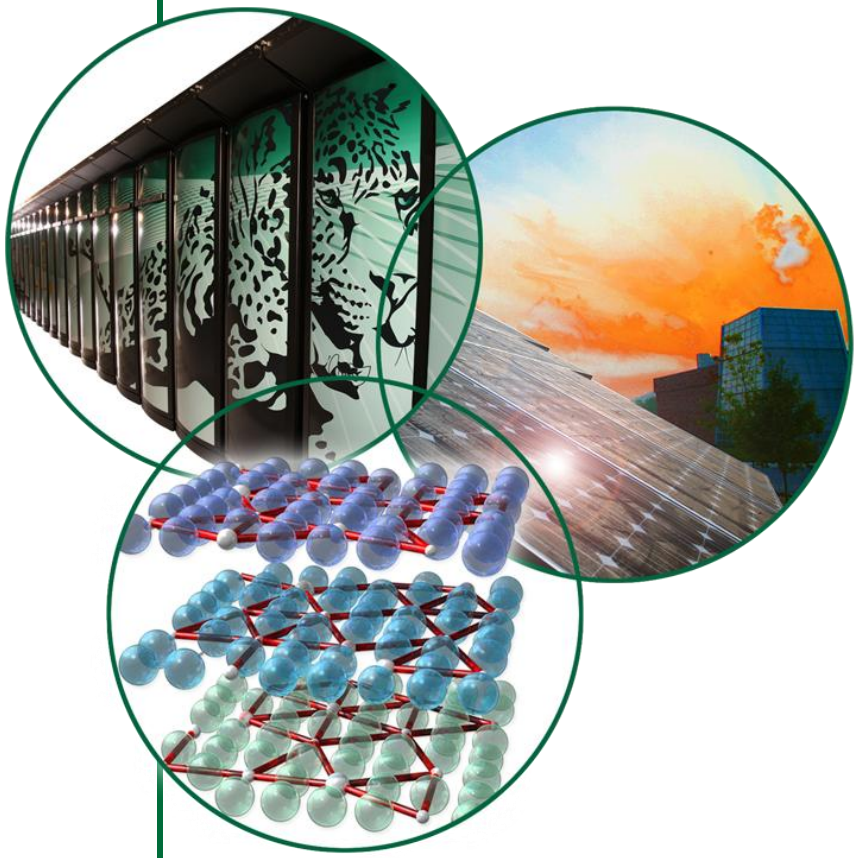
Scale:
A Comprehensive Modeling and Simulation Suite for Nuclear Safety Analysis and Design



Brad Rearden

SCALE Project Leader

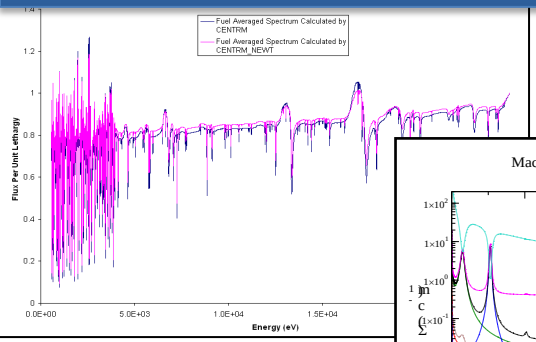
Reactor and Nuclear Systems Division

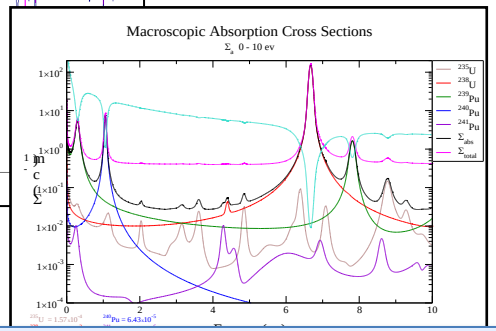
U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY

