OAK RIDGE National Laboratory

Emerging Initiatives in SCALE

Presented to:
2018 SCALE Users' Group Workshop

Presented by:
Bradley T. Rearden, Ph.D.
Leader, Modeling and Simulation Integration
Reactor and Nuclear Systems Division
Oak Ridge National Laboratory

August 27, 2018

ORNL is managed by UT-Battelle, LLC for the US Department of Energy

U.S. DEPARTMENT OF ENERGY

SCALE Evolution (1976 – present)

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 5.0 – SCALE 6.1

2004 – 2011

Expanded Capabilities to Address a Broader Classes of Analysis

Reactor physics for LWR, MOX, HTGR, CANDU, FHR, and high-burnup fuels

Shielding analysis for large, complex systems with automated variance reduction

Sensitivity and uncertainty analysis, especially for validation and gap analysis

High-fidelity criticality safety in continuous energy

Graphical user interfaces and visualization tools

Expanded impact

Used in 56 nations by regulators, industry, utilities, and researchers

SCALE 6.2

2016 – 2018

Increased Fidelity, Infrastructure Modernization, Parallelization, Enhanced Quality Assurance

Solutions for extremely complex systems

High-fidelity shielding, depletion and sensitivity analysis in continuous energy

Simplified and efficient lattice physics

Unified user interface

Modern, modular software design integrated with QA

Expanded Use

9,000 users

Tools leveraged by many projects

SCALE 6.3 – SCALE 7.0

2018 –

High-performance Monte Carlo, Capabilities for Advanced Reactors and Advanced Fuels, Integration with Many other Tools

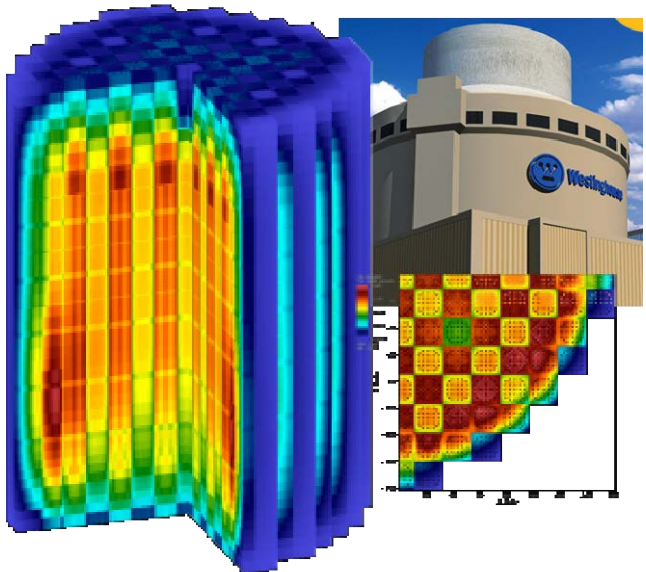
Focused capabilities for ATF and nonLWR

High-fidelity, highly parallelized criticality shielding, depletion and sensitivity analysis in continuous energy

Extended modern, modular software design

Expanded Integration

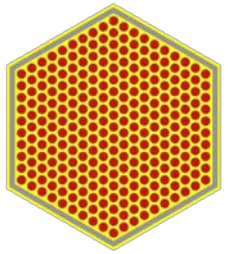
Tools directly integrated with many projects



OAK RIDGE National Laboratory

SCALE is part of the NRC's reactor licensing path

scale
Nuclear Systems Modeling & Simulation



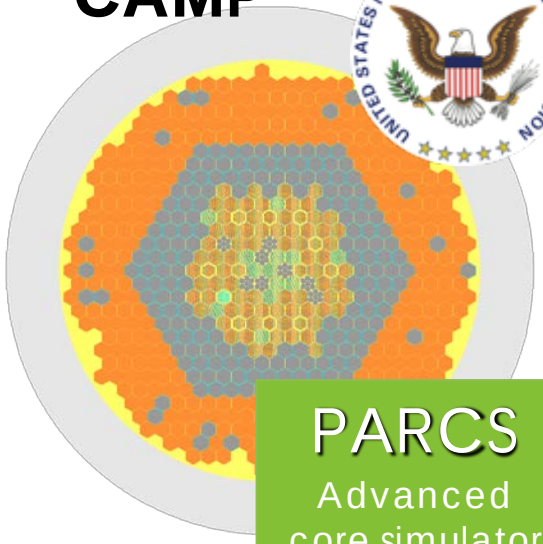
ENDF
Physics data
Thermal scattering law, resonance data, energy distributions, fission yields, decay constants, etc.

AMPX
Validated cross section libraries in multigroup (O(100g)) or continuous-energy (O(100,000g); depletion and decay data

TRITON / Polaris
Transport and depletion in 1D, 2D, and 3D for LWR, ATF, and nonLWR

ORIGEN / ORIGAMI
Depletion, activation and decay
Reactor-specific radioactive source term characterization

CAMP



PARCS
Advanced core simulator
Neutron flux solver and depletion

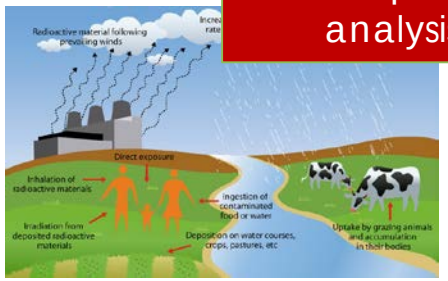
TRACE
System level temperature distributions and feedback

AGREE
Temperature distributions for gas reactors

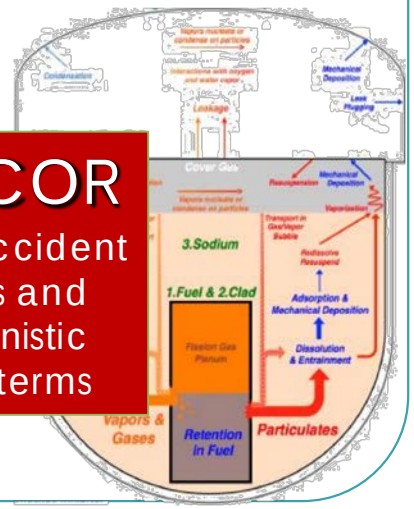
FAST
Fuel performance

CSARP

MACCS2
Offsite consequence analysis



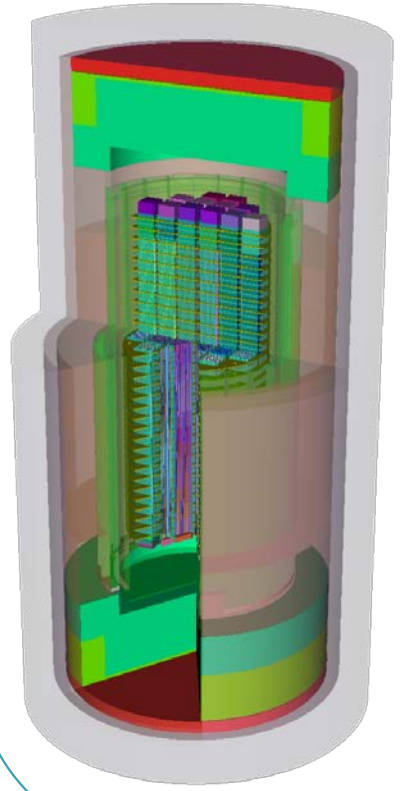
MELCOR
Severe accident analysis and mechanistic source terms



OAK RIDGE National Laboratory

SCALE is part of NRC's transportation and storage licensing path

scale
Nuclear Systems Modeling & Simulation



UNF-ST&DARDS
Used Nuclear Fuel-Storage, Transportation & Disposal Analysis Resource and Data System

ENDF
Physics data
Thermal scattering law, resonance data, energy distributions, fission yields, decay constants, etc.

AMPX
Validated cross section libraries in multigroup (O(100g)) or continuous-energy (O(100,000g); depletion and decay data

TRITON / Polaris
Transport and depletion in 1D, 2D, and 3D for LWR, ATF, and nonLWR

CSAS / KENO
3D criticality safety analysis

MAVRIC / Monaco
3D shielding and dose rate analysis

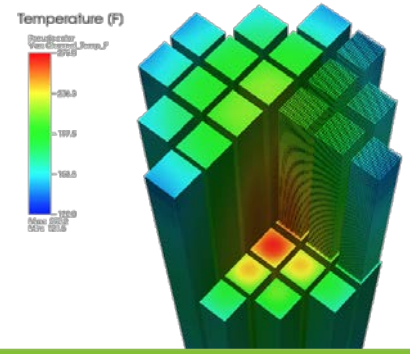
TSUNAMI
Sensitivity and uncertainty analysis and validation applicability

ORIGEN / ORIGAMI
Depletion, activation and decay
Reactor-specific radioactive source term characterization

Structural analysis

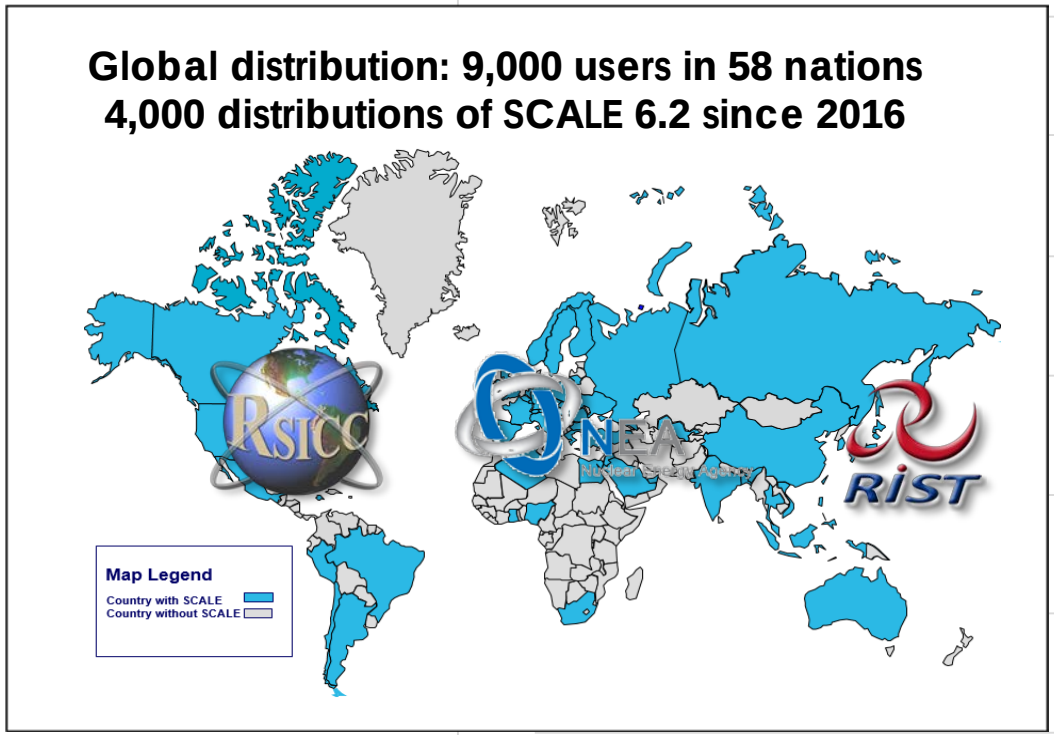
ANSYS / LS-DYNA
Commercial finite element analysis

Thermal analysis



STAR-CCM+ / FLUENT
Commercial computational fluid dynamics codes

SCALE licenses by version



OAK RIDGE National Laboratory

SCALE training courses are routinely provided to the user community

Public courses at ORNL and NEA
Application-specific training provided at NRC and user facilities

Fall 2018 SCALE training classes at ORNL, October 15 – November 9	
October 15-19	Sensitivity and Uncertainty Analysis for Criticality Safety Assessment and Validation
October 22-26	SCALE/TRITON Lattice Physics and Depletion
October 29 - November 2	SCALE/ORIGEN Standalone Fuel Depletion, Activation, and Source Term Analysis
November 5 – 9	SCALE Criticality Safety and Radiation Shielding

Point-of-contact: Germina Ilas, ilasg@ornl.gov

OAK RIDGE National Laboratory

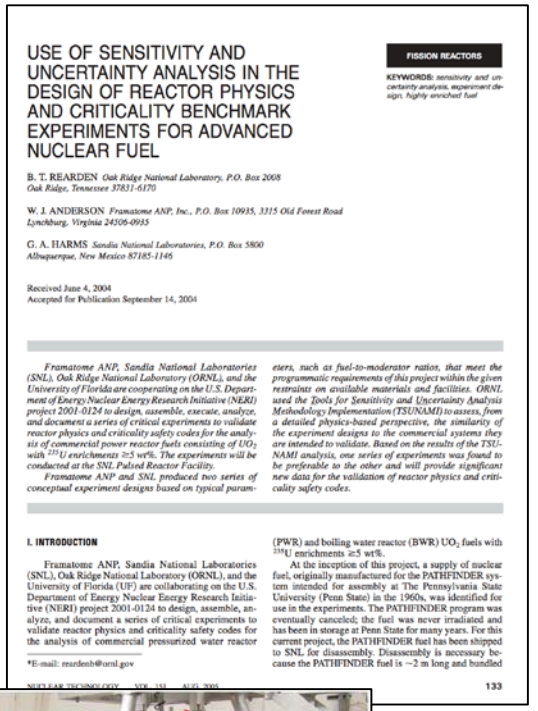
Collaboration with other projects:

