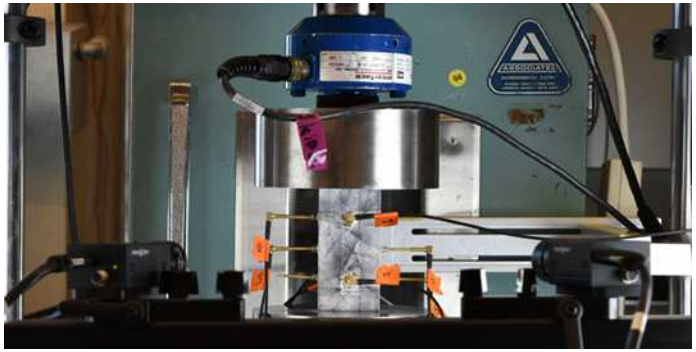
SAND2018-0744PE



LDRD Past & Present Summary

Erik K. Webb

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. 2018-XXXXP

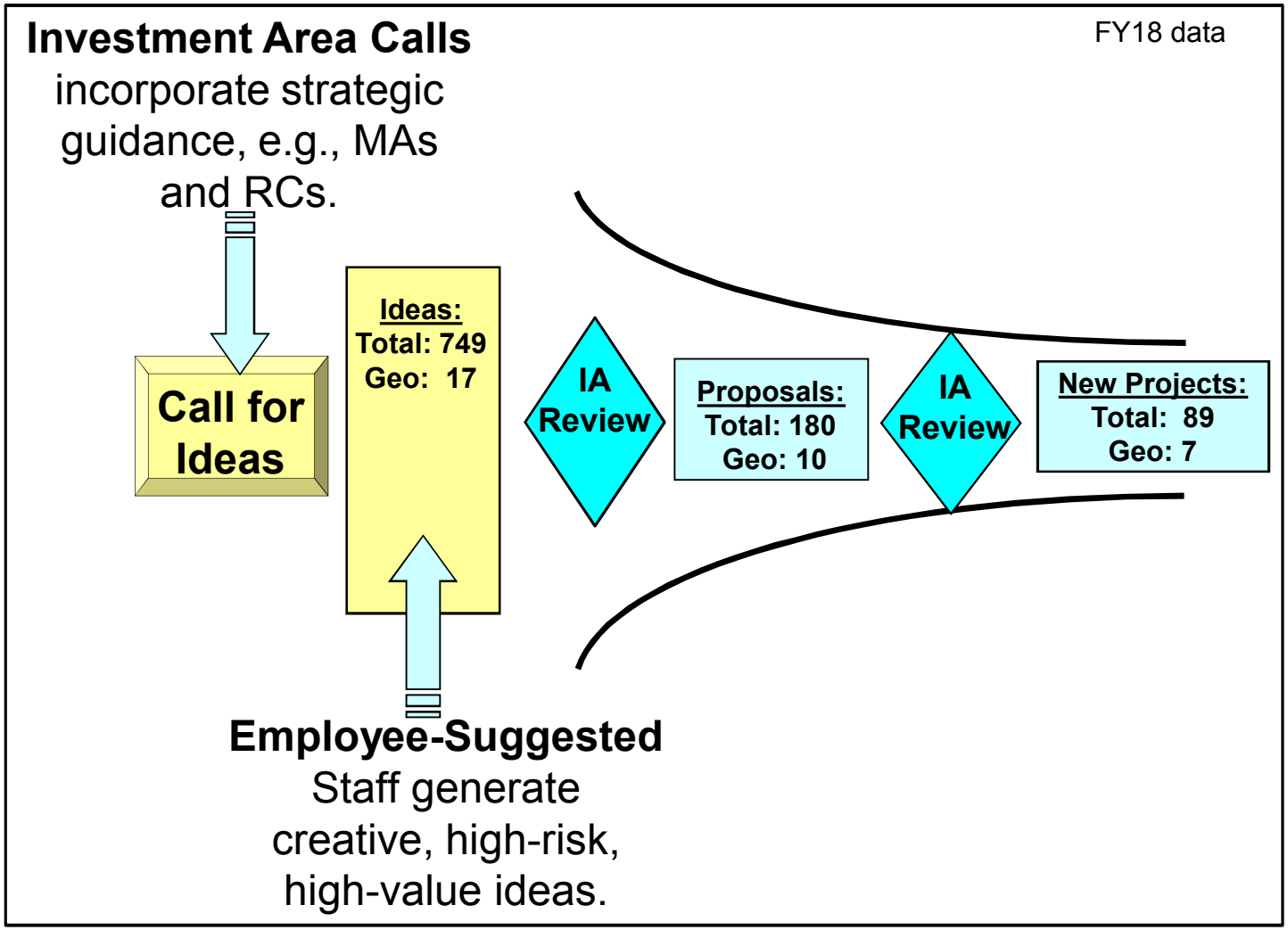
U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