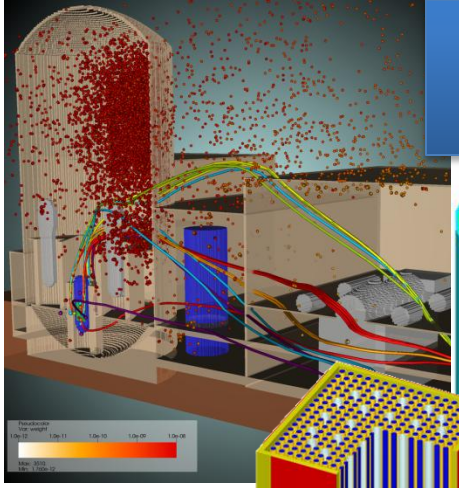
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

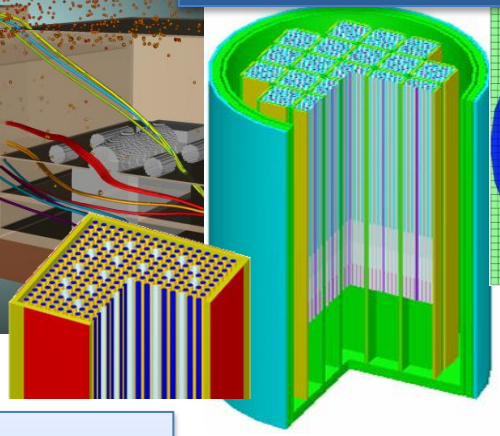
Convenient Material Input and Current Nuclear Data with Continuous-Energy Resonance Processing

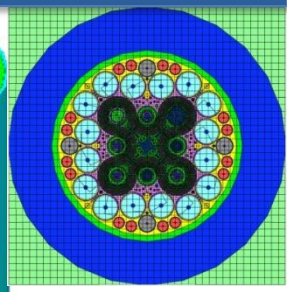




High-Resolution Geometry Modeling in Monte Carlo and Deterministic Transport



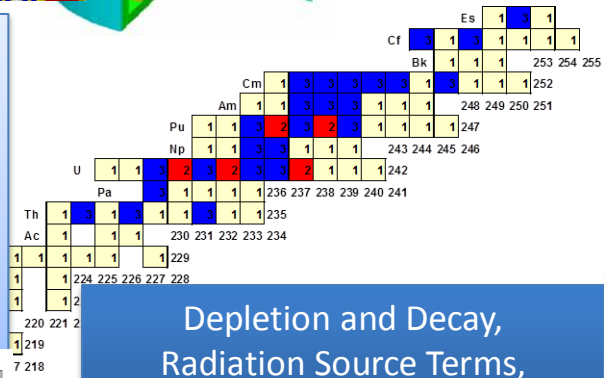




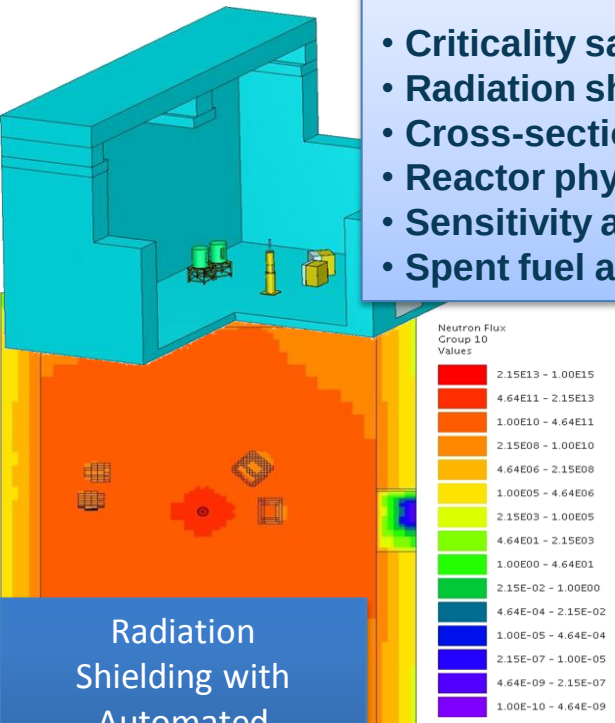
SCALE Capabilities

- Criticality safety
- Radiation shielding
- Cross-section processing
- Reactor physics
- Sensitivity and uncertainty analysis
- Spent fuel and HLW characterization

