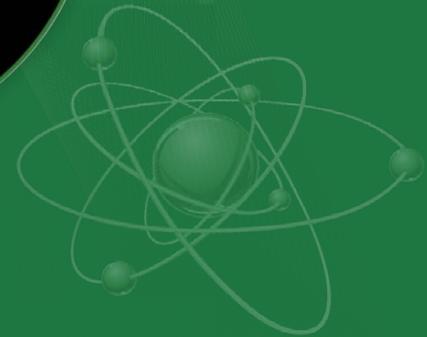
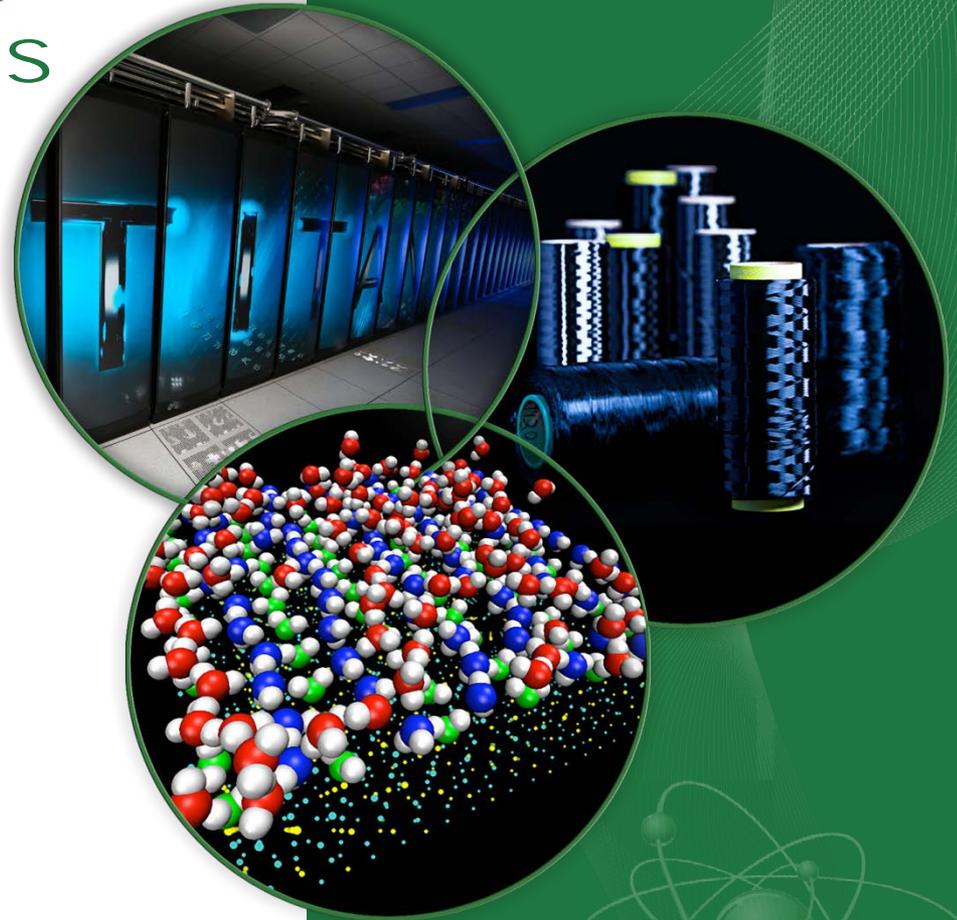


Overview of Reactor and Nuclear Systems Division

John Wagner
RNS Division Director
wagnerjc@ornl.gov
865-241-3570



Focus areas

Reactor and Fuel Cycle Technology

Nuclear Systems Technology

Nuclear Security

M&S Tools and Data

Reactor and Nuclear Systems Division

John Wagner, Director



SCALE Development and Maintenance

Brad Rearden



NRC Projects Office

Julie Stringfield



Radiation Safety Information Computational Center

Tim Valentine



Advanced Reactor Systems and Safety

Gary Mays



Nuclear Data and Criticality Safety

Mike Dunn



Nuclear Security Modeling

Vince Jodoin



Radiation Transport

Bob Grove



Reactor Physics

Steve Bowman



Thermal Hydraulics and Irradiation Engineering

Grady Yoder, Jr.



