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An Overview of Los Alamos Weapons Program

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Los Alamos
NATIONAL LABORATORY
EST 1943

October 2019

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

Guiding principal of Los Alamos:

"There must be no barriers for freedom of inquiry. There is no place for dogma in science. The scientist is free, and must be free, to ask any question, to doubt any assertion, to seek for any evidence, to correct any errors."

J. Robert Oppenheimer

Los Alamos National Laboratory – A National Security Science Resource for the Nation

- **Established in 1943 as part of the Manhattan Project**
  - Designed, tested, and delivered to the Army Air Corps 2 weapons that helped end World War II
    - Little Boy 8/6/45
    - Fat Man 8/9/45
- **To date, Los Alamos has designed and certified 46 of the 63 nuclear weapon systems put into the US stockpile**
- **Today's stockpile consists of 7 types of weapons.**
  - W76* & W88* are carried on Trident submarines
  - W78* & W87 are carried on ICBMs
  - B61* / B83 / W80* are carried on aircraft
- **Annually, Los Alamos, along with Sandia and Lawrence Livermore, are legally obligated to report to the President on the state and health of the deterrent**

* = LANL Designed Weapons

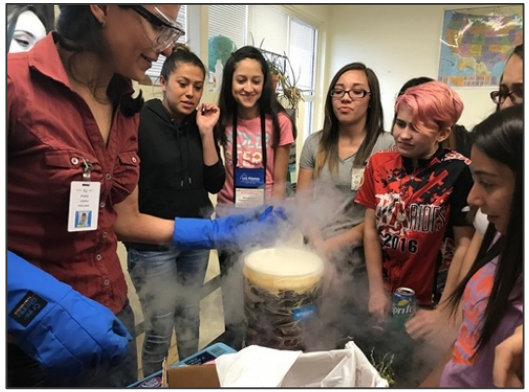
Robust student and postdoc programs are vital to the Laboratory's early-career pipeline

- Each year, more than 1,880 students and 400 postdocs work at Los Alamos
  - Los Alamos pays for advanced degrees
- Conversion of postdocs to technical staff is our most highly utilized early career pipeline

Percentage of total LANL population who were former students or postdocs

36%	61%	33%
All LANL employees (Reg, TRMA)	All R&D scientists & engineers	Managers

U.S. Service Academy and ROTC summer internships



Summer Physics Camp

Supercomputing Challenge

Nuclear policy views of the incoming Chairman of the Joint Chiefs of Staff

"I agree that nuclear modernization remains the number one modernization priority. I think accelerating modernization, where possible and fiscally responsible, should be a major component of this mitigation."

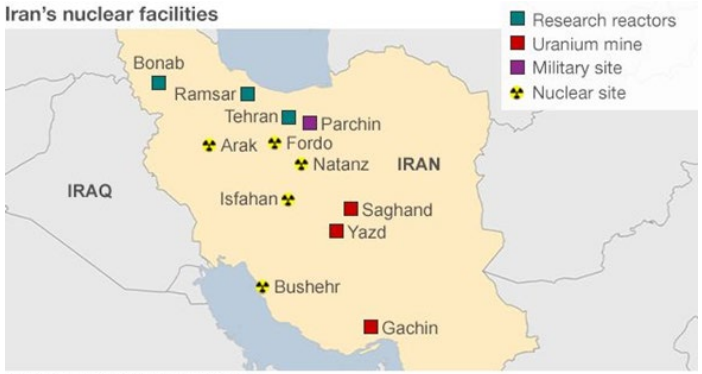
"I believe the NPR recommended force structure changes including low yield ballistic missile warhead for the D-5 and the nuclear armed sea-launched cruise missile are necessary to enable our flexible and tailored deterrence strategy as we modernize aging nuclear forces."

"I think that modernizing the nuclear triad is critical to maintaining the effectiveness of our global nuclear deterrence. Similarly, modernizing DOE's nuclear weapons complex, some of which dates to the Manhattan Project is equally critical. Without adequately modernizing DOE's Nuclear Weapons Complex, the United States' ability to remain a nuclear armed state will erode."

