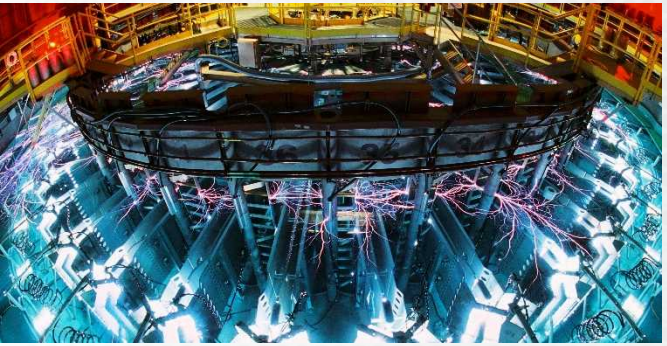
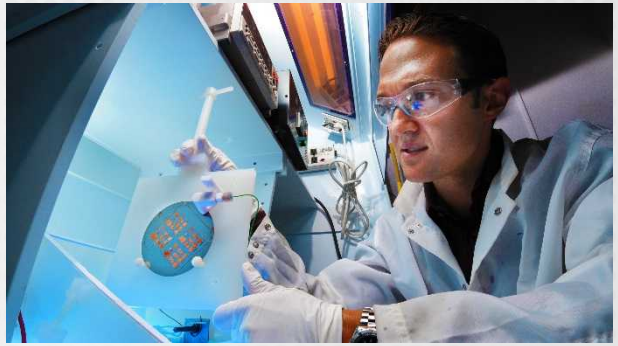
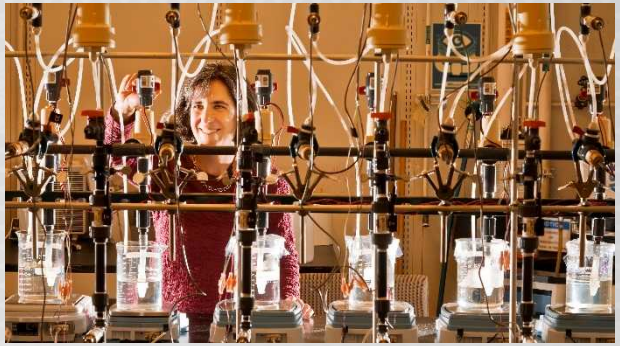
Exceptional service in the national interest

SAND2017-6966C


Scientific Cooperation between the National Nuclear Security Administration and Israel Atomic Energy Commission

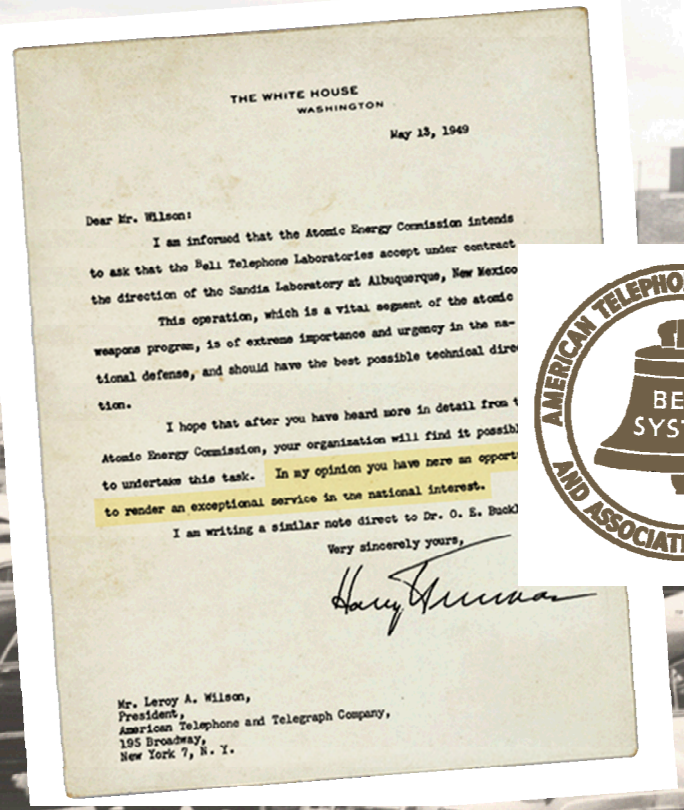
Stephen Younger, Sandia National Laboratories Director

12 July 2017

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525. SAND NO. 2017-6555 PE

Introduction to Sandia National Laboratories

Sandia: An FFRDC for nearly seven decades



THE WHITE HOUSE
WASHINGTON

May 13, 1949

Dear Mr. Wilson:

I am informed that the Atomic Energy Commission intends to ask that the Bell Telephone Laboratories accept under contract the direction of the Sandia Laboratory at Albuquerque, New Mexico

This operation, which is a vital segment of the atomic weapons program, is of extreme importance and urgency in the national defense, and should have the best possible technical direction.