Used Fuel Systems

John Scaglione



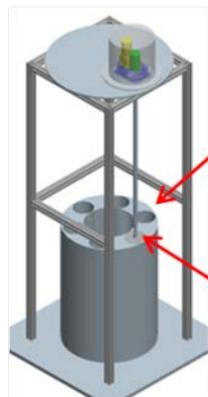
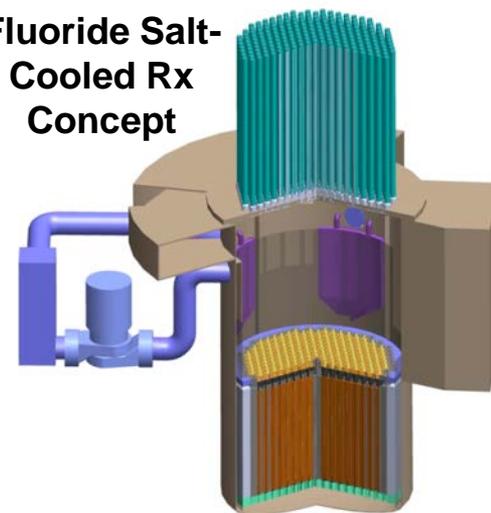
Reactor Technology and Safety is a Key R&D Area



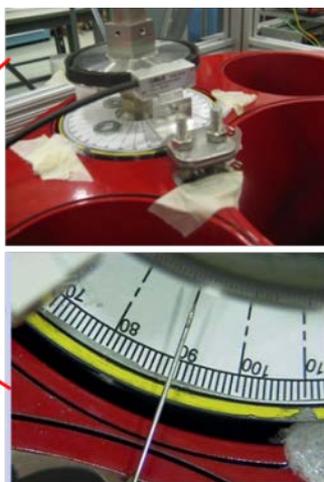
Liquid Salt Test Loop

- Developing and evaluating advanced reactor concepts and technologies
- Material and fuel development and performance
- I&C, reactor physics, and dosimetry
- Irradiation experiment design, safety, fabrication, and performance
- Experimentation and analysis for T/H and CFD
- Economic evaluations, and site assessment
- Regulatory research and licensing support

Fluoride Salt-Cooled Rx Concept

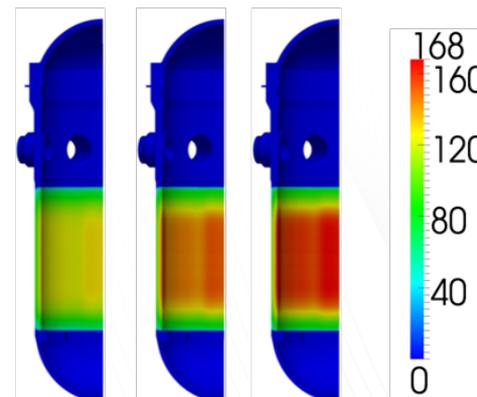


Advanced Reactor Control Drive Testbed



Transition temperature shift (°F)