LDRD – National Mandate

- Authorized in 1992
- Maintain the scientific and technical vitality of the laboratories;
- Enhance the laboratories' ability to address future DOE/NNSA missions (national security);
- Foster creativity and stimulate exploration of forefront science and technology;
- Serve as a proving ground for new concepts in research and development; and
- Support high-risk, potentially high-value research and development = **BOLD OUTCOMES**
- Is Sandia's sole source of discretionary R&D funding

Corporate (General) Process



The IA teams review and select ideas and proposals that will best achieve strategic intent.

Is your idea LDRD?

HIGH-RISK, POTENTIALLY HIGH-REWARD?

Sandia National Laboratories

In FY18, LDRD stakeholders (CTO, Research Foundation Directors, Investment Area leads) are committed to funding bolder* ideas and accepting more risk than in previous LDRD cycles.

***These are actual phrases Sandia's R&D leaders used to describe boldness:**

R&D that enables disruptive solutions for national security

If successful, will result in major impact or transformation

Leading-edge, high-risk/-reward R&D that positions Sandia as a national leader

New Capability

Game-changing R&D

R&D with a high risk of failure

R&D that enables innovative concepts and devices

Transforms or challenges the status quo

R&D that transforms capabilities or significantly improves our understanding of fundamental physical phenomena

R&D that fundamentally challenges the current assumptions resident in our ST&E disciplines

Transformational, differentiating ideas that change the way people think about a problem

R&D that will fundamentally transform the approaches, techniques, tools of Mission Areas – differentiating for the laboratory

Geoscience Research Foundation (RF)

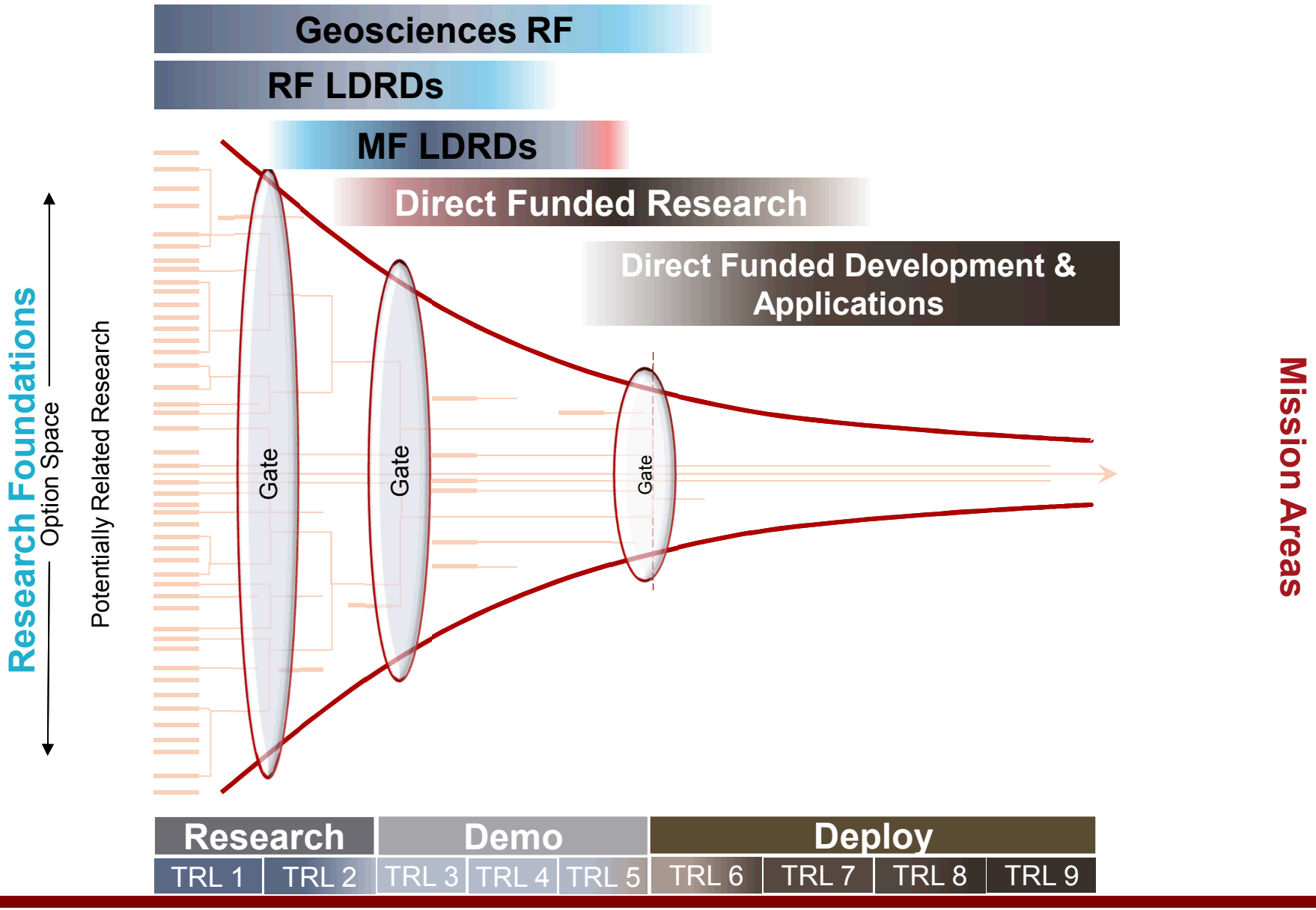
"Encouraging Boldness"