I hope that after you have heard more in detail from the Atomic Energy Commission, your organization will find it possible to undertake this task. In my opinion you have here an opportunity to render an exceptional service in the national interest.

I am writing a similar note direct to Dr. O. E. Buckley

Very sincerely yours,

Harry Truman

Mr. Leroy A. Wilson,
President,
American Telephone and Telegraph Company,
195 Broadway,
New York 7, N. Y.

...ny opinion you have here an opportunity to render an exceptional service in the national interest.

JULY 1945
Los Alamos creates Z Division at Sandia Base

NOVEMBER 1, 1949
Sandia Laboratory is established and managed by AT&T

MARCH 8, 1956
Sandia's California site is established

JULY 26, 1993
Martin Marietta wins first Sandia Corporation contract competition and in 1995 merges with Lockheed to become Lockheed Martin

DECEMBER 16, 2016
The NNSA awards the Sandia prime contract to National Technology and Engineering Solutions of Sandia (NTESS), a subsidiary of Honeywell International

MAY 1, 2017
The new prime contract goes into effect

Sandia sites

Albuquerque, New Mexico

Livermore, California

Kauai, Hawaii

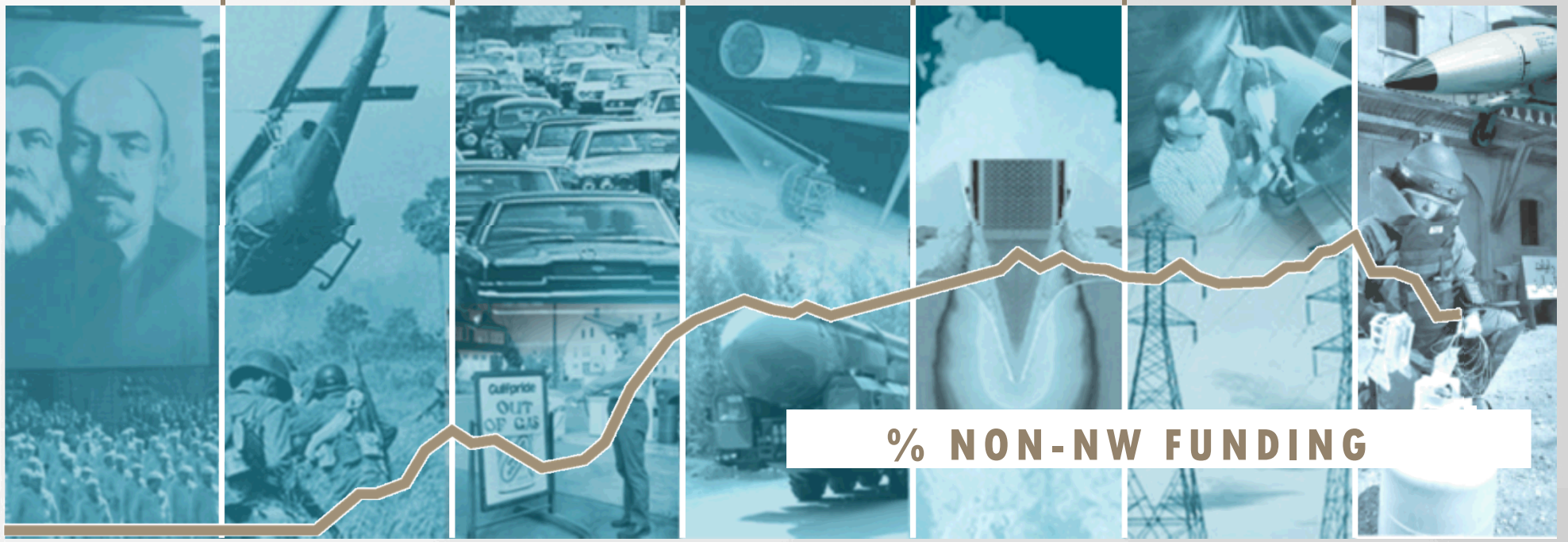
Waste Isolation Pilot Plant
Carlsbad, New Mexico

Pantex Plant
Amarillo, Texas

Tonopah, Nevada

Sandia: A multimission lab

1950s	1960s	1970s	1980s	1990s	2000s	2010s
NW engineering and test	NW stockpile diversity and build-up	NW + energy: Multiprogram laboratory	DOE Multiprogram + missile defense and other DOD work	DOE Multiprogram + DOD, economic competitiveness	Expanded national security role post 9/11	LEPs Cyber, bio, space, terrorism
Arms race	Cuban missile crisis Vietnam conflict	Energy crisis	Cold war	Stockpile stewardship	Broader national security	Evolving national security challenges



~3,400 employees	~7,600 employees	~ 7,100 employees Layoffs in late 1970s	~8,200 employees	~8,400 employees 96-97, 2 rounds of voluntary separation	Workforce of approximately 9,400	Today, workforce of approximately 12,000

