



**Savannah River
National Laboratory™**

OPERATED BY SAVANNAH RIVER NUCLEAR SOLUTIONS

We put science to work.™

Savannah River National Laboratory (SRNL) – Scientific Computing – Where We Have Been And Where We Are Going!

Emphasis on Scientific Computing

Mary K Harris, PhD
Chief Information Officer

*Presented at University of South Carolina
November 11, 2014*

SRNL-STI-2014-00563

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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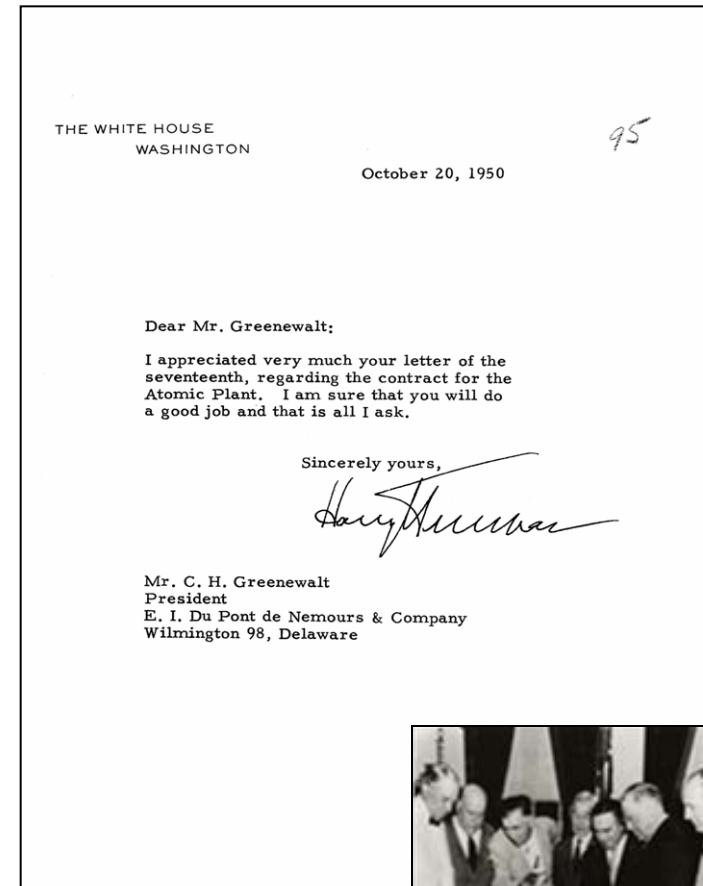


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Chronology of the Savannah River Site

- **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**
 - Westinghouse 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



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



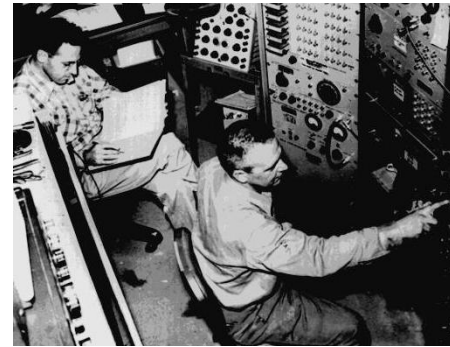
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Historical Facts of Note

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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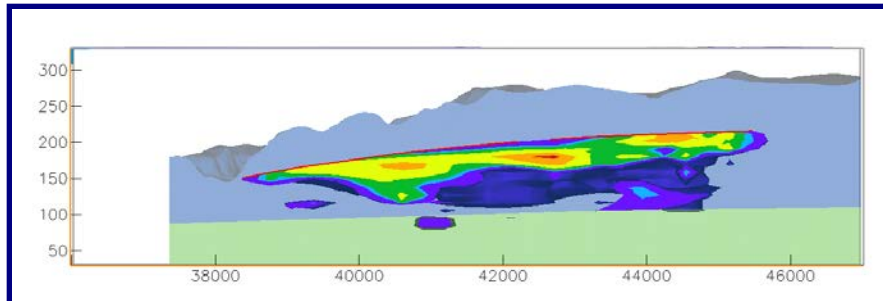
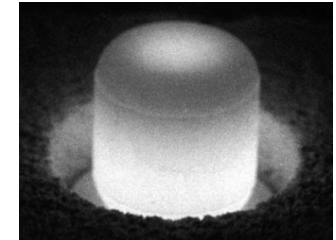
Historical Facts of Note

