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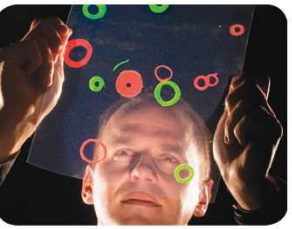

Sandia's LDRD Program: Quality of Science

Randy Schunk

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Sandia National Laboratories

Exceptional service in the national interest

U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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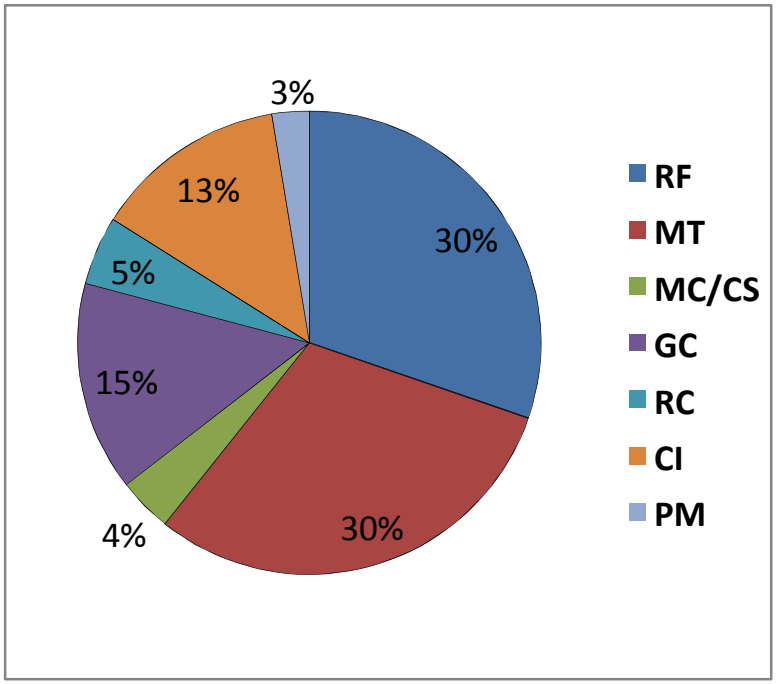
3. **Quality of Science**

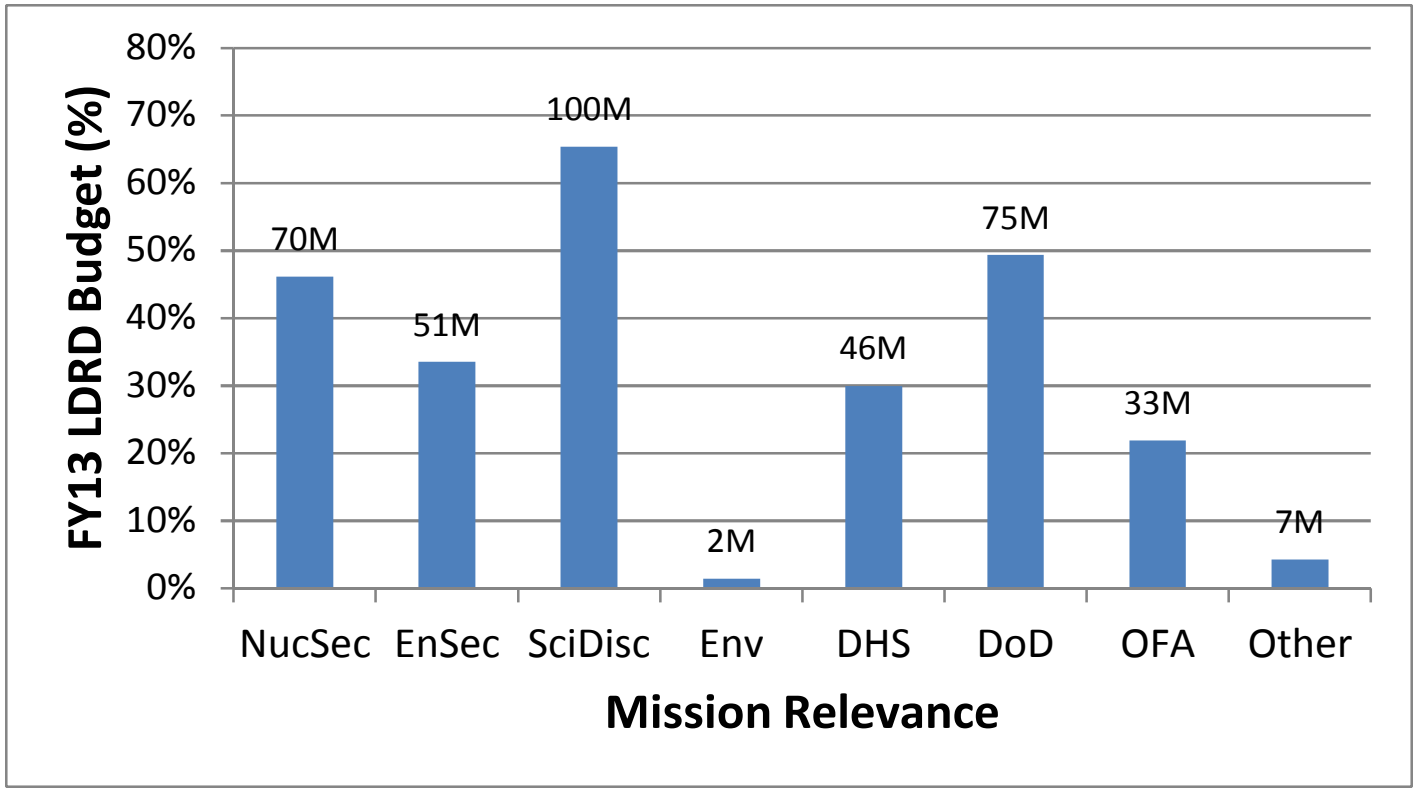
Discuss the mechanisms and/or processes that your laboratory uses to ensure LDRD projects produce quality science. How does your laboratory measure the quality of science of proposed LDRD projects?