A purpose statement for Sandia National Laboratories

Sandia develops advanced technologies to ensure global peace

The nuclear weapons program at Sandia

Three nuclear weapons imperatives

ENSURE THE CURRENT STOCKPILE'S SAFETY, SECURITY, RELIABILITY, AND EFFECTIVENESS

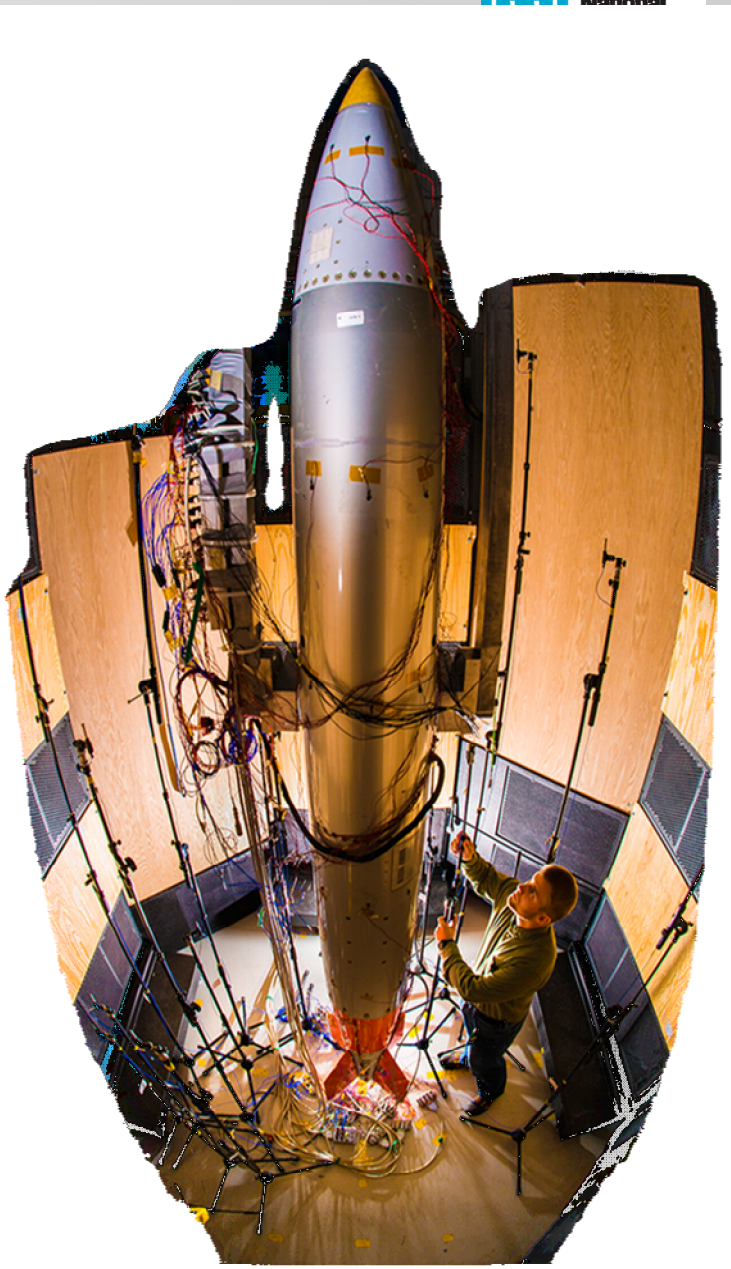
SUSTAIN THE U.S. NUCLEAR DETERRENT

Extend the life of stockpile warheads and conduct associated programs

- W76-1 LEP, B61-12 LEP, W88 ALT 370, W80-4 LEP, Mk21 Fuze Replacement
- Mobile Guardian Transporter

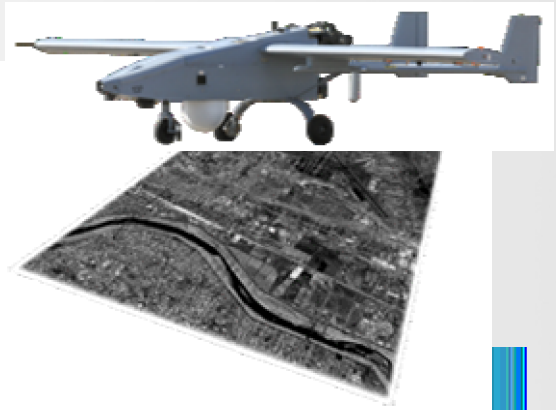
Maintain readiness to counter emerging and unconventional threats