Sandia National Laboratories

Approach/Results:

- Seedlings
  - "Seedlings" are intended to build a future Grand Challenge (GC)
  - Geoscience RF held a workshop presented by Jerry Simmons and Greg Frye-Mason for prospective seedling teams
  - Received nine ideas for seedlings
  - Starting in October 2017: three seedling LDRDs will be funded at $100K each
  - March 2018 competitive review: Seedlings will be evaluated and two will receive an additional $100K for the rest of FY18 and
  - FY19 – FY20: One "baby grand" at $1M for the next two years
- One-Year Projects
  - Funded two bold projects but the ideas were not fully developed
    - Depending on results, these 2 will be encouraged to submit as Ideas for FY19
- Reserve Funds
  - $154K to fund "exploratory" projects throughout the year
    - $140K funded "An Advanced Persistent Homology Toolbox for Real-time, Automatic Classification of Seismic Signals" in January 2018

Research Path



FY18 Geoscience LDRD Portfolio

Sandia National Laboratories

PM	PI	Title	FY18 Budget ($K)	FY19 Mortgage ($K)	FY20 Mortgage ($K)
		Tradtional			
LEE,MOO	INGRAHAM,MATHEW	High Fidelity Hybrid Method for In Situ Borehole Stress Determination	$464	--	--
MULLER,RICK	CRISCENTI,LOUISE	Chemical-Mechanical Modeling of Subcritical-to-Critical Fracture in Geomaterials	$467	--	--
PARROTT,LORI	KLISE,KATE	Developing Fugitive Emissions Sensor Networks: New Optimization Algorithms for Monitoring, Measurement and Verification	$371	--	--
LEE,MOO Y.	YOON,HONGKYU	Integrated Geomechanics and Geophysics in Induced Seismicity: Mechanisms and Monitoring	$420	$522	--
MCMAHON,KEVIN	MATTEO,ED	Monitoring and Repair of Damaged Cement-Geomaterial Interfaces in High Pressure High Temperature Repository and Borehole Scenarios	$422	$644	--
PARROTT,LORI	BAMBHA,RAY	Attribution of Methane Emissions in the Arctic and Continental US	$375	$394	--
VIGIL,STEVE	WEISS,CHET	Prediction and Inference of Multi-scale Electrical Properties of Geomaterials	$376	$405	--
SYMONS,NEILL	ALBERT,SARAH	Unlocking Real Time Infrasound Event Classification Abilities using Machine Learning	$98	$98	--
MACKINNON, BOB	KUHLMAN,KRIS	Characterization and Sampling of Ultralow Permeability Geomaterials using Electrokinetics	$195	$195	$195
LEE,MOO	HEATH,JASON	Optimizing Electromagnetic Signal Transmission for Distributed Embedded Wireless Sensors for Geoscience Applications	$97	--	--
LEE,MOO	JENSEN,RICHARD	Active Tracers for In Situ Computing in Porous and Fractured Media	$98	--	--
PARKS,MIKE	PETERSON,KARA	Arctic Tipping Points Triggering Global Change	Each Seedling receives an initial budget of $98 K. After March, two Seedlings will get **$100K** each.	One project will get $1M	One project will get $1M
REYNA,DAVID	REICHARDT,TOM	Developing the Color Key for "Hyperspectral Google Earth"			
LEE,MOO	DEWERS,TOM	Control of Wellbore Integrity and Reliability for US Energy and			
		Committed Funds	**$3,877**	**$3,256**	**$1,195**
		Reserve	**$154**	**$775**	**$2,836**
		Budget	**$4,031**	**$4,031**	**$4,031**

Academic Alliance (AA)

- In FY18, three Geoscience LDRDs received $295K in additional funds (above and beyond the amount funded by the Geoscience Research Foundation) to partner with five designated Academic Alliance universities

PURDUE UNIVERSITY — $75K (1 LDRD)