- DOE Nuclear Data and Benchmarking (ND/B) Program
- NNSA Nuclear Criticality Safety Program
- DOE Used Fuel Disposition (UFD) R&D Program
- High performance computing:
  - DOE-NE Consortium for the Advanced Simulation of LWRs (CASL)
  - Exascale Computing Project

Nuclear Data and Benchmarking Program

U.S. DEPARTMENT OF ENERGY | Office of Nuclear Energy

- New Nuclear Energy Enabling Technology (NEET) Crosscutting Program
- Partner with industry, NRC, and other programs to:
  - Identify priority needs for nuclear data and benchmarking
  - Perform new data measurements and evaluations
  - Support integral experiments and handbooks
  - Participate in application benchmark studies


USE OF SENSITIVITY AND UNCERTAINTY ANALYSIS IN THE DESIGN OF REACTOR PHYSICS AND CRITICALITY BENCHMARK EXPERIMENTS FOR ADVANCED NUCLEAR FUEL

FISSION REACTORS

KEYWORDS: sensitivity and uncertainty analysis, experiment design, highly enriched fuel

B. T. REARDEN *Oak Ridge National Laboratory, P.O. Box 2008 Oak Ridge, Tennessee 37831-6170*

W. J. ANDERSON *Framatome ANP, Inc., P.O. Box 10935, 3315 Old Forest Road Lynchburg, Virginia 24506-0935*

G. A. HARMS *Sandia National Laboratories, P.O. Box 5800 Albuquerque, New Mexico 87185-1146*

Received June 4, 2004
Accepted for Publication September 14, 2004

Framatome ANP, Sandia National Laboratories (SNL), Oak Ridge National Laboratory (ORNL), and the University of Florida are cooperating on the U.S. Department of Energy Nuclear Energy Research Initiative (NERI) project 2001-0124 to design, assemble, execute, analyze, and document a series of critical experiments to validate reactor physics and criticality safety codes for the analysis of commercial power reactor fuels consisting of UO_2 with ^{235}U enrichments ≥5 wt%. The experiments will be conducted at the SNL Pulsed Reactor Facility.

Framatome ANP and SNL produced two series of conceptual experiment designs based on typical parameters, such as fuel-to-moderator ratios, that meet the programmatic requirements of this project within the given restraints on available materials and facilities. ORNL used the Tools for Sensitivity and Uncertainty Analysis Methodology Implementation (TSUNAMI) to assess, from a detailed physics-based perspective, the similarity of the experiment designs to the commercial systems they are intended to validate. Based on the results of the TSUNAMI analysis, one series of experiments was found to be preferable to the other and will provide significant new data for the validation of reactor physics and criticality safety codes.

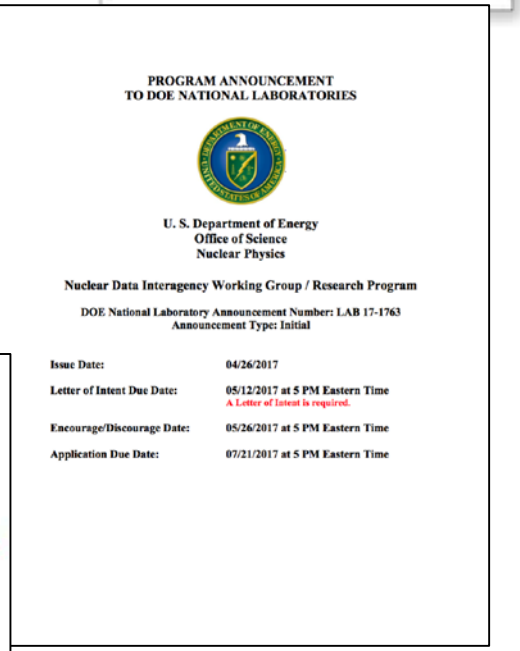
I. INTRODUCTION

Framatome ANP, Sandia National Laboratories (SNL), Oak Ridge National Laboratory (ORNL), and the University of Florida (UF) are collaborating on the U.S. Department of Energy Nuclear Energy Research Initiative (NERI) project 2001-0124 to design, assemble, analyze, and document a series of critical experiments to validate reactor physics and criticality safety codes for the analysis of commercial pressurized water reactor (PWR) and boiling water reactor (BWR) UO_2 fuels with ^{235}U enrichments ≥5 wt%.

At the inception of this project, a supply of nuclear fuel, originally manufactured for the PATHFINDER system intended for assembly at The Pennsylvania State University (Penn State) in the 1960s, was identified for use in the experiments. The PATHFINDER program was eventually canceled; the fuel was never irradiated and has been in storage at Penn State for many years. For this current project, the PATHFINDER fuel has been shipped to SNL for disassembly. Disassembly is necessary because the PATHFINDER fuel is ~2 m long and bundled

*E-mail: reardenb@ornl.gov

133

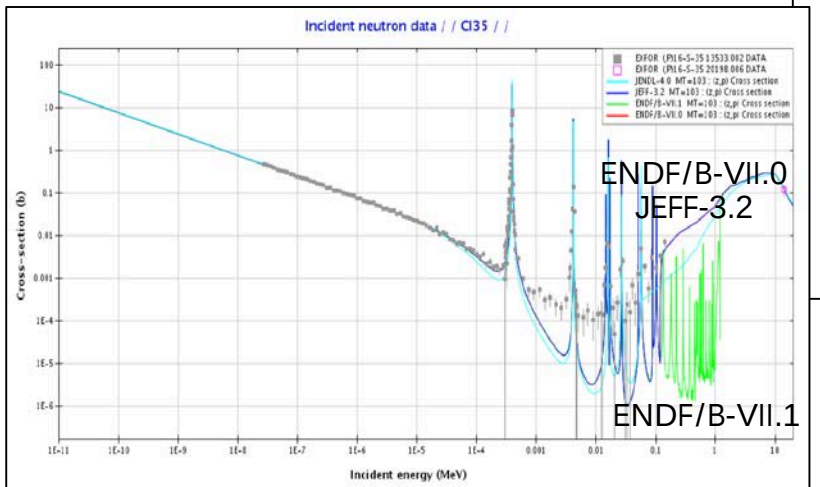

PROGRAM ANNOUNCEMENT
TO DOE NATIONAL LABORATORIES

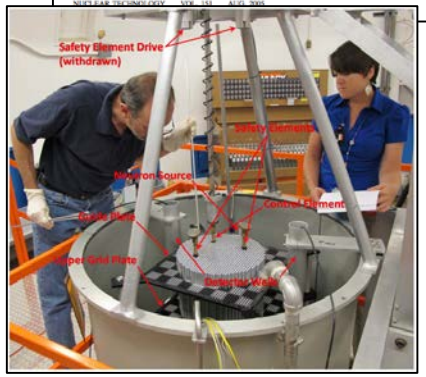
U. S. Department of Energy
Office of Science
Nuclear Physics

Nuclear Data Interagency Working Group / Research Program

DOE National Laboratory Announcement Number: LAB 17-1763
Announcement Type: Initial

Issue Date:	04/26/2017
Letter of Intent Due Date:	05/12/2017 at 5 PM Eastern Time A Letter of Intent is required.
Encourage/Discourage Date:	05/26/2017 at 5 PM Eastern Time
Application Due Date:	07/21/2017 at 5 PM Eastern Time

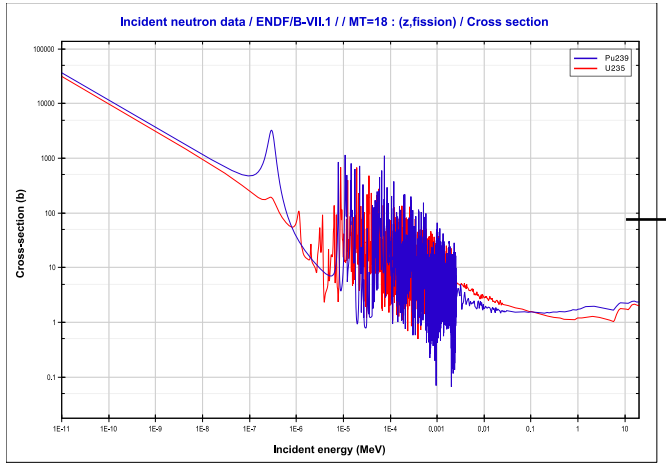


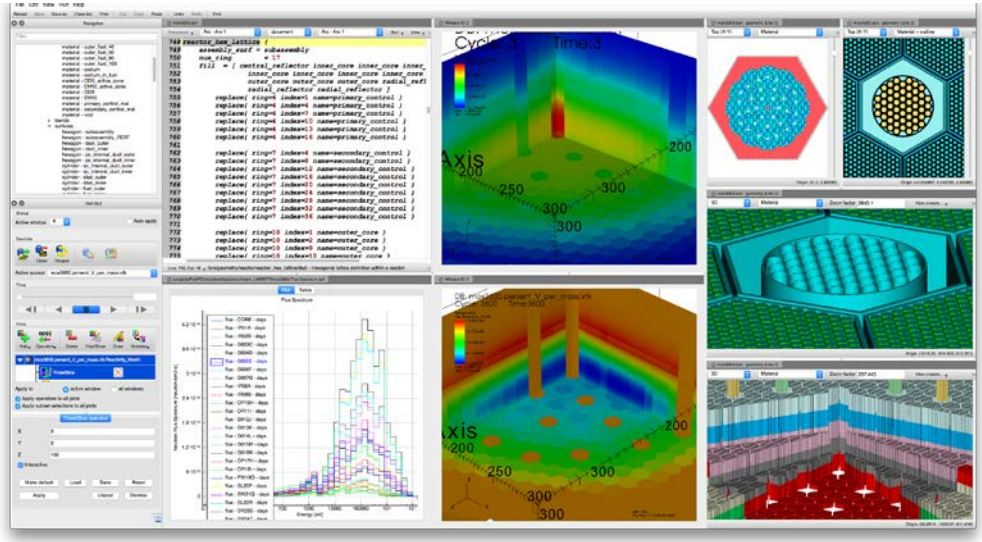


OAK RIDGE National Laboratory

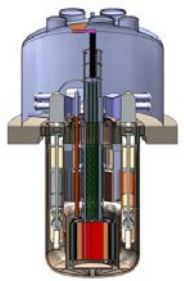
Nuclear data is necessary for reliable modeling and simulation of the next generation of nuclear reactors because of limited experimental data

- SCALE/AMPX
  - assessment of nuclear data needs
- TSUNAMI/Sampler
  - uncertainty quantification
  - validation assessment
  - experiment design

