SAND2011-5582P

Sandia National Labs

Engineering Sciences Overview

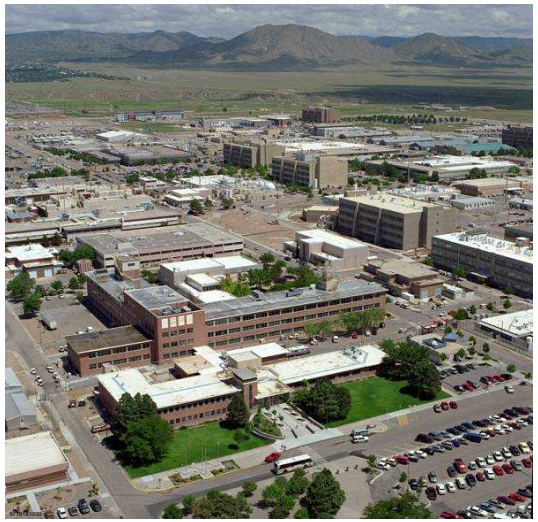
Visit to Cummins Inc.

August 10th, 2011

Duane Dimos

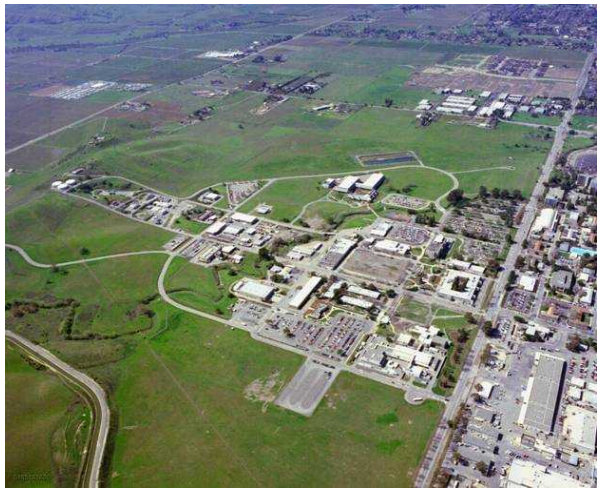
Director, Engineering Sciences Center

Sandia National Laboratories:
A mission-driven, multi-program laboratory

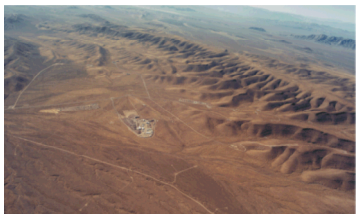


~8500 employees
>10500 people
> 1500 Ph.D. staff
~$2.4B budget

Albuquerque, New Mexico



Livermore, California



Yucca Mtn, Nevada

WIPP, New Mexico

Kauai Test Facility, HI

Pantex, Texas

Tonopah Test Range, NV

***Vision*: Sandia is the provider of innovative, science-based, systems-engineering solutions to our Nation's most challenging national security problems.**

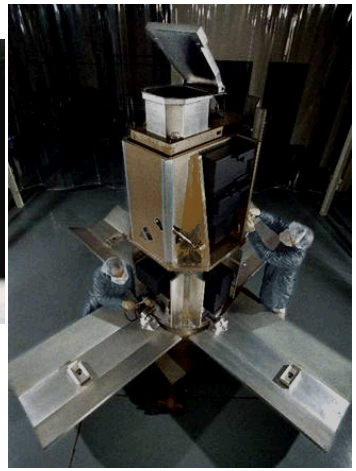
Sandia's Four Mission Areas (Strategic Management Units)

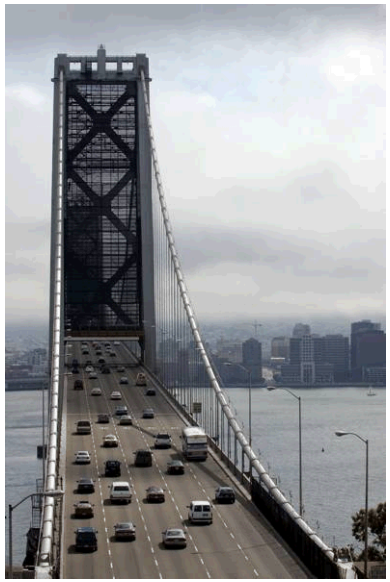
Nuclear Weapons (DOE/NNSA)

