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Sandia National Laboratories

Native American Heritage Observance Event

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AFRL Phillips Space Conference Center
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U.S. DEPARTMENT OF ENERGY
NNSA National Nuclear Security Administration

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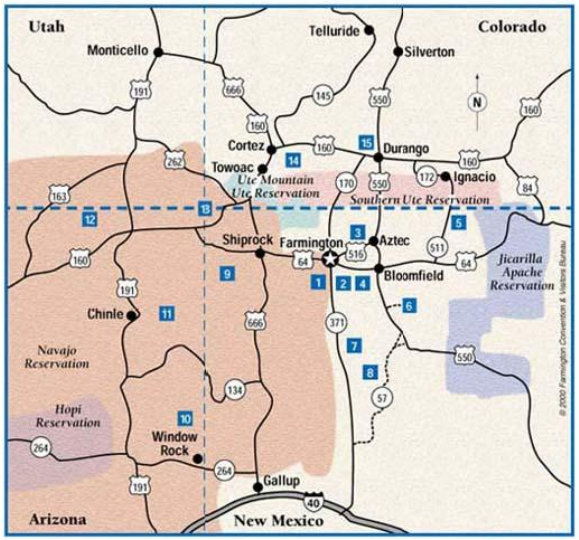
Personal Background

- Grew up on the Diné reservation in Shiprock, NM

My grandmother,
Yili Bah Atcitty



Rug made by my mother,
Betty Mae Atcitty

Personal Background Cont.

- Raised in a ~ 500-square-foot substandard house
- Family income ~ $5k/yr
- Mother sold rugs to help support the family

Educational & Professional Background

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- Shiprock High School
- *San Juan College (AS General Science)*
- New Mexico State University (BS & MS EE)
- Virginia Tech University (Ph.D. EE)
- Worked at Sandia for over 17 years
  - Power engineering and power electronics for weapon and energy systems
  - Three patents, one pending
  - Four R&D 100 Awards
  - Over 40 technical publications
  - Weapon Internship Program Graduate 2002
  - AISES Technical Excellence Award 2007
  - Sandia's Up-and-Coming Innovator Award for Center 6100