Advance Policy Questions 7/11/19 Confirmation Hearing

21st century geopolitical realities are challenging the existing security/political/economic structures and institutions

- China
- Russia
- Confrontational North Korea
- Turmoil in Europe
- Iran and Middle East
- Nuclear proliferation
- Terrorism/Cyber
- Resource competition



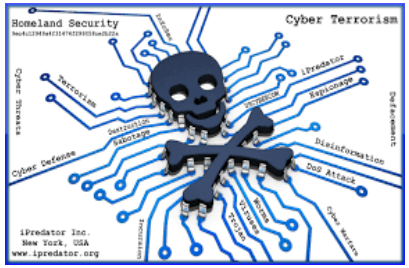
Source: New Scientist/ Global Security

How countries compare	Pakistan	India
Population	173 million	1.2 billion
Religion	Mainly Muslims	Mainly Hindus
GDP per person	$2,400	$2,600
Life expectancy	63 (M), 65 (F)	67 (M), 72 (F)

Military Strength INDIA PAKISTAN

Strategic balance between India and Pakistan:

	India	Pakistan
Armed forces (troops)	1.3 million	610,000
Surface warships	54	12
Combat aircraft	886	340
Submarines	16	5
Nuclear missiles	30-35	33-60
Military spending	$27 billion	$5.2 billion



The geopolitical realities demand the Laboratory's excellence for solutions to national security

- @12,000 employees
  - 2,200 PhDs
  - 1,100 veterans
  - @1,800 summer students
- $2.8B budget
- 36 square miles
- 47 technical areas
- 1,280 buildings / 9M sq. feet
  - 11 nuclear facilities
- 268 miles of roads (100 paved)

LANL is hiring @1,000 new employees annually

LANL is *the* design laboratory for the majority of the Nation's on-alert deterrent

