Savannah River National Laboratory™

OPERATED BY SAVANNAH RIVER NUCLEAR SOLUTIONS

We put science to work.™

Savannah River National Laboratory (SRNL) Overview of SRNL

Emphasis on Scientific Computing

Mary K Harris, PhD
Chief Information Officer

Presented at University of South Carolina
September 22nd, 2015

SRNL-STI-2015-00499

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FLUOR • NEWPORT NEWS NUCLEAR • HONEYWELL

SRS Snapshot

- 198,334 acres,
  or about 310 square miles
  - Fourth largest DOE site in the United States (behind Nevada Test Site, Idaho National Laboratory and Hanford Site)
- SRS workforce: Approximately 8,000
  - Prime contractor (about 58 percent)
  - DOE-SR and DOE-NNSA
  - Other contractors

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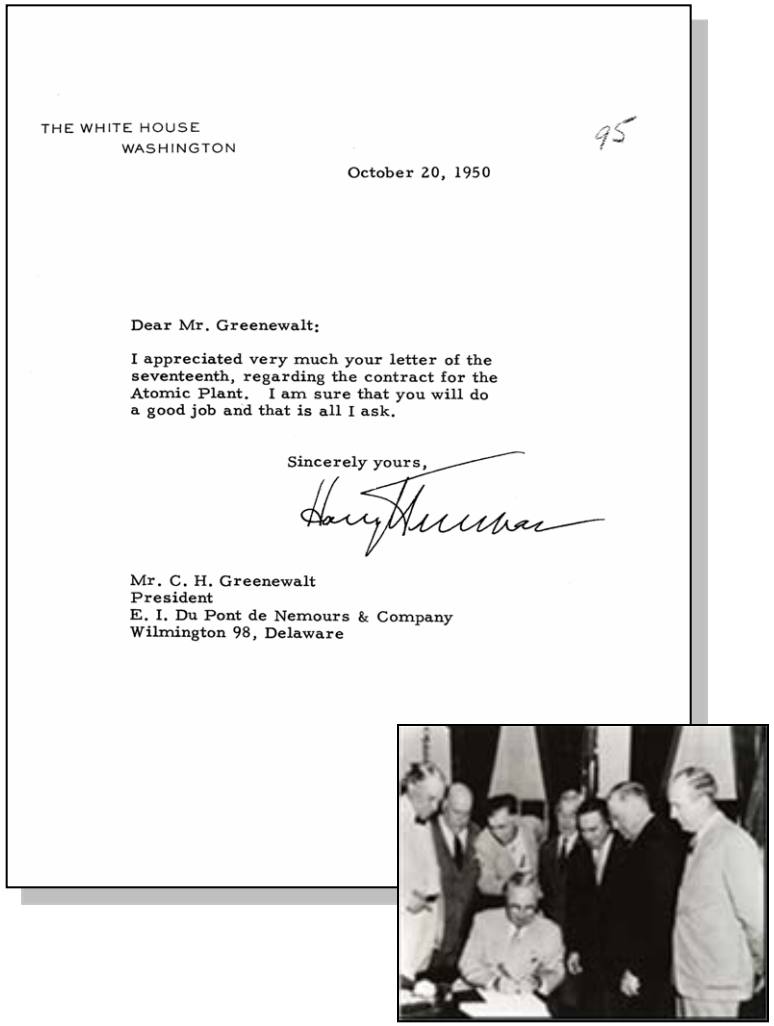
Chronology of the Savannah River Site

- Sept. 23, 1949
  - President Truman announced Russia tested its first atomic weapon
- June 12, 1950
  - Atomic Energy Commission asked E.I. Du Pont de Nemours & Company to undertake a new atomic project
  - Du Pont built SRS and operated it for nearly 40 years
- April 1, 1989
  - Washington Savannah River Company took the reins as SRS's prime contractor
- August 1, 2008
  - Savannah River Nuclear Solutions assumed responsibility for SRS management and operations
- July 1, 2009
  - Savannah River Remediation now in charge of liquid waste disposition



THE WHITE HOUSE
WASHINGTON

95

October 20, 1950

Dear Mr. Greenewalt:

I appreciated very much your letter of the seventeenth, regarding the contract for the Atomic Plant. I am sure that you will do a good job and that is all I ask.

Sincerely yours,

Harry Truman

Mr. C. H. Greenewalt
President
E. I. Du Pont de Nemours & Company
Wilmington 98, Delaware

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Initial Construction Facts

Earth moved	39 million cubic yards (a wall 10 feet high and 6 feet wide from Atlanta, GA to Portland, OR)
Concrete	1.5 million cubic yards (a highway six inches thick and 20 feet wide from Atlanta, GA to Philadelphia, PA)
Reinforcing steel	118,000 tons (a train 30 miles long)
Structural steel	27,000 tons (a train eight miles long)
Lumber	85 million board feet (enough for 15,000 homes)
Roads	230 miles of new roads (including South Carolina's first clover leaf intersection)
Railroads	63 miles of permanent new track
Blueprints	2 million
Process Steel	All of the 304L and 316L stainless steel available in the United States from 1951 through 1953

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Site History

- The Atomic Energy Commission builds a nuclear weapons complex

Six South Carolina towns moved; 6,000 people relocated

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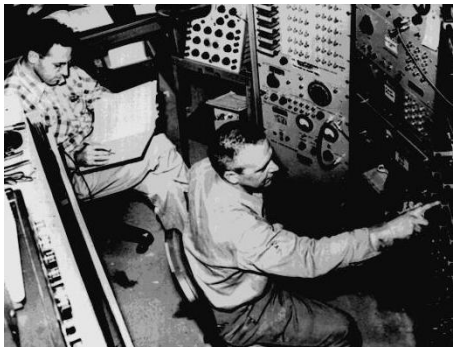
Historical Facts of Note

1956: Neutrino was discovered by Fred Reines & Clyde Cowan

P Reactor.