- 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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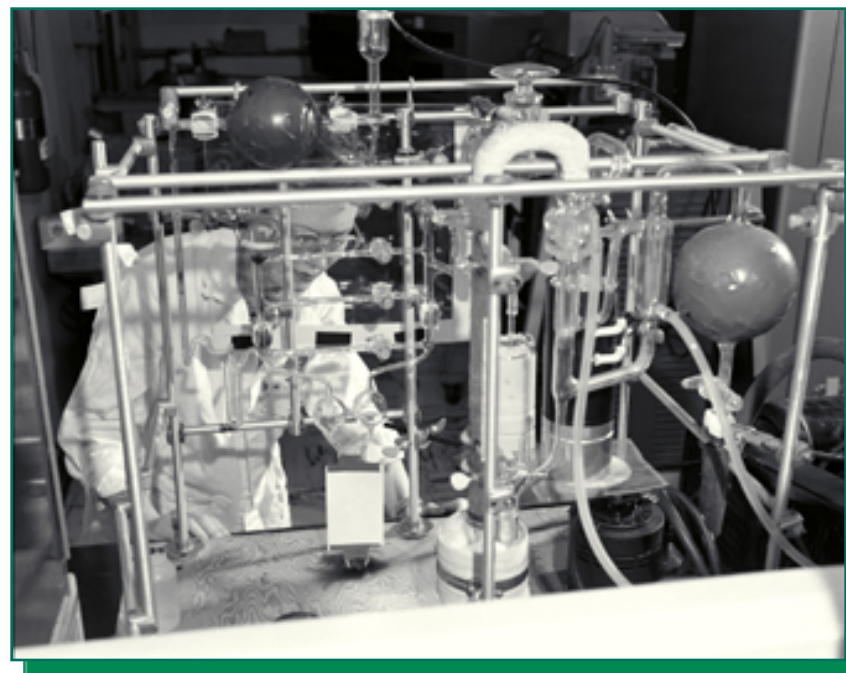


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Early Days of the Laboratory