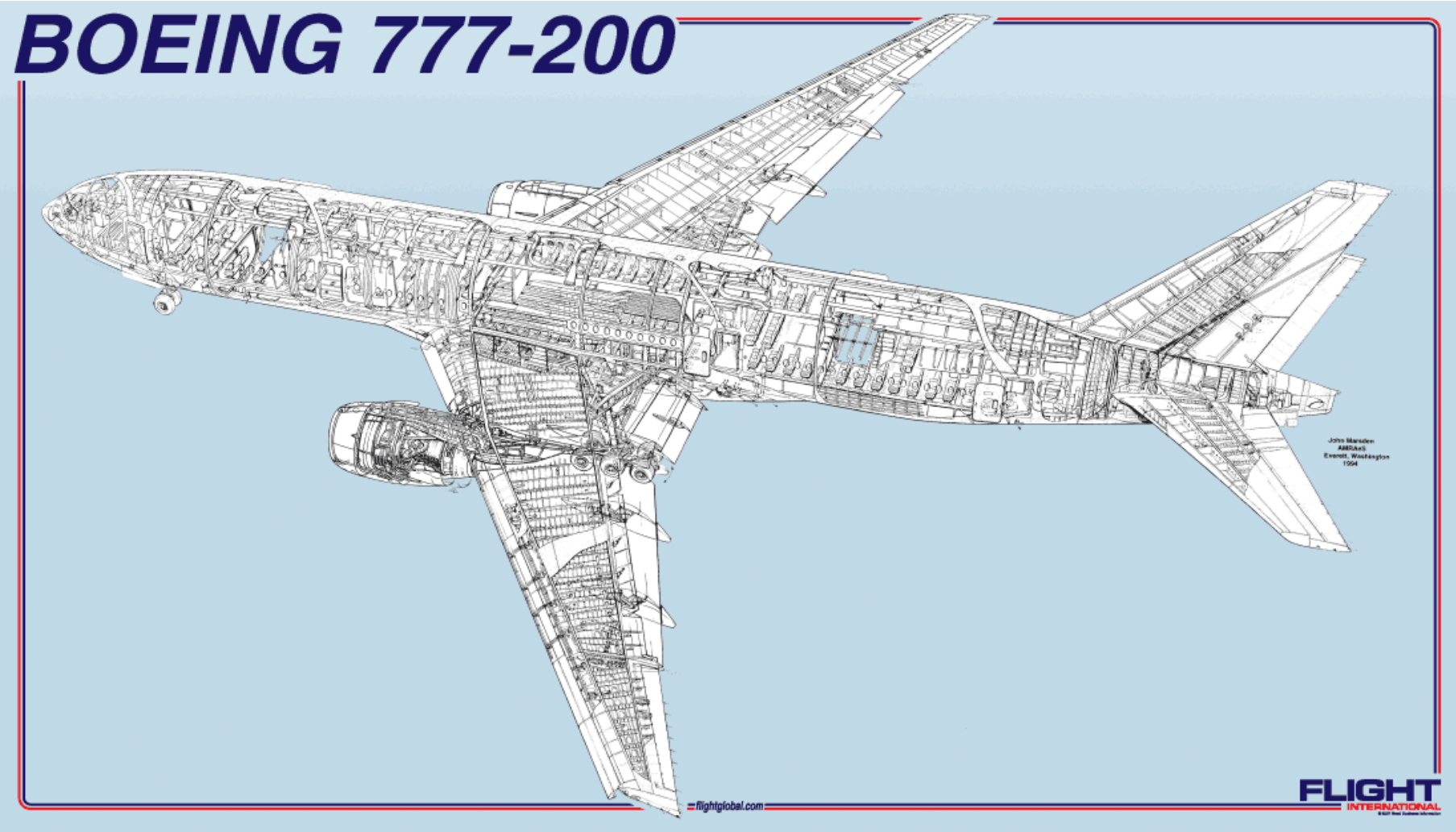
W76
W88
} US Navy

W78
B61
} US Air Force

"Nuclear weapons have and will continue to play a critical role in deterring nuclear attack and in preventing large scale conventional warfare between nuclear armed states… "

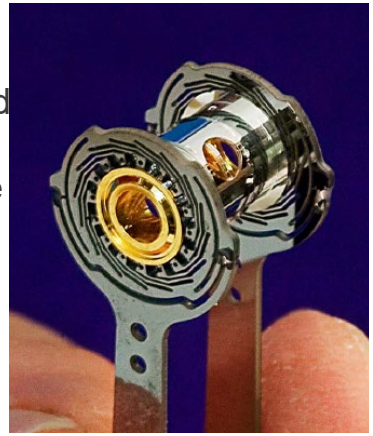
Former Secretary of Defense Jim Mattis, Nuclear Posture Review

Would you fly in it after its been parked for 20 + years?



Science, engineering and computations underpins all national security work of the laboratory

- **Experiments**
  - 1,000s experiments conducted annually to further our understanding and confidence in the stockpile
- **Modeling and simulation**
  - World class computing hardware/software
- **Designer judgement**
  - Experimental data used to check judgement
  - Train next generation