1995 Physics Nobel Prize



- 1961: University of Georgia founded the Savannah River Ecology Laboratory (SREL) to study effects of radiation on the environment

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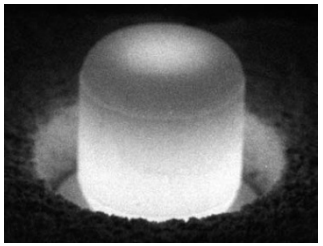
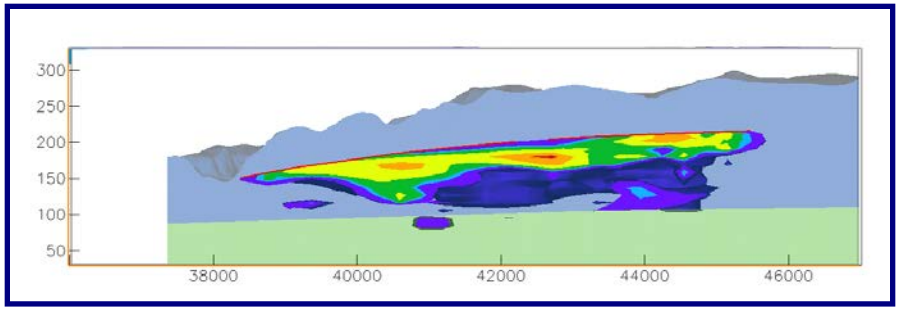
Historical Facts of Note

- 1972: SRS designated as a National Environmental Research Park

- 1980's: Produced Pu-238 for NASA's deep space exploration program



Environmental Cleanup began under the RCRA program



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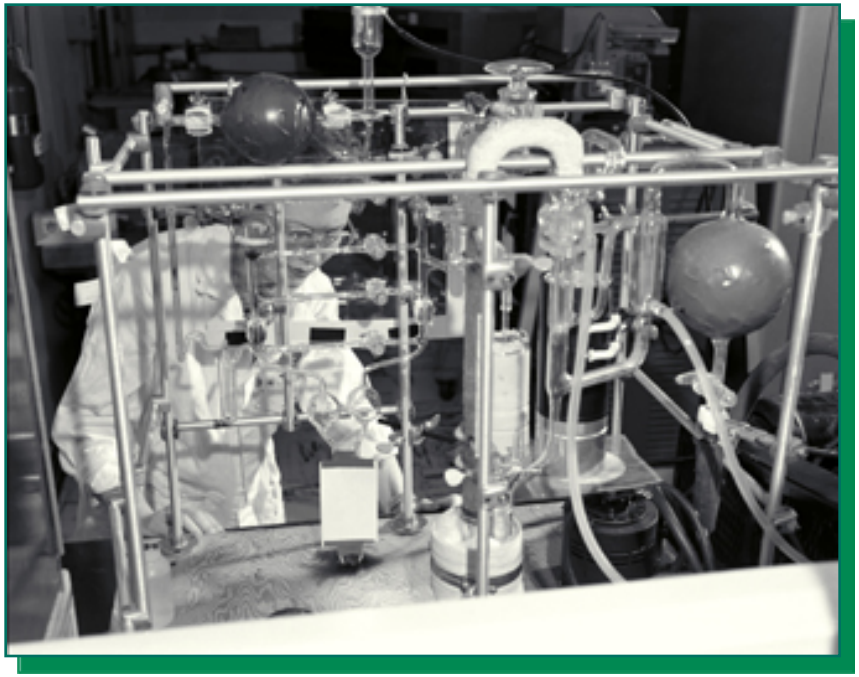
Early Days of the Laboratory

- Began operation in 1953
- Original mission:
  - Reactor research
  - Chemical separations
  - Tritium/Hydrogen support
  - Environmental science and monitoring
- Changing missions:
  - End of Cold War in 80's focus on safe containment disposition/environmental clean up/D&D
  - Response to 9/11 homeland security initiatives
  - Need for energy independence has led to dual use of hydrogen technology followed by other clean energy initiatives



SRNL brought technological support to nation's cold war efforts

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SRNL Facilities

Aiken County's Savannah River Research Campus

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SRNL at a Glance

~ 930 Staff

~ $222M (FY15 projected)

~ 300 Discrete Work Activities

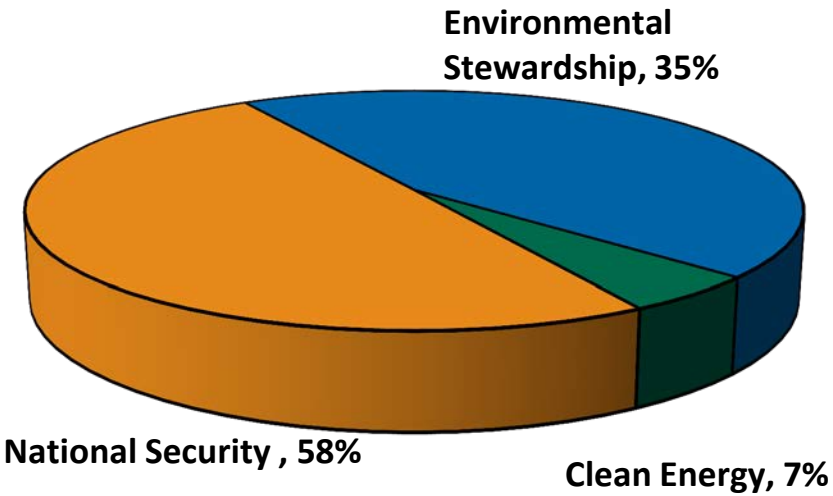
Multi-Program Laboratory

> 65% of funding from non-SRS customers

Core Nuclear Capabilities

- Environmental Remediation and Risk Reduction
- Nuclear Materials Processing and Disposition
- Nuclear Detection, Characterization and Assessments
- Gas Processing, Storage and Transfer Systems