LDRD has helped Sandia maintain strong laboratory capabilities

- **Research Foundations (RF)** – anticipate future research needs and capabilities for NW and our other national security missions
- **Mission Foundations (MF)**– address difficult national security areas critical to mission success (Cybersecurity)
- **Grand Challenges (GC)** – bold, high-risk ST&E challenges with enormous potential impact on national security
- **Corporate Investments (CI)** – incubate strategic research initiatives, nurture our workforce and develop external partnerships
- **Program Management (PM) –** program operations

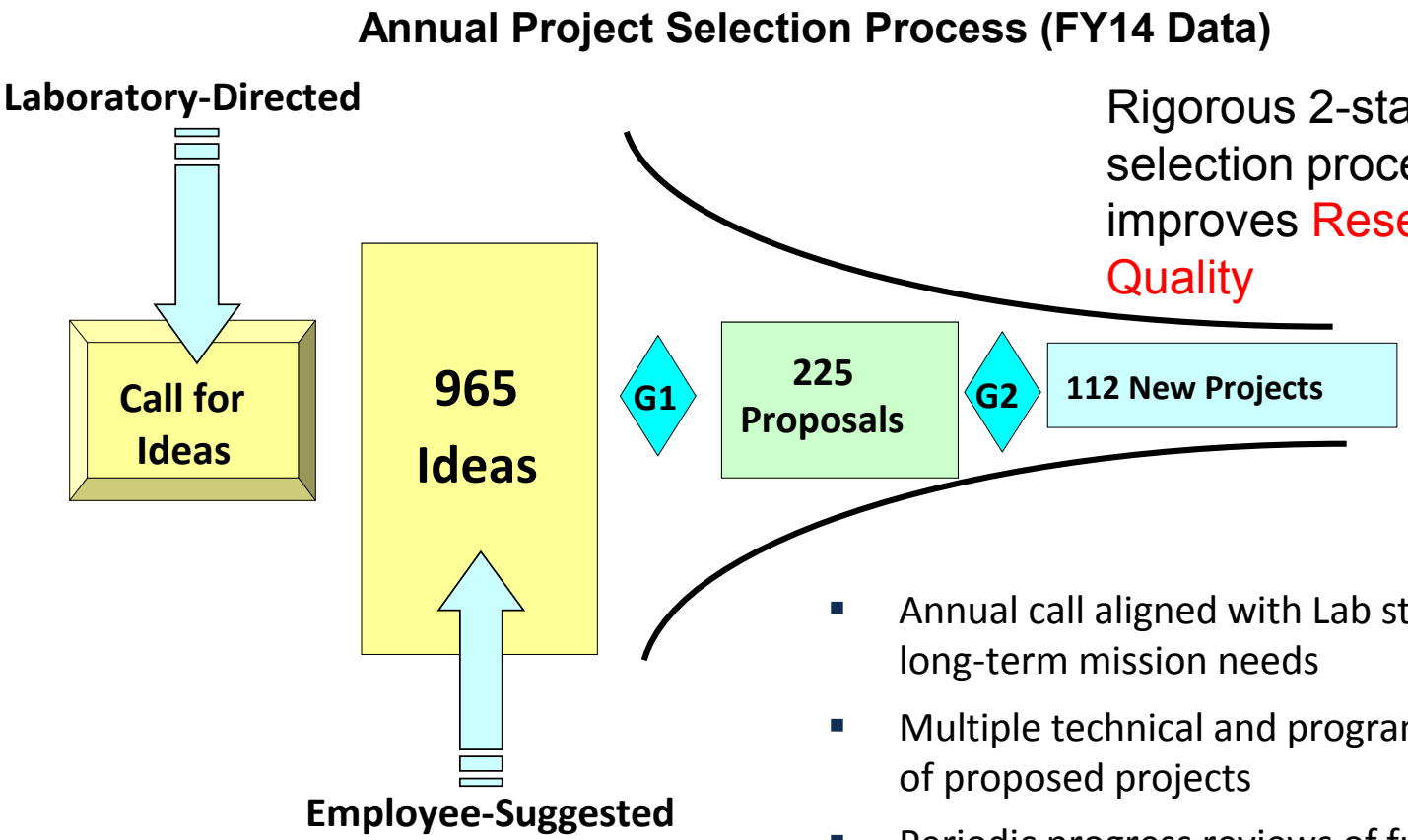


LDRD has helped Sandia maintain strong laboratory capabilities

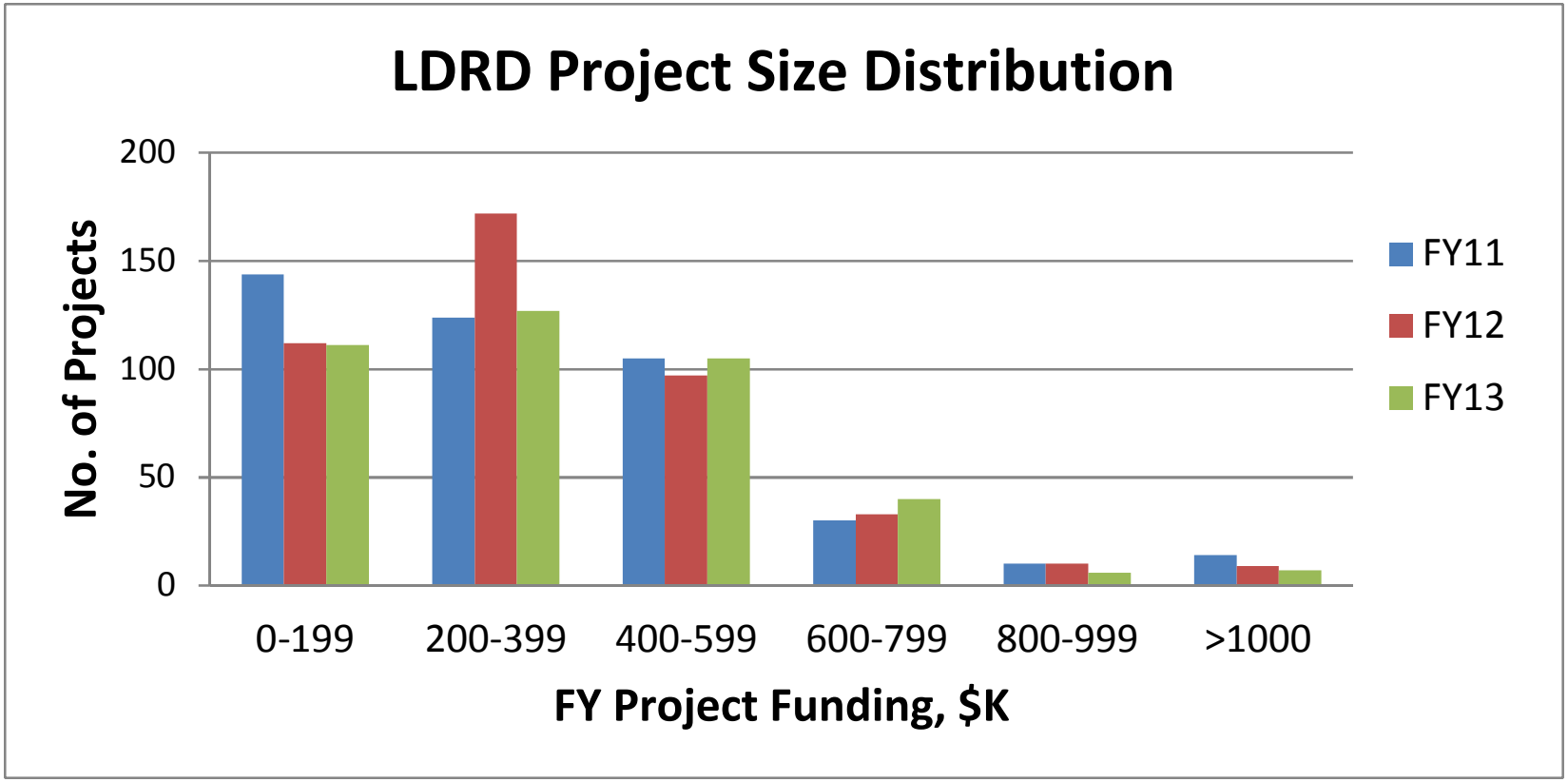


Program size is ~$150M in FY13, but multi-mission nature of many projects create greater effective value to the laboratory!