- 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

SRNL Facilities



Aiken County's
Savannah River
Research Campus

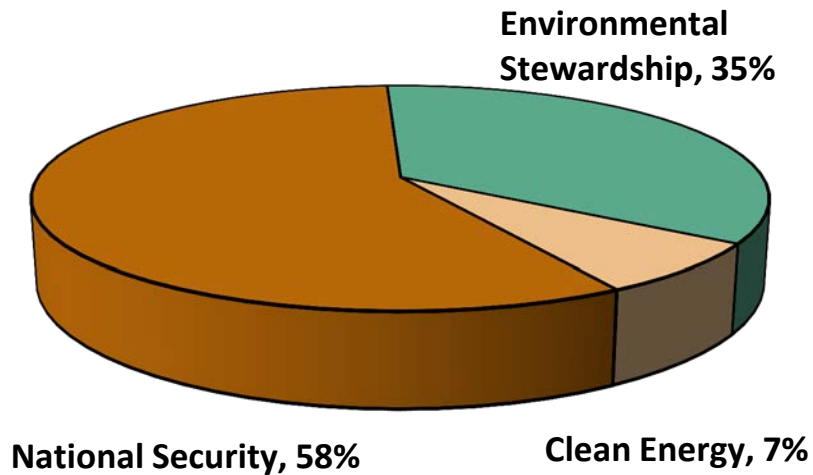


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SRNL at a Glance

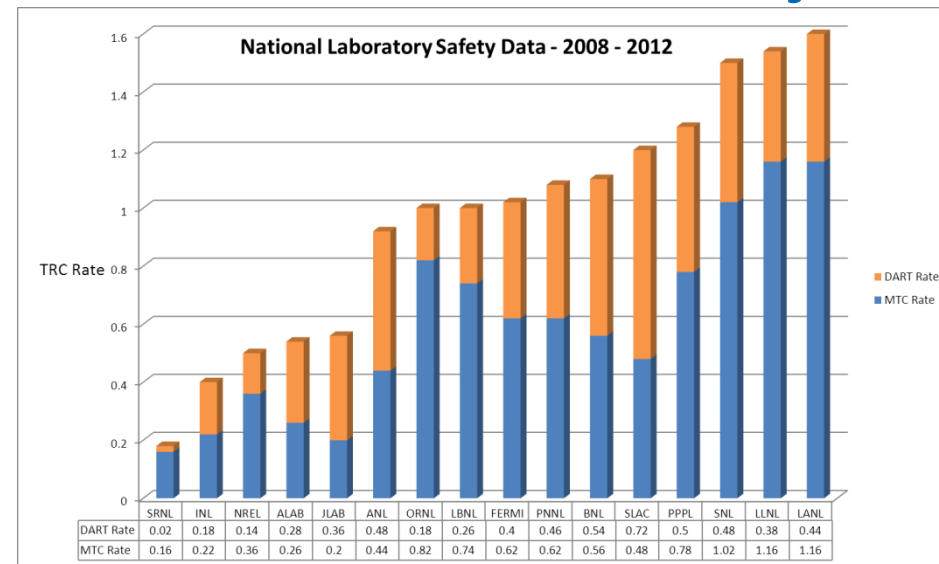
- ~ 825 Staff
- ~ \$214M (FY13 work performed)
- ~ 300 Discrete Work Activities
- Multi-Program Laboratory
 - >65% of funding from non-SRS customers



SRNL FY13 Execution

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Safest National Laboratory

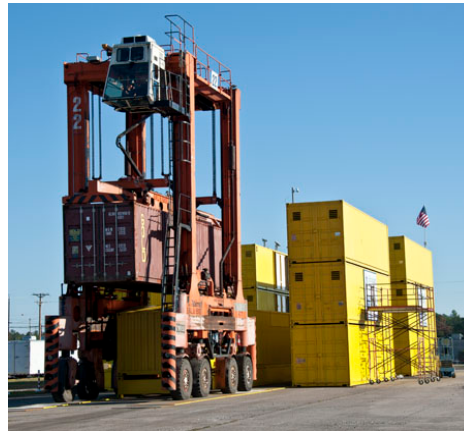


Multi-Program National Laboratory



Environmental Stewardship

- Waste Treatment
- Materials Stabilization and Disposition
- Remediation and Cleanup
- Assessments and Verification



National Security

- Tritium Stewardship
- Non-proliferation
- Nuclear Materials Recovery
- Homeland Security
- Intelligence
- Forensics/Law Enforcement



Clean Energy

- Hydrogen Production and Storage
- Nuclear Fuel Cycle R&D
- Renewable Energy Research

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What is Scientific Computing?

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Vision

SRNL is the Nation's premier Applied Science Laboratory for solving critical national issues

Strategic Thrusts

Lead the DOE Complex and the nation in translating discovery research into practical application