Safest National Laboratory – 2005-2014



SRNL FY15 Execution

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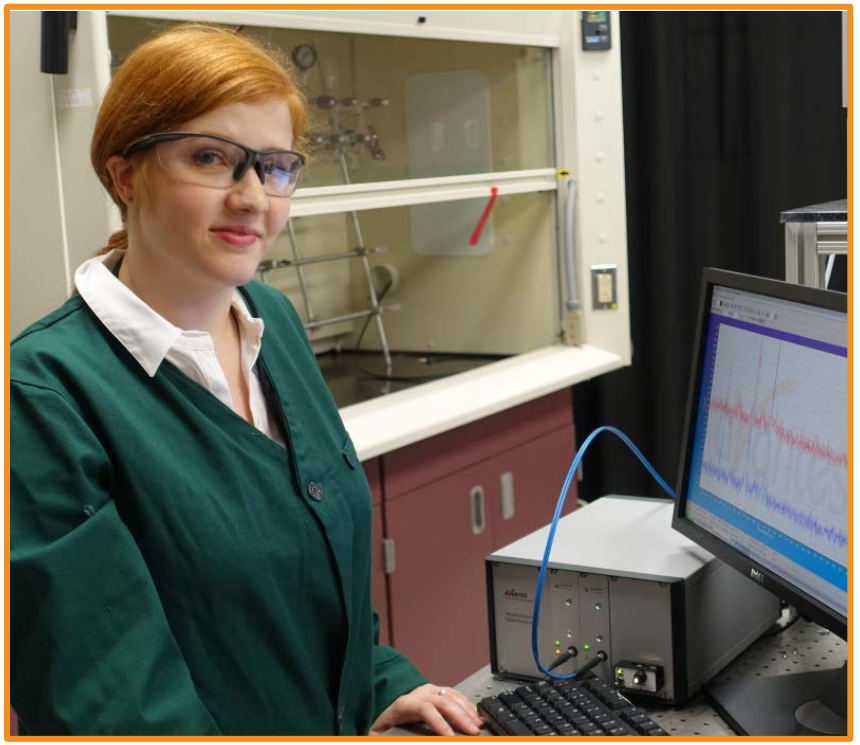
Partner with Regional Universities

- Over 400 sponsored projects involving regional university staff
- Over 300 internships
- Over 350 degrees from regional universities
- Over 107,000 students reached through “teach-ins”
- University Scholars pilot with USCA - $400K investment



University of South Carolina Aiken

Clemson University

Georgia Regents University Augusta

University of South Carolina

Georgia Institute of Technology

SC State University

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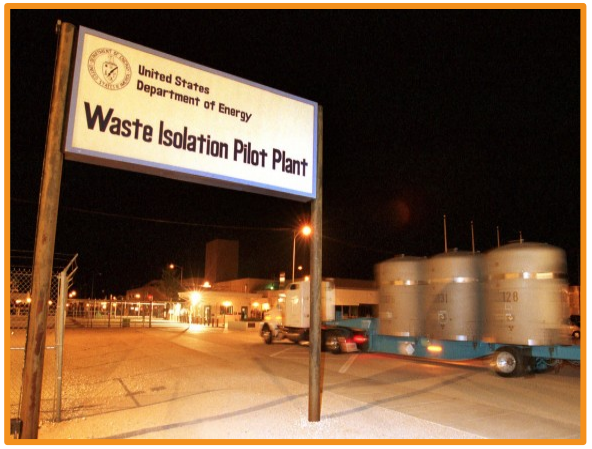
SRNL is Critical to DOE-EM Success

- Over $5 billion in projected savings in past five years
- Advanced Technologies



- Support to Fukushima
- Leadership of Initiatives at Hanford, WIPP

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In National Security, Our Reach Extends Far Beyond SRS

Tritium Expertise

Event Signatures

Mobile Plutonium Facility

Nuclear Packaging

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Essential to U.S. Non-Proliferation Objectives

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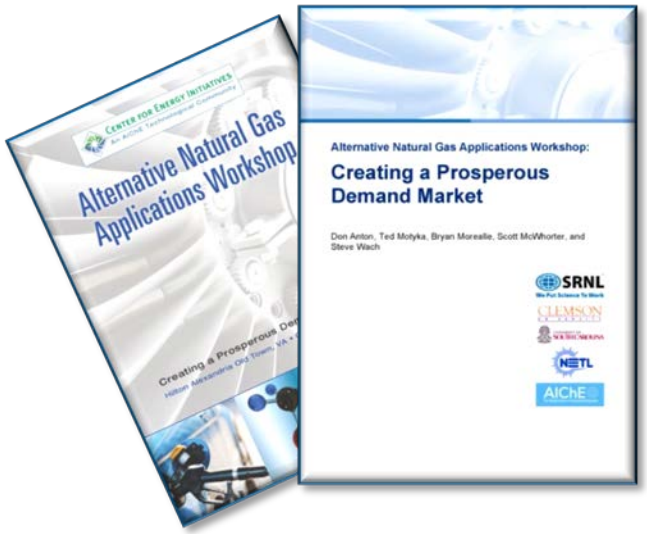
SRNL Contributes to Clean Energy Initiatives

Hydrogen Research

Safe Nuclear Fuel

SmartGrid / Cyber Security



Natural Gas Leadership

Solar Research Recognition

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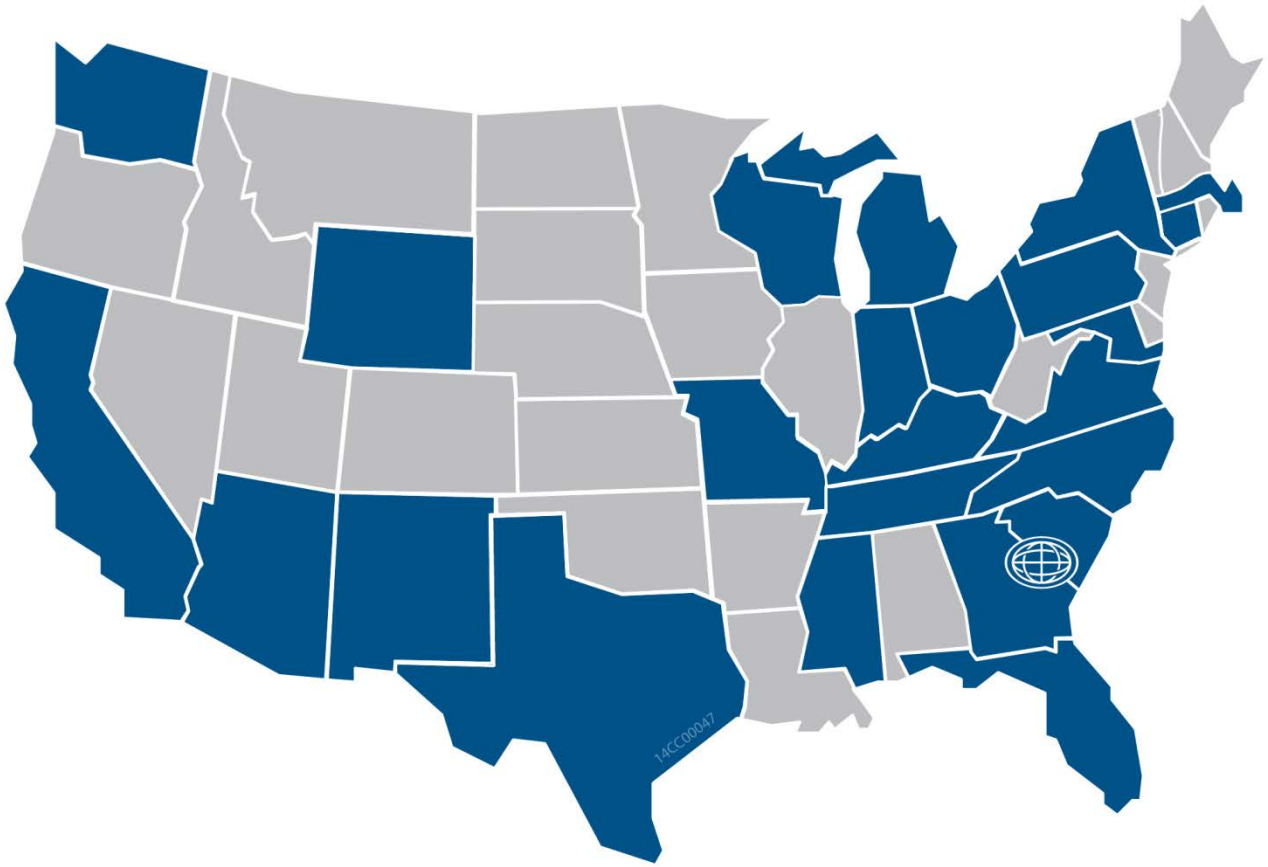
Impacting National Economic Competitiveness