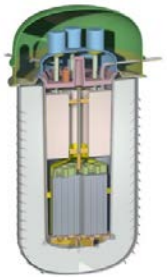




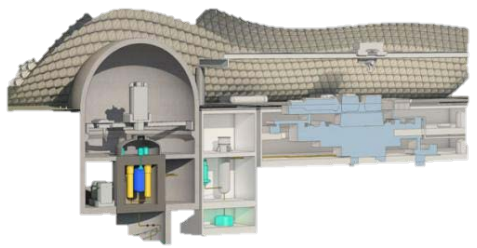
TerraPower



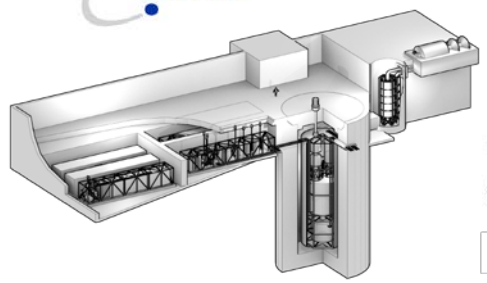
TERRESTRIAL ENERGY



TRANSATOMIC



Flibe ENERGY



X-energy

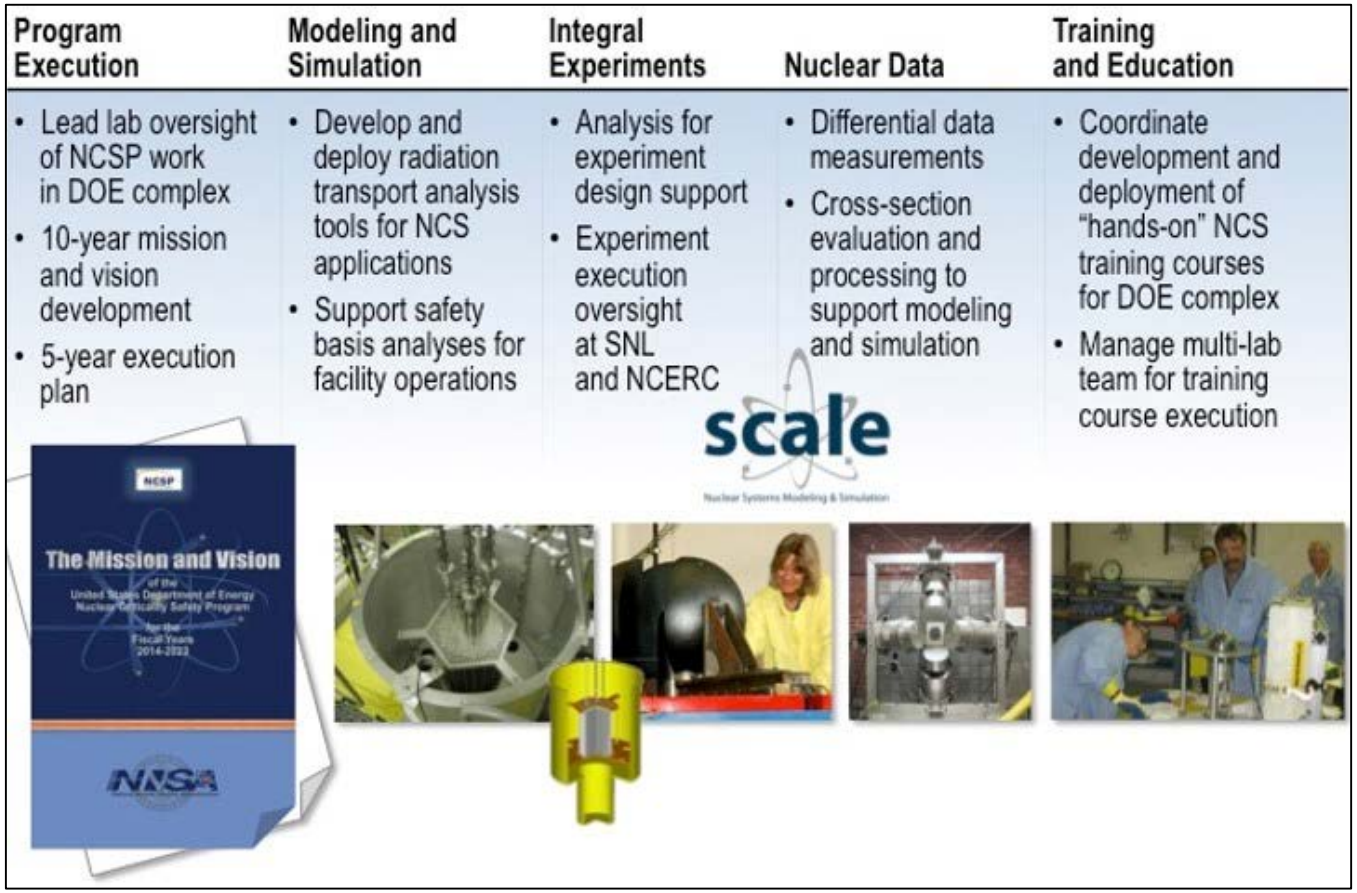
OAK RIDGE National Laboratory

Collaboration with other projects:

- DOE Nuclear Data and Benchmarking (ND/B) Program
- NNSA Nuclear Criticality Safety Program
- DOE Used Fuel Disposition (UFD) R&D Program
- High performance computing:
  - DOE-NE Consortium for the Advanced Simulation of LWRs (CASL)
  - Exascale Computing Project

NNSA Nuclear Criticality Safety Program

- Technology infrastructure needed to enable sites to perform safe, efficient fissionable material operations in the DOE Complex
  - Nuclear data generation and testing
    - SAMMY, AMPX
  - Criticality safety assessments
    - AMPX, KENO
  - Criticality accident alarm system analysis
    - KENO, ORIGEN, MAVRIC
  - Validation and uncertainty quantification
    - TSUNAMI, Sampler
  - Nuclear criticality and shielding experiment design
    - TSUNAMI, MAVRIC



OAK RIDGE National Laboratory

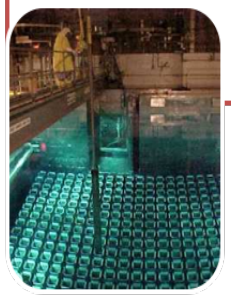
Collaboration with other projects:

- DOE Nuclear Data and Benchmarking (ND/B) Program
- NNSA Nuclear Criticality Safety Program
- DOE Used Fuel Disposition (UFD) R&D Program
- High performance computing:
  - DOE-NE Consortium for the Advanced Simulation of LWRs (CASL)
  - Exascale Computing Project

UNF-ST&DARDS integrates data with analysis capabilities to simplify UNF characterization process

Discharge data

- Assembly ID
- Assembly type
- Initial enrichment
- Discharge burnup
- Cycle start and end dates



Assembly data

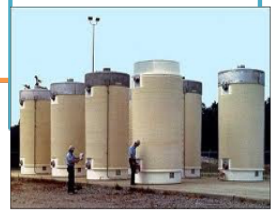
- Geometric configuration
- Materials of construction
- Design dimensions
- Control components

Reactor data

- Cycle specific burnup
- Soluble boron
- Rod insertion history
- Batch loadings
- Axial burnup profiles
- Moderator temperature

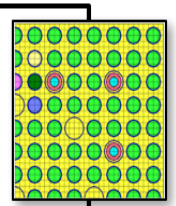
Cask data

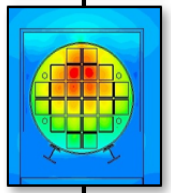
- Geometric configuration
- Materials of construction
- Design dimensions
- Cask loading patterns
- Component loading



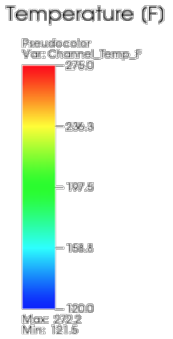
Models

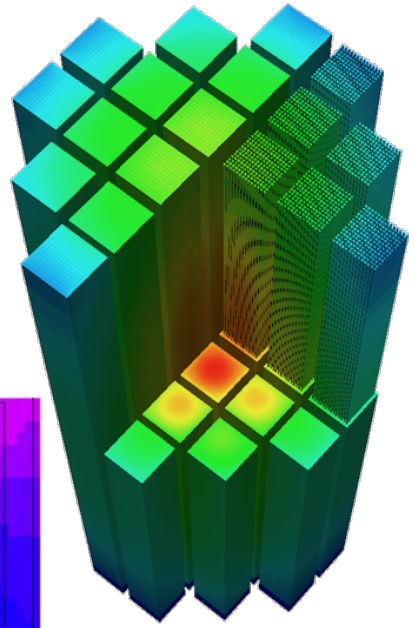
- Depletion: Triton, ORIGEN
- Thermal: COBRA-SFS
- Criticality: KENO-VI
- Dose
- Containment
- Fuel performance

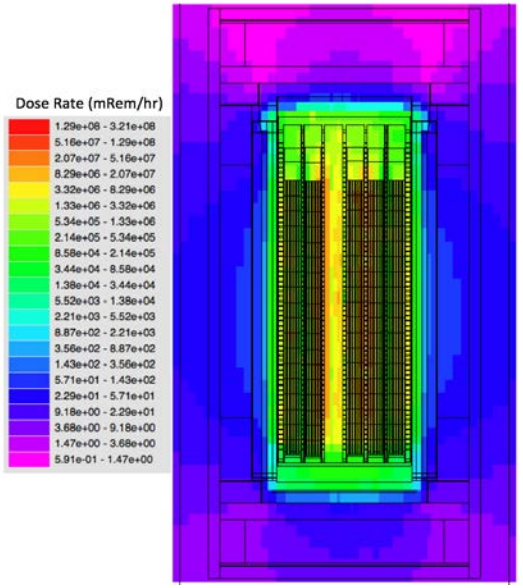




scale







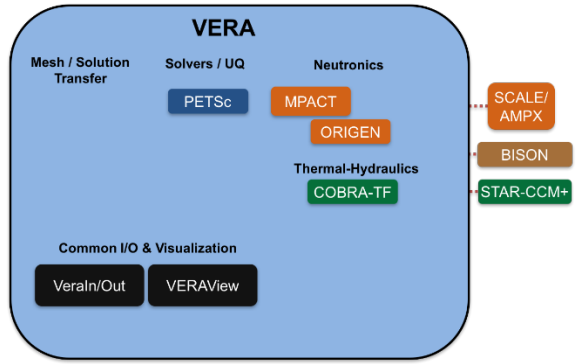
OAK RIDGE National Laboratory

Collaboration with other projects:

- DOE Nuclear Data and Benchmarking (ND/B) Program
- NNSA Nuclear Criticality Safety Program
- DOE Used Fuel Disposition (UFD) R&D Program
- High performance computing:
  - DOE-NE Consortium for the Advanced Simulation of LWRs (CASL)
  - Exascale Computing Project

VERA Core Simulator

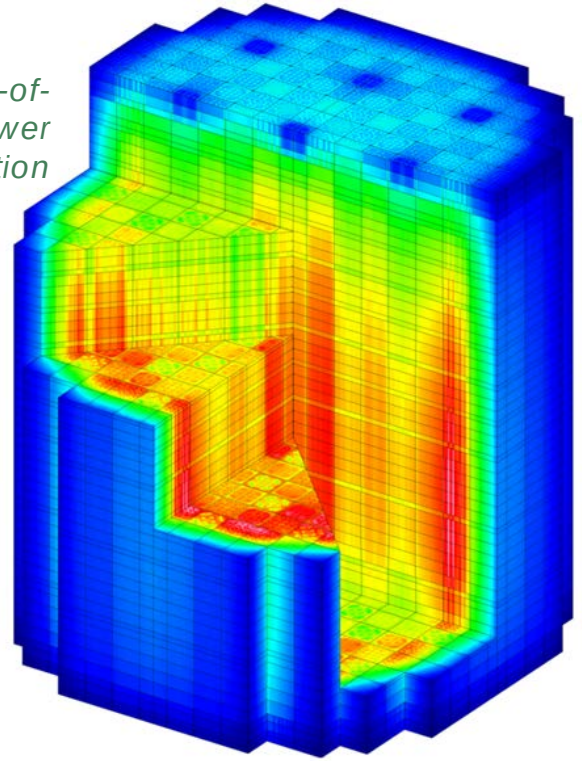
Virtual Environment for Reactor Applications
Flexible multiphysics framework



MPACT or Shift

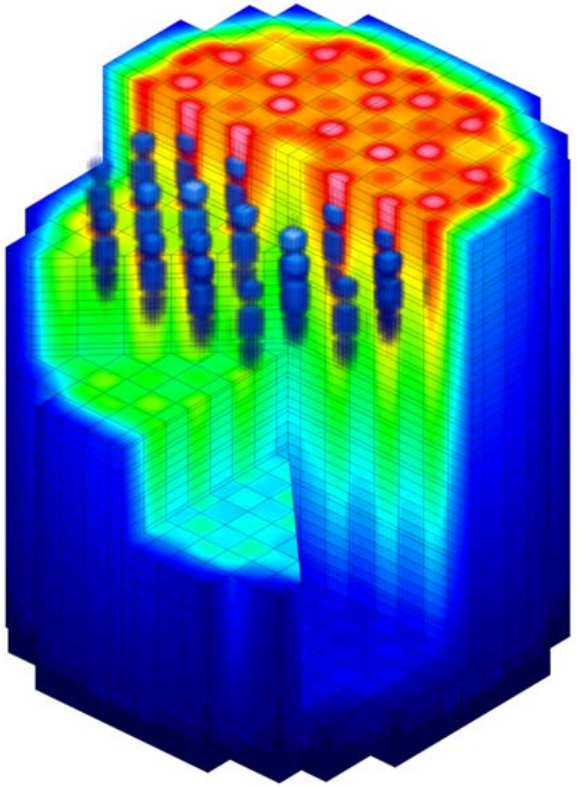
Advanced pin-resolved 3-D whole-core deterministic neutron transport in 51 energy group or continuous energy SCALE/AMPX nuclear data library

WB1C11 Beginning-of-Cycle Pin Power Distribution



CTF

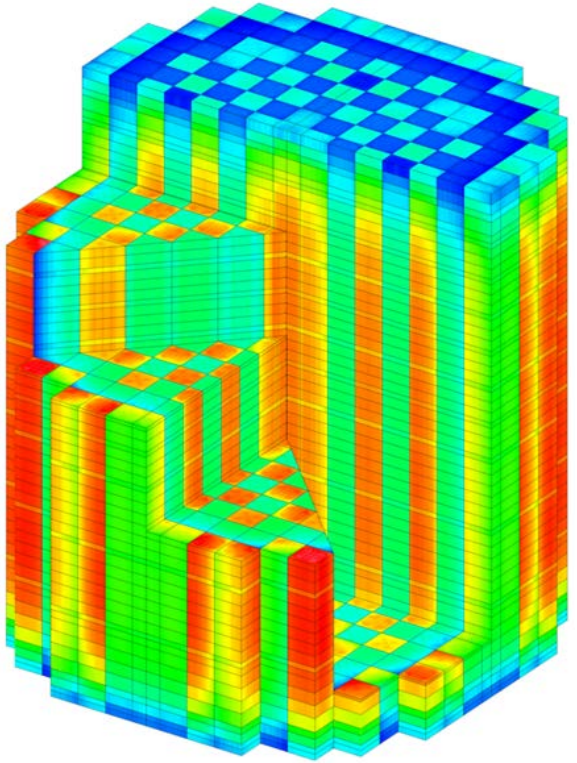
Subchannel thermal-hydraulics with transient two-fluid, three-field solutions in 14,000 coolant channels with crossflow