Environmental Stewardship

National Security

Clean Energy

Nuclear Materials

Enable SRNL Researchers with Secure Computing & Collaboration Tools

Strategic Computational Technologies & Initiatives

Collaboration

Portals

Secure Remote Access

Internal & External Collaboration

Intranet Improvements

Video Conferencing

Webinars

Scientific Computing

Increase Awareness of Capabilities

Software

Storage

Backup

Work Group Space

Mobility

Guest Wireless in all PPAs

Wireless in LA

IOS Apps

Web Apps

IPAD Loaner Program for Travel

Cyber Security

Risk Based Graded Approach

Segmentation Architecture

Visualization

ensuring multiprogram excellence

Initiatives

enabling execution

Critical Enablers

Strong working Relations with SRNS Information Services

Sustained Funding

Customer Confidence

Skilled Resources

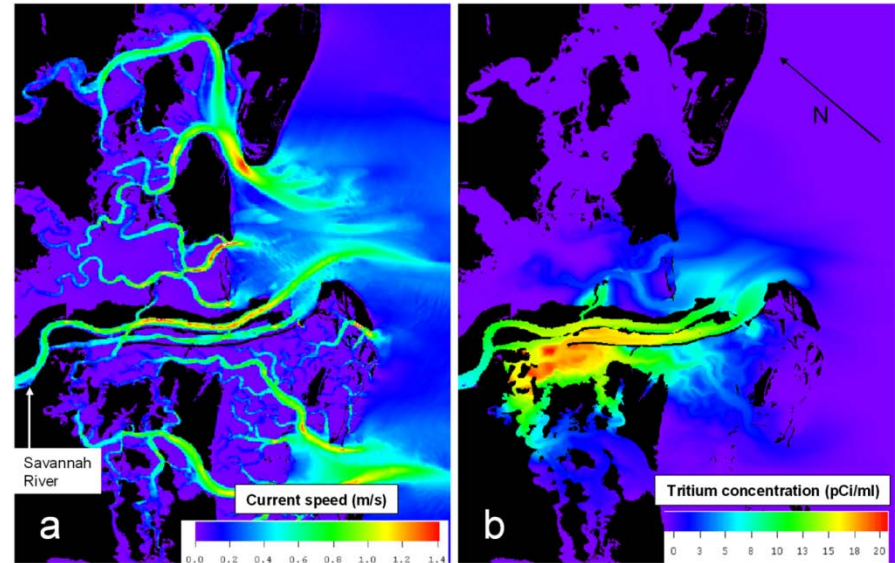
National Laboratory, University & Industrial Partnerships



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

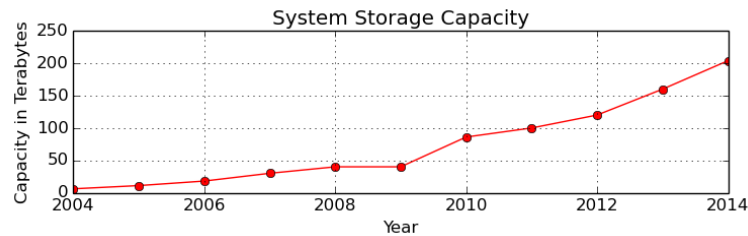
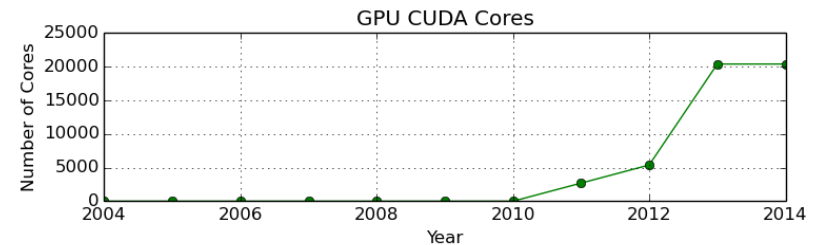
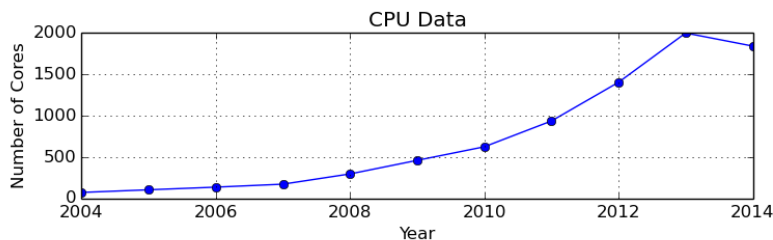
National Lab and University Participation