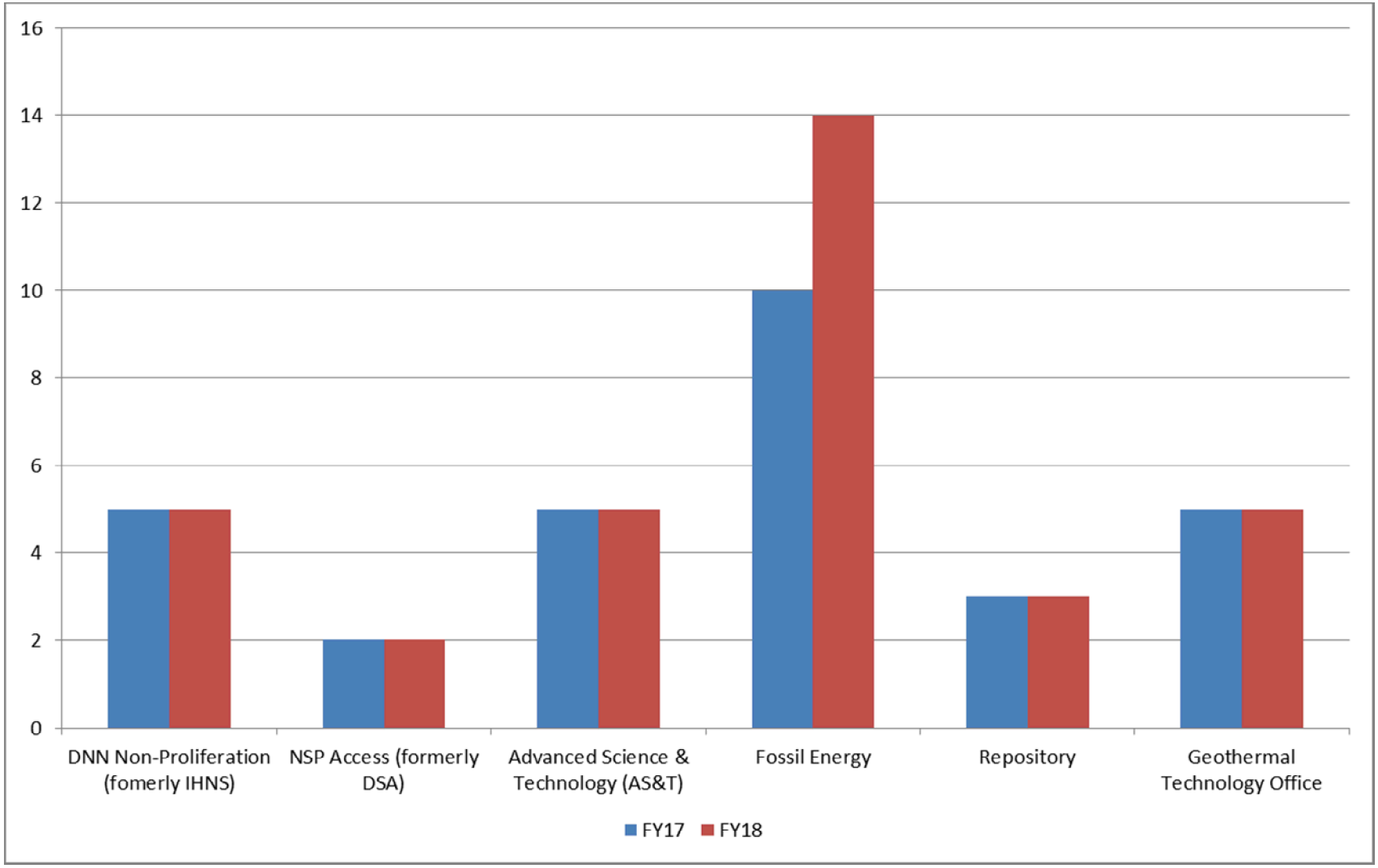
ILLINOIS

TEXAS The University of Texas at Austin — $220K (2 LDRDs)

Georgia Tech

THE UNIVERSITY of NEW MEXICO — $100K (1 LDRD)

LDRDs: Geoscience Specialties



Note: Some LDRDs have multiple specialties

Major Geoscience Technical Themes

Sandia National Laboratories

- Emphasis of "Quantitative Geoscience for National Security"
- Intersection of national security and Earth Science occurs across a wide zone spanning 30km above to several km below the Earth's surface
  - Encompassing the solid earth, oceans, and the atmosphere
- Geoscience R&D must address the coupled thermal, chemical, biological, hydrological, physical, energy propagation, and mechanical behavior of naturally occurring, significantly heterogeneous, and dynamic materials, ensuring integrated understanding and information across scales ranging from nanometers to hundreds of kilometers.

EAB Comments

Assessment:

"We are impressed by the high quality of research. As noted above in the discussion of bold outcomes, it is conservative in the risks it takes, but it is very good and very innovative in this light."

"**We think the RF should consider:**

- Very high-risk, but high-reward, initiatives can have time durations of a decade.

- Working from a problem. It is really hard to say a planned effort is going to be transformational, and it may be unrealistic to expect transformational research on a three-year timescale. Given this, it may be much more productive to find a problem and then plan a bold research strategy. There is a sizable body of work that can be leveraged here."

Priority Areas for FY19 Investments

Sandia National Laboratories

- New sensing tools and methods that provide multi-dimensional (space, time, types of data) information
- Advanced tools for mapping and integration of complex data streams
- Micro to macro scale fluid (both liquid and gas)
- Approaches, models, computation tools and decision approaches that provide better parameterization
- Atmospheric data collection, models and interpretation that can understand and interpret natural and anthropogenic changes
- Data collection, models and rapid interpretation of ocean processes