WB1C11 Middle-of-Cycle Coolant Density Distribution

SCALE/ORIGEN

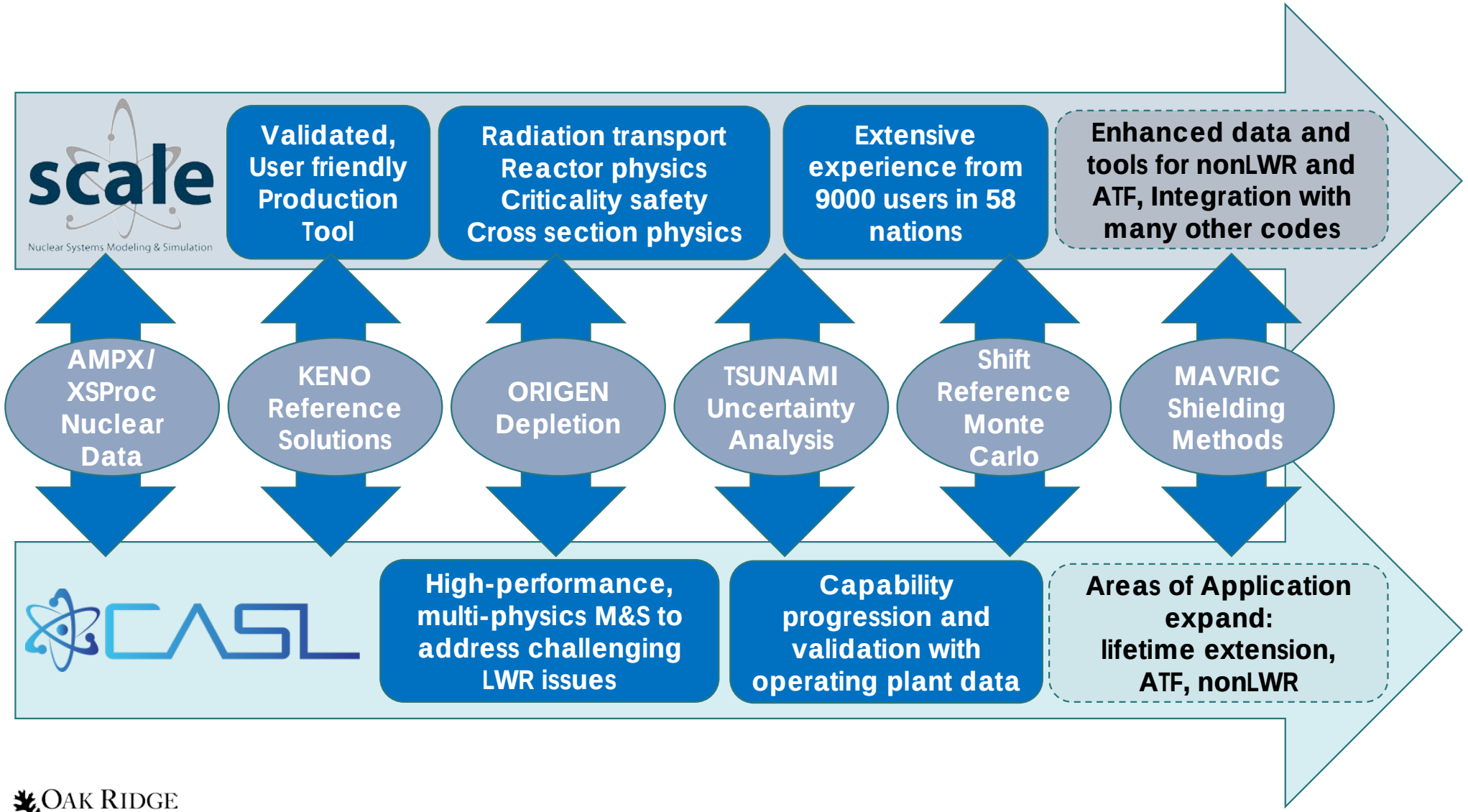
Isotopic depletion and decay in >2M regions tracking 263 isotopes in 2.5 million depletion regions



WB1C11 End-of-Cycle Pin Exposure Distribution

R&D 100

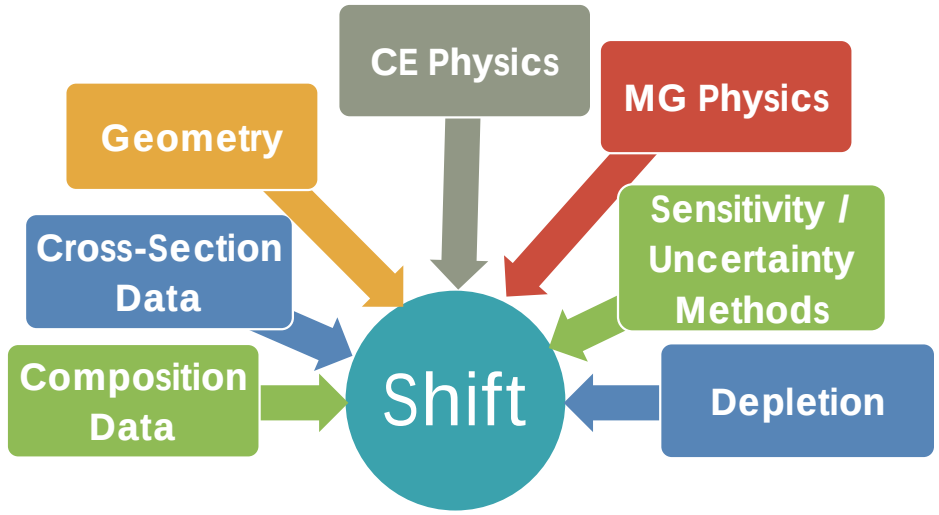
SCALE and CASL:
Meeting user needs while transforming the state-of-the-art



- Wide range of integrated tools with strong validation basis
- Versioned releases through RSICC
- Attractive for capacity computing
- Scalable from design scenarios to challenge problems
- Flexible multi-physics framework for expansion to other nuclear applications

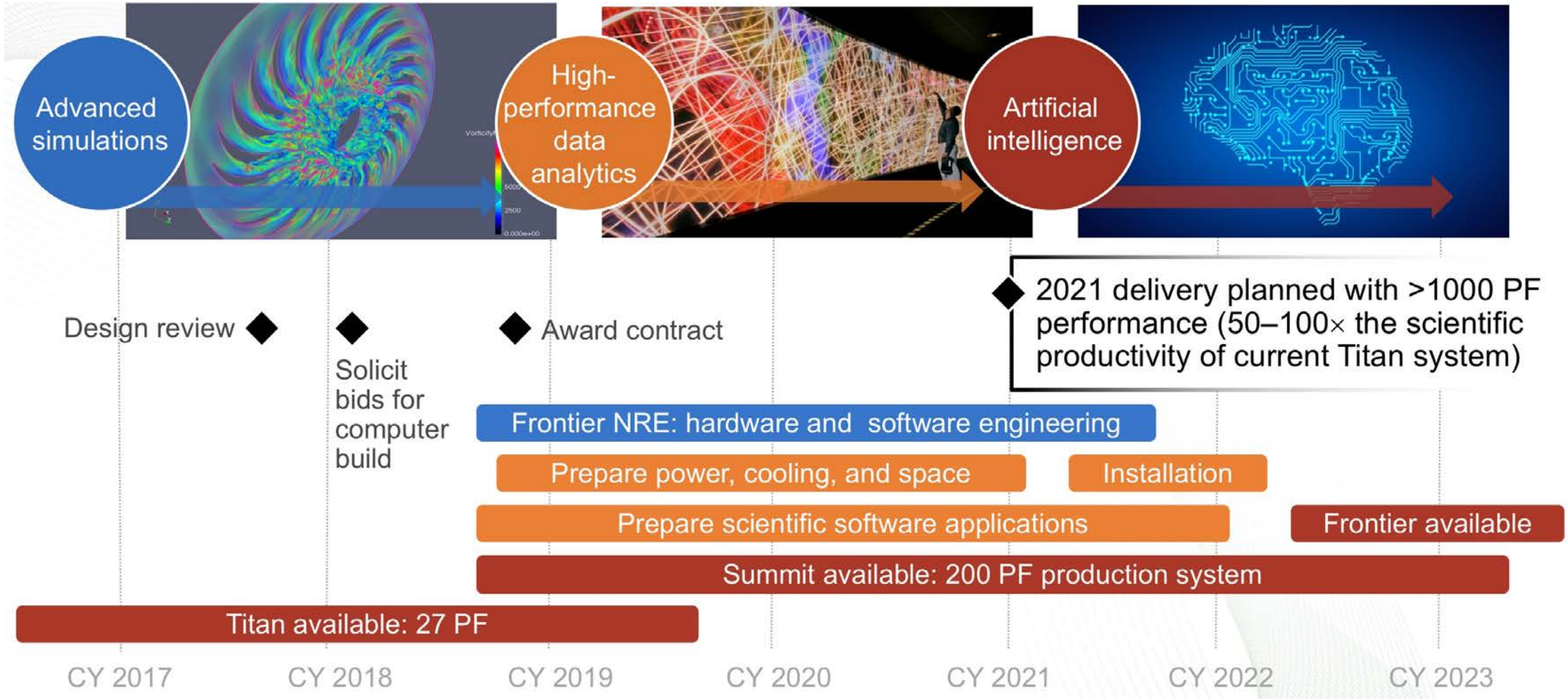
Shift Monte Carlo code system

- Flexible, high-performance Monte Carlo radiation transport *framework*
- Shift is physics agnostic
  - SCALE CE physics
  - SCALE MG physics
- Shift is geometry agnostic
  - SCALE geometry
  - Exnihilo RTK geometry
  - MCNP geometry
  - DagMC-CUBIT CAD geometry

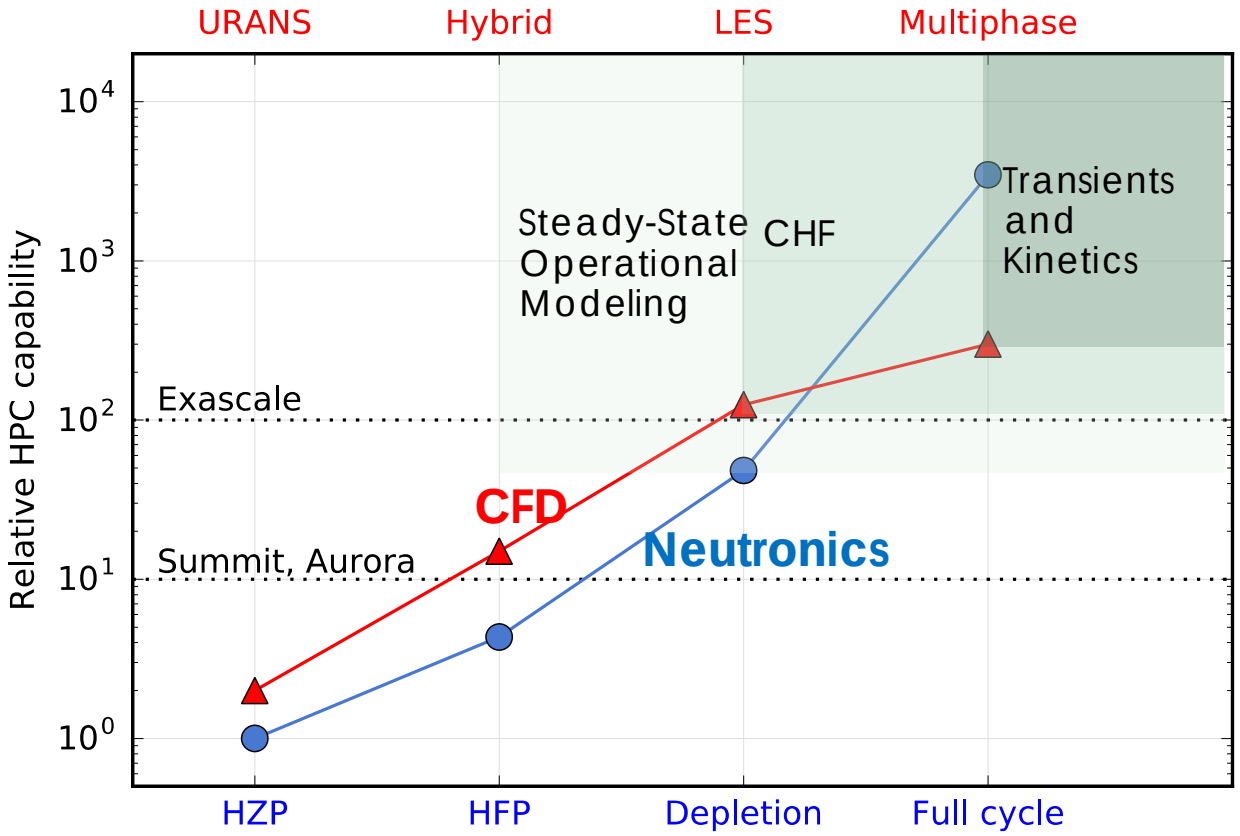


- Fixed-source and eigenvalue solvers
- Integrated with Denovo for hybrid methods
- Multiple parallel decompositions and concurrency models
- Shift is designed to scale from supercomputers to laptops