Working with Companies in 24 States Through CRADAs and Other Agreements

(10 agreements in South Carolina; 8 in Georgia)

Work for Non-Federal Entities (~$24M 2008–2014)



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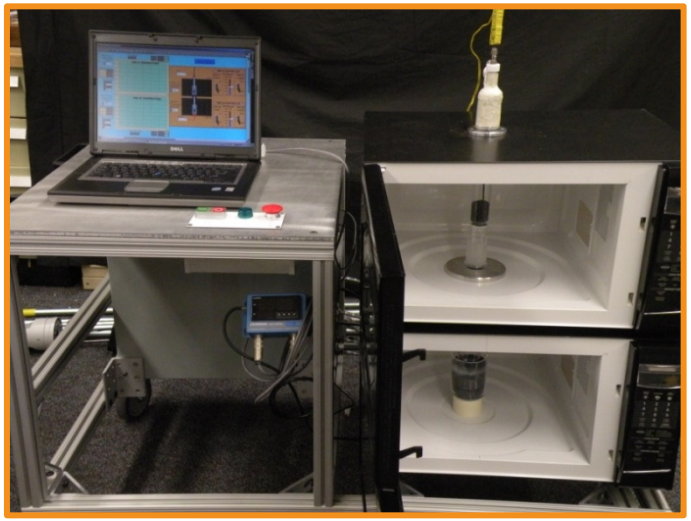
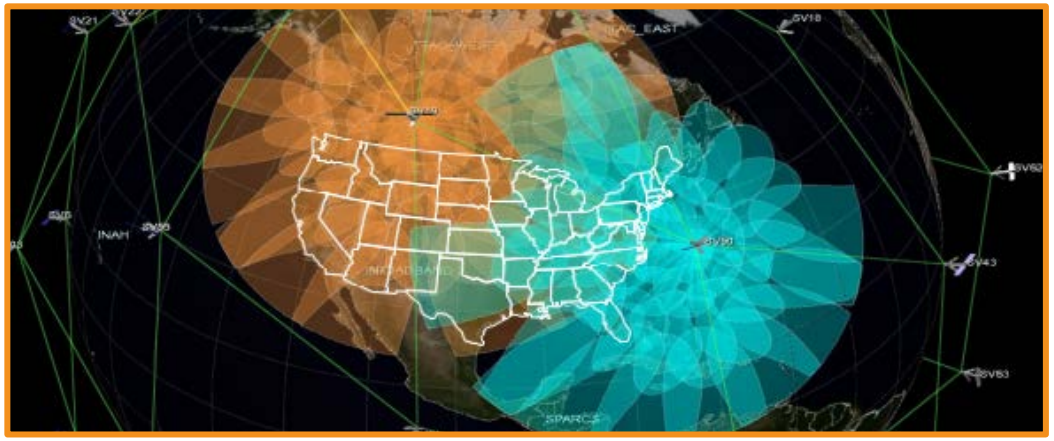
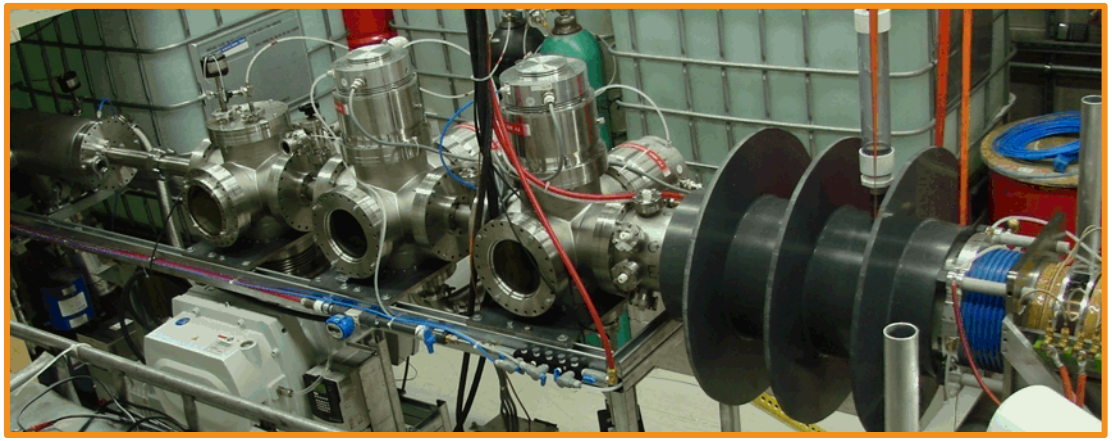
Partners to Commercialize Technology