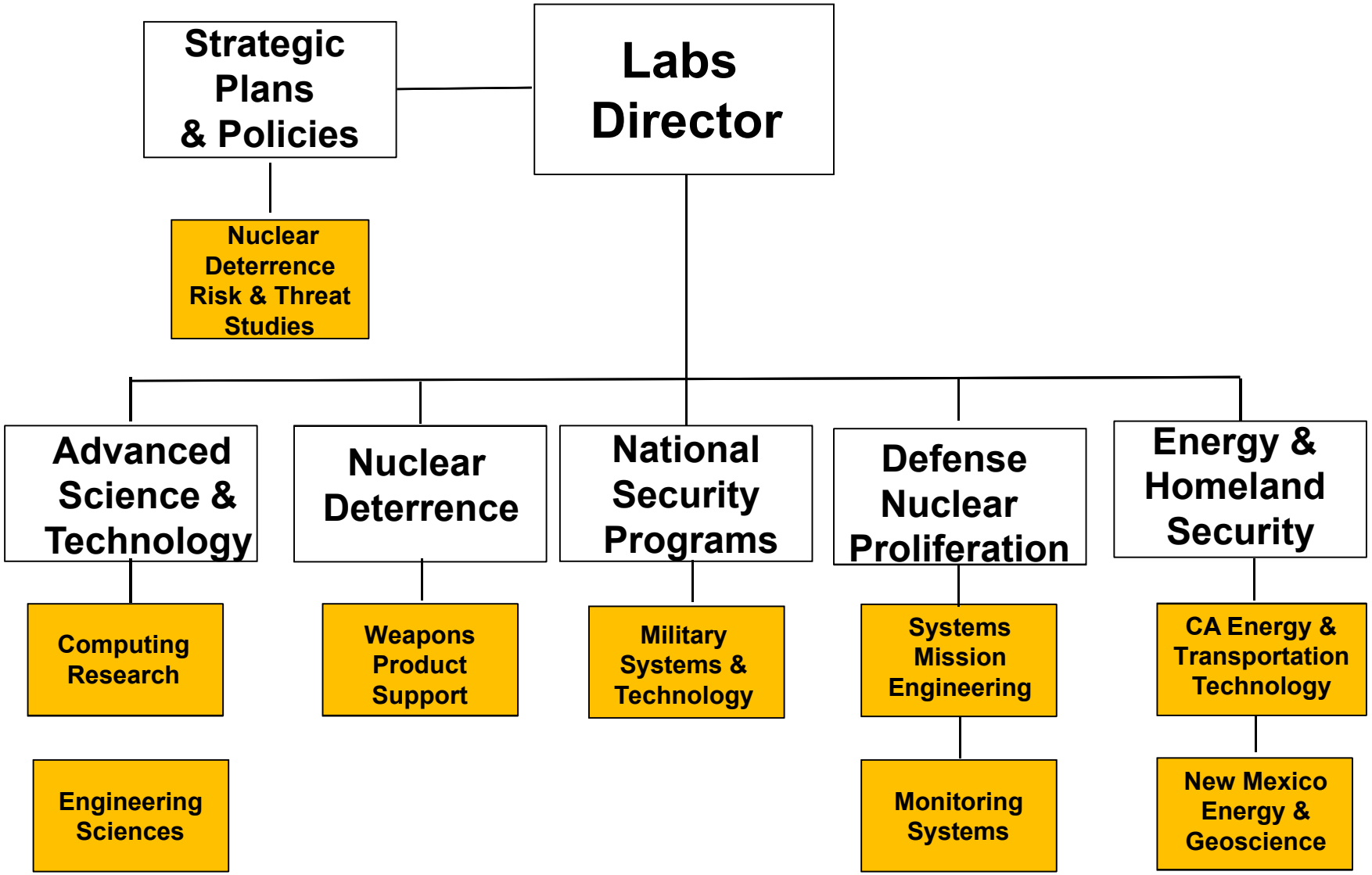
FY18 LDRD Selection Criteria

- Build greater connection to Security Portfolios through jointly applicable investments
- Alignment with more specific technical needs
- Connection to either Mission Foundation or future Mission customers is important
- **“BOLD”** Science
- At least one team member who is
  - currently engaged with direct funded work related to national security missions
  - help bring an understanding of mission needs to the research team
  - be specifically identified in each idea submission

Build Greater Connection to Security Portfolios

- Meeting with POCs from each of the Mission Areas to discuss their needs and opportunities to collaborate
- Adding Internal Board members to have representation from all the Mission Areas

