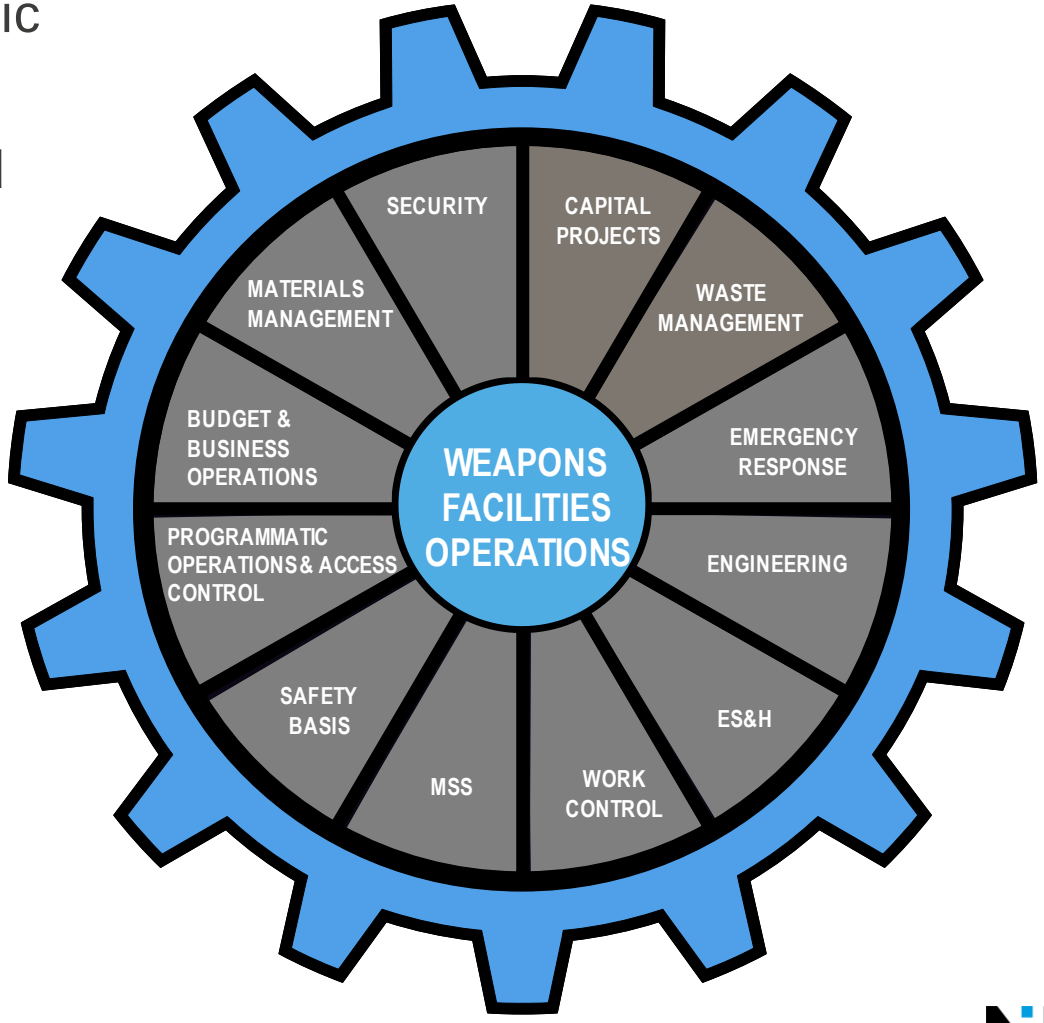
Overview

- To operate, maintain, and construct world class infrastructure in direct support of mission-focused research and development efforts
- To set the standard for operational excellence within the DOE Complex
- Charged with facilitating mission execution at the Weapons Engineering Tritium Facility (WETF), which is a Hazardous Category II Nuclear Facility; DARHT, HE Sciences, Firing Sites, and Detonator Facilities, a portfolio which comprises >500 buildings and ~30 square miles



WFO Capabilities

- Maintain and execute strategic infrastructure plans
- Establish facility budgets and priorities
- Commence and suspend operations
- Enable compliant facility operations
- Report and investigate occurrences
- Implement the emergency management program
- Ensure facility performance assurance and evaluation



References and Recommended Reading

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Thank you!

Questions?

Email us: **NFO@lanl.gov**