DEVELOP AND SUSTAIN THE CAPABILITY-BASED SCIENCE AND ENGINEERING FOUNDATION



National security and defense nuclear nonproliferation programs at Sandia

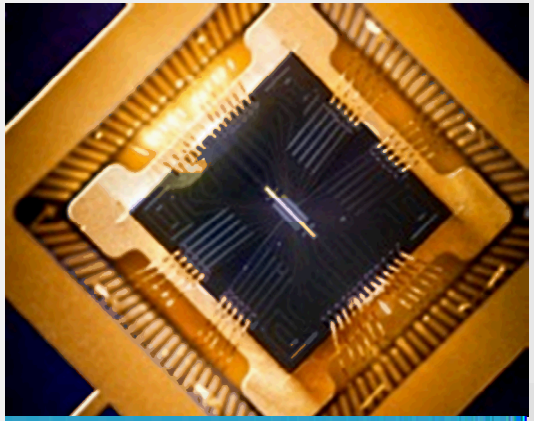
Information Operations



Reconnaissance

Remote Sensing & Verification

Space Mission



Science & Technology Products

Proliferation Assessment

Integrated Military Systems

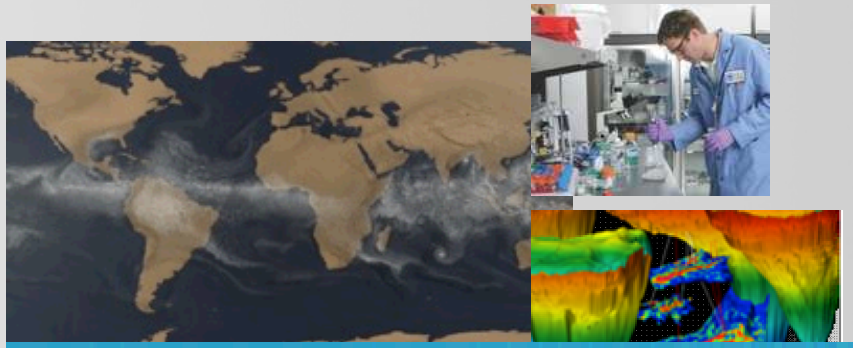
Energy programs at Sandia

Energy Research

- ARPAe, BES Chem Sciences, ASCR, CINT, Geo Bio Science, BES Material Science

Nuclear Energy & Fuel Cycle

- Commercial nuclear power & fuel, nuclear energy safety & security, and DOE-managed nuclear waste disposal



Climate & Environment

- Measurement & modeling, carbon management, water & environment, and biofuels

Renewable Systems & Energy Infrastructure

- Renewable energy, energy efficiency, grid and storage systems

Transportation Energy & Systems

- Vehicle technologies, biomass, fuel cells, and hydrogen technology

Global and homeland security programs at Sandia

Global Security

Remote Sensing & Verification

Homeland Security Programs

Homeland Defense &
Force Protection

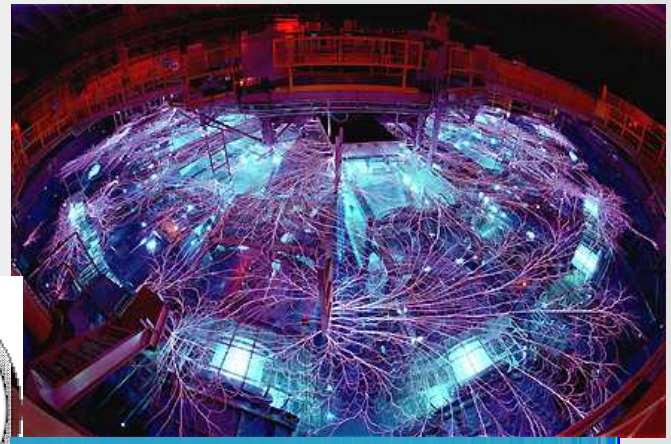
WMD Counterterrorism
& Response

Cyber &
Infrastructure Security

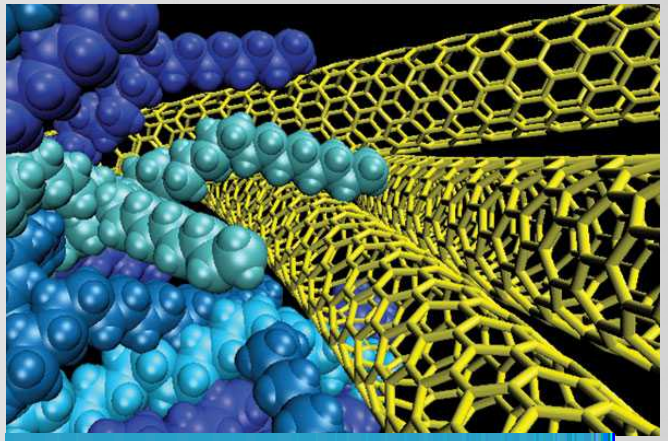
Research

Enduring discipline-based competencies are essential to our missions

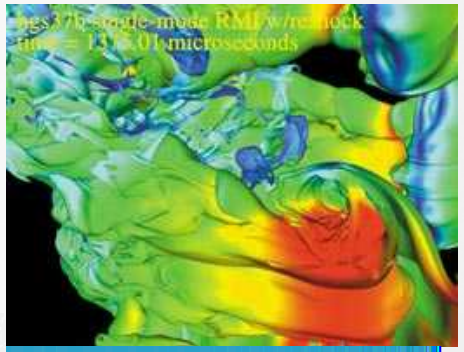
Computing &
Information Sciences



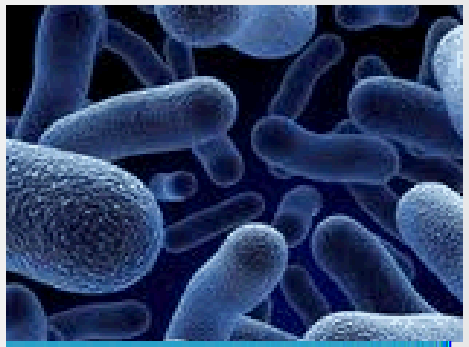
Radiation Effects &
High Energy Density Science