Electric Utility Background

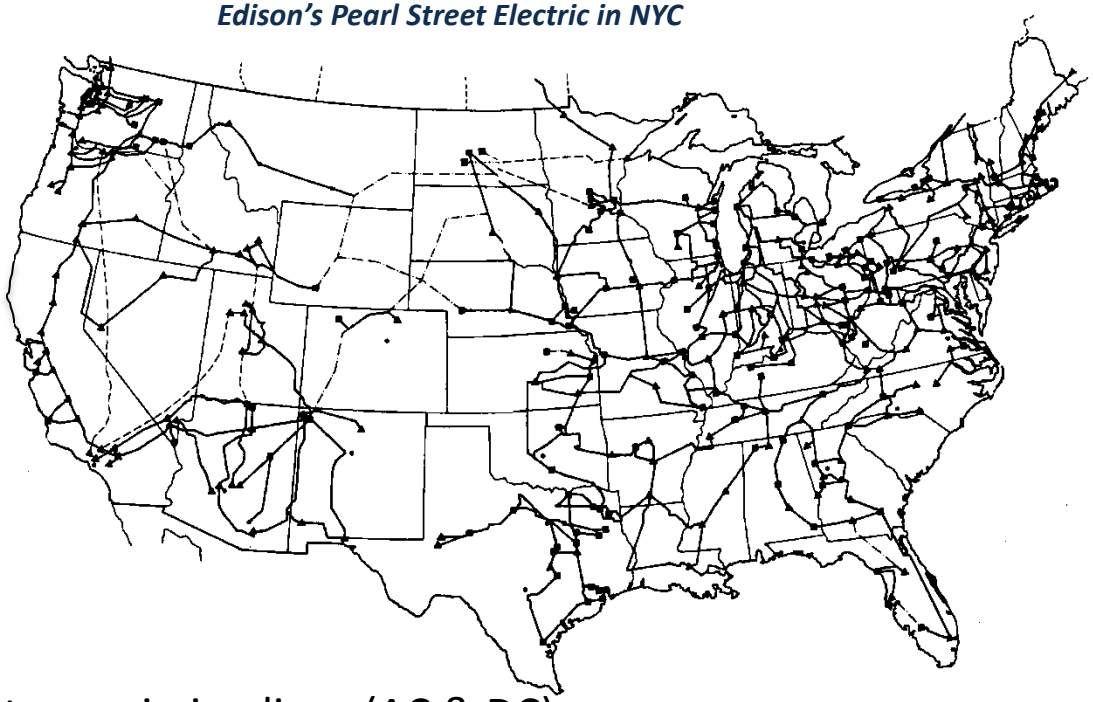
Common AC voltages

Transmission
- 765kV
- 500kV
- 345kV
- 230kV

Sub-Transmission
- 69kV
- 30kV
- 15kV

Distribution
- 4kV
- 2kV
- 600V
- 480V
- 240V
- 120V

First modern electric system developed in 1882 by Thomas Edison's Pearl Street Electric in NYC



- Made up of:
- Over 150 thousand miles of transmission lines (AC & DC)
- 10s of thousands of Generating Units totaling ~1000GW of total capacity
- Millions of transformers, relays, and controls
- 100s of Billions of dollars in total investments in transmission and distribution

Electric Utility Major Blackouts

- San Diego/Arizona/Baja Blackout September 2011
  - 5M affected, HV transmission line failure from AZ to CA
- Northeast Power Blackout August 14, 2003

Source: http://www.globalsecurity.org/eye/blackout_2003.htm

~ 45M people affected US, 10M Ontario Canada

~ 6B in financial losses

- Western US Blackout August 1996
  - High demand, heat wave, and sagging power lines
- New York City Blackout July 1977
- Northeast Blackout November 1965

Transportable Systems

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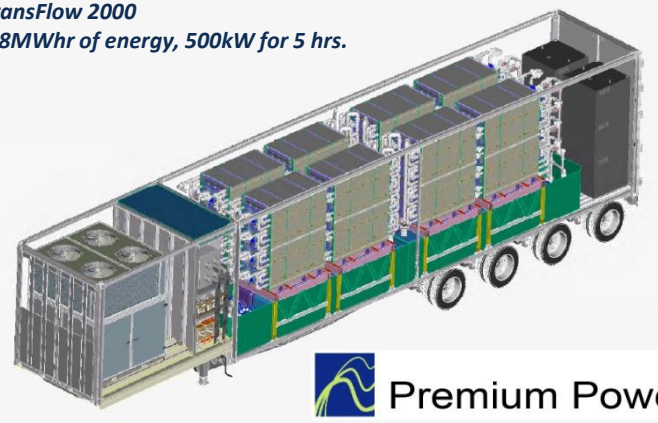
Peak Shaving, Demand Response, T&D Deferral, etc.

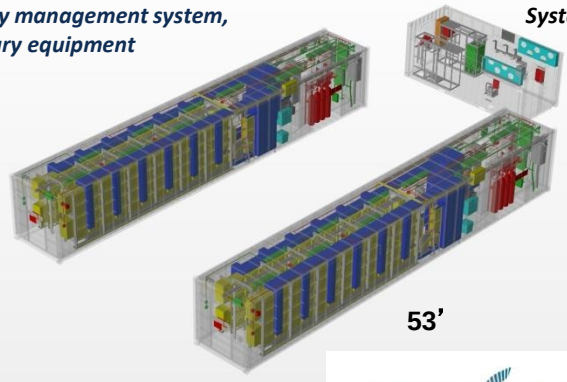
TransFlow 2000
2.8MWhr of energy, 500kW for 5 hrs.