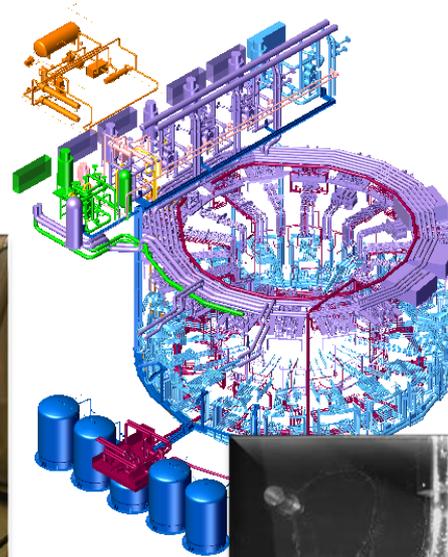
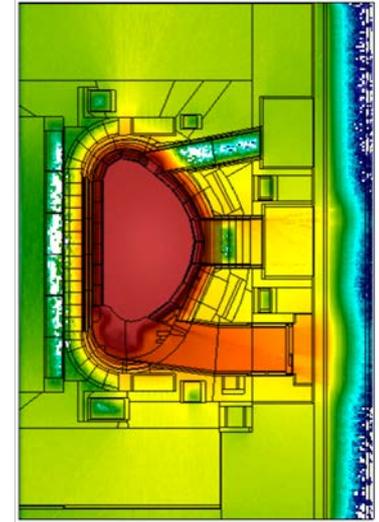
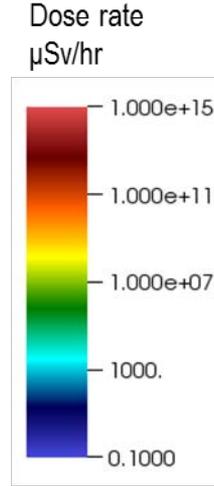
Modeling tool to predict RPV degradation, under development with INL and UT



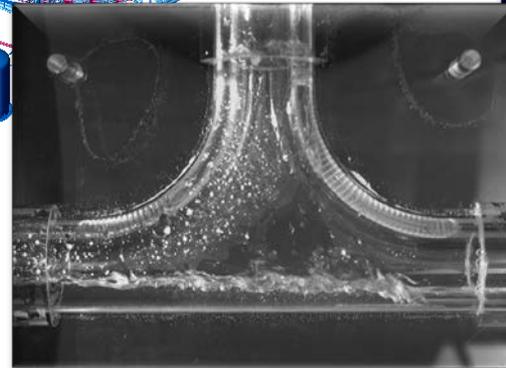
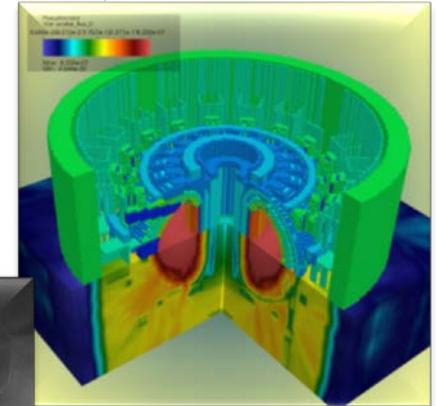
32 years 60 years 80 years

Nuclear Systems Technology and Safety

- **Fuel cycle systems analysis**
- **Facility design and operational safety**
 - ITER-related experiments and analysis
 - SNS-related experiments and analysis
- **Criticality safety**



TCWS &
System
Interfaces



U.S. Nuclear Criticality Safety Program (NCSP) Leadership



Program Execution

- Lead lab oversight of NCSP work in DOE complex
- 10-year mission and vision development
- 5-year execution plan

Modeling and Simulation

- Develop and deploy radiation transport analysis tools for NCS applications
- Support safety basis analyses for facility operations

Integral Experiments

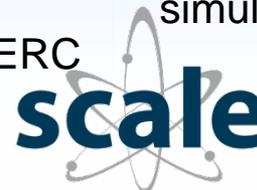
- Analysis for experiment design support
- Experiment execution oversight at SNL and NCERC

Nuclear Data

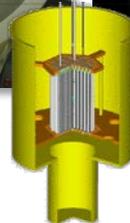
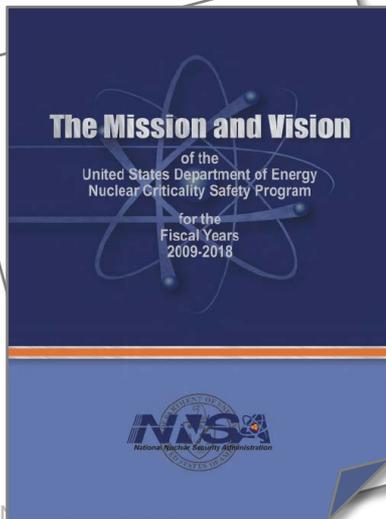
- Differential data measurements
- Cross-section evaluation and processing to support modeling and simulation