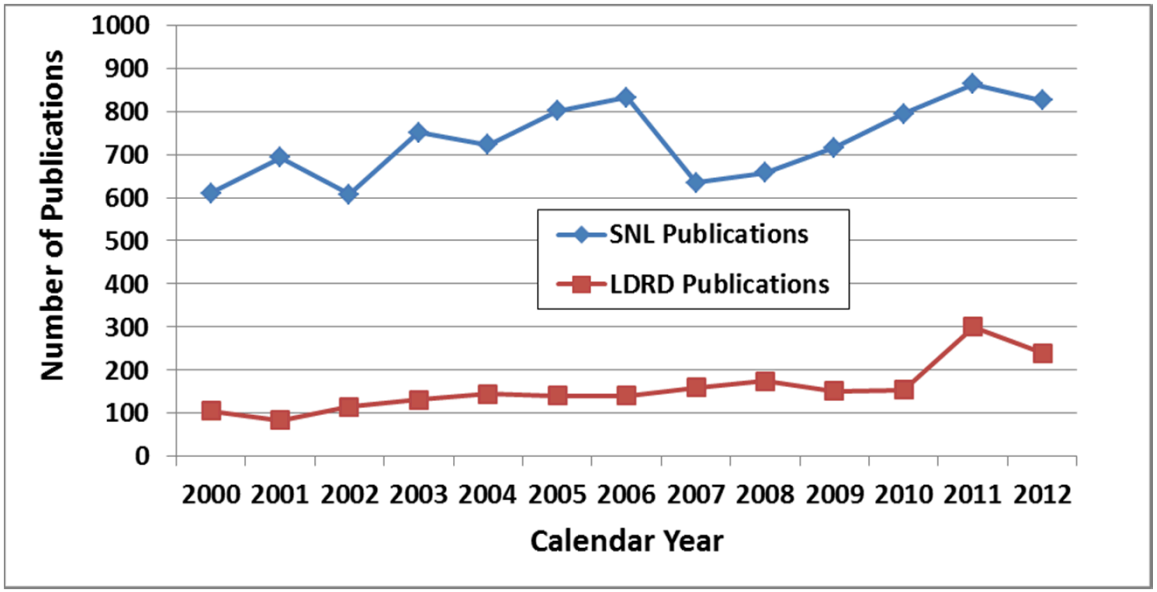
LDRD is transparently & rigorously managed



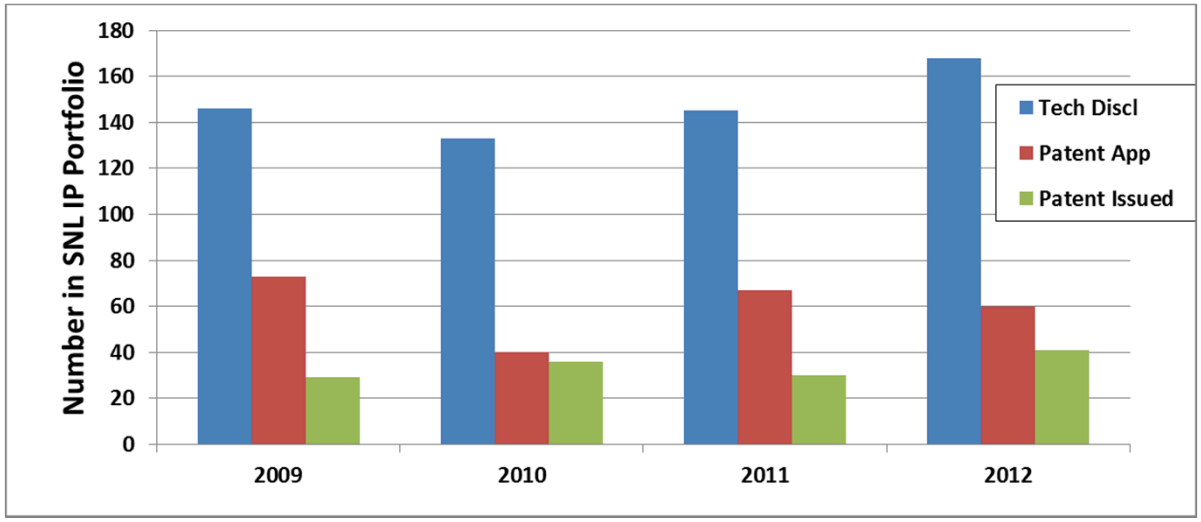
- Annual call aligned with Lab strategy and long-term mission needs
- Multiple technical and programmatic reviews of proposed projects
- Periodic progress reviews of funded projects against documented milestones
- Annual portfolio reviews by external experts
- Annual DOE/NNSA SFO review and concurrence on all projects


LDRD Project Size Distribution
No. of Projects
200
150
100
50
0
0-199
200-399
400-599
600-799
800-999
>1000
FY Project Funding, $K
FY11
FY12
FY13