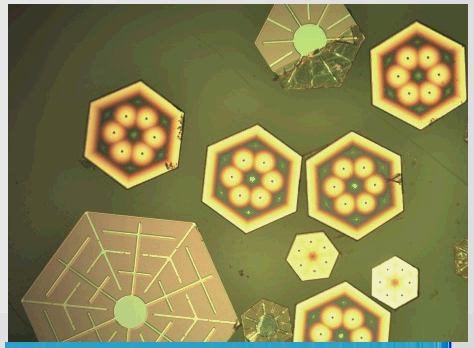
Materials Sciences



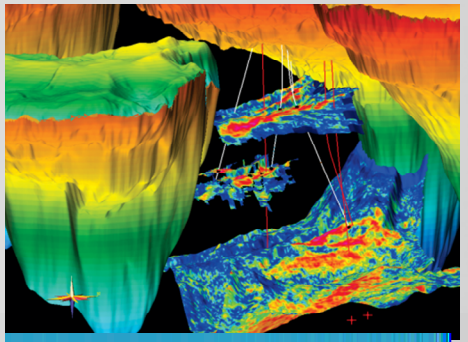
Engineering Sciences



Bioscience



Nanodevices &
Microsystems



Geoscience

Topic Area III

Project Proposals

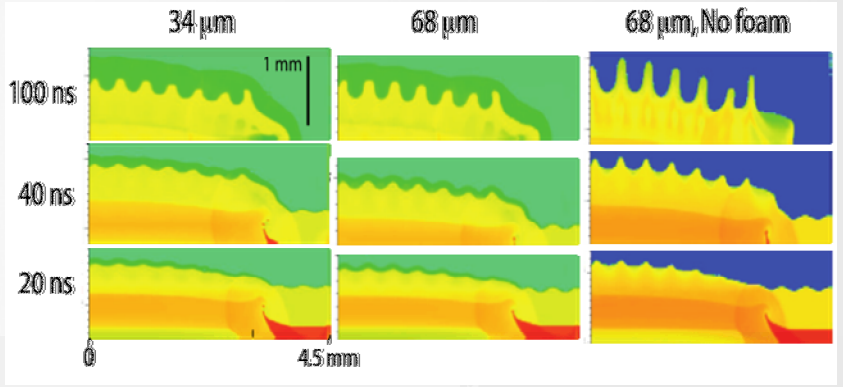
Hydrodynamic instabilities in HED plasmas

Project objectives

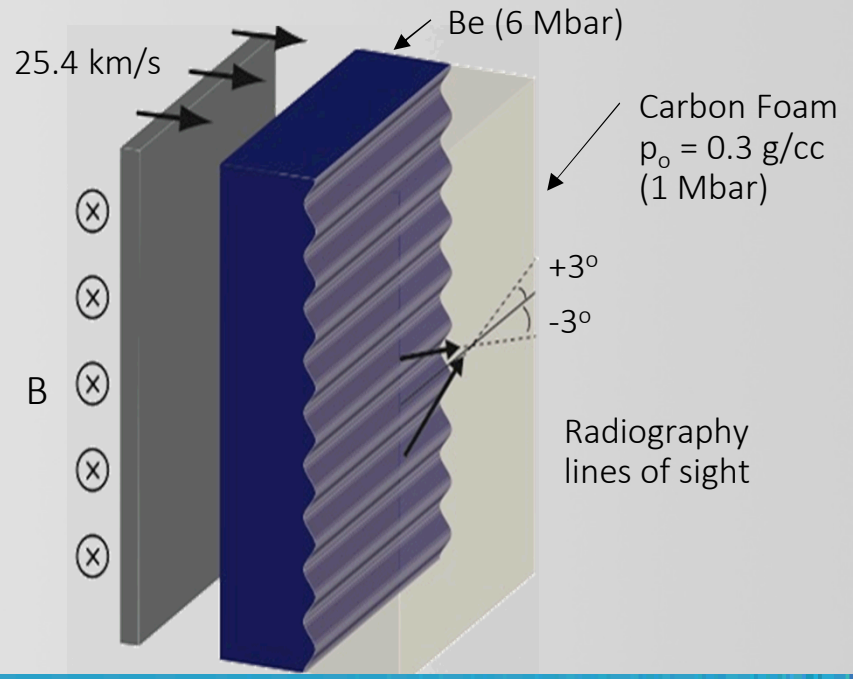
The Z machine's long drive time of 100 ns will allow us to study outstanding problems in high energy density (HED) plasma instability