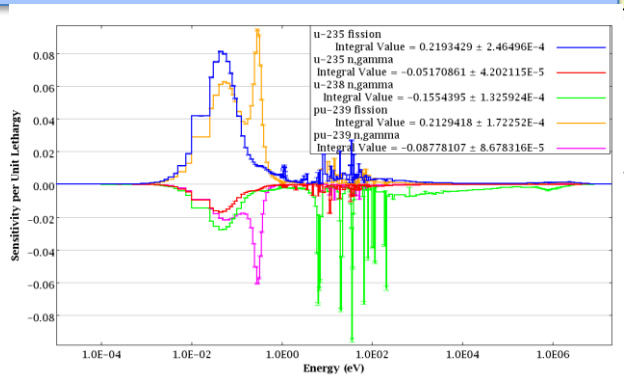
scale



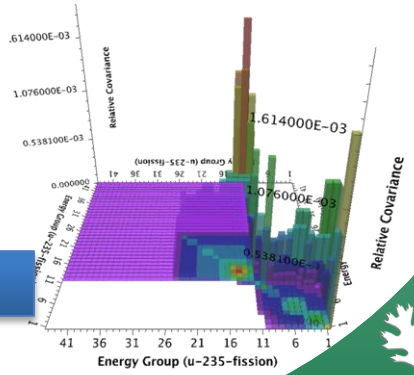
Depletion and Decay, Radiation Source Terms, and Decay Heat



Radiation Shielding with Automated Variance Reduction



Sensitivity and Uncertainty Analysis



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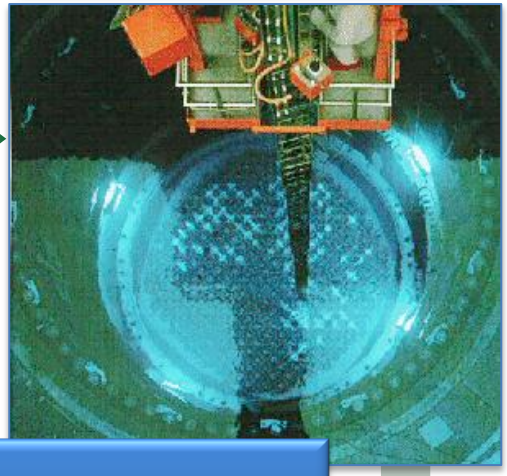
Applications of SCALE

Material Processing & Fuel Fabrication

Commercial and Research Reactors

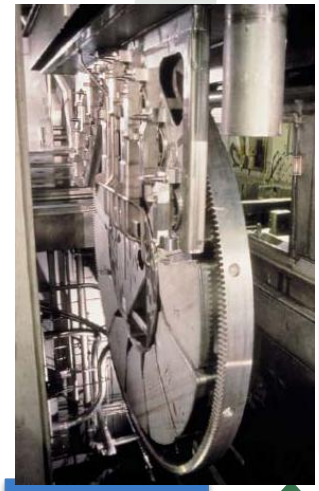


Storage

Transportation

Disposal

Recycling



Oak Ridge National Laboratory

SCALE 0.0 – SCALE 4.4a

1980 – 2000

Established for Nuclear Regulatory Commission

Provides an independent rigorous nuclear safety analysis capability for out-of-reactor license reviews