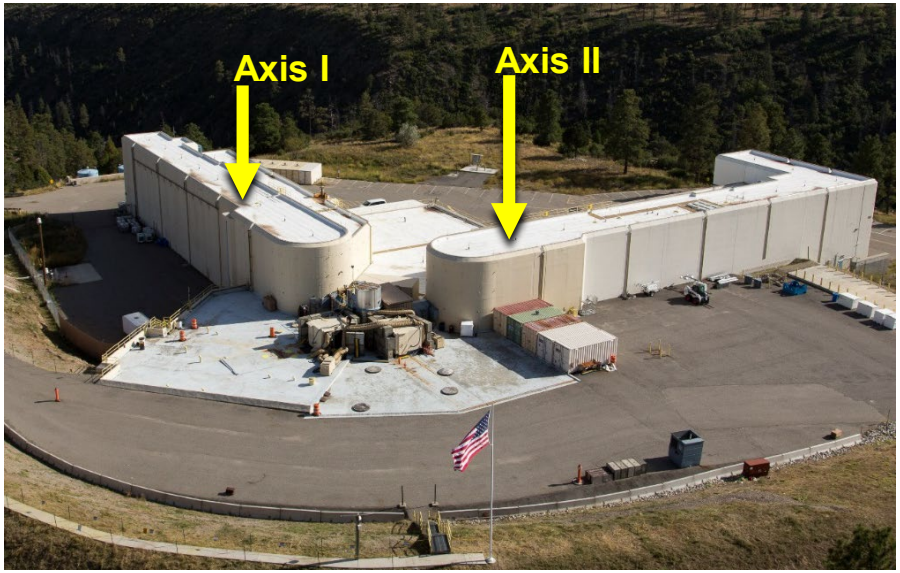


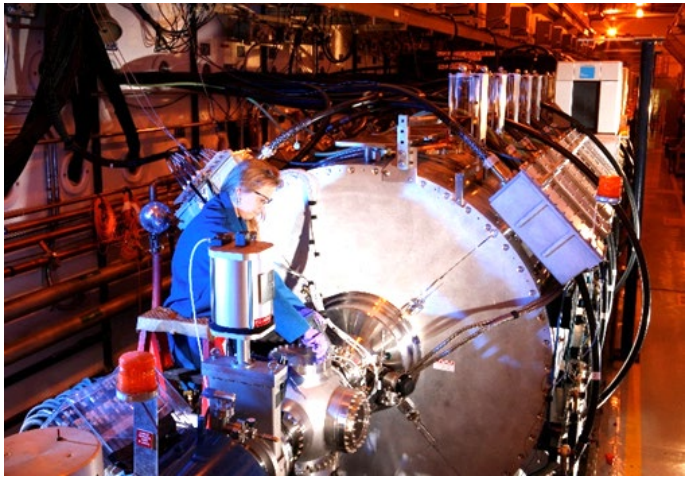
High Energy Density (HED) Experiments

Large bore powder gun – measure differences in performance of weapon materials of interest

World class radiographic capabilities supports LANL/LLNL weapons and global security programs

- DARHT world-class X-ray radiography for non-nuclear tests
- Axis I: single image
- Axis II: four images
- Experiments fully contained to reduce environmental impacts and increase shot rate





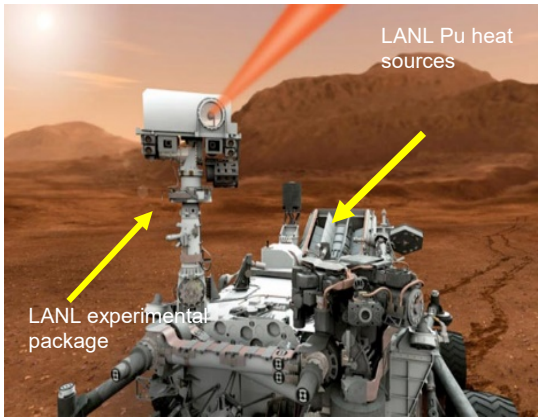
Petascale Supercomputing is critical to Los Alamos' national security missions

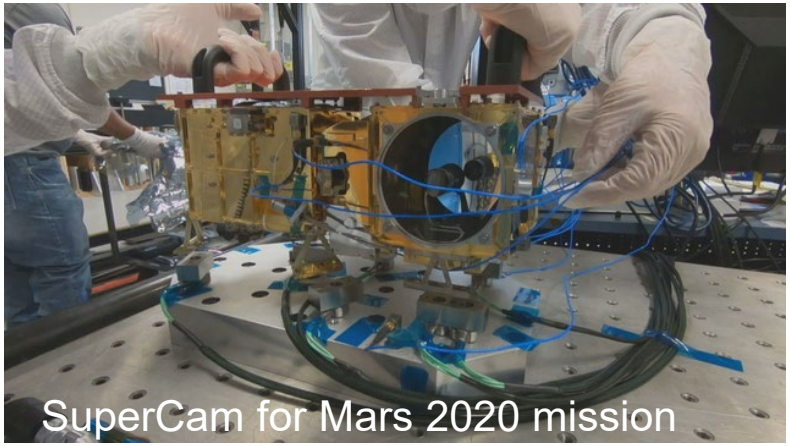
- Stockpile challenges are increasingly complex as systems continue to age
- DARHT, LANSCE etc provide large data sets to resolve stockpile challenges
- Data sets require ever more capable machines that can quickly process information
- Capacity and Capability machines
  - Trinity
  - Fire, Ice