- 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

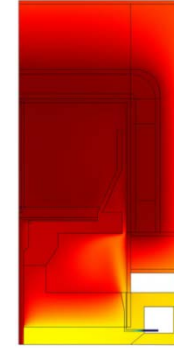
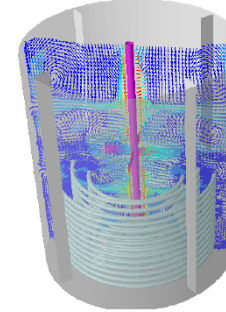
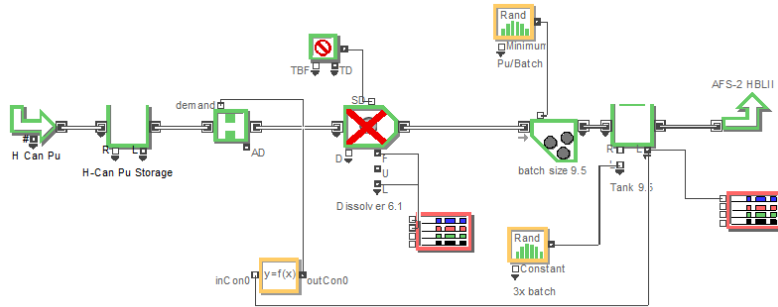


**SRNL continues to grow in HPC infrastructure
with plenty of room for expansion**

–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

Integrated Computational Analysis for AFS-2 Startup



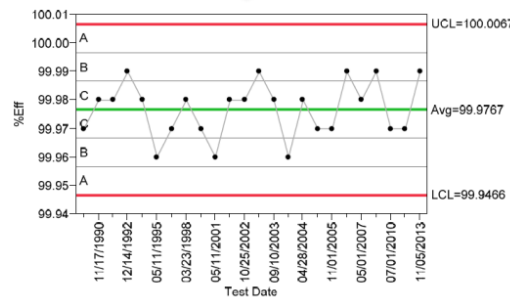
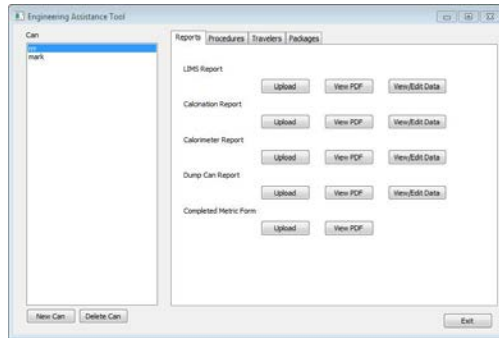
Supply Chain

