



SHORT COURSE: RENEWABLE ENERGY INTEGRATION

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Sandia National Laboratories**

**Renewable Energy Short Course, Burlington, VT
26 July, 2011**

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
for the United States Department of Energy's National Nuclear Security Administration
under contract DE-AC04-94AL85000.



Class Outline

- **Welcome and Introductions**
- **Seminar Purpose**
- **Schedule for the Day**
- **Introduction to Sandia National Laboratories**

Some things not addressed in this presentation:

Organics, Dye-sensitized, nanomaterials, quantum dots, etc.



Purpose

- **Increased integration of renewable energy sources into the electrical grid is a goal of many stakeholders. However due to the inherent characteristics of different renewable energy sources, such integration poses many technical challenges such as choosing the right mix of resources, managing the inherent variability of the generation sources, optimizing infrastructure upgrades, and planning for sustainability.**
- **The goal of this 1-day course is to provide stakeholders vital information about the specific characteristics of various renewable energy sources and the associated challenges of integrating these technologies on to the electrical grid.**
- **Define concrete steps to aid Vermont in its transition to renewable energy**



General Rules

■ Informal environment

- Ask questions
- Be respectful and listen to others
- Offer answers or relevant experience
- Contribute and provide feedback



■ Introductions

- Name
- Affiliation
- Experience/interest in RE
- What do you hope to gain/learn?



Schedule

| | |
|----------------------|---|
| <i>8:30 – 9:00</i> | <i>Welcome, Introductions, and Seminar Purpose Introduction to Sandia (Stein and Hill)</i> |
| <i>9:00 – 9:30</i> | <i>Renewable energy outlook in the and World (Stein)</i> |
| <i>9:30 – 10:00</i> | <i>Renewable energy outlook in Vermont (TBD)</i> |
| <i>10:00– 10:15</i> | <i>Morning Break</i> |
| <i>10:15 – 11:30</i> | <i>Power Systems Fundamentals (Hill)</i> <ul style="list-style-type: none"><i>• Generation, Transmission and Distribution</i> |
| <i>11:30-12:00</i> | <i>Energy Games I</i> |
| <i>12:00 – 1:00</i> | <i>Lunch</i> |
| <i>1:00 – 1:40</i> | <i>Wind Power (Hill)</i> |
| <i>1:40 – 2:20</i> | <i>Solar Power (Stein)</i> |
| <i>2:20 – 3:00</i> | <i>Energy Games II</i> |
| <i>3:00 – 3:15</i> | <i>Afternoon Break</i> |
| <i>3:15 – 4:00</i> | <i>Integration Case Studies (Stein)</i> |
| <i>4:00 – 4:30</i> | <i>Short Course Review, Issues, Moving Forward</i> |



Sandia's Heritage

"Exceptional service in the national interest"



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 response 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.