Tandem Forensic Microwave



Iridium Satellite Communications System



Courtesy of SHINE Medical Technologies

Medical Isotope Production

Sound Anchor™

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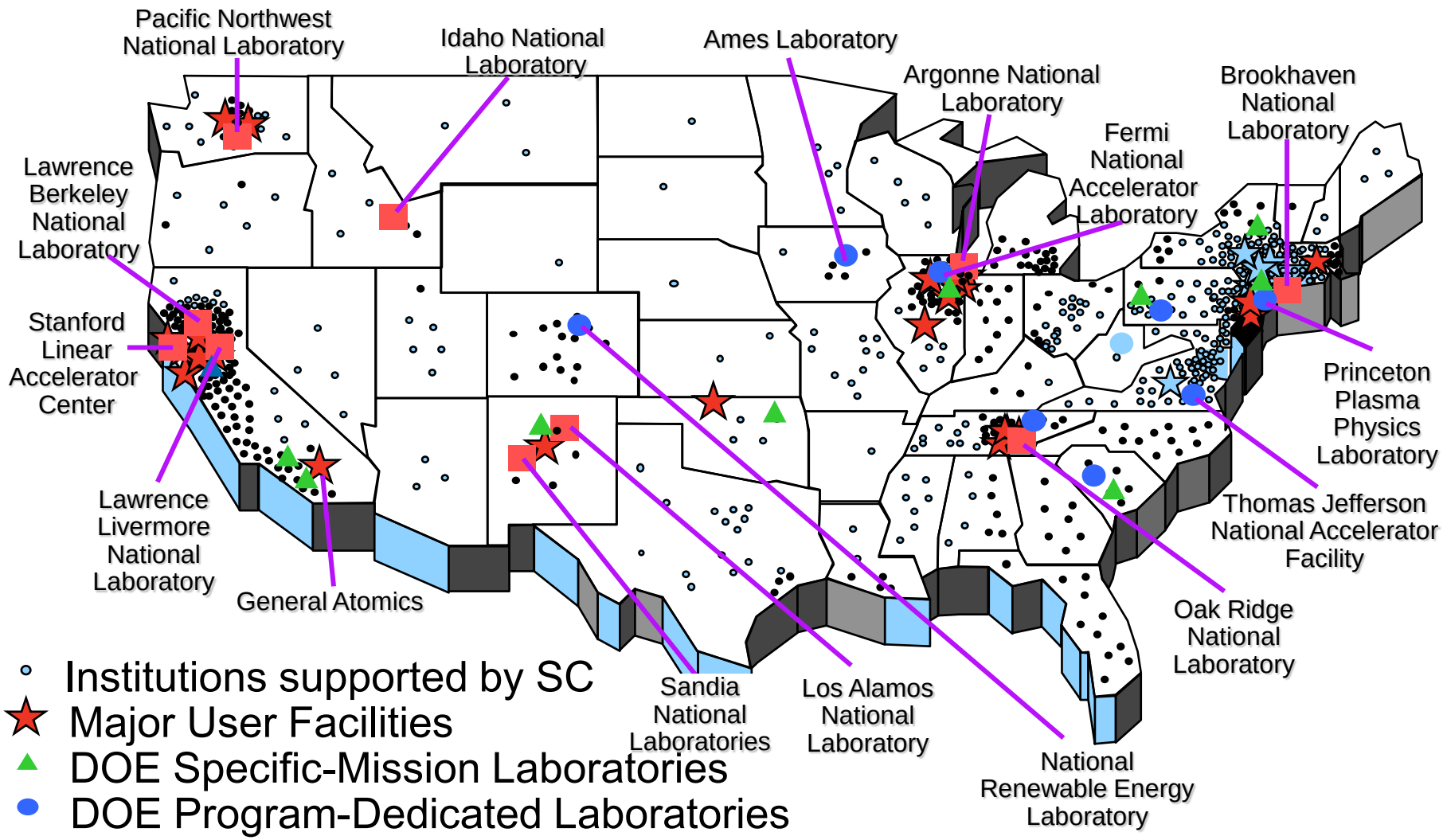
Office of Science US Community

Drives ESnet Design for Domestic Connectivity



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What is Scientific Computing?

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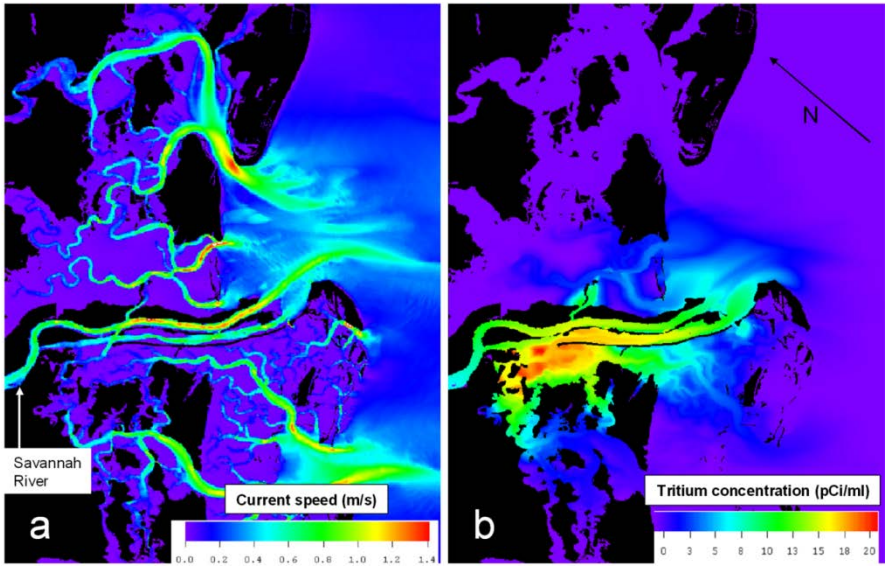
SRNL Computational Technical Staff

Approximately 65 Computational Professionals

- *Engineers*
  - Chemical
  - Mechanical
  - Nuclear
  - Environmental
  - Civil
  - Systems
- *Computer Scientists & Engineers*
- *Meteorologists*
- *Statisticians*
- *Chemists*



Experience spans broad spectrum of applications supporting Environmental Stewardship, National Security, and Energy Security

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SRNL CIO Office

Scientific Computing (SC)