Training and Education

- Coordinate development and deployment of “hands-on” NCS training courses for DOE complex
- Manage multi-lab team for training course execution



Nuclear Systems Modeling & Simulation



CASL

- Continuous-energy, high-fidelity reference solutions for reactor physics
- Cross-section data libraries
- Reactor fuel depletion
- Uncertainty quantification

DOE Used Fuel Disposition

- Radiation shielding
- Nuclear fuel depletion
- Used fuel source terms
- Criticality safety analysis
- Uncertainty quantification

DOE Nuclear Criticality Safety Program

- Criticality safety assessments
- Sensitivity and uncertainty analysis
- Advanced validation methods
- Experiment design
- Criticality accident alarm system analysis and design

Nuclear Regulatory Commission

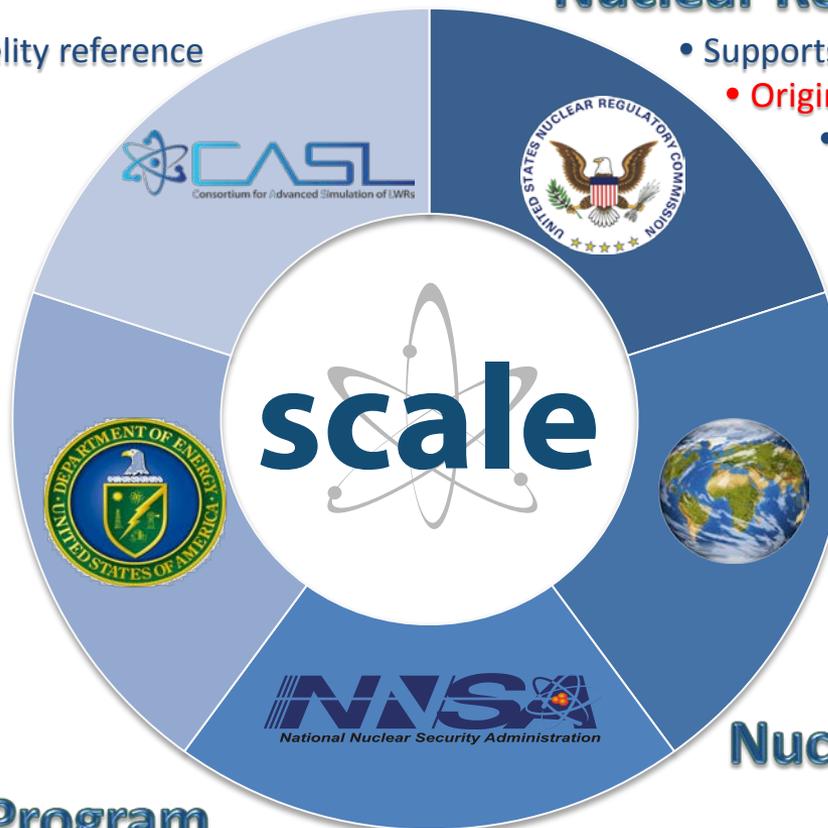
- Supports licensing and regulatory research
- **Original sponsors of SCALE – since 1976**
- Reactor physics and source terms
- Criticality safety and shielding
 - Cross section data libraries

Global Distribution

- **5500 users in 40 nations**
- Regulators
- Industry
- Research and Development

Nuclear Nonproliferation and Safeguards

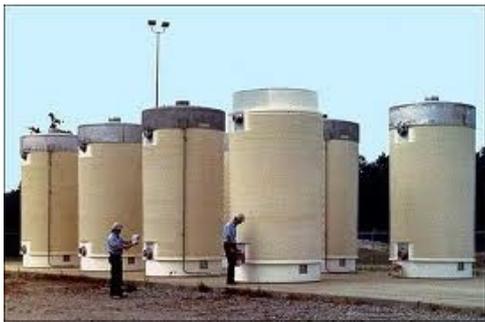
- Used fuel and radionuclide source terms
- Reactor depletion analysis
- Radiation transport
- Nuclear forensics