Key Capabilities

Criticality safety

Radiation source term characterization

Radiation shielding

Heat transfer

scale

Nuclear Systems Modeling & Simulation

SCALE 5.0 – SCALE 6.1

2004 – 2011

Expanded Capabilities to Address a Broader Class of Problems & Sponsors

Reactor physics

Shielding analysis with automated variance reduction

Sensitivity and uncertainty analysis

High-fidelity criticality safety in continuous energy

Graphical user interfaces and visualization tools

Expanding Use

Used in 40 nations by regulators, vendors, utilities, and researchers

SCALE 6.2 – SCALE 7.0

2012 – 2014

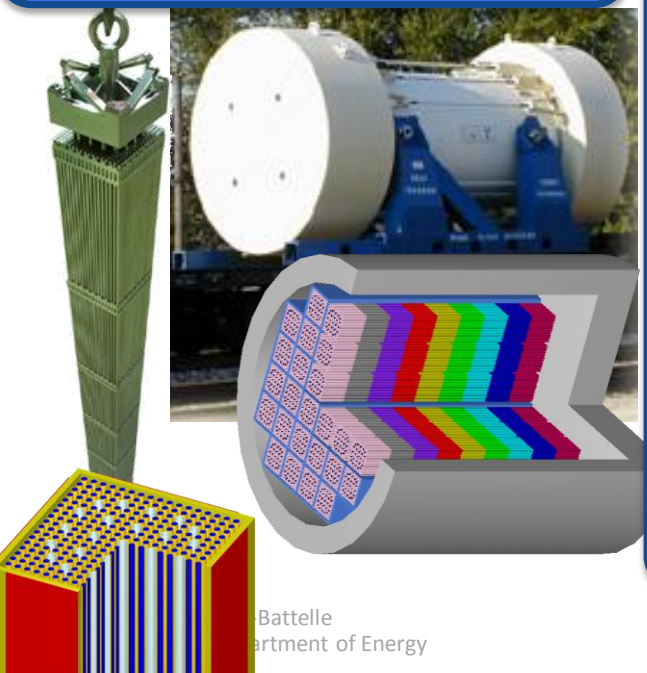
HPC Integration, Architecture Modernization, Further Expansion of Capabilities

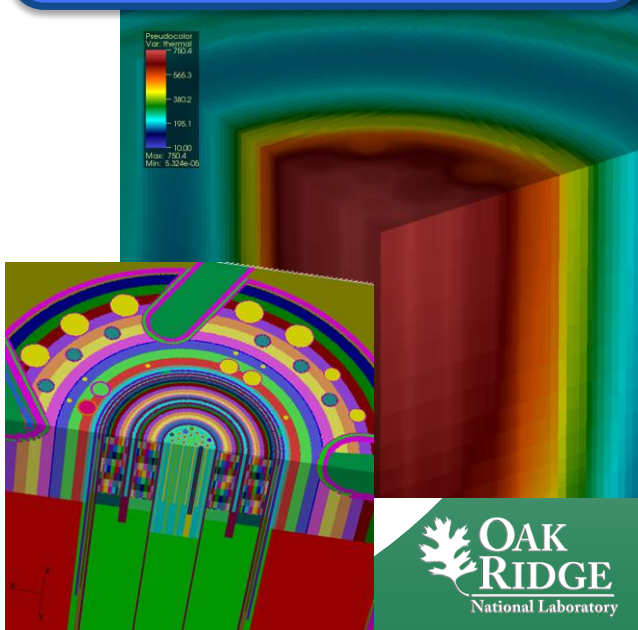
Solutions for extremely complex systems

High-fidelity shielding, reactor physics and sensitivity analysis in continuous energy