Sandia locations

Albuquerque,
New Mexico



Livermore,
California



Emeryville,
California



Waste Isolation Pilot Plant,
Carlsbad, New Mexico



Pantex, Texas



Tonopah, Nevada



The Evolution of Our Mission

1950s

Production engineering and manufacturing engineering



1960s

Development engineering



1970s

Multiprogram laboratory



1980s

Research, development and production



1990s

Post-Cold War transition



2000s

Expanded national security role



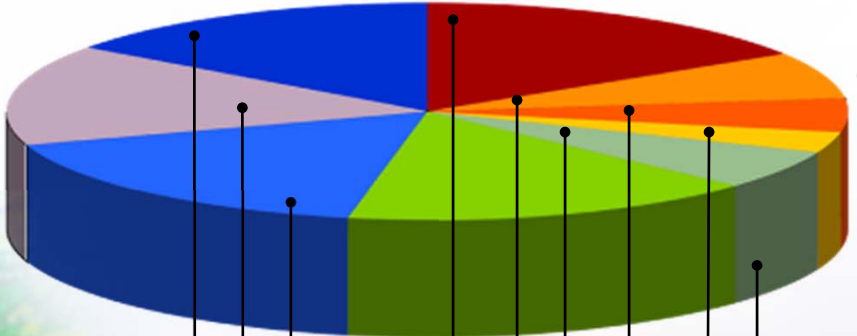
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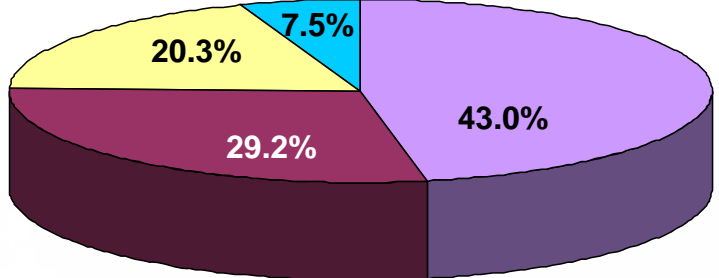
People and Budget

- FY10 permanent workforce: 8,478
- FY10 budget: \$2.4B

Technical Staff (3,921) by Degree
(Start of FY09)

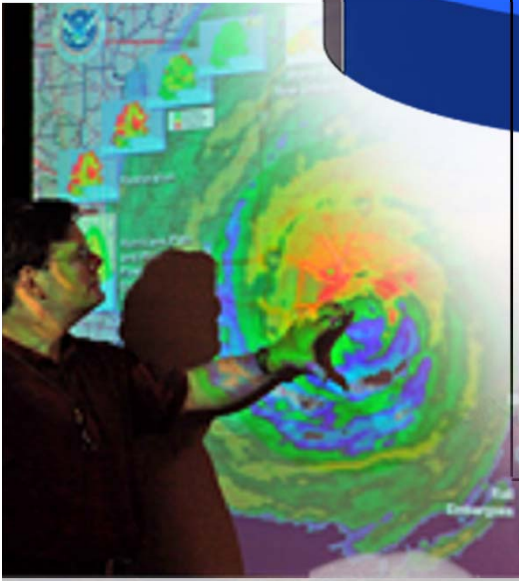


- Electrical Engineering 17%
- Mechanical Engineering 15%
- Other Engineering 15%
- Computing 16%
- Math 3%
- Chemistry 5%
- Physics 6%
- Other Science 7%
- Other Fields 16%



(Operating Budget)

- Nuclear Weapons
- Defense Systems and Assessments
- Energy, Resources and Non-proliferation
- Homeland Security and Defense



Sandia State-of-the-Art Facilities

Microelectronic, Materials, Nanotechnology, and CSP

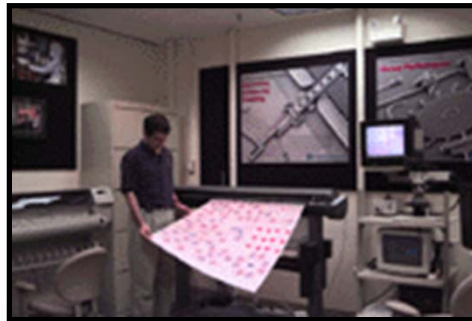


Microelectronics and Semiconductor Materials Processing



Microelectronics Development Lab (MDL)

Microelectronics Development Lab (MDL)



Microsystems & Engineering Science Applications (MESA)

Materials Sciences, Nanotechnology Technology, and CSP

Center for Integrated Nanotechnology (CINT)



Integrated Materials Research Lab (IMRL)

National Solar Thermal Test Facility



Sandia's Photovoltaic Facilities

PV Systems Evaluation and Optimization Lab



Distributed Energy Technology Lab



**Simulate small μ grid or community
(25 homes and businesses), including
PV-Storage-Fuel Cells-Generators**

**Grid Integration Studies and Technology
Prototyping & Development Environment**

- **Controlled Side-by-Side Component, Array and System Characterization**
- **Comprehensive Data Acquisition Systems**
- **Grid Integration, Inverters, Combiners, Disconnects- All Reconfigurable**



Thank You!