- Nonlinear evolution of a Richtmyer-Meshkov (RM) unstable interface with a multimode perturbation
- Transition to turbulence of a Rayleigh-Taylor (RT) unstable interface

The team will propose, conduct, and analyze instability experiments within the Z Fundamental Science Program



Example of a flyer plate–driven RM instability



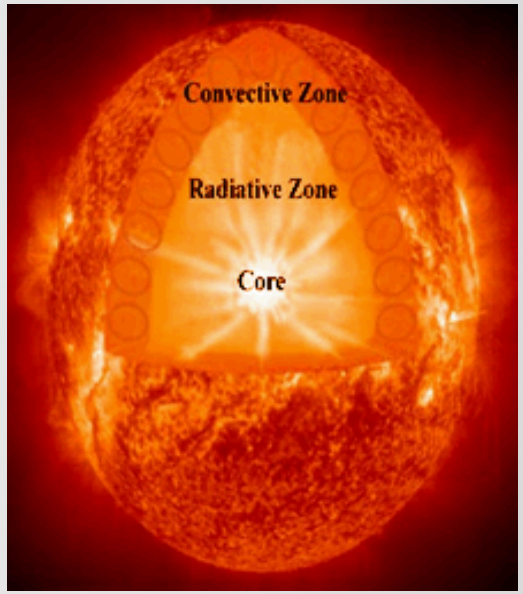
Experimental geometry of the proposed HED instability experiment. Images will be captured with two-frame, x-ray radiography (6.2 or 7.2 keV) diagnostic

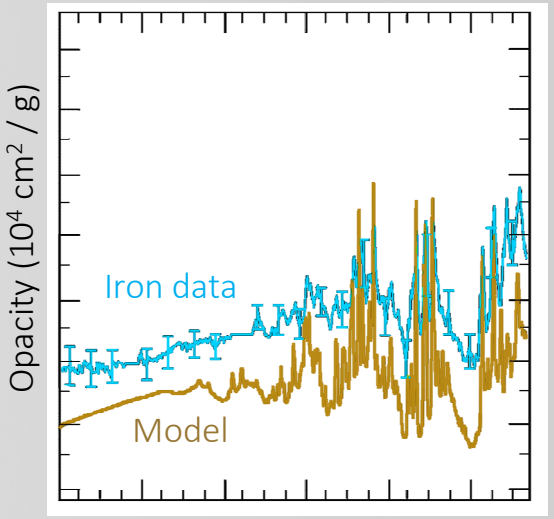
Opacity microequivalence

Issues, project approach and objectives

ISSUES

- Solar interior predictions do not match helioseismology
- Z experiments measured iron plasma opacity at solar convection/radiation boundary conditions
  - The measured iron opacity is higher than predictions
  - Helps resolve the solar problem, but we need to understand what causes the discrepancy
- Opacities are needed at the higher temperatures and densities deep inside stars; present experiments cannot reach the required conditions





The model is compared to Z iron data at 182 eV and 3.1 x 10^{22} cm^3 (density)

Bailey *et al., Nature* 2015

APRROACH AND OBJECTIVES

- A lower Z element at existing conditions could test iron opacity models deep in the sun
  - Higher temperature and density means more ionization
- The team will use calculations and experiments to evaluate the microequivalence approach
- Any experiments will be proposed and competed within the Z Fundamental Science Program