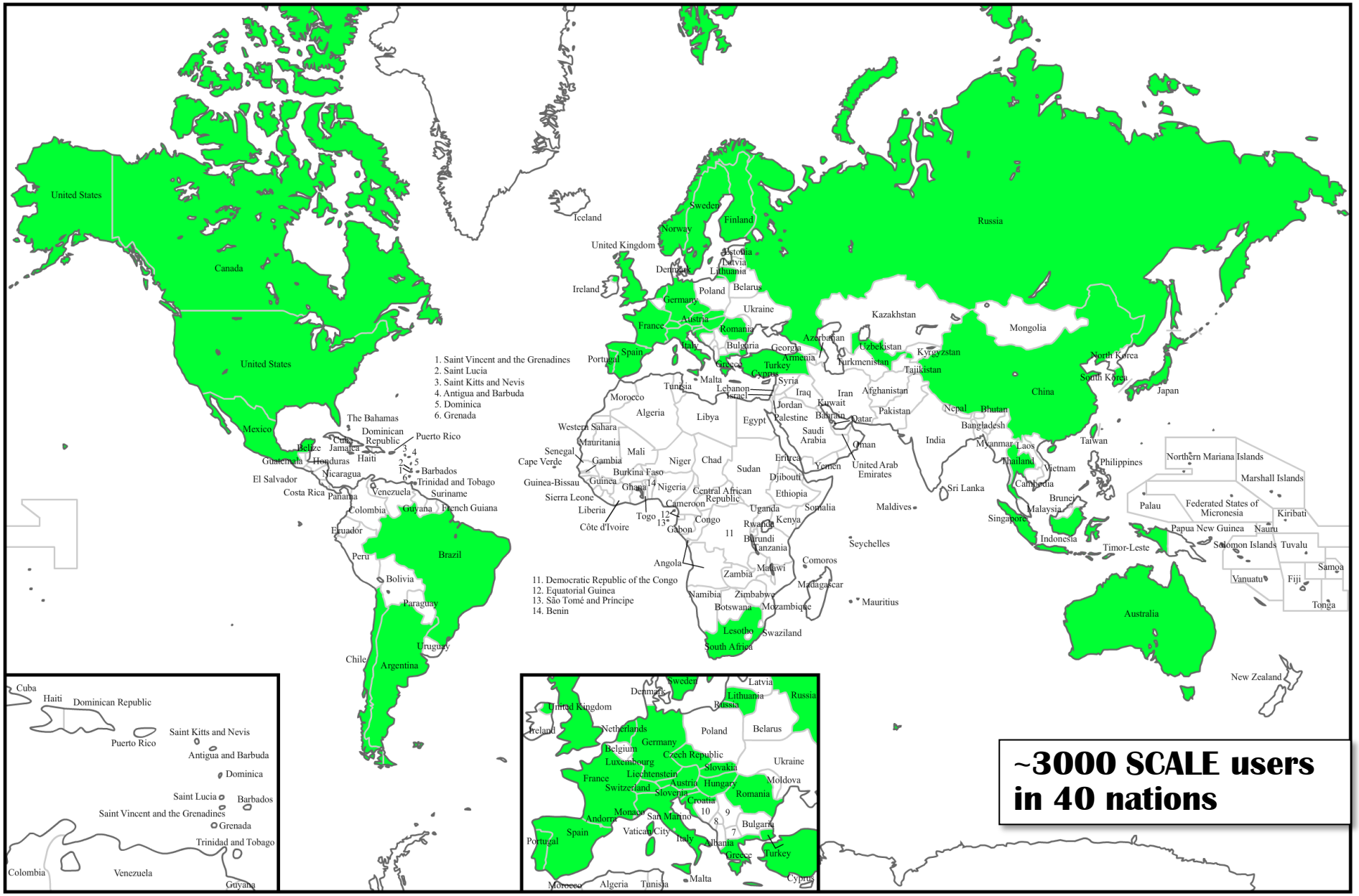
Scalable from single core PCs to massively parallel machines