ORNL is Playing a Major Role in Used Nuclear Fuel R&D

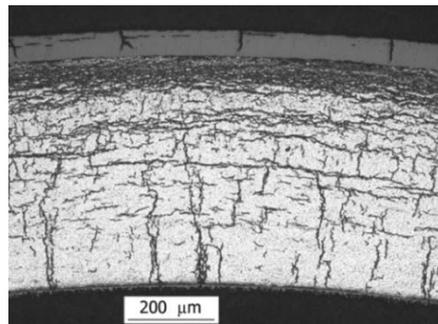
Staff: Providing outcome-focused leadership

- Leadership of multi-lab assessment of disposition options for used nuclear fuel (UNF) inventory
- Leadership roles in DOE and NRC UNF programs
- National Technical Director for Nuclear Fuels Storage and Transportation
- Conducting forefront R&D



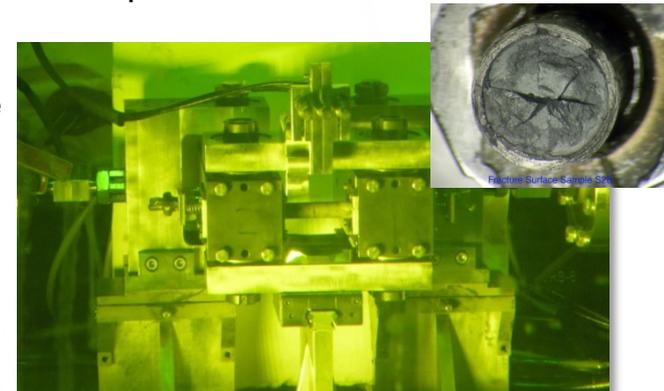
Facilities and resources: Enabling outcomes

- HFIR: Cladding irradiation and nondestructive neutron scattering for advanced understanding and predictive model development
- Hot cells: Critical to R&D with actual UNF
- Developed fatigue testing device and process to understand mechanical performance UNF during transport
- Staff experience and computational tools to assess system performance



Result: Delivering technical solutions

- Improved fundamental understanding of UNF mechanical properties
- Science-based engineering solutions for safety and integrity issues related to UNF
- Establishing knowledge, data, and tools for enabling UNF disposition



Integration of data, experiments, and analysis

Used Nuclear Fuel Inventory and Spent Fuel Analysis for Safety, Safeguards, and Security

Validated Codes and Nuclear Data

Experimental validation via domestic and international partnerships:

- Sweden SKB assembly calorimeter measurements
- Destructive fuel assay measurements for more than 120 spent fuel samples
- Europe RG MOX fuel and domestic WG MOX

Staff Experience and Applications

- Industry; fuel and reactor design analysis
- Industry: storage and transport systems
- Regulatory research and licensing support
 - Criticality safety
 - Burnup Credit
 - Decay Heat
 - YMP Repository
- DOE Used Fuel Disposition Campaign
- Spent fuel safeguards for Euratom and IAEA
- Regulatory technical basis and guidance

Facilities and Resources

- ORNL facilities for measured data
 - Fuel examination
 - Radiochemical labs
- Integrated UNF information and analysis capability for
 - Standard fuel and cask models
 - Reactor operations database
- CURIE central data dissemination and exchange website