Topic Area V

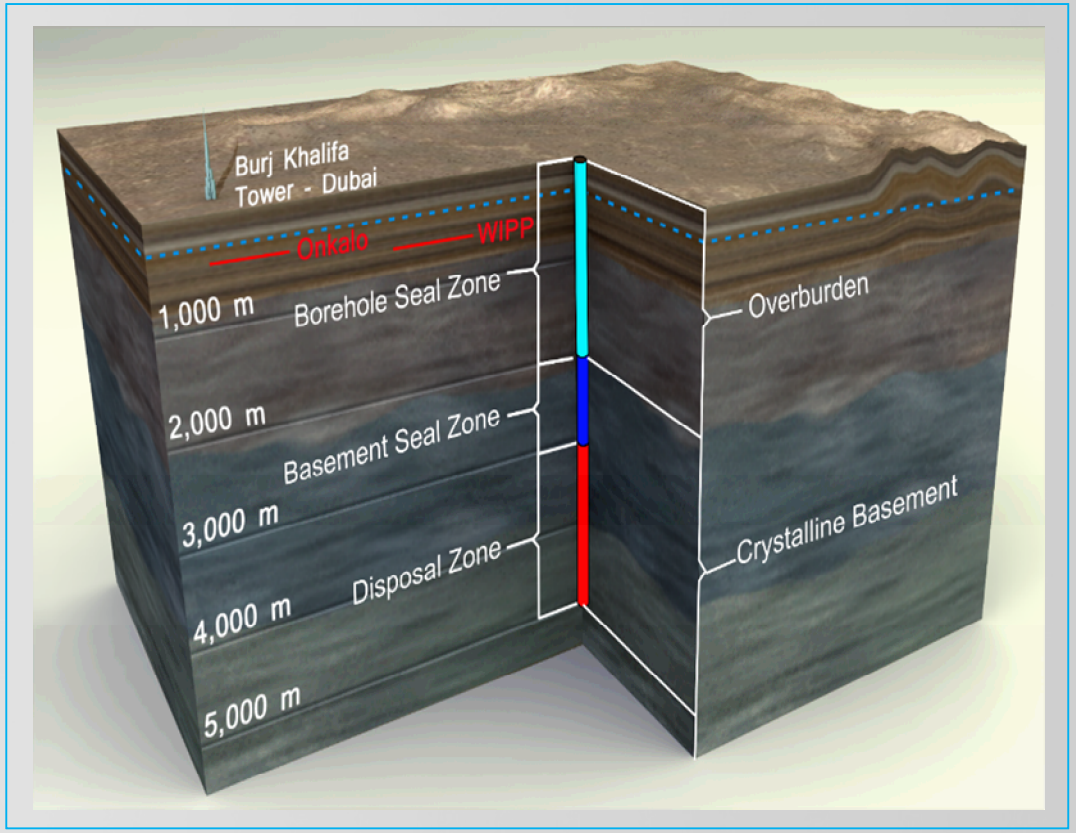
Project Proposals

Evaluate deep borehole disposal of radioactive waste

Project objectives

- Identify locations suitable for deep borehole disposal of radioactive waste
- Define types and amounts of radioactive waste of Israeli origin to be disposed in deep boreholes
- Develop suitable borehole concepts for radioactive-waste disposal in Israel
- Develop preliminary cost estimate for implementing borehole disposal
- Develop a preliminary field test program with clearly articulated cost, performance, and schedule metrics

Project Tasks	Israel	SNL	LANL	LLNL
Task 1: Describe the geology and locations of sites suitable for deep borehole disposal	X	X	X	X
Task 2: Characterize and document the Israeli-origin radioactive waste to be disposed	X	X		
Task 3: Describe conceptual borehole design concepts compatible with Israeli sites and radioactive waste	X	X	X	X
Task 4: Document a preliminary cost estimate for implementing a borehole disposal program	X	X		
Task 5: Complete a preliminary field test program that describes drilling, testing, costs, and schedule	X	X	X	X

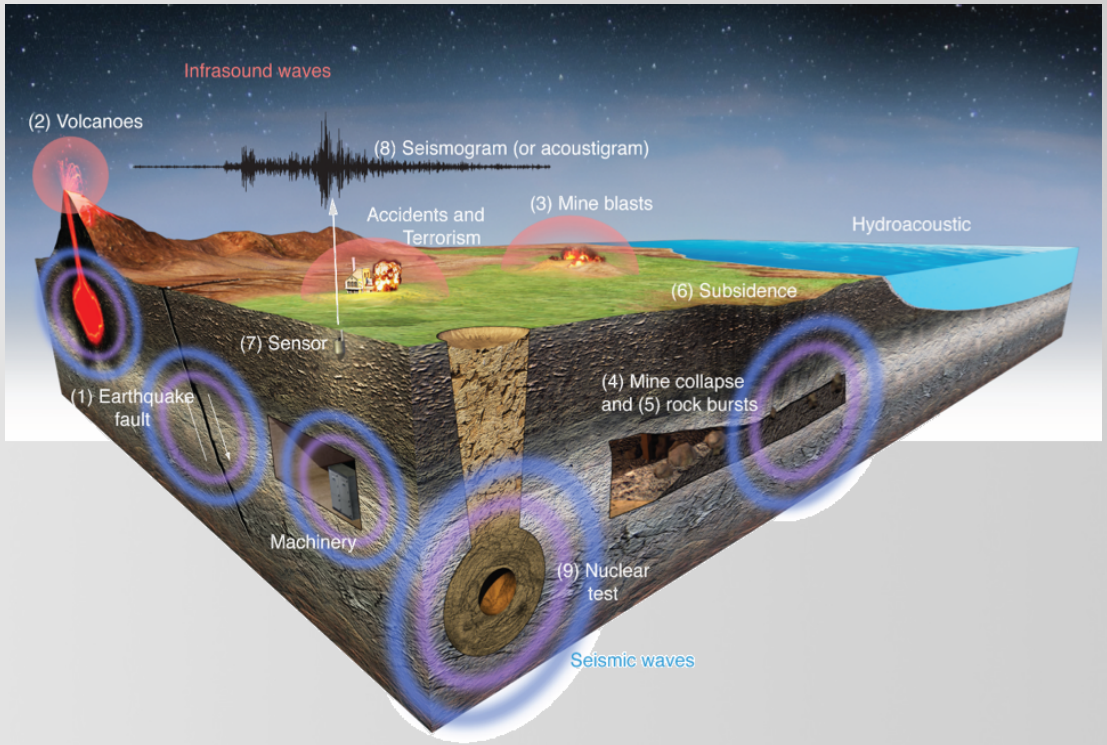


Big data analytics for global seismic monitoring

Project objectives

- Machine-learning and big-data techniques yield revolutionary advances for analyzing massive data stores across the web; use machine learning to identify seismic phases automatically
- Demonstrate methods based on machine learning to match multiple automatically detected phases at numerous recording stations with correct seismic sources