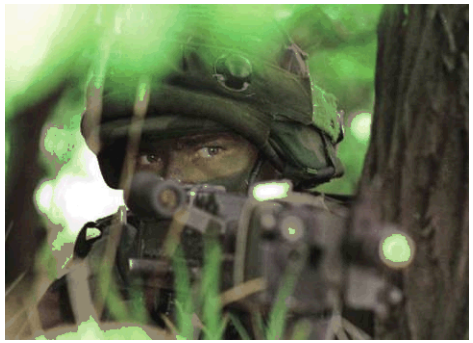
- Core program – lab stewardship

National Security & Technology Systems (non-NW programs)

- Defense Systems & Assessments (DoD and Intelligence)
- Energy, Climate, & Infrastructure Security
- International, Homeland, and Nuclear Security





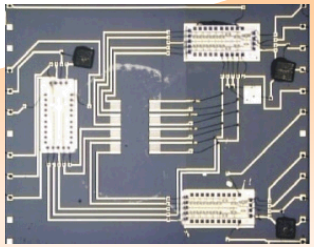


Sandia's capabilities are underpinned by six research disciplines

Stephen Rottler
Sandia VP & CTO

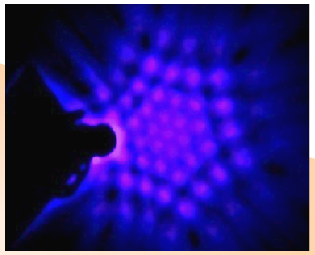
Strategic Capabilities

High Performance Computing & Simulation



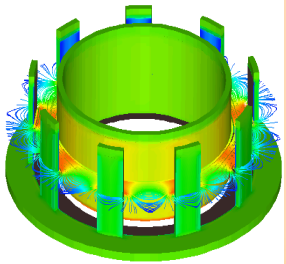
Microsystems

Extreme Environments

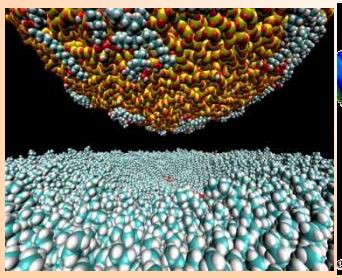


Nanotechnology

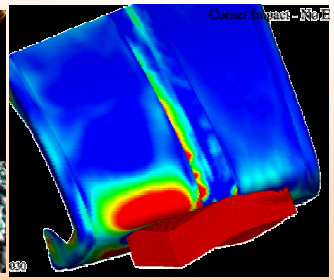
Computer Science



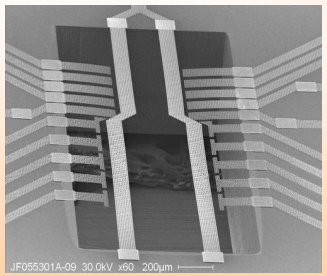
Materials



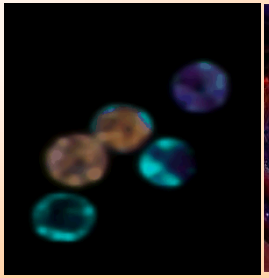
Engineering Sciences



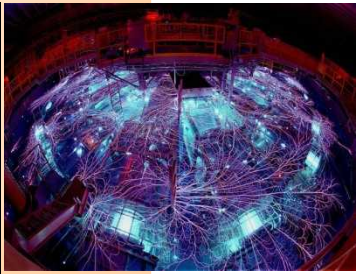
Micro Electronics



Bioscience



Pulsed Power



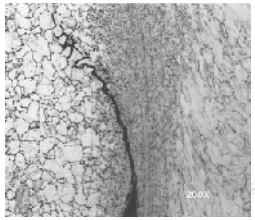
Research Foundations

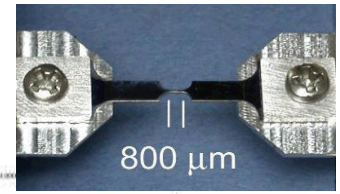
NNSA National Nuclear Security Administration

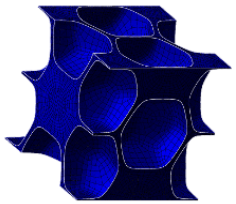
Sandia National Laboratories

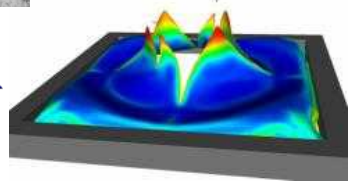
Technical Focus Themes for Engineering Sciences