- Linux High Performance Computing (HPC) systems - 1500 cores, 35 TB memory, 260 TB disk storage
- 10Gbit Network for Research & Collaboration
- Archival Retrieval & Analysis of Scientific Datasets
- Linux, Windows & Web Software Development, Laboratory Database
- Support SRNL Atmospheric Technologies

Other Functions

- Unclassified Cyber Security
- Collaboration – internal & external initiatives
  - Video Conference Support
  - Specialized Desktop Support

Special Projects

- ATG Tower Expansion – data loggers
- Grid Modernization and Wind Turbine
- Offshore Wind Buoy
- WFO Data Collection and Download
- Pilot External Collaboration Cloud Based Web Applications

National Lab and University Participation

- Member of Executive Committee of National Laboratory CIO Council
- Represent SRNL at National Lab Supercomputing14 Booth
- Member of 2 Industrial Advisory Panels
  - USC-Columbia Computer Sciences & Eng.
  - USC-Beaufort Computational Sciences

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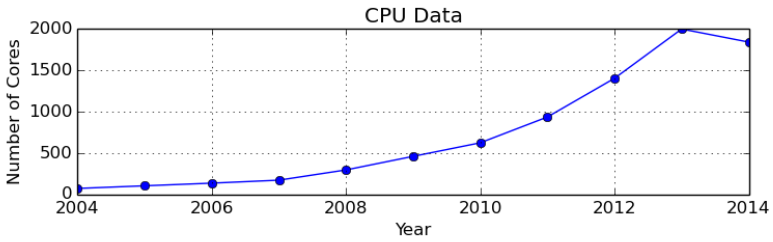
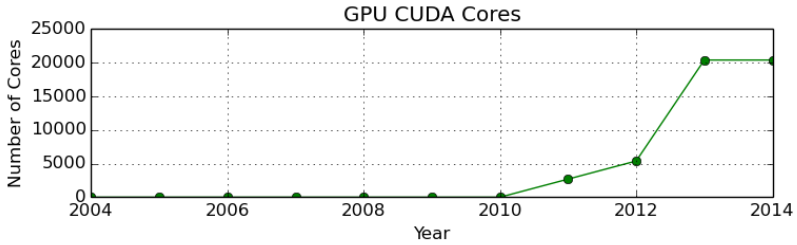
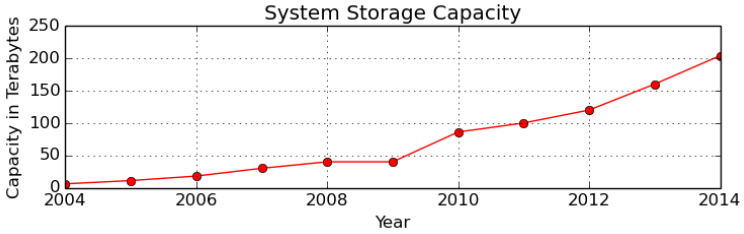
High Performance Computing

- Expandable High Performance Computing (HPC) infrastructure – room for growth
  - Storage, Archive, Continuity of Operation (COOP)/disaster recovery
  - 10G intranet at SRNL
  - Mobile and remote wireless networks







SRNL continues to grow in HPC infrastructure with plenty of room for expansion

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Scientific Applications Management & Development

- Software
  - SAS, JMP (statistics)
  - Fluent, Abaqus, Comsol, Patran/Thermal, MCNP (eng. modeling)
  - Gaussian, Castep, Dmol, Cosmotherm, Wien, ADF (Comp. Chem)
  - ACM, Aspen Plus, OLI, Verse, Extend (Process Modeling)
  - Porflow, Goldsim
  - Python R, Open Foam
  - Python-Java-Fortran-C

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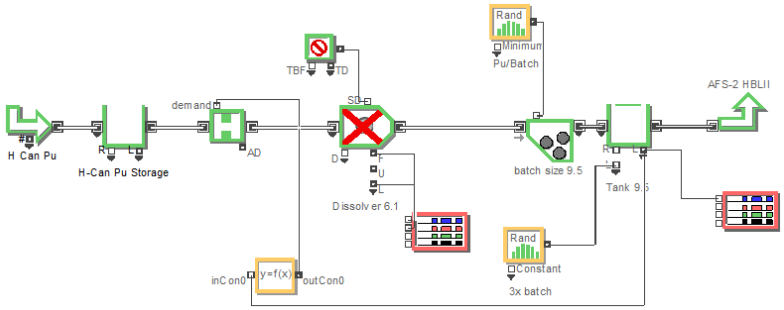
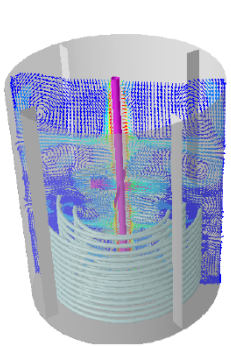
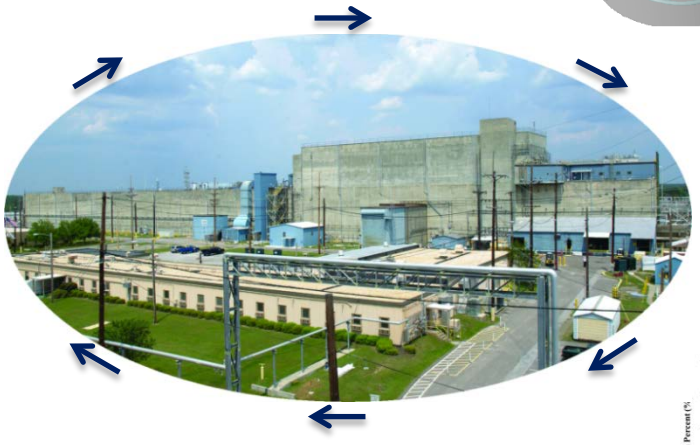
Integrated Computational Analysis for AFS-2 Startup