LDRD – Historical Outcomes (Pubs and IP)



Measuring Quality -Many metrics…these are the obvious ones



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LDRD Program Rigorously Reviewed and Monitored (Helping *Ensure* Quality)

Review Criteria:
Strategy

Relevance

Quality

Workforce

Impact

Sandia Research Advisor Board

Research/Mission Foundations:
- Investment Area Teams (SMEs, Management)
- External Review Boards (ERB)

Grand Challenges:
- Investment Area Team (CTO, Research Leadership Team)
- External Advisor Boards (ERB)
- Business and Market Intelligence support

Program is Rigorously Reviewed by External Review Boards, Advised by Business Intelligence, Monitored by IATs

LDRD Also Advances Scientific Frontiers, Fuels Innovation, and Builds Research Talent

Sandia National Laboratories

LDRD generates a disproportionate share of Sandia's research productivity:

- 26% of Sandia's refereed publications (2008-2012)
- 46% of patents (2009-2013)
- 24% of copyrights (2009-2013)
- 68% of R&D 100 awards (2009-2013)

Measuring Quality

LDRD helps sustain our research talent base:

- LDRD funding supports 56% of Sandia's Postdocs (2009-2013)
- 73% of Sandia Postdocs converted to R&D staff were supported by LDRD (2009-2013)
- 202 PhD hires have led Early Career R&D LDRD projects since FY2010
- In FY2012, over 300 students worked on LDRD at Sandia
- In FY2013, nearly $7M of LDRD funding went to over 50 universities
- *Over 50% of Early Career LDRD researchers already directly support the nuclear weapons mission; these new researchers further nurture Sandia's science and engineering capabilities base essential to the stockpile stewardship program*

Other Research Quality Activities

- Measuring:
  - Metrics – Publication rate, *publication quality*, IP (Quality)
  - Impacts assessments (ROI, mission impacts, anticipated impacts) - (Quality and Relevance)
  - LDRD Archeology (current "reputation" traced back to earlier LDRD investments) – (Quality and Relevance)
  - LDRD Tracking – Search forward for "reputation" (Quality)

  Important to distinguish "quality" from "relevance"

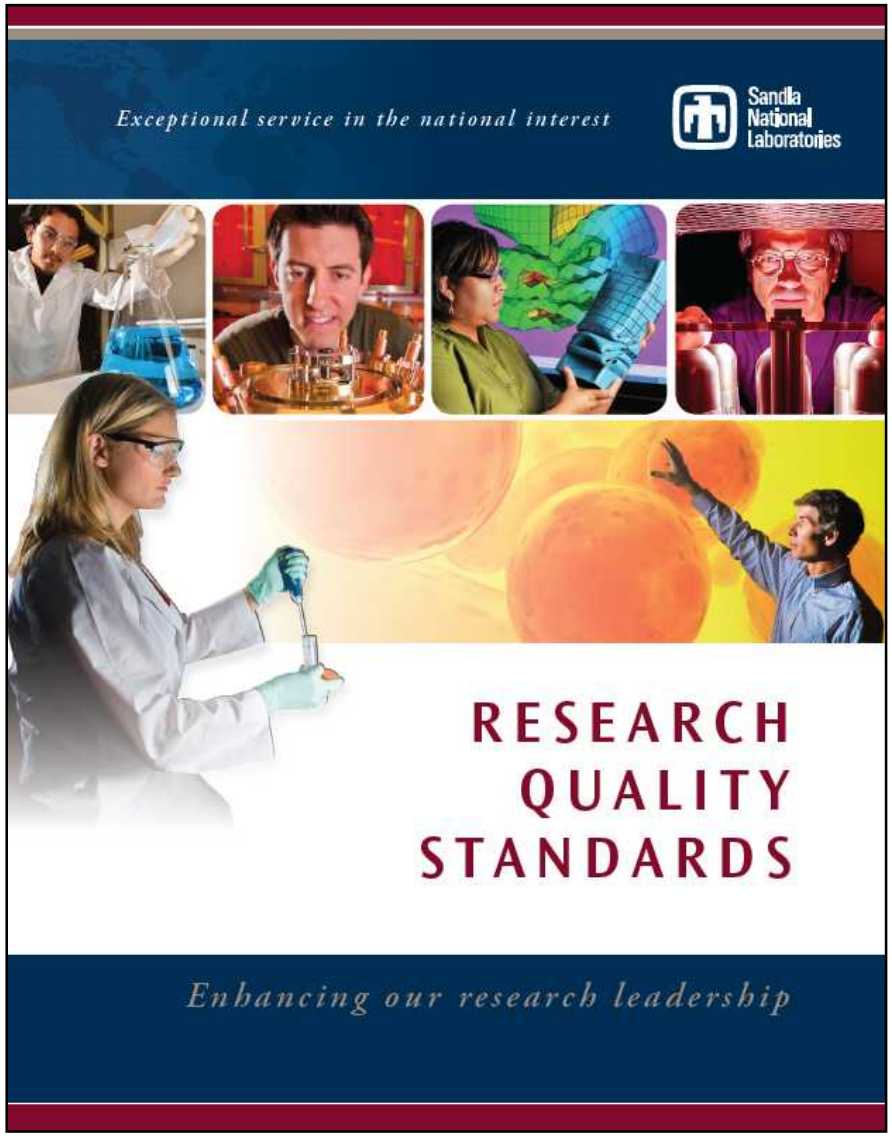
- Ensuring:
  - Research Quality Standards – more to come
  - The Life of PI workshop (staff driven)