Integration with CASL Virtual Environment for Reactor Analysis





SCALE Map of the World



~3000 SCALE users in 40 nations

SCALE Users

Regulators

Industry vendors

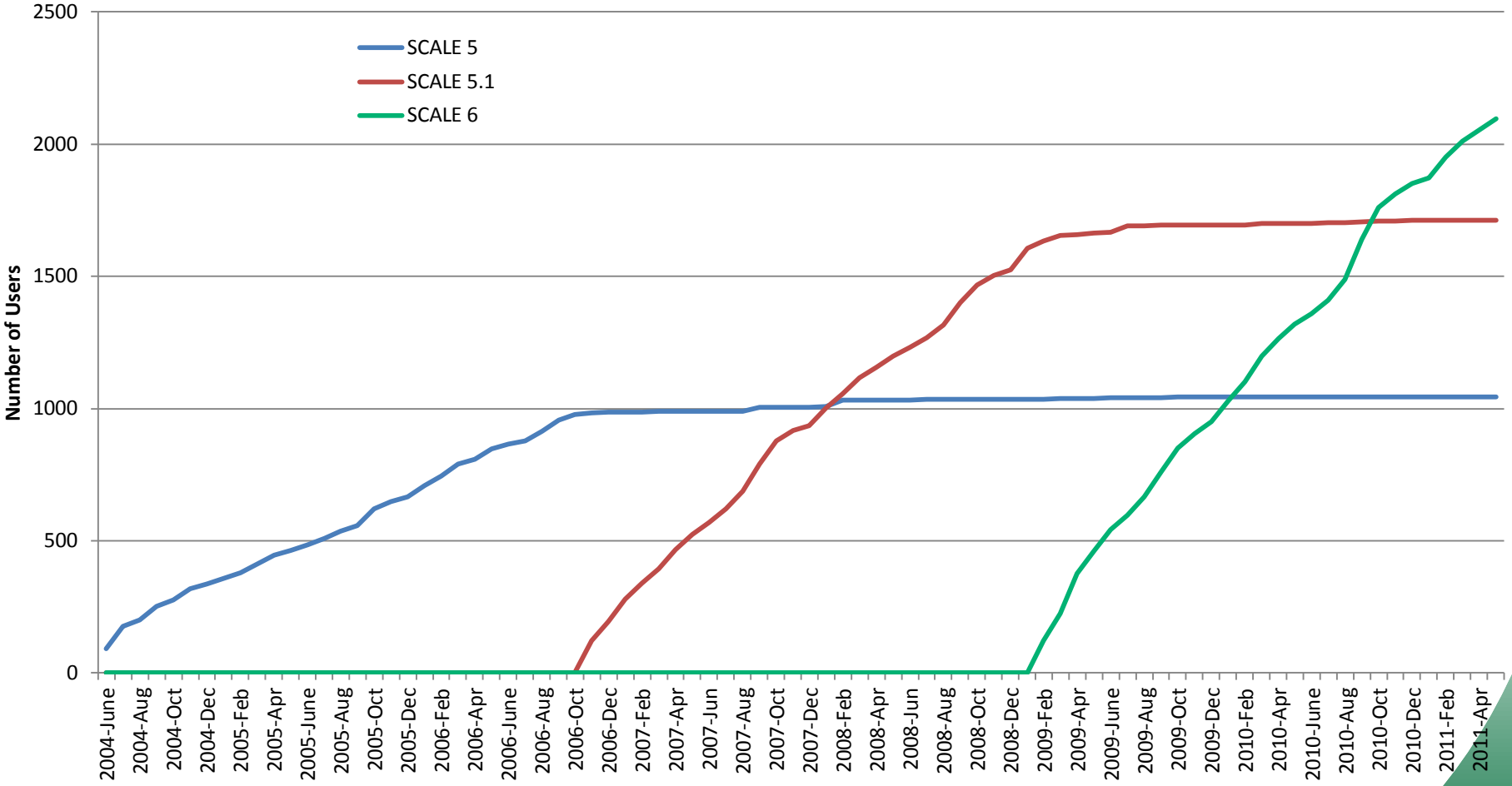
Utilities

Research laboratories

Government agencies

Universities

Scale – Growing user base



SCALE has large, talented team with a wide range of expertise and next-generation members