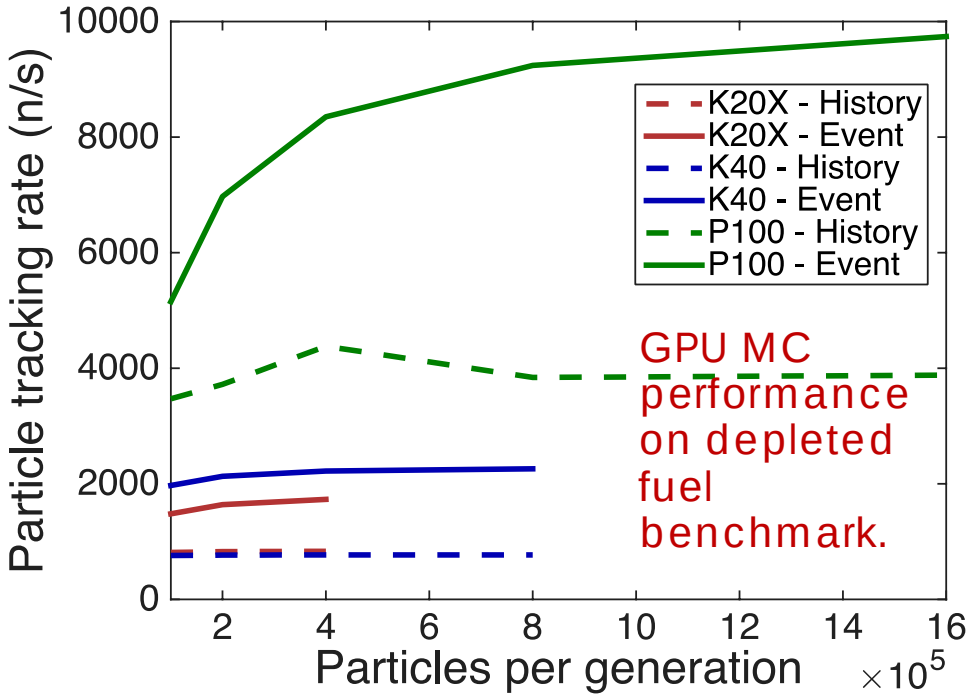
Shift is being extended for operation on GPUs as part of the $2B Exascale Computing Project



Application project: ExaSMR



- Improved Monte Carlo particle tracking rate allows reduction in statistical errors
- Cost of tallies and data access is implicit in this measure
- Improved device performance yields better results – Algorithms are tracking hardware improvements



OAK RIDGE National Laboratory

SCALE 6.3

- Motivation – Advanced Systems
- Nuclear data libraries
- Shift Monte Carlo Code
- Beta release

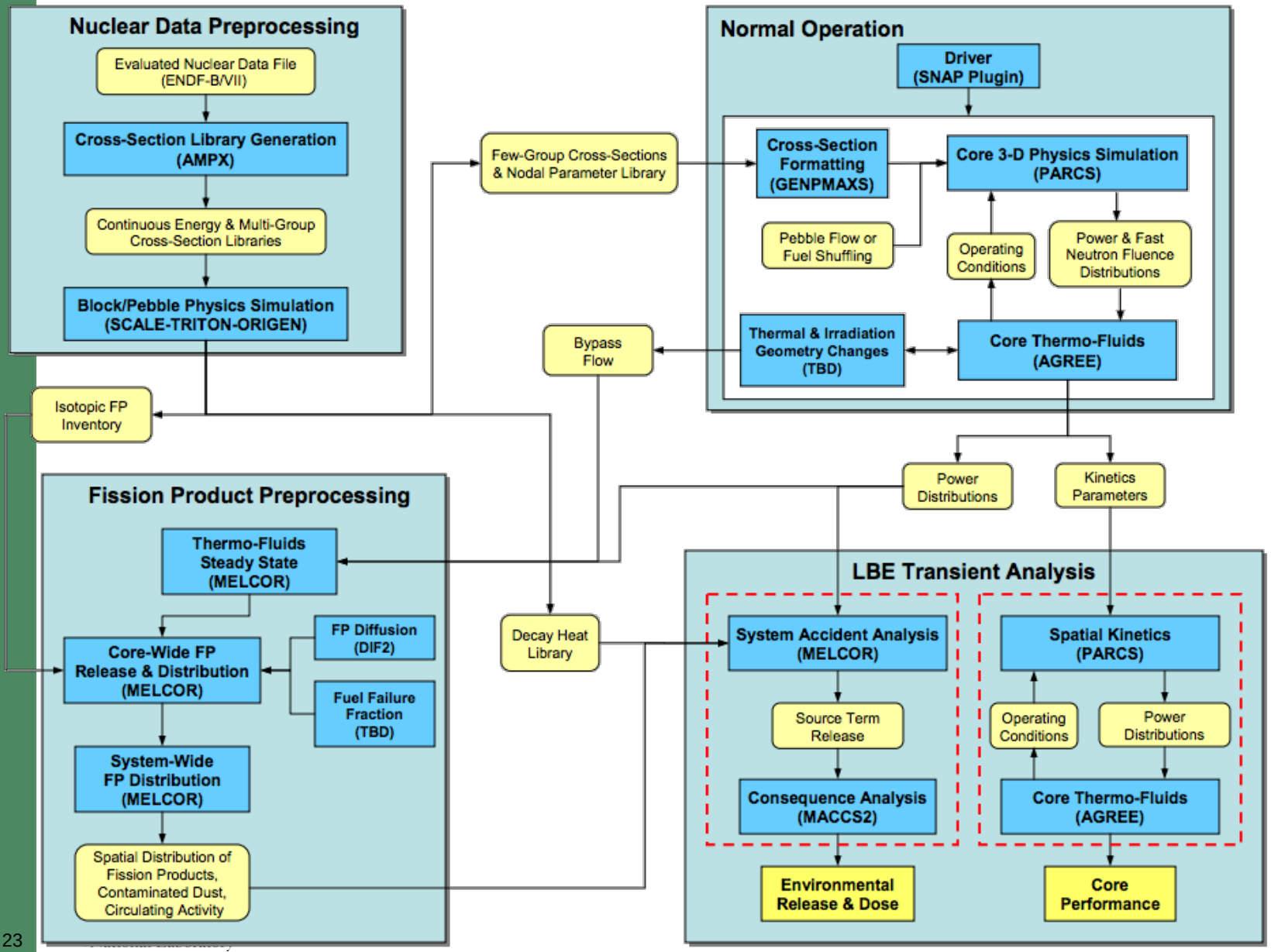
Abbreviated advanced reactor technology matrix (1/2)

Reactor Type	Companies	Licensing action expected	Fuel / Enrichment	Thermal spectrum	Fast Spectrum	Coolant	Radial core expansion	Flowing Fuel	Fuel Form	Control elements
HPR	Oklo	2019	~20%		✓	Sodium heat pipes	✓		Metallic Castings	External drums
	Westinghouse (eVinci)	2019	19.75%	Thermal/ Epithermal		Sodium heat pipes (dual condenser)			Oxide	External drums
SFR	TerraPower (TWR)		~20%		✓	Sodium	✓		Metallic Rods	Internal rods
	GE PRISM		~20%		✓	Sodium	✓		Metallic Rods	Internal rods
LFR	Westinghouse		15-20%		✓	Lead	✓		Oxide/ Nitride	Internal rods
HTGR	X-energy (Xe-100)	2020s	15.5%	✓		Helium		Pebbles	TRISO	External rods
	Areva (SC-HTGR)		~20%	✓		Helium			TRISO	Internal rods
FHR	Kairos	2020s	~17%	✓		FLiBe		Pebbles	TRISO	External rods

Abbreviated advanced reactor technology matrix (2/2)

Reactor Type	Companies	Licensing action expected	Fuel / Enrichment	Thermal spectrum	Fast Spectrum	Coolant	Radial core expansion	Flowing Fuel	Fuel Form	Control elements
MSR	Terrestrial Energy (IMSR)	2019	~5%	✓		Proprietary		Salt	Molten Salt	Internal rod
	Transatomic	2020s	~5%	Thermal/ Epithermal		FLiBe		Salt	Molten Salt	Internal ZrH moderating rods
	TerraPower (MCFR)	2020s	~20%		✓	Chloride salt		Salt	Molten Salt	External rods?
	Elysium		~20%		✓	Chloride salt		Salt	Molten Salt	
	FLiBe Energy		Thorium	✓		FLiBe		Salt	Molten Salt	Internal rods

NRC NGNP Evaluation Model (2008)



U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

NRC Evaluation Model Development

RIC 2010
Next Generation Nuclear Plant (NGNP) Research

J.M. Kelly
USNRC Research
March 11, 2010

Department of Energy

DOE, NRC Issue Licensing Roadmap For Next-Generation Nuclear Plant

AUGUST 15, 2008

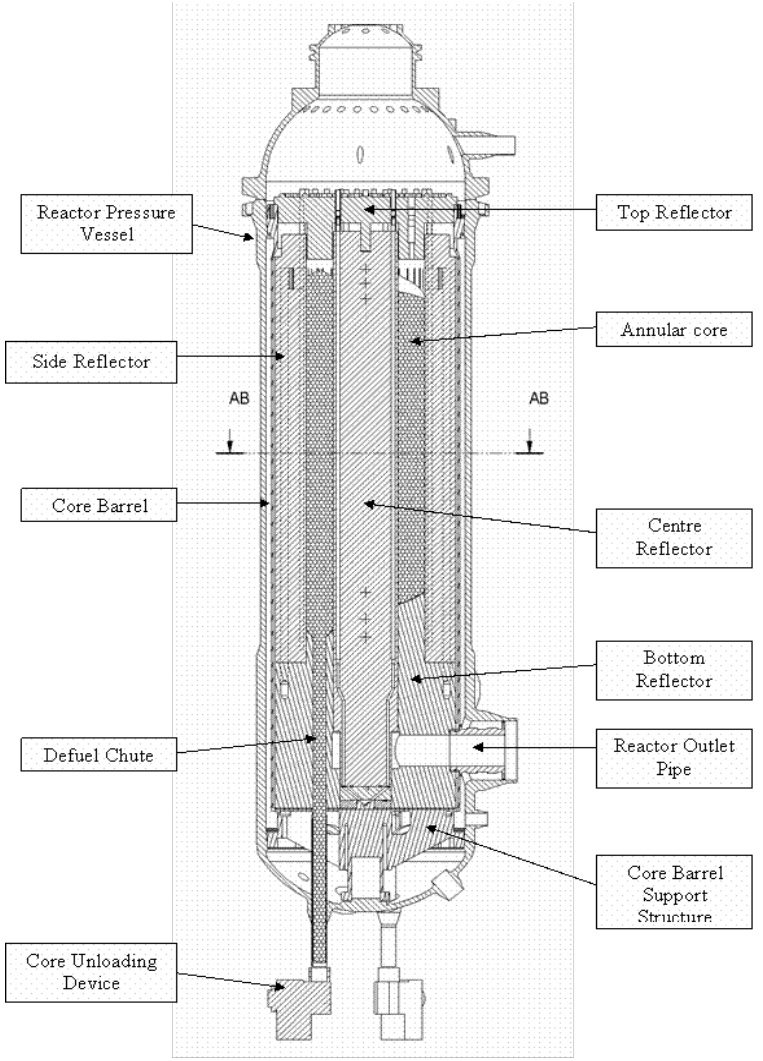
Home » DOE, NRC Issue Licensing Roadmap For Next-Generation Nuclear Plant

WASHINGTON, DC -The U.S. Department of Energy (DOE) and the U.S. Nuclear Regulatory

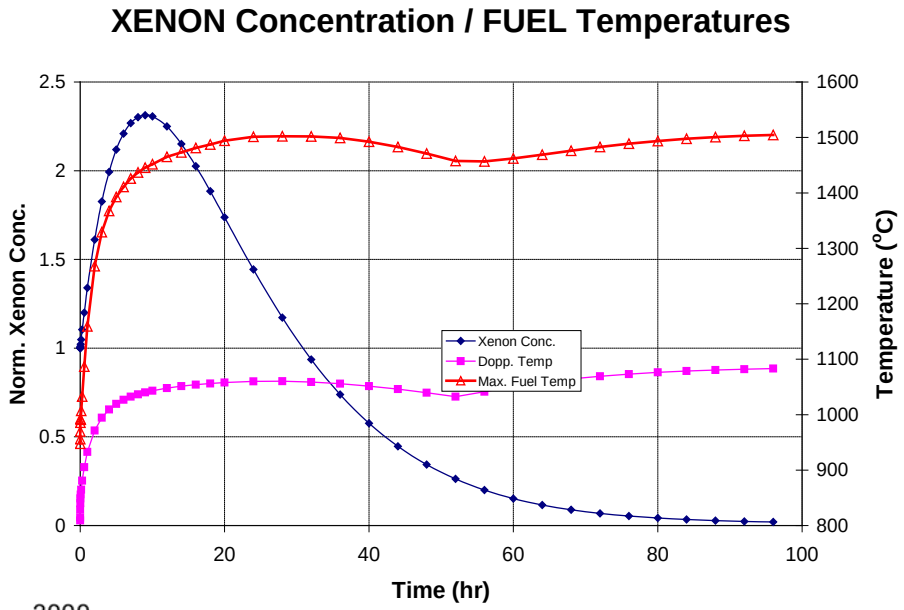
"The NRC's new reactor licensing process is currently focused on light-water reactors, and the staff is confident this basic framework can also support an NGNP review," said NRC Chairman Dale Klein. "We will work with DOE to supplement that framework with NGNP-specific items."