Solid Mechanics

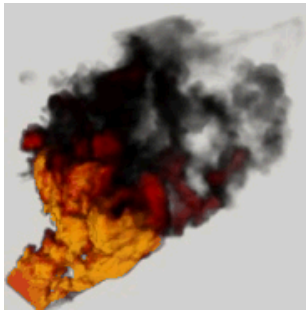




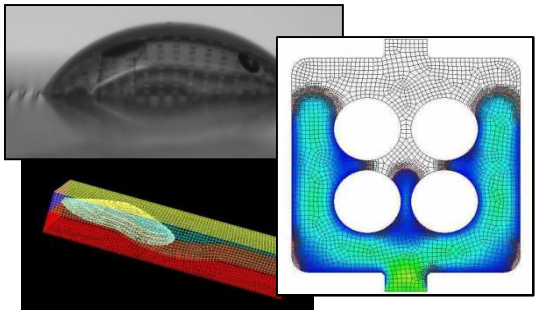




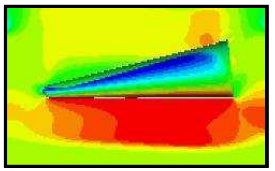
Thermal & Fire Sciences



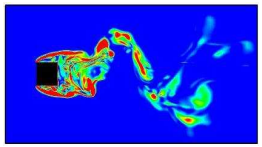
Fluid Mechanics

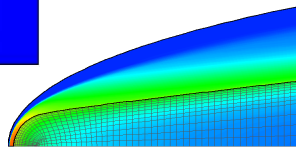


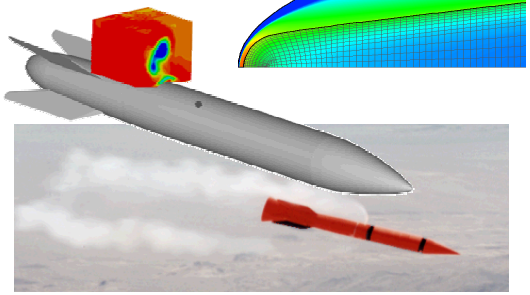
Structural Dynamics



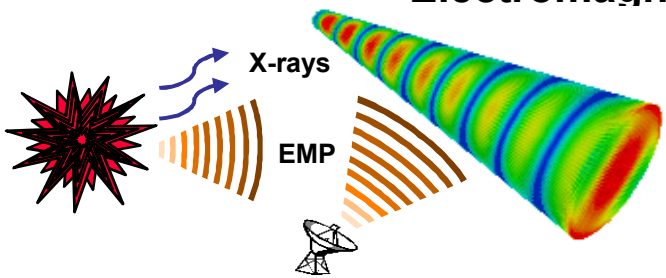
Aerosciences







Electromagnetics



Engineering Sciences: Strategic Objectives and Goals

***Mission**: To provide validated, science-based engineering expertise and solutions across the product life cycle (design, manufacturing, qualification, life assessment and resolution of in-service problems) to inform engineering decisions.*

Objective 1: Pervasive use of computational simulation throughout Sandia

- Goal: Enable predictive simulation – comprehensive code strategy with V&V
- Goal: Deliver engineering analysis in a time frame consistent with design iterations
- Goal: Develop and execute computational simulation engagement plans with all major lab engineering programs

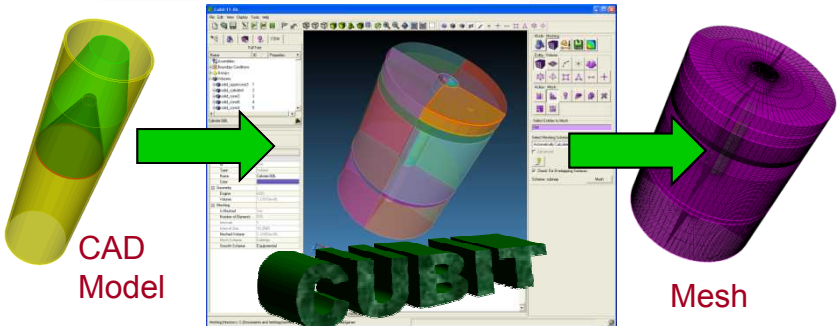
Objective 2: Improved integration of computational and physical simulation

- Goal: Have computational models support all test and evaluation programs
- Goal: Improve capability for characterizing combined environments to provide more realistic environmental evaluation
- Goal: Use modeling as a discovery tool for driving experiments