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

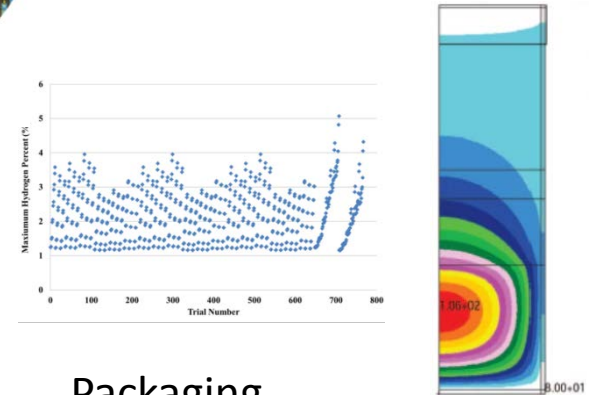


Computational Fluid Dynamics

- Tank Mixing
- Furnace Temperature Profiling



Safety-Basis Statistics and Calculations



Scientific Computing

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

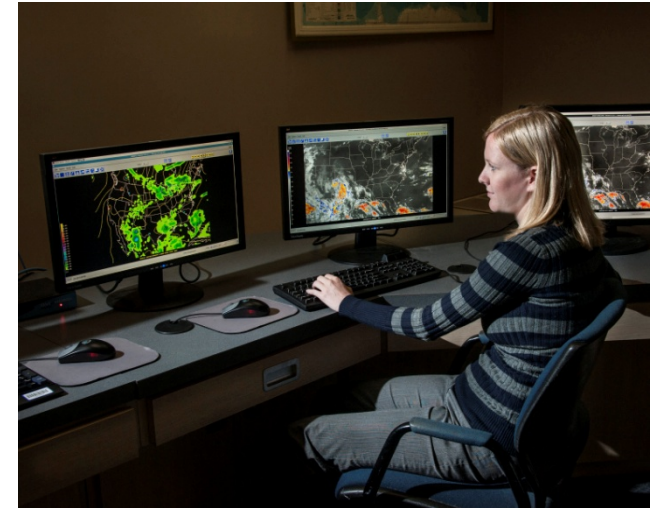
Packaging

- 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

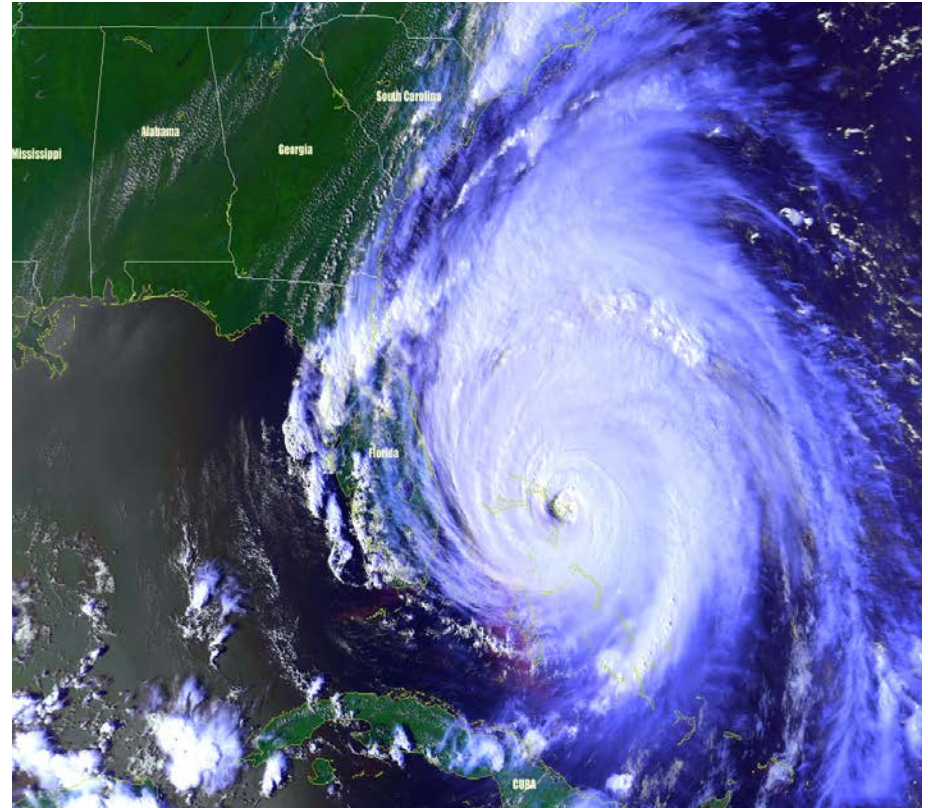
Meteorological Monitoring

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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Improving Foundation Design: Analyzing Hydrodynamic Loads from Hurricanes

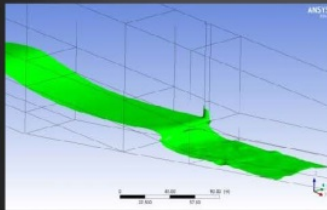
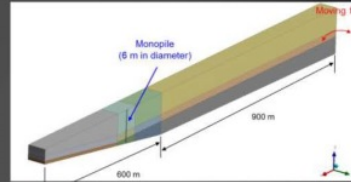