Grid Stabilization/Renewable Integration

1MW battery stack, battery management system, auxiliary equipment

Power Control System Module



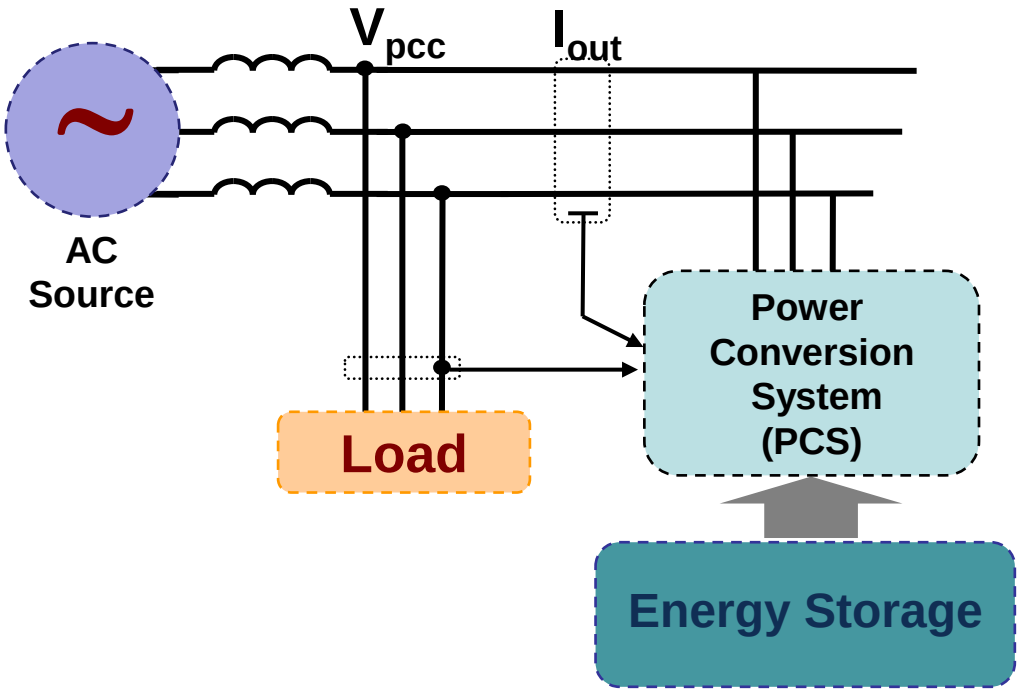
Wind farm dynamic VAR compensation

Benefits

- Lower Installation Cost
- Less Time from Installation to Operation
- Use at Multiple Sites Optimizes Overall System Use

Why is DOE/Sandia interested in power electronics?

- PCS can be 20-40% of overall energy storage system cost.
- Need for significantly reduced installed cost/kVA and footprint, improved control capability and increased reliability