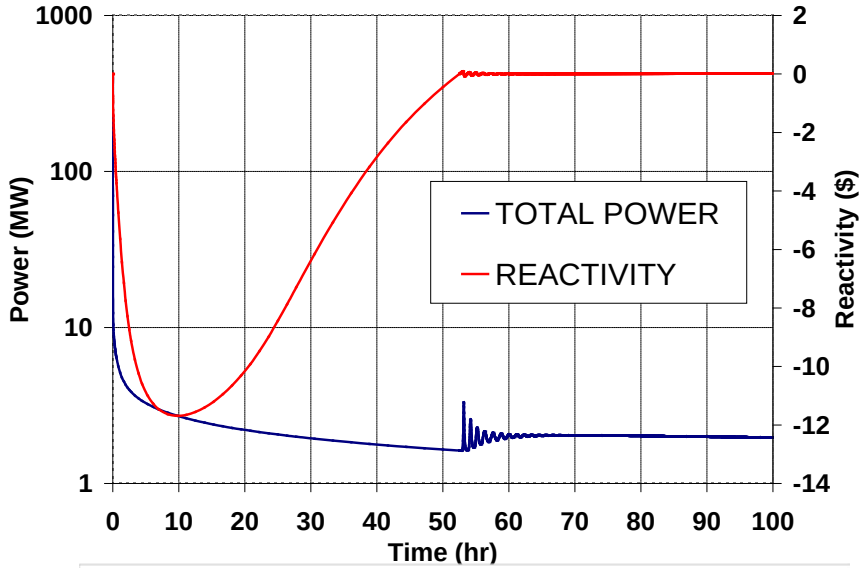
OECD/NEA PBMR-400 Benchmark

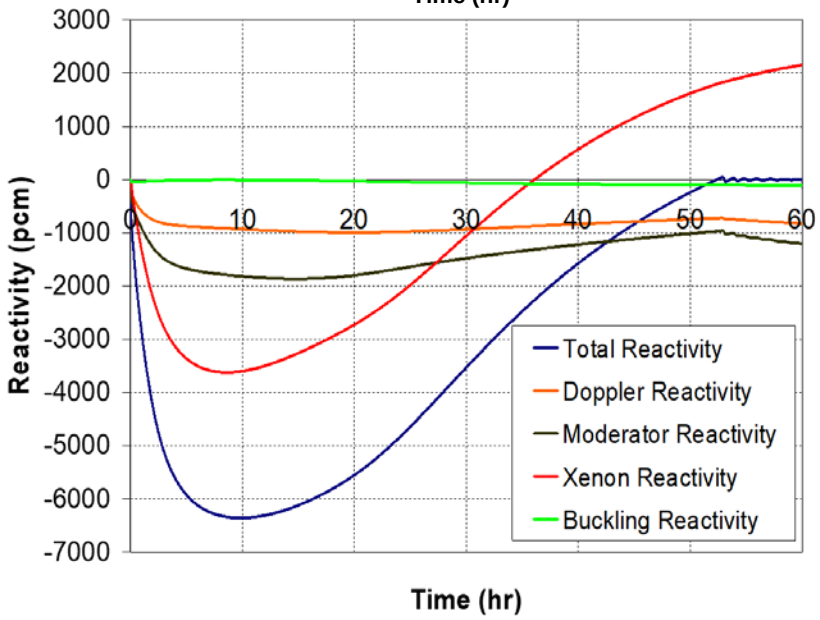
PBMR Characteristic	Value
Thermal Power	400 MW
Core configuration	Vertical with fixed centre graphite reflector
Outer diameter	3.7 m
Core Height	11 m
Reactor pressure	9MPa
Mass flow rate	192.5 kg/s
Core inlet temperature	500°C.

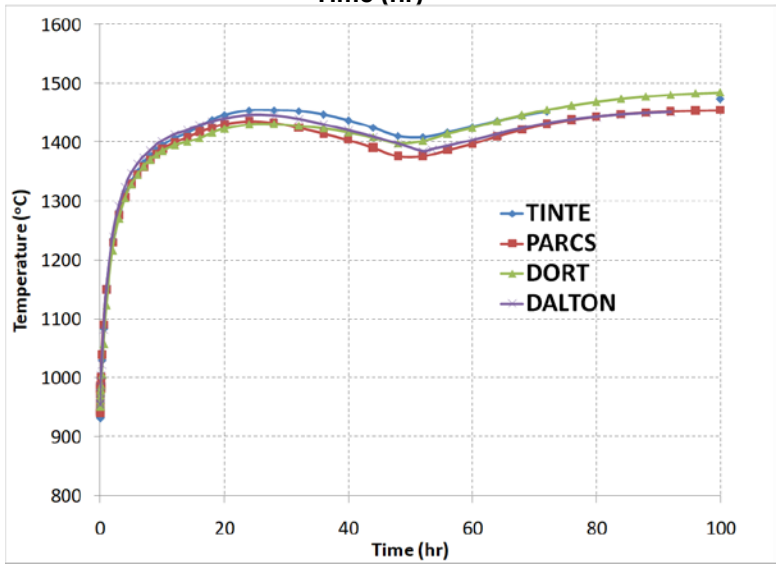


SCALE/PARCS/AGREE CASE T-1: Depressurised Loss of Forced Cooling (DLOFC) without SCRAM





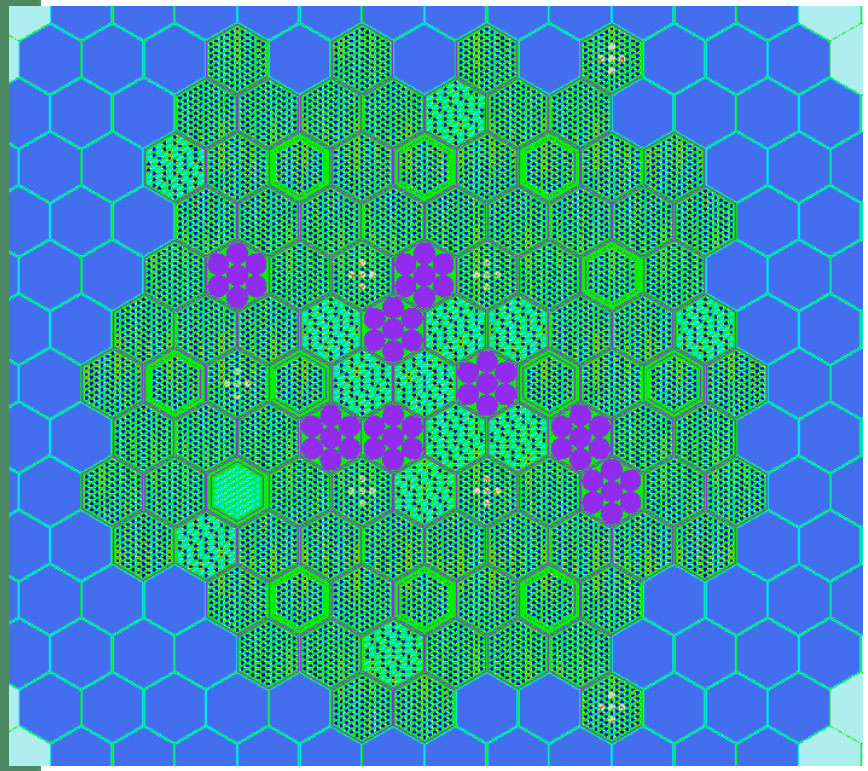


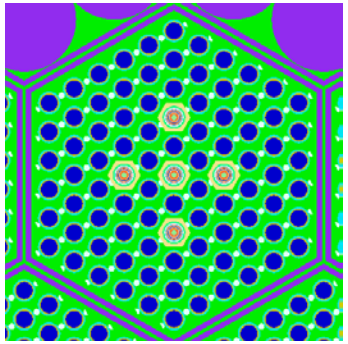


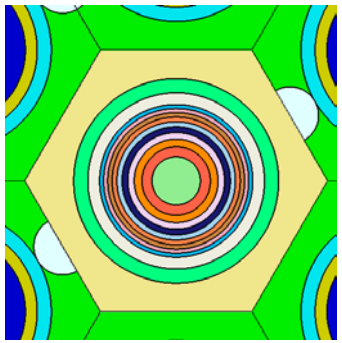
OAK RIDGE National Laboratory

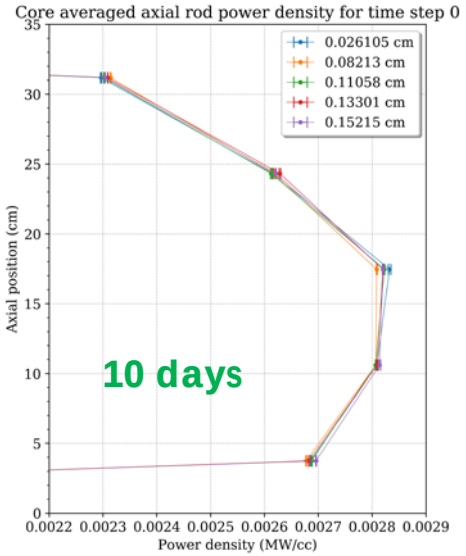
Sodium fast reactors: EBR-II Model with TRITON / Shift

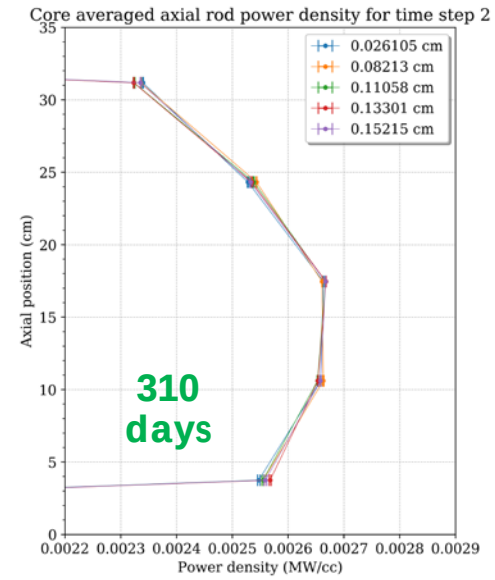
- Hi fidelity Monte Carlo neutronics with depletion for with coupling to NRC's FAST fuel performance code









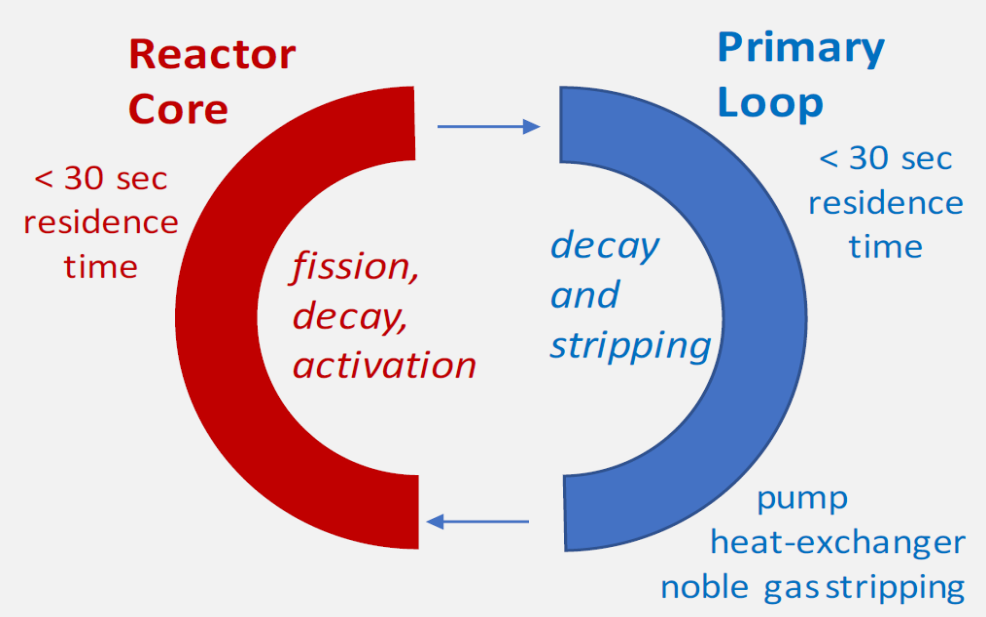


TRITON for MSR neutronics (a.k.a. ChemTRITON)