Life of "PI" Workshop

- Young-staff initiated and developed!
- How *might* staff gain the skills needed to become effective PIs?

We recognized an enormous need for PI "Best Practices" to be shared

Research Quality Standards



Research quality is primarily determined by the actions of individual researchers.

New or inexperienced researchers are the ones most likely to be unaware of actions or decisions that can lead to poor research outcomes in the Sandia environment.

They are also less likely to be aware of actions they can take that can lead to better research outcomes in the Sandia environment.

With this in mind we created the research quality standards with the intent of helping our new hires avoid common problems and be more aware of techniques and approaches that can enhance their performance.

The standards can be accessed at this link: http://mstc.sandia.gov/1730/docs/Research%20Quality%20Standards_2013F.pdf

Acknowledgements: Carol Sumpter, Mike Daily, et al.

Reference Materials

The team reviewed three documents that helped us structure our standards.

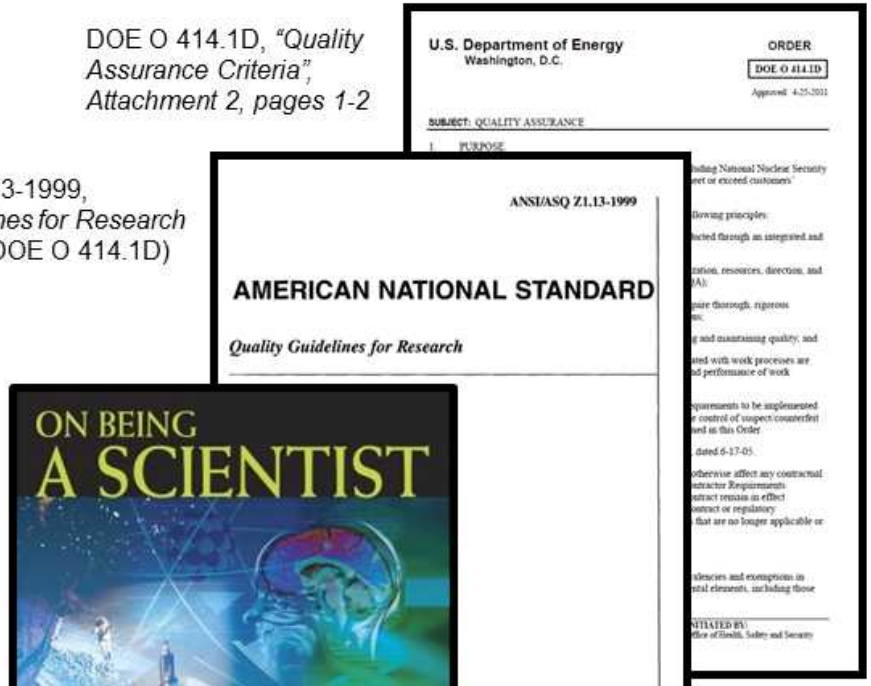
These documents discuss commonly recognized research quality issues identified by the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine, the U.S. Dept. of Energy, and the American Society for Quality:

1) *On Being A Scientist, A Guide To Responsible Conduct In Research*, 3rd edition, The National Academies Press, 2009.

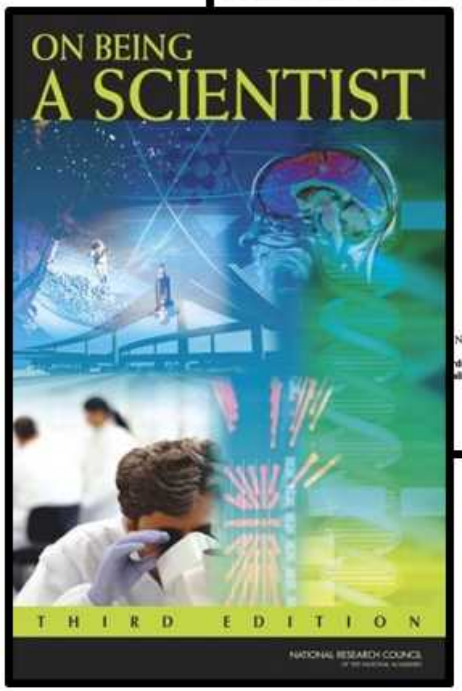
2) ANSI/ASQ Z1.13-1999, *Quality Guidelines for Research*

3) DOE O 414.1D, *Quality Assurance Criteria*, Attachment 2, pages 1-2.