Security & Safeguards

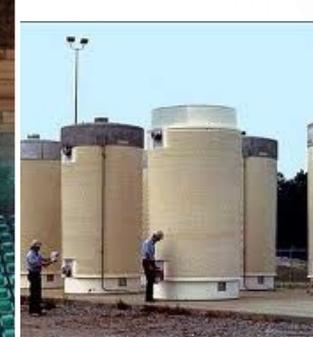
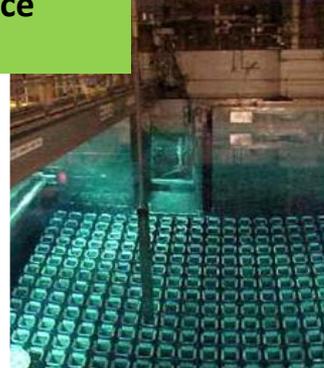
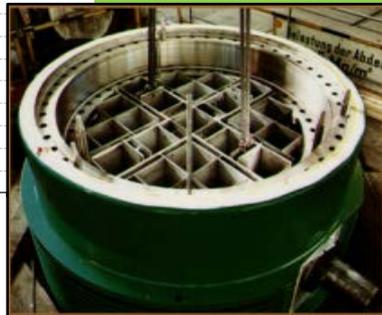
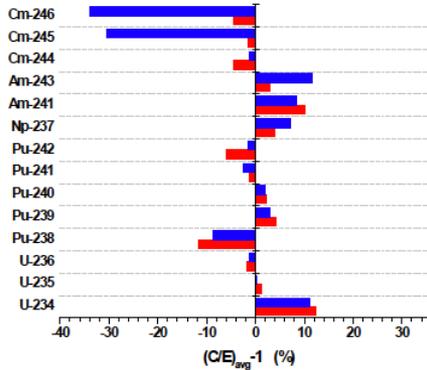
Inventory Analysis

Fuel Cycle Assessment

Safety & Licensing



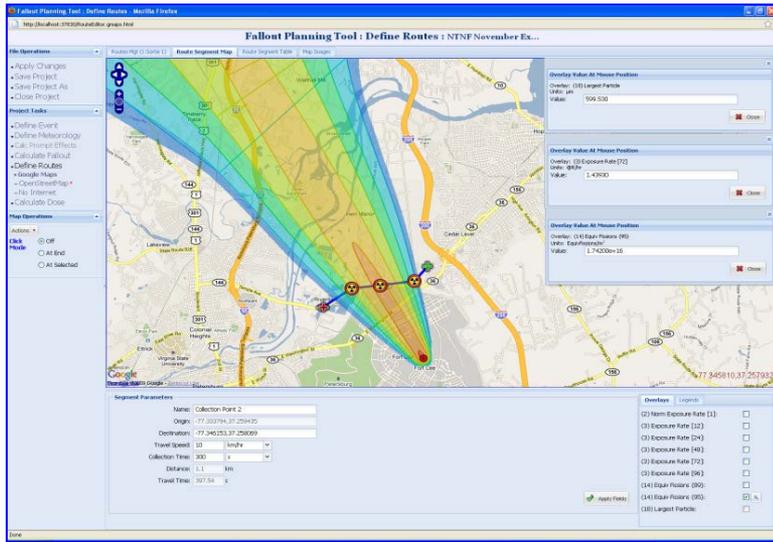
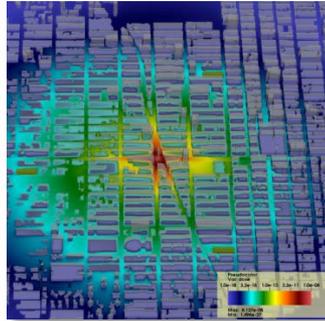
Scale 5.1-ENDF/B-V
Scale 6.1-ENDF/B-VII



Nuclear Security Analysis

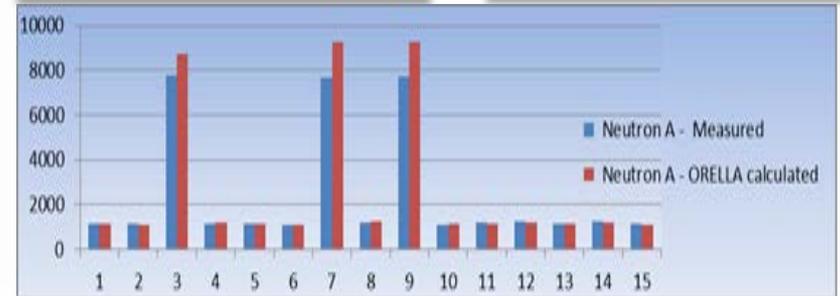
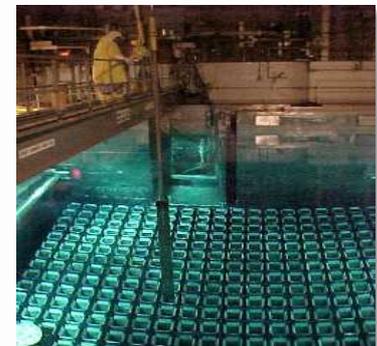
DELFI and Denovo/Advantg