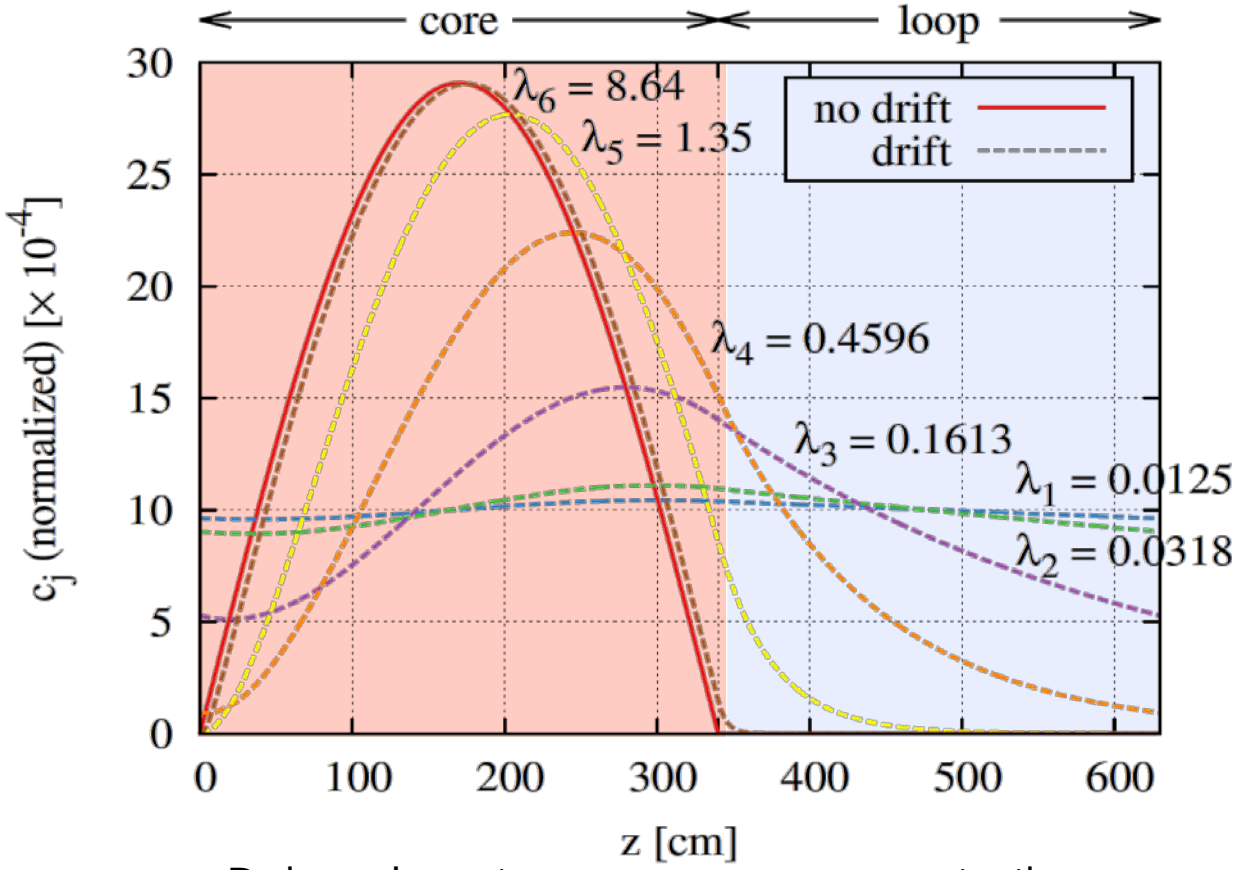
$^{131,132}Cd \rightarrow ^{131}In \rightarrow ^{131}Sn \rightarrow ^{131}Sb \rightarrow ^{131}Te \rightarrow ^{131}I \rightarrow ^{131}Xe$

<1 sec <1 sec 1 min. 23 min. 25 min. 8 days

soluble
sometimes soluble
insoluble
gaseous



- Delayed neutron precursor drift
- Material removal and feed

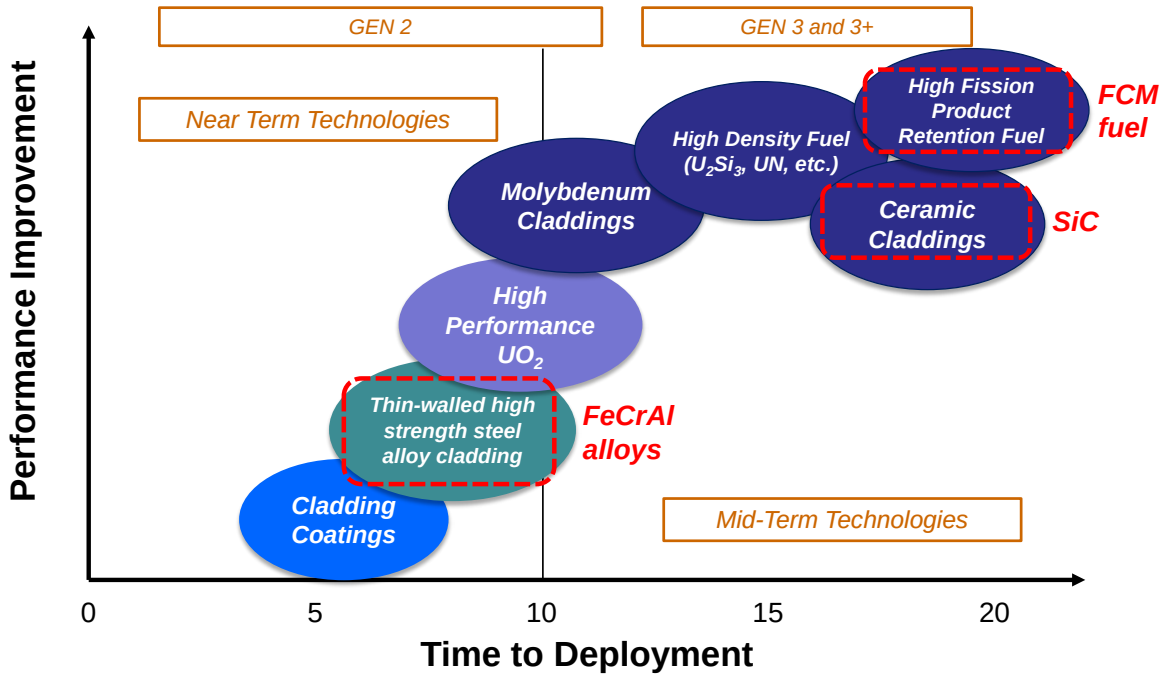


Delayed neutron precursor concentrations in the primary loop of a liquid-fueled MSR.

Demonstration of VERA-MSR for integrated multiphysics analysis of Molten Salt Reactor Experiment (MSRE) Transient.

SCALE is being extended for advanced fuel concepts

- ATF concepts must meet existing needs for plants and improve performance during accident scenarios
- High-burnup fuel will require additional validation and performance assessments
- Goals:
  - Extend tools for normal operation (NO), anticipated operational occurrences (AOOs), design basis accidents (DBAs)
  - Maintain compatibility with existing infrastructure
- Polaris has been benchmarked for AFT concepts



Westinghouse HITACHI Exelon framatome

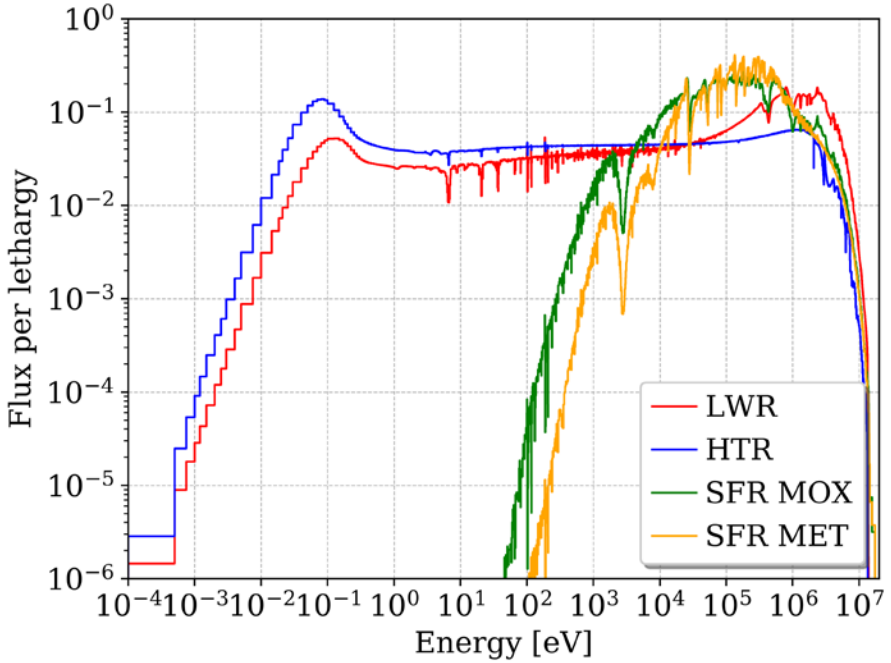
OAK RIDGE National Laboratory

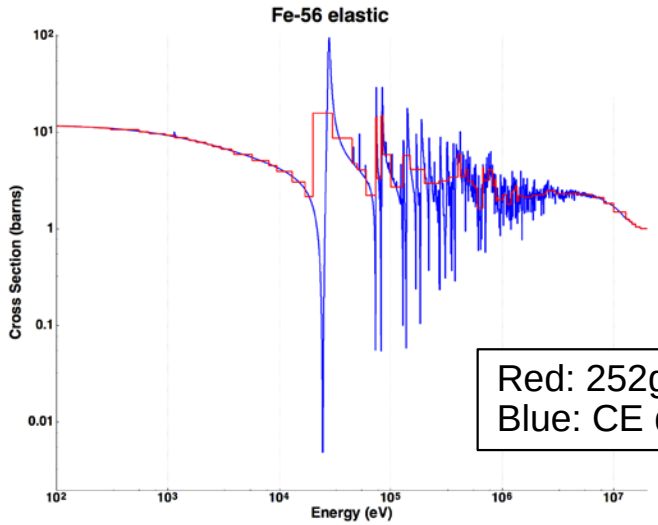
SCALE 6.3

- Motivation – Advanced Systems
- Nuclear data libraries
- Shift Monte Carlo Code
- Beta release

Updated nuclear data libraries for advanced systems

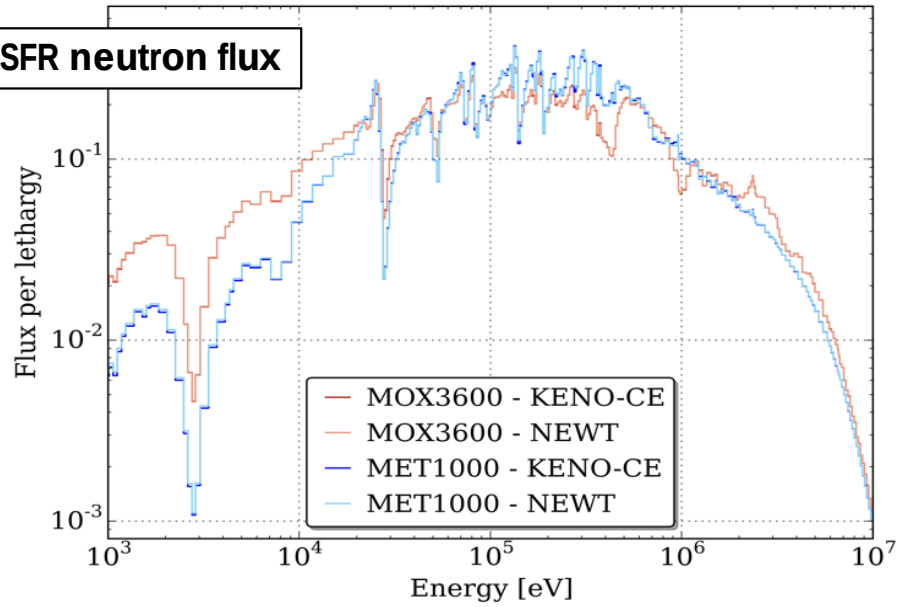
- With SCALE 6.2 MG libraries optimized for thermal systems are available
- Group structures and weighting spectrum are being optimized for advanced systems