RF Internal Board Representation

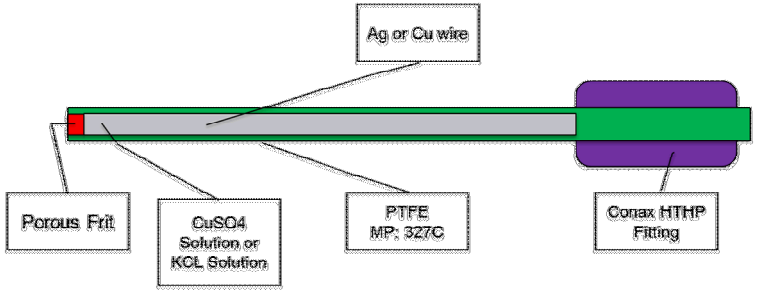


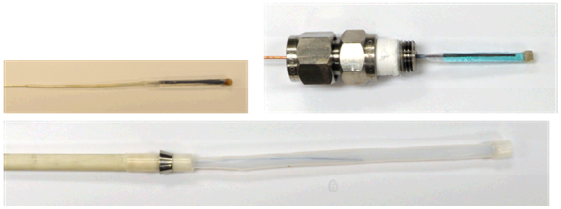
Accomplishments – FY17

- Early Career
  - 5 Early Careers; 9 junior staff (Members) and 5 Post-Docs
- Follow-on Funds
- Peer Reviewed Publications
  - 11 papers published; 7 in review/revision; 23 in prep
- Awards
  - One conference paper was selected for a publication in a special issue of the Journal of Loss Prevention in the Process Industries.
- Intellectual Property
  - 1 Patent Application filed; 2 TAs submitted and 1 software copy written
- Corporate Impacts
  - Research Foundation Annual Reports

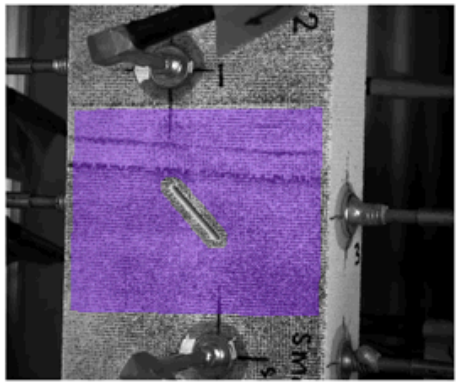
FY17 Key LDRD Research Accomplishments

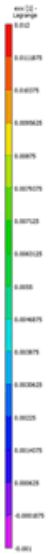
- **Development of a Downhole Technique for Measuring Enthalpy in Geothermal Resources (Zack Cashion, PI)**
  - Demonstration of an effective approach to measuring steam fraction in HTHP two phase flowing systems by tracking chloride concentration
  - Improved temperature and pressure testing capabilities have been established as a result of this LDRD and capabilities funds





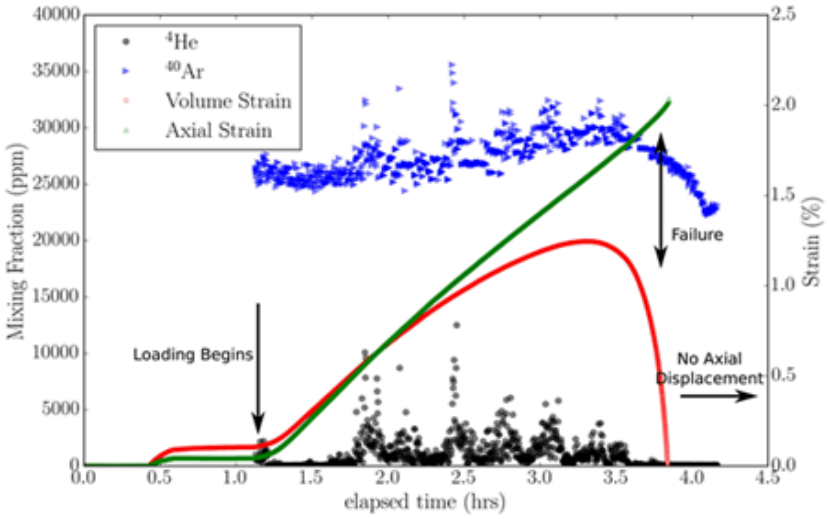
- **Digital Rock Physics (Mario Martinez, PI)**
  - Demonstrated technology to apply 3D printing for geoscience applications
  - Developed new GeoScience Imaging & Additive Manufacturing Laboratory





FY17 Key LDRD Research Accomplishments (cont'd)

- **Real-Time Degassing of Rock during Deformation (Steve Bauer, PI)**
  - Development of a new diagnostic tool with multiple applications, and the creation of a variety of new techniques for tracing changes in stress and strain in earth materials.
  - Collected basic data for real time gas release during deformation



- **Self-Tuning Seismic Sensor Data Processing (Tim Draelos, PI)**
  - Released Adaptive Self-Tuning Dynamic detections result in fewer missed and false than static detections over 22-hour period of real Mt. Erebus data