Los Alamos: center for plutonium excellence and critical to science and security

- **Deliver parts for LANL experimental science**
- **Deliver parts for DoD Mission**
  - 30 pits per year 2030
  - Partner with STRATCOM, Global Strike, USAF, USN…….
- **Deliver parts for NASA and other federal agencies**
- **Provide technical options to meet new and emerging challenges**
  - IAEA training
  - Additive manufacturing

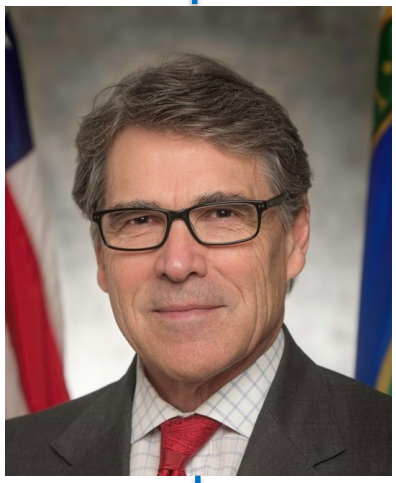
Mars Curiosity Rover





IAEA
International Atomic Energy Agency

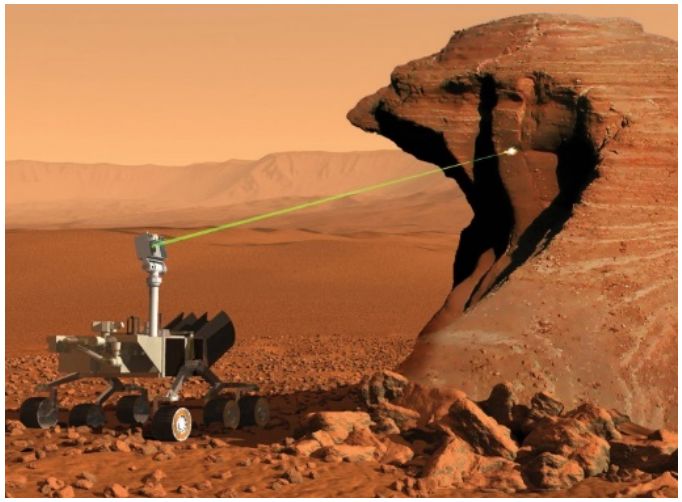
By law, Los Alamos Director reports on the state and health of the Nation's deterrent