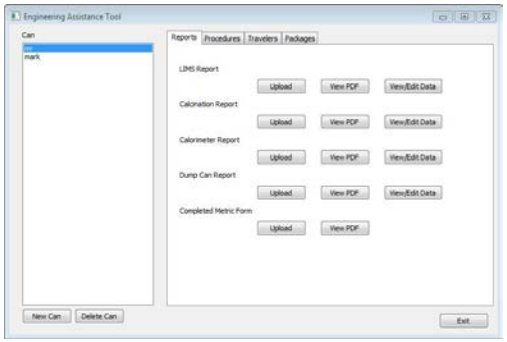




Supply Chain

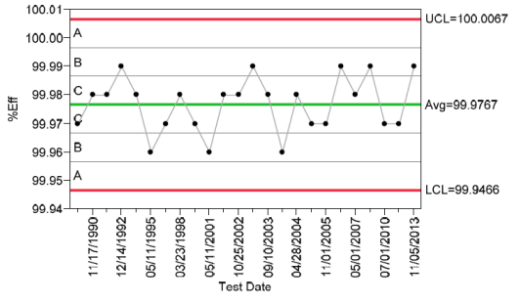
- Production Rates for AFS-2
- Waste Minimization – Tracking Overall Nitrate Flows





Scientific Computing

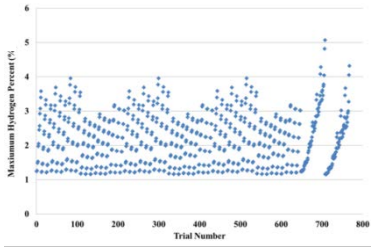
- Database for Generating Procedure Records for EDWS
- Electronic TTR System



Safety-Basis Statistics and Calculations

Computational Fluid Dynamics

- Tank Mixing
- Furnace Temperature Profiling



Packaging

- Flammability Studies
- Steady State Temperatures
- Water Content Determination

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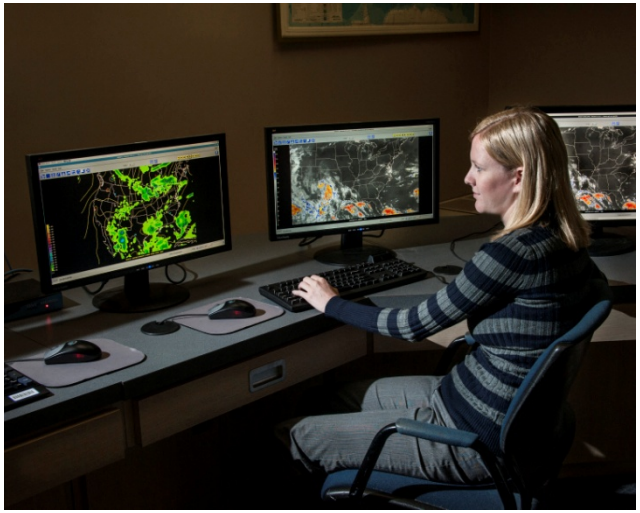
Experience – Meteorological Analysis and Forecasting

- Six meteorologists with 2-30 years of operational forecasting experience.
- Site-specific climate analyses for locations of interest to customers.
- Development of task-specific statistical or graphical forecast guidance products for operational use.



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Major Program Areas

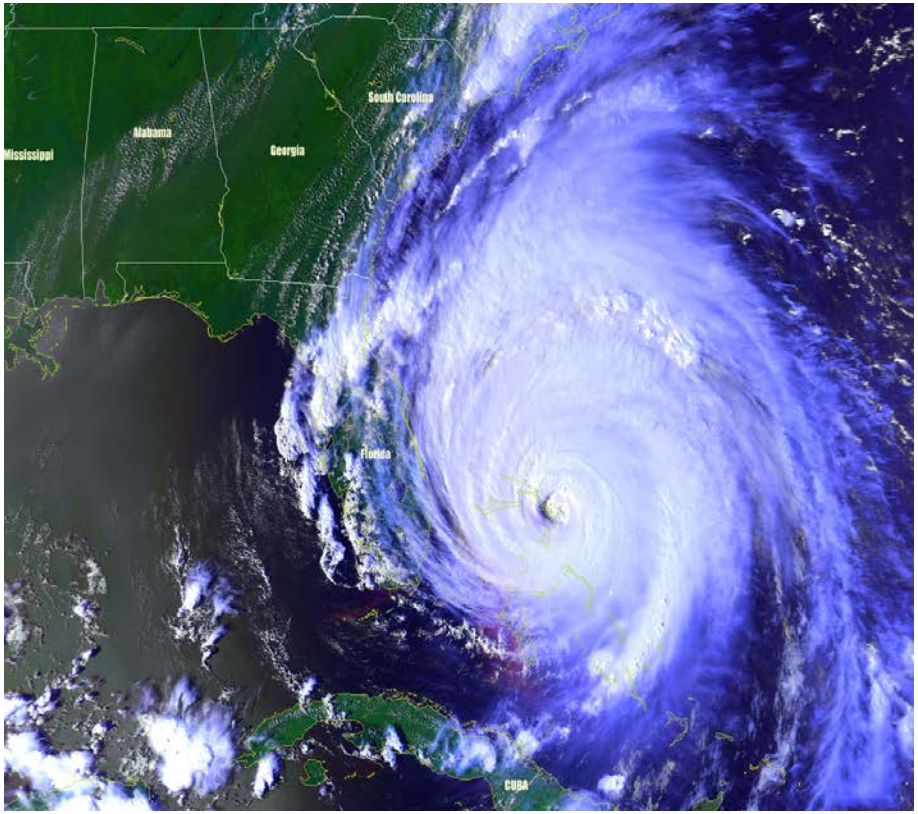
Emergency Response Systems

Meteorological Monitoring

Weather Forecasting and Analysis

Advanced Atmospheric Modeling

Applied Studies and Research



- *meteorological hazards analysis*
- *air quality and permitting (Title V, tank farms)*
- *field experiments (tracer experiments, ground truth collections)*
- *energy security and policy (CO2 monitoring, renewable energy resources- wind, solar)*
- *climate change*