LEADERSHIP TEAM

- **John Wagner** – Manager - Design, Safety & Simulation Integration
- **Brad Rearden** – SCALE Project Leader
- **Mike Dunn** – Group Leader - Nuclear Data & Criticality Safety
- **Bob Grove** – Group Leader - Radiation Transport
- **Steve Bowman** – Group Leader - Reactor Physics
- **Mark Williams** – Computational Methods Lead

NUCLEAR DATA

- **Luiz Leal** – Cross Sections and Covariance Data
- **Doro Wiarda** – Cross Sections and Covariance Data
- **Goran Arbanas** – Cross Sections and Covariance Data

REACTOR PHYSICS

- **Matt Jessee** – TRITON
- **Ian Gauld** – ORIGEN, SAS2, and ARP
- **Germina Ilas** – ORIGEN-ARP Libraries
- **Ugur Mertyurek** – Lattice Physics
- **Bryan Broadhead** – Reactor Analysis
- **Brian Ade** – Testing/Training
- **Andrew Godfrey** – Reactor Analysis/ CASL
- **Dan Ilas** – Reactor Analysis
- **Ron Ellis** – Reactor Analysis
- **Harold Smith** – Reactor Analysis

CRITICALITY SAFETY

- **Lester Petrie** – CSAS/KENO V.a, KENO-VI, XSRNPM
- **Sedat Goluoglu** – CE-Monte Carlo, MIPLIB, SMORES
- **Georgeta Radulescu** – STARBUCS
- **Don Mueller** – Testing/Training
- **Davis Reed** – Testing/Training
- **B.J. Marshall** – Testing/Training
- **Cihangir Celik** – CE-Monte Carlo

RADIATION TRANSPORT

- **Douglas Peplow** – MAVRIC/Monaco
- **Thomas Miller** – MAVRIC/Monaco
- **Tom Evans** – Denovo Lead
- **Greg Davidson** – Denovo
- **Josh Jarrell** – Denovo
- **Scott Mosher** – Monte Carlo Methods
- **Kursat Bekar** – Monte Carlo Methods
- **Keith Bledsoe** – Uncertainty Analysis
- **Joel Risner** – Testing/Training

INFRASTRUCTURE

- **Sheila Walker** – SCALE SQA
- **Rob Lefebvre** – User Interfaces, Support
- **Jordan Lefebvre** – Build, Install, Platforms
- **Jay Billings** – Architecture
- **Donnie Newell** – Regression Testing, Parallel Algorithms
- **Debbie Weaver** – SCALE Manual

Next-generation staff

OAK RIDGE National Laboratory

Scale 6.1 Team

Scale Leadership Team

- John Wagner
  Design, Safety and Simulation Integration Manager
- Brad Rearden
  Scale Project Leader
- Mike Dunn
  Nuclear Data and Criticality Safety Group Leader
- Bob Grove
  Radiation Transport Group Leader
- Steve Bowman
  Reactor Physics Group Leader
- Mark Williams
  Scale Computational Methods Lead

Developers/Reviewers

- Doro Wiarda
- Douglas Peplow
- Georgeta Radulescu
- Ian Gauld
- Lester Petrie
- Mark Williams
- Matt Jessee
- Rob Lefebvre
- Sedat Goluoglu
- Tom Evans
- Ugur Mertyurek

Testers

- Andrew Godfrey
- B.J. Marshall
- Brian Ade
- Dan Ilas
- Davis Reed
- Don Mueller
- Harold Smith
- John Scaglione
- Mark Baird
- Ron Ellis
- Scott Mosher

Reviewers

- Germina Ilas
- Joel Risner
- Thomas Miller

Infrastructure

- Donnie Newell
- Jordan Lefebvre
- Sheila Walker

Documentation

- Debbie Weaver
- Hannah Turpin

Questions?

Nuclear Systems Modeling & Simulation

Brad Rearden

SCALE Project Leader

scalehelp@ornl.gov

OAK RIDGE National Laboratory