DOE O 414.1D, *"Quality Assurance Criteria", Attachment 2, pages 1-2*



ANSI/ASQ Z1.13-1999, *Quality Guidelines for Research* (referenced in DOE O 414.1D)



On Being A Scientist, A Guide To Responsible Conduct In Research, 3rd edition, The National Academies Press, 2009

http://www.nap.edu/catalog.php?record_id=12192

Research Quality Standards, Page 39

Hardcopies of the standards will be made available for:

- Every R&D L1 Manager
- Every R&D Manager
- Every Director and above
- Others on request

THE DANGERS OF OVEREAGERNESS

A government agency put out a call for research proposals for ways to mitigate a widespread and difficult problem. A research scientist had a great idea and submitted it. Not hearing back from the funding agency, the researcher, on a shoe-string budget, moved forward and implemented his idea, at least with some preliminary experiments. It seemed to work. While this was going on a major story hit the news regarding an incident that the researcher's work might have prevented if the technology had been available. Because of the compelling human interest connection and the obvious value of such a technology, there was a push to get a press release out on the technology.

An article for the company paper was written, having been appropriately reviewed and approved by management, legal, security, etc. A month later a press release was issued, also having been appropriately reviewed and approved by a large number of people. The story was picked up and carried by the *Washington Post*, *The New York Times*, and other publications. But the government agency that had put out the original call for proposals also saw the press release, tested the technology, and found that it did not work as expected.

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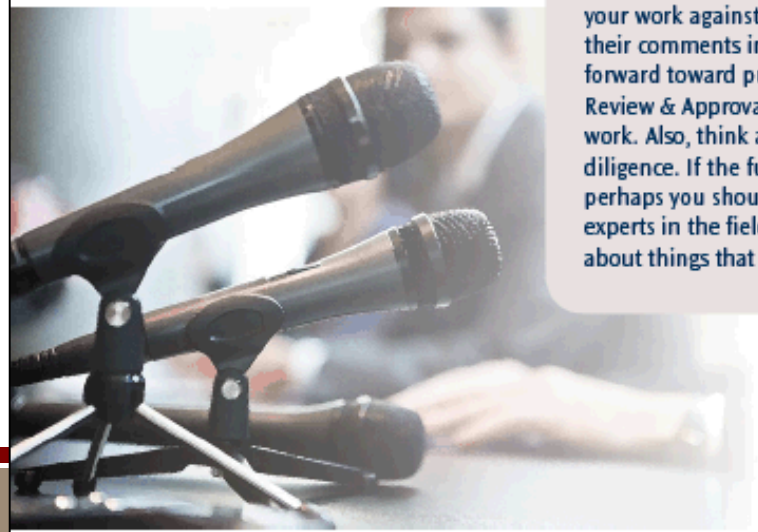


MORAL OF THE STORY

When large and momentous claims that can capture the emotions and imagination of the public are to be released publicly, the need for critical and unemotional scientific peer review by experts in the field is critical and must be performed and documented. Ask your manager to create an internal peer review team to spend a day critically reviewing your work against the claims being made and documenting their comments in a written report before you allow it to go forward toward public release. This is important because Review & Approval can't review the technical aspects of your work. Also, think about what needs to be done for due diligence. If the funding agency did not select your proposal perhaps you should call them and find out why or find other experts in the field to provide some unemotional feedback about things that may be fooling you in your results.

Resources That Are Available for You

Sandia National Laboratories

Research Quality Standards (Available Now Electronically, Hardcopies in Dec.)

76 page document which includes the 50 case studies.
http://mstc.sandia.gov/1730/docs/Research%20Quality%20Standards_2013F.pdf

Research Quality Resource Sheet (Dec. 2013)

Two page document that summarizes the vision and intent of the standards and points to the standards document, reference materials, and the web site.

Research Quality Description (Dec. 2013)

One pager that describes what Research Quality means to us.