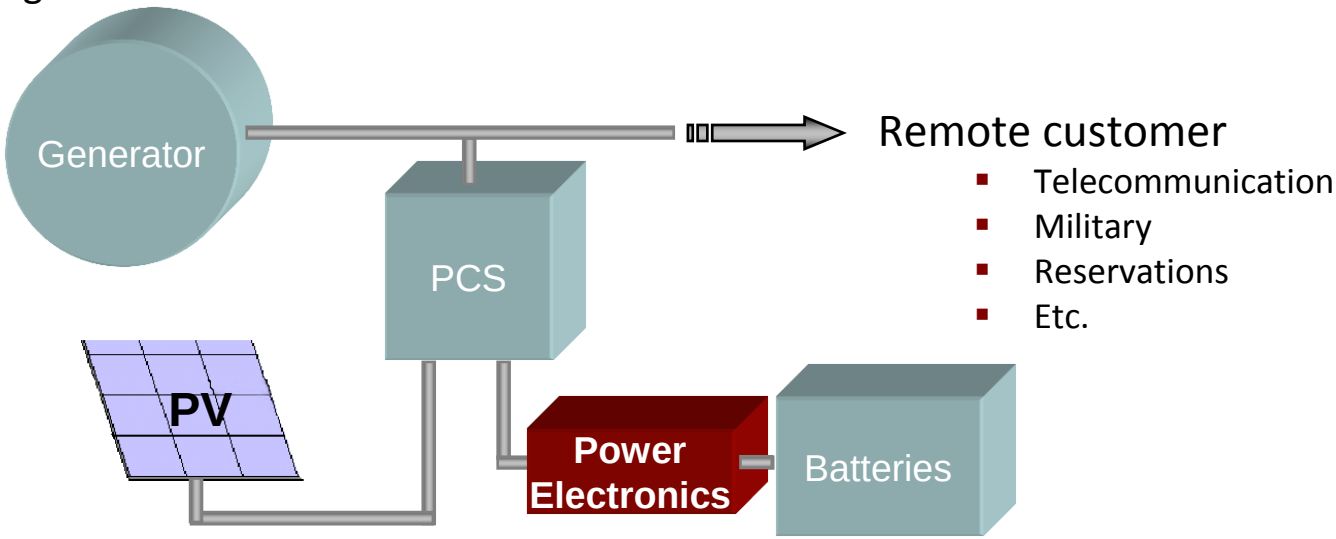


The PCS is a key component of the energy storage system—it can represent 20-60% of the total system cost.

Optimal Management of Batteries in Electric Systems

Problem:

- Generator provides battery management
- High fuel usage, emission, increase maintenance
- PV spillage



Solution:

- With additional electronics battery provides its own management
- US Patent (6,353,304) 3/5/02
- US Patent (7,567,060) 6/3/07

Coast Guard National Distress System

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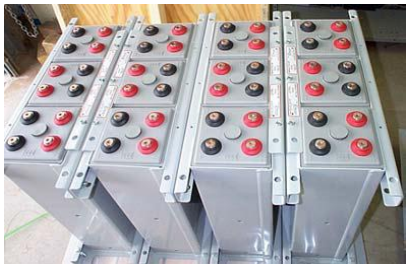

Duke Island Installation

High-temperature Silicon Carbide (SiC) Power Module

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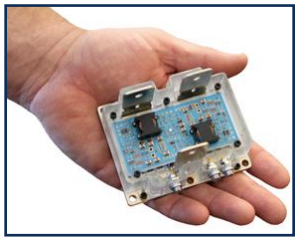
F-35 Joint Strike Fighter