Tropical Cyclone History

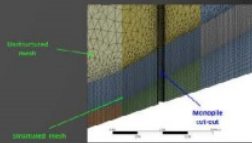


Hurricanes present a challenge for designers of foundations for offshore wind turbines. CFD tools are valuable for simulating the turbulent phenomena resulting from steep and breaking waves. Multiphase simulations with dense mesh and long time sequences with small time steps require optimized computation schemes for efficient use of computing resources

Structured and unstructured mesh of the 1500m domain using resolution down to 5cm was necessary to accurately compute the turbulent wave behavior at breaking and the hydrodynamic response of a flexible structure.



High temporal resolution is necessary in addition to high spatial resolution capture the transient effects of the wave breaking on the structure.



FUNDING AGENCY: USDoE

FUNDING ACKNOWLEDGEMENT: EERE
Wind and Water Power Technology Office

RESOURCE: Geosciences Department,
SRNL

CONTACT: Andrew Kall, SRNL
andrew.kall@srnl.doe.gov



SuperComputing 2014

Code: FLUENT

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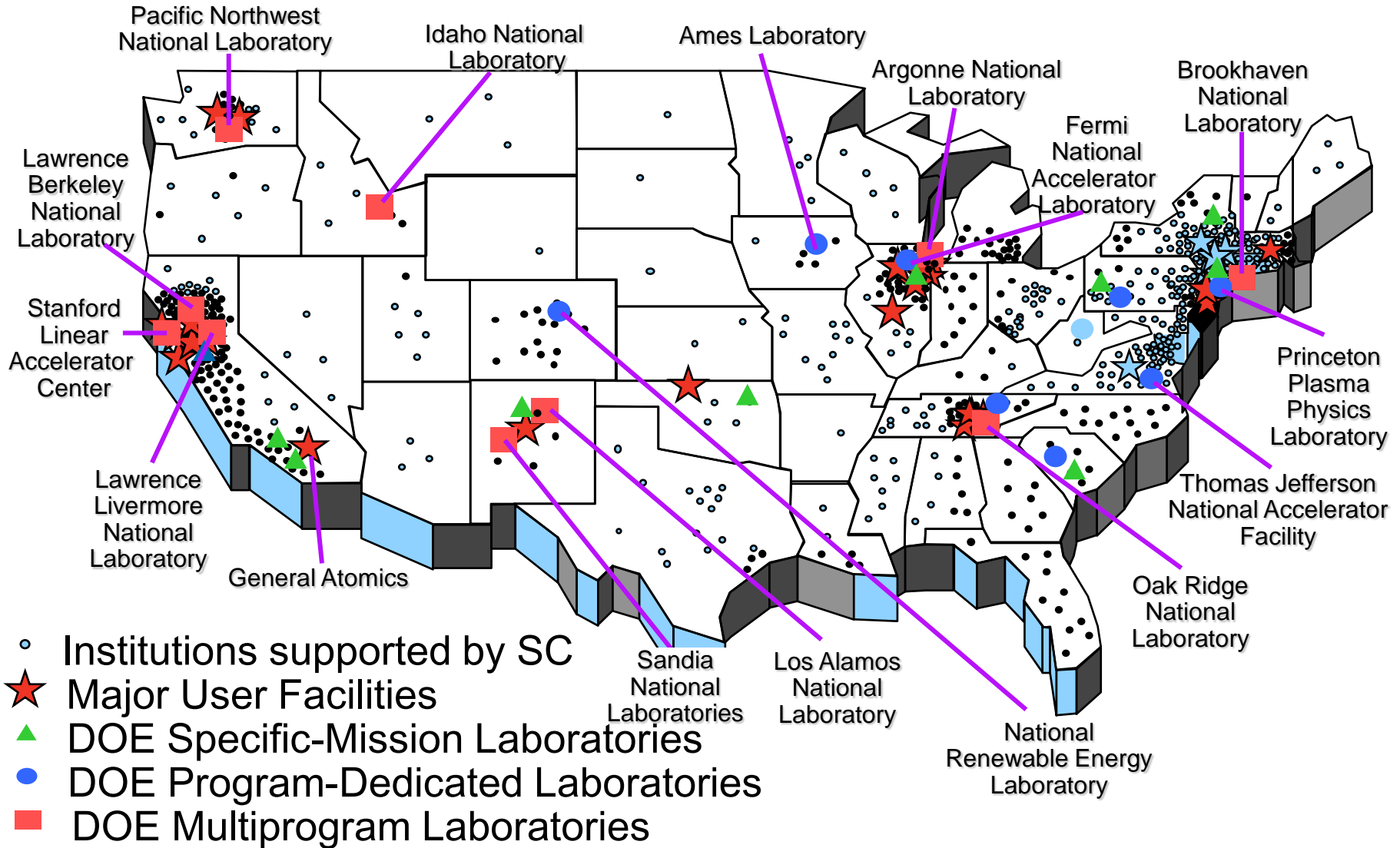