Research Quality Web Site (Jan. 2014)

Provides on-line version of the standards along with additional supporting materials.
https://cto.sandia.gov/prodevel.html

Two Hour Defect Prevention Workshop - DPS100 (Available on Request)

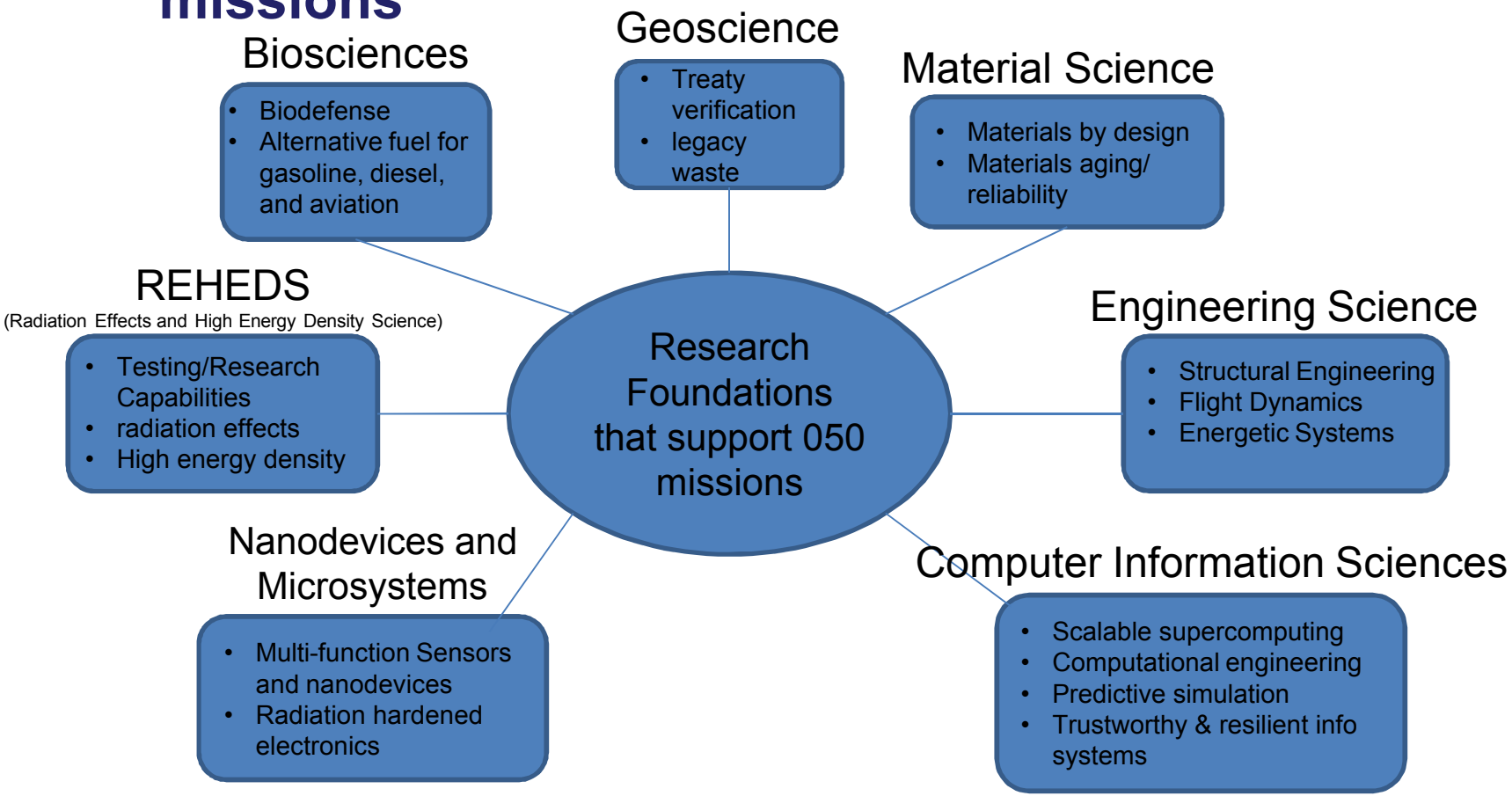
Reviews the technical basis for why prevention is the most cost effective way to assure quality and examples of how to apply it to Research & Development. Two versions of the workshop are available, one for researchers and one for product developers.
Contact Carol Sumpter or Mike Daily (org. 1730)
http://mstc.sandia.gov/1730/def-prev-best-prac-research.shtml

Backups

Sandia National Laboratories

3c. Building national security capability:

LDRD helps Sandia maintain a strong technical capability base to support 050 missions



Additional benefits/outcomes of LDRD

- **Publications**: In FY12, the number of peer-reviewed publications associated with LDRD funds was 239, or 29% of the Sandia total
- **Collaborations with government, industry & universities:**
  - 282+ LDRD projects include collaborations with government, industry, and universities
  - Universities: $6.7M in LDRD investments, or 35% of Sandia's contracts with universities
- **Patents:** In FY12, 41 patents granted were associated with LDRD projects, or 49% of the Sandia total
- **Awards:**
  - **R&D 100:** In FY13, Sandia received three and contributed to a fourth. Three had their roots in LDRD projects.
  - **Asian American Engineer of the Year:** Jeffrey Tsao (LDRD participant)
  - **Federal Laboratory Consortium:** Two awards associated with LDRD
  - **Professional societies:** Five new fellows (LDRD participants)
  - **TechConnect Innovation Award:** MEPV LDRD grand challenge