Objective 3: National leadership in advancing the engineering sciences

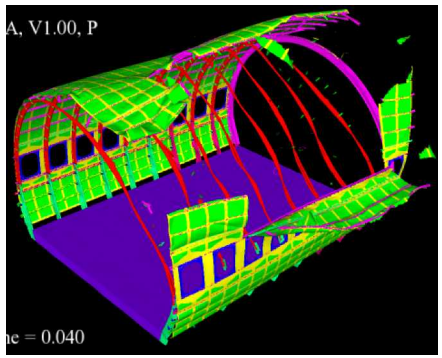
- Goal: Drive innovation in key engineering science disciplines
- Goal: Build partnerships/collaborations with recognized leaders in engineering sciences to advance our capabilities

Sandia Engineering Codes



Preprocessing - meshing

CTH is a massively-parallel Eulerian shock-physics code



CTH licensed to hundreds of external DOE & DoD agencies and their subcontractors

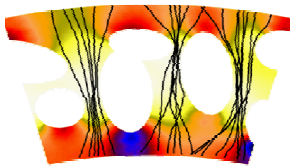
Sierra Mechanics is our core engineering mechanics code family (NW & other)

- Thermal/fluids/aerodynamics
- Solid mechanics/structural dynamics
- Coupled physics (thermo-mechanical) capabilities
- Intrinsic V&V

Highly parallel > 10M degrees of freedom

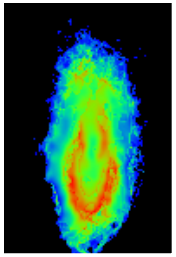
EMPHASIS

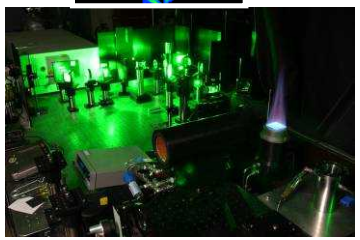
EMPHASIS Electromagnetic Suite Is comprised of time domain, frequency domain, and particle in cell codes



We steward significant test capabilities to perform research, development and applications work

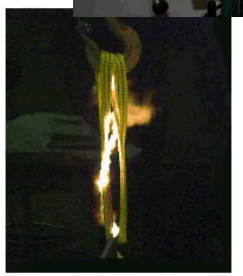
Trisonic & hypersonic flow characterization





Noninvasive laser-based thermal/flow diagnostics

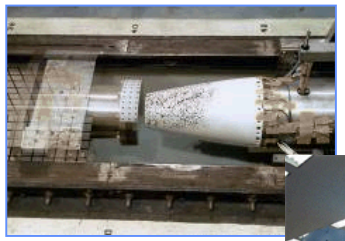
Sled Track, Blast Tube and Aerial Cable facilities

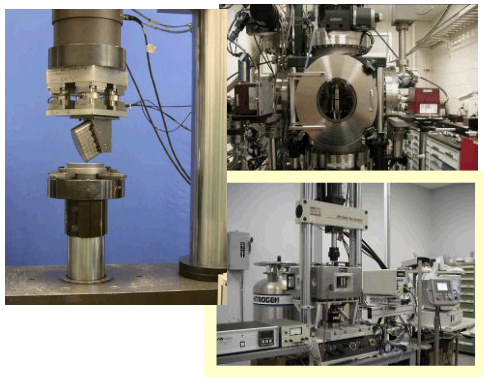


Electrical & EM Facilities

Thermal Test Complex – Radiant heat & fire testing

Modal, vibration, and mechanical shock & centrifuge facilities





Mechanics Labs

NNSA National Nuclear Security Administration

Sandia National Laboratories

Achieving our strategic objectives and impact

1. Appropriate level of rigor and response time for the various modeling needs – design through product acceptance
2. Improvements in how we determine and document analysis rigor, including solution verification, experimental validation, archival data management, etc.
3. Largely replacing test as the basis for product acceptance and moving to limited high-value testing for verification
    - Incorporating statistical approaches for environmental requirements and combined environments testing
4. Learning best practices from others (and sharing our efforts) for continuous improvement

Collaborations and other sponsored work are important

- **Other Sandia mission areas and projects**
- **Industry**
  - Goodyear,
  - Proctor & Gamble,
- **DoD**
  - CREATE
  - ARDEC, TARDEC, Picatinny, ARL, etc.
- **NASA (and JPL)**
- **Atomic Weapons Establishment**