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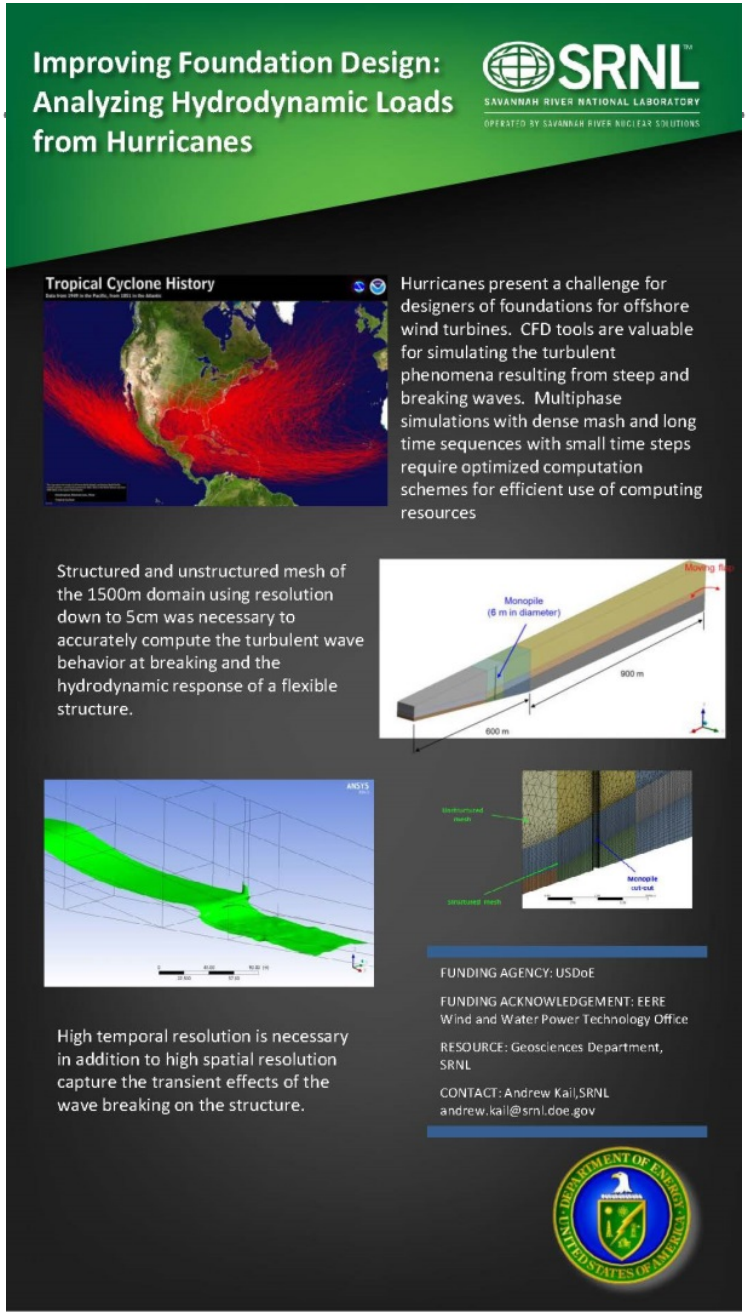

SuperComputing 2014

Code: FLUENT

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What's on the horizon?

- The future requires:
  - New advances in computing technology: hardware, software, algorithms, applications
  - New advances in data management, data analytics, visualization
  - MAJOR CYBER SECURITY ENHANCEMENTS
- Data Explosion
  - Will drive these advances
  - e.g.; genomics, climate
  - 50% of traffic is from "Big Data" on Esnet
- Current computing environment is not optimal for:
  - Collaboration of geographically distributed data, user, and facilities,
  - Interactive workflow, real time analysis

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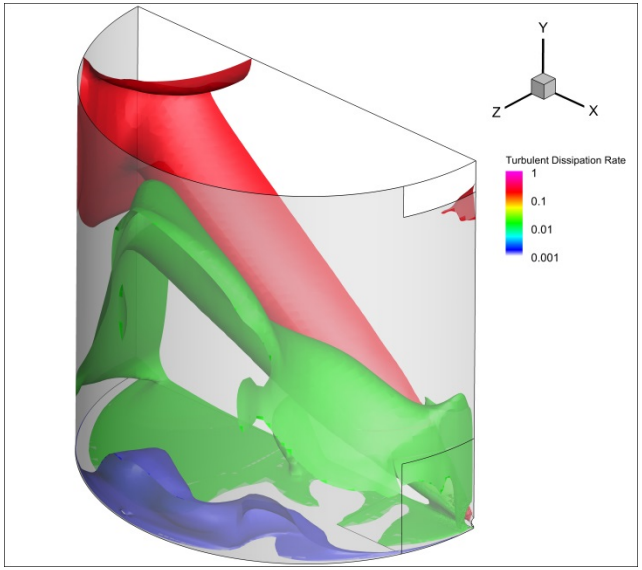
Other things to consider

- The world has changed – technology changing rapidly
- IT world also changing rapidly
  - PC sales flat
  - Growth is with tablets, smartphones, and other handheld devices
- Innovations need to be driven
  - Cyber Security analytics
  - Processors & Memory
  - System Designs
  - System Software
  - Algorithms
  - Data management
  - Data analytics – Visualization – Machine learning



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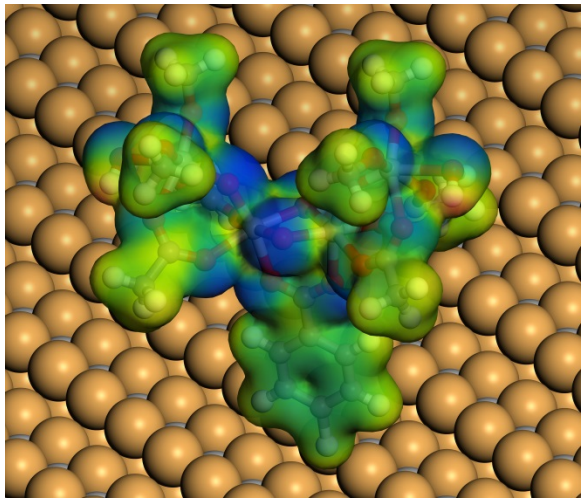
Other things to consider

- Cyber Security
  - Recent headlines of data breaches are becoming all too common
  - Personal information, credit cards, health data
  - Seeing more and more “hacktivist” groups claiming server breaches
  - Huge opportunities for the future in Cyber R&D
  - Needed to protect our nation – infrastructure (e.g.; power grid, nuclear reactors, dams, petroleum pipelines), industry (e.g.: banking, pharmaceutical, health, other energy driven business), intellectual property (e.g.; patents, proprietary data)

Final thoughts

- We will model things you never imagined over the next 5 – 10 years
- Computer technology has become part of our daily lives, economic base, science and engineering advances including security
- Computer scientists and engineers along with cyber security expertise is crucial for today's world
- The need for collaboration and connectivity will increase
- You are part of this future!



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QUESTIONS?

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