Project Tasks (Year One)	Israel	SNL	LLNL
Task 1: Hold a workshop in Israel	x	x	x
Task 2: Develop shareable data sets for machine learning and joint seismic/infrasound development	x	x	x
Task 3: Characterize open-source big-data processing algorithms that should be investigated for seismic events	x		x

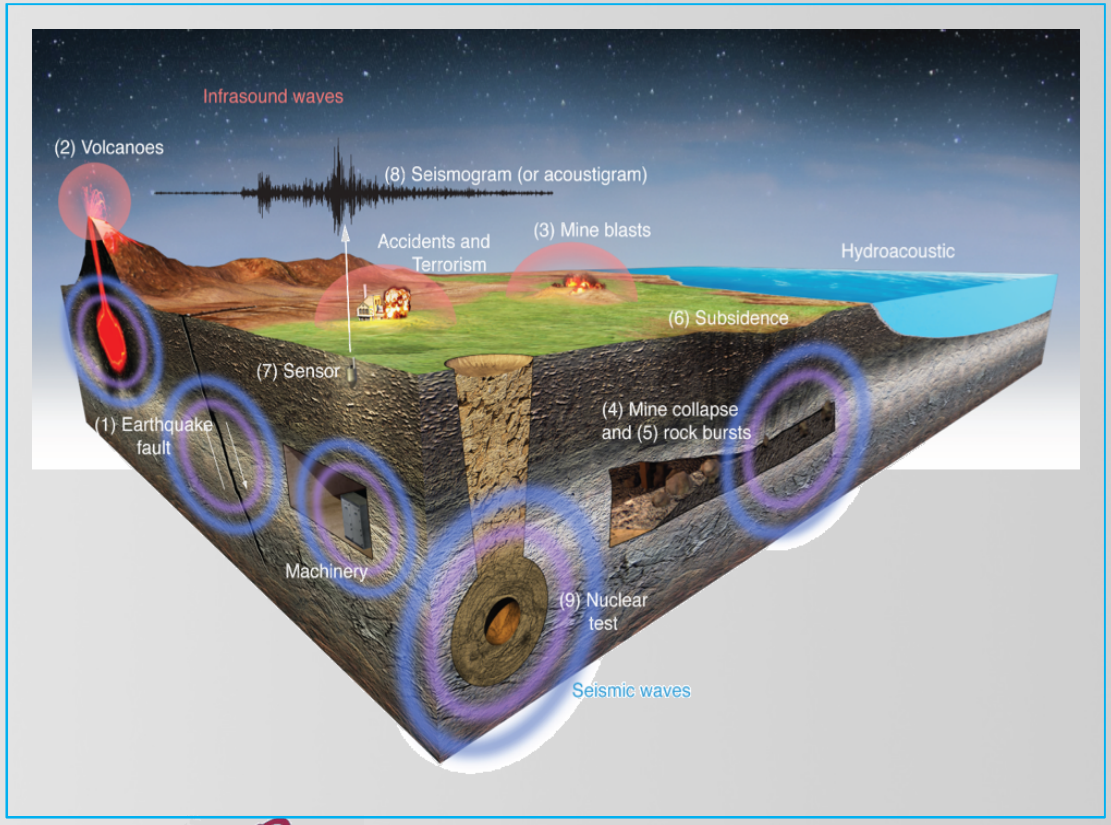


Combination of seismic and infrasound data

Project objectives

- Develop methods to combine seismic and infrasound data to better understand emplacement conditions of underground explosions
- Develop the mathematical background to combine these disparate types of data for more accurate event location and characterization
- Develop modeling for the portioning of seismic and infrasound data at various depths of burial/emplacement
- Investigate techniques for inverting the combined signals from known events and apply to events of common interest

Project Tasks (Year One)	Israel	SNL	LLNL
Task 1: Hold a workshop in Israel	x	x	x
Task 2: Characterize available seismic/infrasound modeling tools available at participating institutions	x	x	x



First experiments with RDDs in an urban environment

The Israel–United States–Canada Goldstar experiments extend to an urban environment previous outdoor experiments with radiological dispersal devices (RDDs)

- Phase 1 of the experiments took place in Israel in October 2016
- Phase 2 is scheduled to take place in Israel from September 17 to October 4, 2017

Conclusions

- Sandia National Laboratories is actively engaged in the NNSA-IAEC partnership to promote cooperation for regional security

- Enhanced lab-to-lab partnership through visits of facilities, technical and scientific cooperation, and personnel exchanges