What's on the horizon?

- **The future requires:**
 - New advances in computing technology: hardware, software, algorithms, applications
 - New advances in data management, data analytics, visualization
- **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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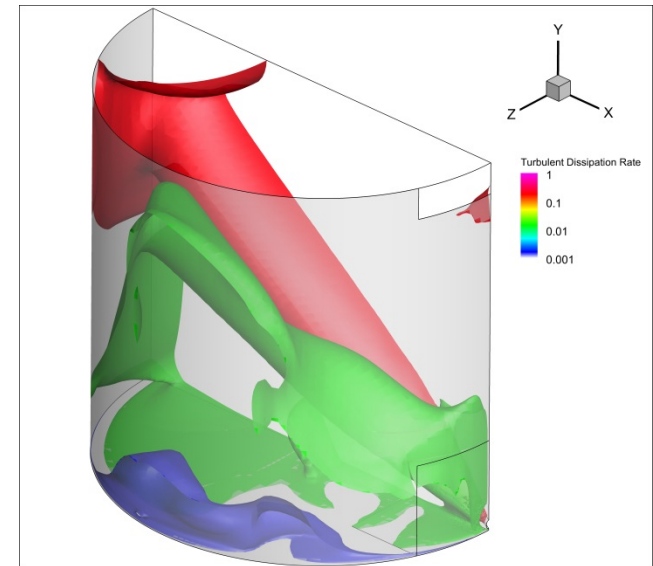
Office of Science US Community Drives ESnet Design for Domestic Connectivity



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Other things to consider

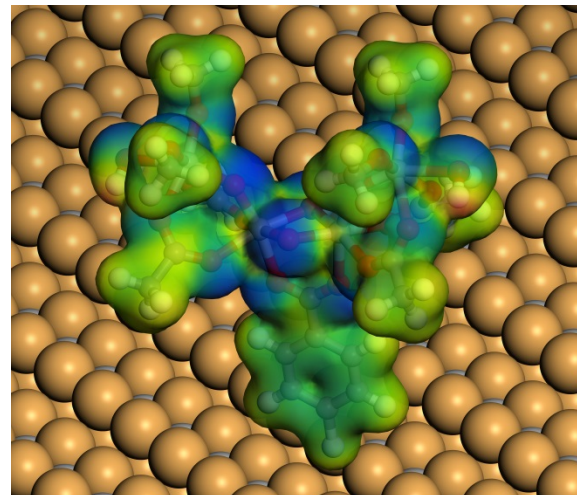
- The world has changed – technology changing rapidly
- IT world also changing rapidly
 - PC sales flat
 - Growth is with tablets, smartphones, and other handheld devices
- Innovations need to be driven
 - Processors & Memory
 - System Designs
 - System Software
 - Algorithms
 - Data management
 - Data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



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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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