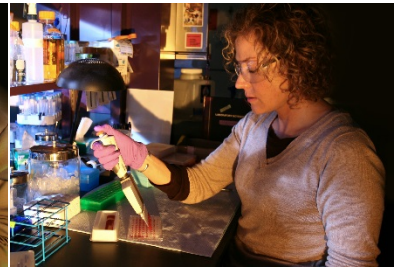


LANL's multidisciplinary science and engineering capability

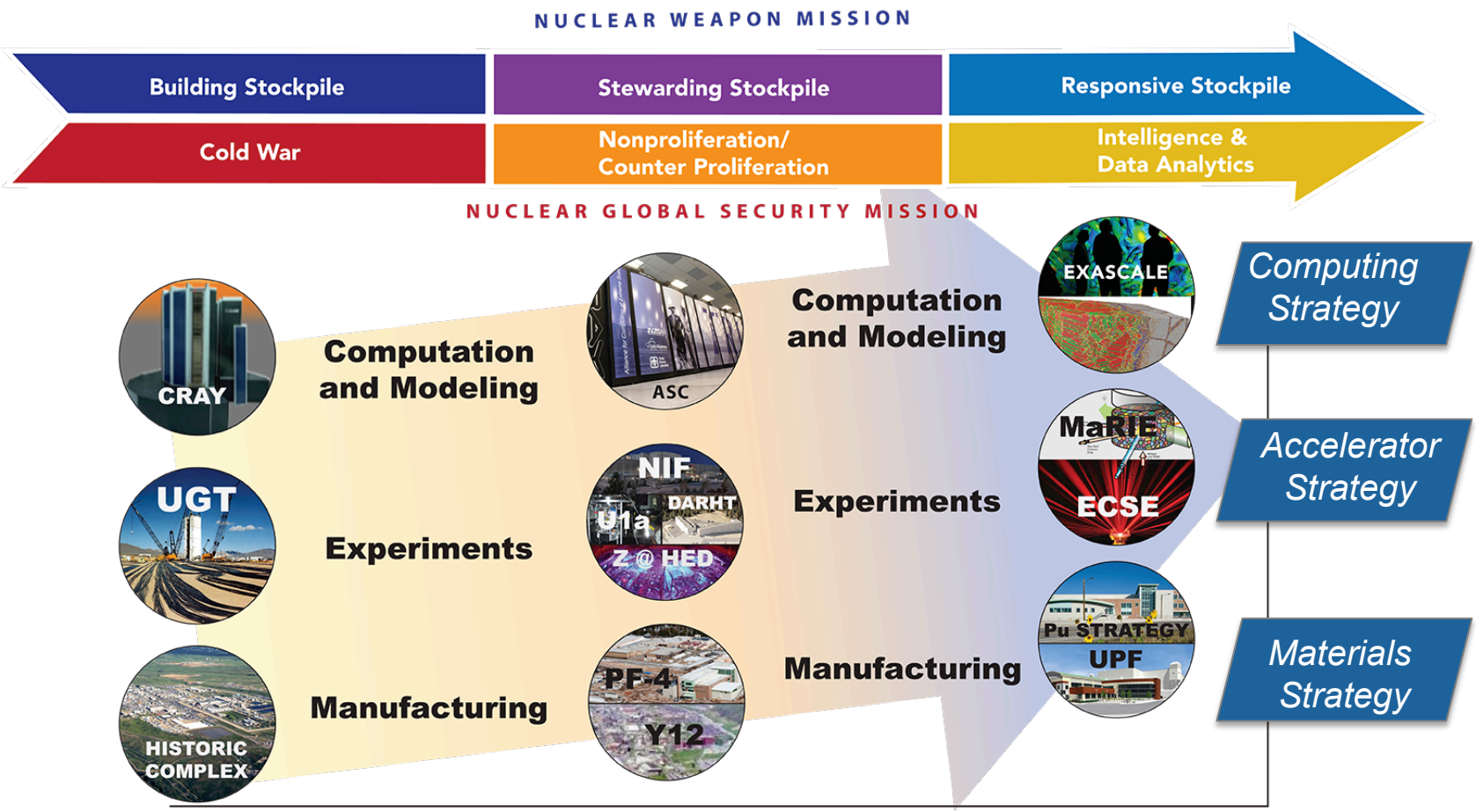
Today's Laboratory is delivering results for the Nation

- For 20 years the Stockpile Stewardship Program has ensured the safety and reliability of US nuclear weapons without full-scale testing
- The new Trinity supercomputer is 40 times faster than the historic Roadrunner machine
- LANL scientists are exploring Mars while developing the next generation Curiosity Rover
- Project ATHENA may soon provide a vastly superior approach for testing new drugs
- Medical isotopes are produced; saving lives
- LANL scientists are doing pioneering work in nanotechnology at CINT





We see an enduring future for an integrated Laboratory



JOIN US AND MAKE A REAL DIFFERENCE FOR THE NATION

A Final Thought

"This Laboratory has always been something of wonder. Everyone one of you should be very proud that you are part of it. Take note it does wonderful things. Do well with it."

Roger Rasmussen
Trinity eyewitness
LANL employee 1944-2005

Rasmussen 1921-2017