Modeling and software to address forensics, consequence management, and operations issues



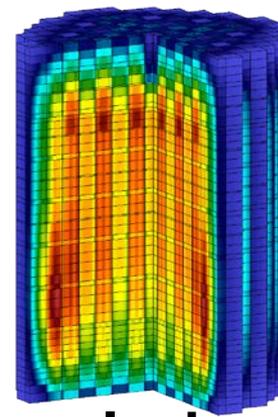
SCALE depletion software: ORIGEN

An integral part of RADAR, Euratom's unattended safeguards system for spent nuclear fuel

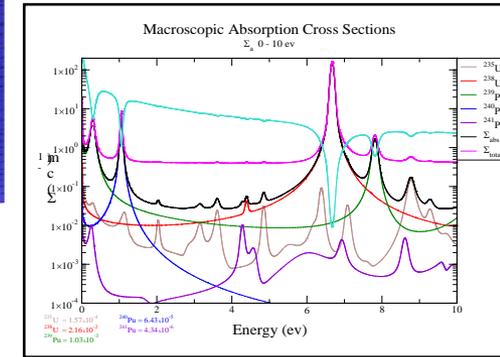


M&S Tools and Data

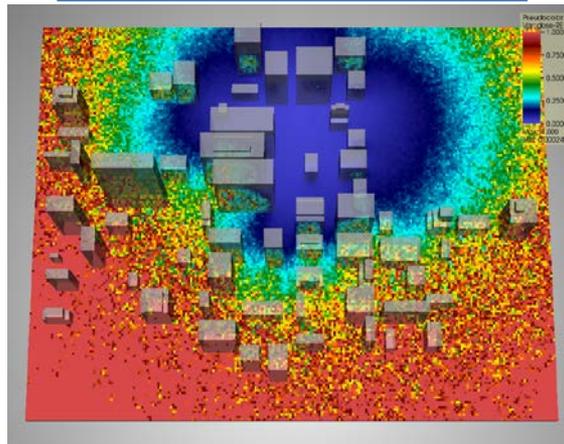
- **New radiation transport and lattice physics capabilities**
 - Extensive experience in deterministic and Monte Carlo methods provides us with unique capabilities
- **Sensitivity, uncertainty, and inverse analysis**
- **Nuclear data measurement, evaluation and processing**
- **High-performance computational R&D**
- **Nuclear weapons fallout physics**



Calculated AP1000®
Fission Rate Distribution



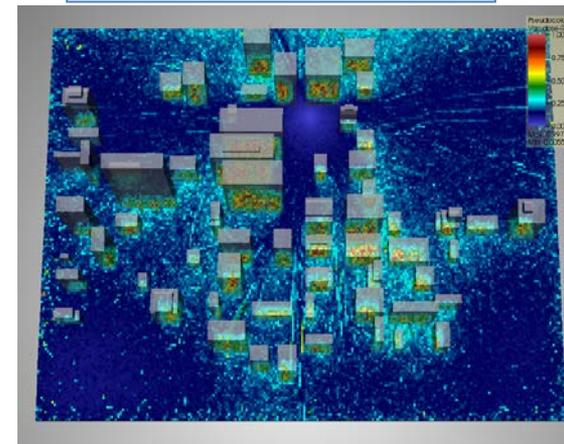
Conventional Monte Carlo



25% of cells
have RE < 20%

48% of cells
have RE < 50%

Hybrid deterministic/MC



77% of cells
have RE < 20%

97% of cells
have RE < 50%