Electric Actuators

2009 R&D100 Winner

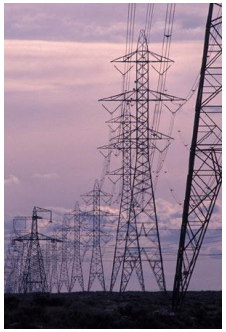
Photovoltaic

Wind



SiC Power Modules

Grid Tied Inverter



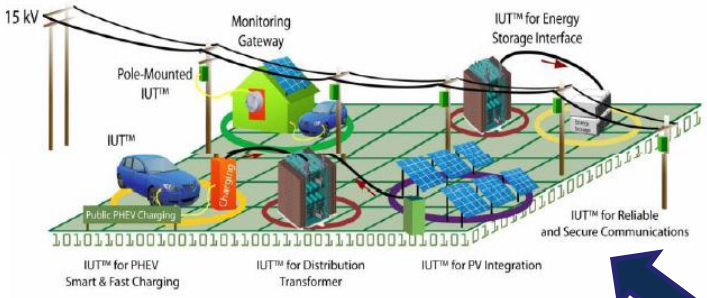
Power Delivery

Boeing 787 Dreamliner

Solid State Power Controllers

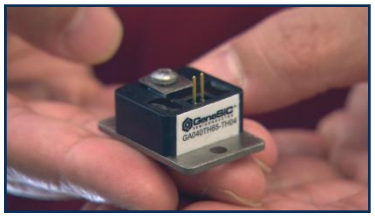
Motor Drives

Ultra-high-voltage Silicon-Carbide (SiC) Thyristor

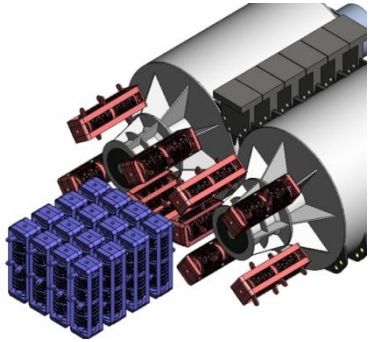


Smart Grid

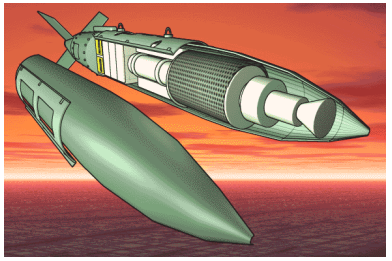
2011 R&D100 Winner



GeneSiC Semiconductor SiC Thyristors

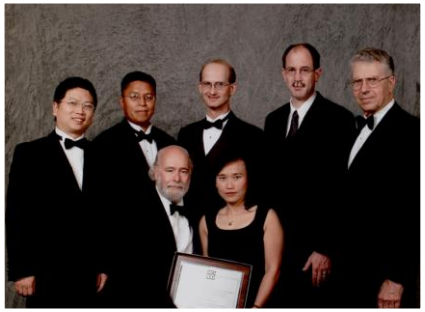
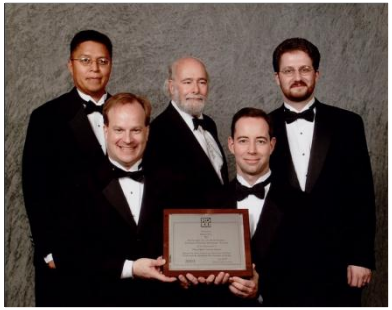
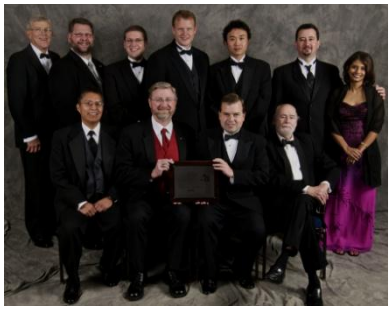


Rail Gun



Pulse forming network

DOE Power Electronics Program R&D 100 Awards


"The Oscars of Invention"- *The Chicago Tribune*

“For 45 years, the prestigious R&D 100 Awards have been helping companies provide the important initial push a new product needs to compete successfully in the marketplace. The winning of an R&D 100 Award provides a mark of excellence known to industry, government, and academia as proof that the product is one of the most innovative ideas of the year.“

- Established by the editors of R&D Magazine

American Indian Science & Engineering Society Technical Excellence Award 2007

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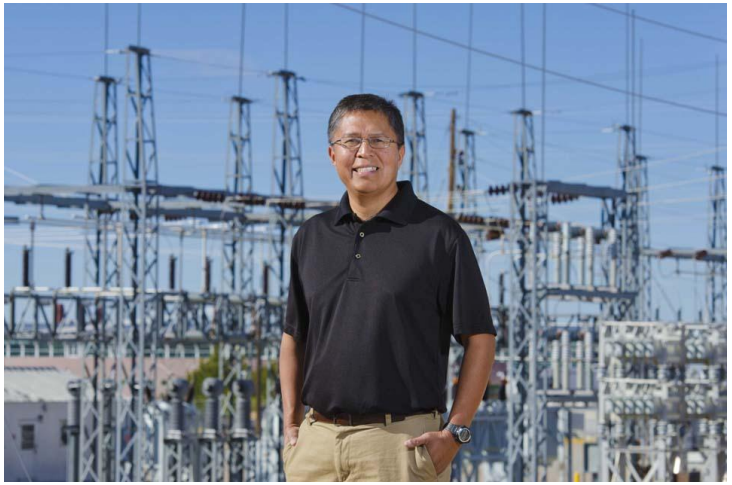
- Technical Excellence
  - The nominee must have made a significant contribution to science, engineering, or technology by having designed, developed, managed, or assisted in the development of a product, service, system, or intellectual property.

Conclusion

Courtesy NTUA

- In general, American Indians are drawn to nature
- Nature has helped our people with food, shelter and natural medicine which continues to this day
- Engineers and scientists have figured out ways to harness the solar light to produce heat or electricity by way of solar concentrators and photovoltaic systems
- Natural fit for American Indians interested in science and engineering

Contact



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