Red: 252g structure
Blue: CE data

302g SFR neutron flux



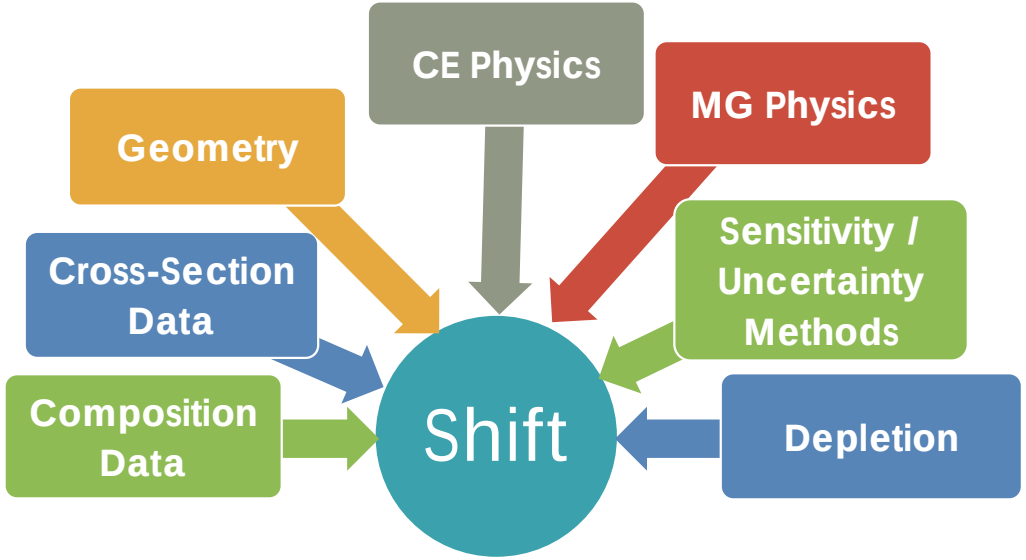
OAK RIDGE National Laboratory

SCALE 6.3

- Motivation – Advanced Systems
- Nuclear data libraries
- Shift Monte Carlo Code
- Beta release

Shift/SCALE integration

- **Integrated in CSAS criticality sequence**
  - KENO V.a and KENO-VI geometry
  - SCALE physics, material, and control specifications
  - Validated with over 600 benchmark experiments
- **Integration in TRITON depletion sequence**
  - ORIGEN depletion
  - Multigroup cross section generation for nodal codes
  - Randomized geometry for TRISO and pebble bed
  - Validated with SFCOMPO data and full core code assessments
- **Integration in TSUNAMI sensitivity/uncertainty sequences**
  - Eigenvalue and generalized perturbation theory sensitivity coefficients with CE physics
- **Integration in MAVRIC shielding sequence**
  - Fixed-source shielding problems using hybrid methods, especially for large facility and site modeling



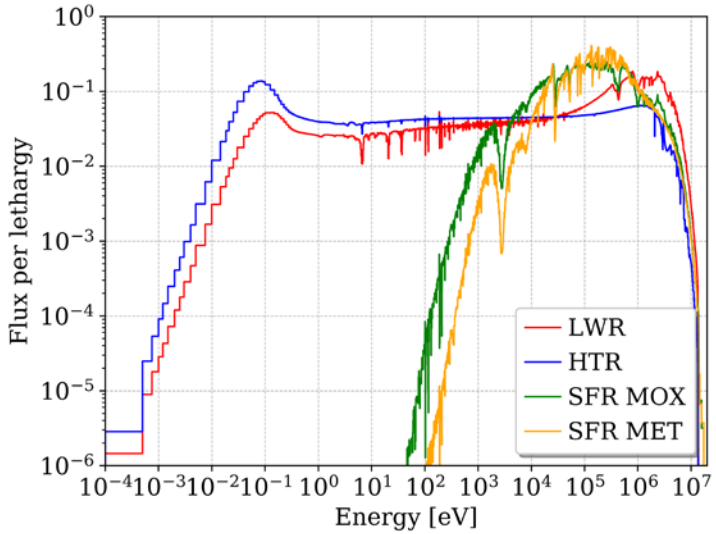
OAK RIDGE National Laboratory

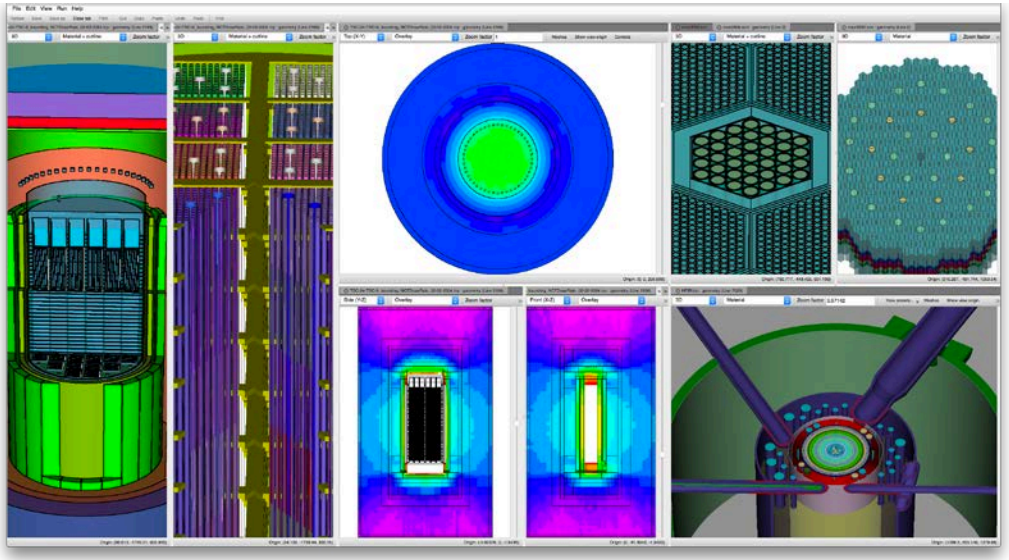
SCALE 6.3

- Motivation – Advanced Systems
- Nuclear data libraries
- Shift Monte Carlo Code
- Beta release

SCALE 6.3 Beta1 (fall 2018)

- ENDF/B-VIII.0 nuclear data libraries
  - Continuous-energy
  - LWR and nonLWR
- Shift Monte Carlo Code integration and feature extension
- Polaris enhancements for ATF and nonLWR
- TRITON MSR capability
- Fulcrum user interface enhancements, including 3D visualization
- Enhanced interoperability with MELCOR and FAST for LWR, ATF and nonLWR





OAK RIDGE National Laboratory

Your SCALE Team

SCALE 6.2 Team Photo – May 2016

Left to right: Ahmed Ibrahim, Germina Ilas, Brandon Langley, Andrew Holcomb, Shane Hart, Cihangir Celik, Seth Johnson, Matt Jessee, Kevin Clarno, Adam Thompson, Bob Grove, Rob Lefebvre, Greg Davidson, Charles Daily, Alan Icenhour, Barbara Snow, Brian Ade, Brad Rearden, Ben Betzler, B. J. Marshall, Kursat Bekar, Will Wieselquist, Mark Baird, Mark Williams, Georgeta Radulescu, Ron Ellis, Thomas Miller, Dan Ilas, Elizabeth Jones, Cecil Parks, Sheila Walker, Teresa Moore, Marsha Henley, Sandra Poarch, Lester Petrie

SCALE Leadership Team

Brad Rearden
Manager, SCALE Code System
Will Wieselquist
Deputy Manager, SCALE Code System
Doug Bowen
Group Leader, Nuclear Data and Criticality Safety
Kevin Clarno
Group Leader, Reactor Physics
Bob Grove
Group Leader, Radiation Transport
Rob Lefebvre
Software Development Coordinator
Matt Jessee
Senior R&D Staff

Strategic Vision
Quality Assurance Plan
Budgets and Staffing
Change Control Board

Radiation Safety Information Computational Center (RSICC)

Tim Valentine

Versioned Releases
User Licensing

Infrastructure and Support

Tony Walsh
Seth Johnson
Brandon Langley
Jordan Lefebvre
Rob Lefebvre
Paul Miller

Quality Assurance System
Build and Test Framework
Deployment

Monte Carlo Development

Brad Rearden
Brian Ade
Kaushik Banerjee
Kursat Bekar
Cihangir Celik
Greg Davidson
Tom Evans
Shane Hart
Seth Johnson
Tara Pandya
Doro Wiarda

KENO/CSAS
MAVRIC/Monaco
Shift
Sourcerer

Decay, Depletion, and Activation Methods

Will Wieselquist
Ian Gauld
Shane Hart
Germina Ilas
Thomas Miller
Steve Skutnik (UT)
Doro Wiarda

ORIGEN
ORIGAMI
Depletion, Decay, and Activation Data

Reactor Physics Methods

Matt Jessee
Brian Ade
Kursat Bekar
Ben Betzler
Greg Davidson
Tom Evans
Cole Gentry
Steven Hamilton
Rob Lefebvre
Ugur Mertyurek
Doro Wiarda
Will Wieselquist

TRITON
Polaris
Advanced Reactor R&D

Nuclear Data and Methods

Cihangir Celik
Rike Bostelmann
Charles Daily
Andrew Holcomb
Matt Jessee
Seth Johnson
Kang Seog Kim
Rob Lefebvre
B.J. Marshall
Marco Pigni
Doro Wiarda

XSProc
Neutron and Gamma Cross Section Data (MG&CE)
Covariance Data

User Interfaces

Rob Lefebvre
Matt Jessee
Brandon Langley
BJ Marshall
Josh Peterson
Will Wieselquist

Fulcrum
Geometry and Data Visualization

Sensitivity and Uncertainty Analysis

Vladimir Sobes
Goran Arbanas
Keith Bledsoe
Rike Bostelmann
Matt Jessee
Rob Lefebvre
B.J. Marshall
Ugur Mertyurek
Will Wieselquist

TSUNAMI
TSURFER
SAMPLER
Optimization and Inverse Analysis

User Interaction and Training

Germina Ilas
Brian Ade
Ben Betzler
Cihangir Celik
Justin Clarity
Ian Gauld
Shane Hart
Marsha Henley
Matt Jessee
B.J. Marshall
Thomas Miller
Douglas Peplow
Will Wieselquist

Courses at ORNL, NEA Data Bank, NRC, and User Facilities
Conference Workshops
Helpline, User Groups
Documentation

Reactor and Nuclear Systems Division

Kenneth Tobin, Director

Sandra Poarch, Division Secretary

July 1, 2018

Consortium for Advanced Simulation of Light Water Reactors

Kevin Clarno[1], Interim Director

Support

Finance Officer, Diane Sams

Human Resources Manager, Emily Patterson

Operations Management Support, Angel Kennedy

Recruiter, Bre Sweet-Kerschbaum

Technical Editor, Rose Raney

Fuel Cycle Technology Integration

Andy Worrall

Modeling and Simulation Integration

Brad Rearden

Will Wieselquist[1], Deputy Manager for SCALE

Marsha Henley[1]

Reactor Technology Integration

Lou Qualls

NRC Projects Office

Bruce Bevard[1]

Lindsey Aloisi

Radiation Safety Information Computational Center

Tim Valentine

Angie Alford[1], Hannah Campbell, Teresa Moore, Barbara Snow, Sheila Walker[6]

Advanced Reactor Engineering

David Pointer

Anita Benn

Syd Ball[5]
Elvis Dominguez-Ontiveros
David Holcomb
Jordan Massengale
Jeff Powers
Kevin Robb
Michael Smith[5]

Data Analytics, Instrumentation and Control Team

Sacit Cetiner, Lead
Scott Greenwood
Mike Muhlheim
Jordan Rader

Reactor Safety and Licensing Team

T. Jay Harrison, Lead
Randy Belles
George Flanagan
Richard Hale
Mike Poore, III
Askin Guler Yigitoglu

Thermal Hydraulics Team

Prashant Jain, Lead
Marc-Olivier Delchini
Emilian Popov
Bob Salko, Jr.
Aaron Wysocki

Nuclear Data and Criticality Safety

Doug Bowen

Marsha Henley[1]

Friederike Bostelmann[5]
Cihangir Celik
Justin Clarity
Shane Hart
B. J. Marshall
Thomas Miller
Ellen Saylor

Nuclear Data Team

Cathy Romano, Lead
Goran Arbanas
Chris Chapman[4]
Klaus Guber
Andrew Holcomb
Marco Pigni
Vladimir Sobes
Dorothea Wiarda

Nuclear Experiments and Irradiation Testing

Joel McDuffee

Andrea Beatty[1]

David Bryant
Nesrin Cetiner
Ryan Gallagher
Richard Howard
Padhraic Mulligan
Christian Petrie
Kurt Smith
Bob Sitterson[2]
Ken Thoms[2]

Radiation Transport

Bob Grove

Elaine Davis

Kursat Bekar
Charles Daily
Scott Mosher
Georgeta Radulescu
Joel Risner
Katherine Royston
Steve Wilson
Jinan Yang

HPC Methods and Applications Team

Tom Evans, Lead
Elliott Biondo[4]
Greg Davidson
Steven Hamilton
Seth Johnson
Tara Pandya

Reactor Physics

Kevin Clarno[1]

Angie Alford[1]

Computer Science Team

Rob Lefebvre, Lead
Mark Baird
Brandon Langley
Paul Miller
Adam Thompson
Tony Walsh

Neutronics Team

Germina Ilas, Lead
Brian Ade
Mehdi Asgari
Ben Betzler
Ron Ellis
Ian Gauld[6]
Andrew Godfrey
Jianwei Hu
Kang-Seog Kim
Travis Lange[4]
Ivan Maldonado[3]
Josh Peterson-Droogh

Reactor Multiphysics Team

Will Wieselquist[1], Lead
Ben Collins
Eva Davidson
Kevin Dugan[4]
Cole Gentry
Aaron Graham[4]
Shane Henderson[7]
Matt Jessee
Ugur Mertyurek
Shane Stimpson

Used Fuel Systems

John Scaglione

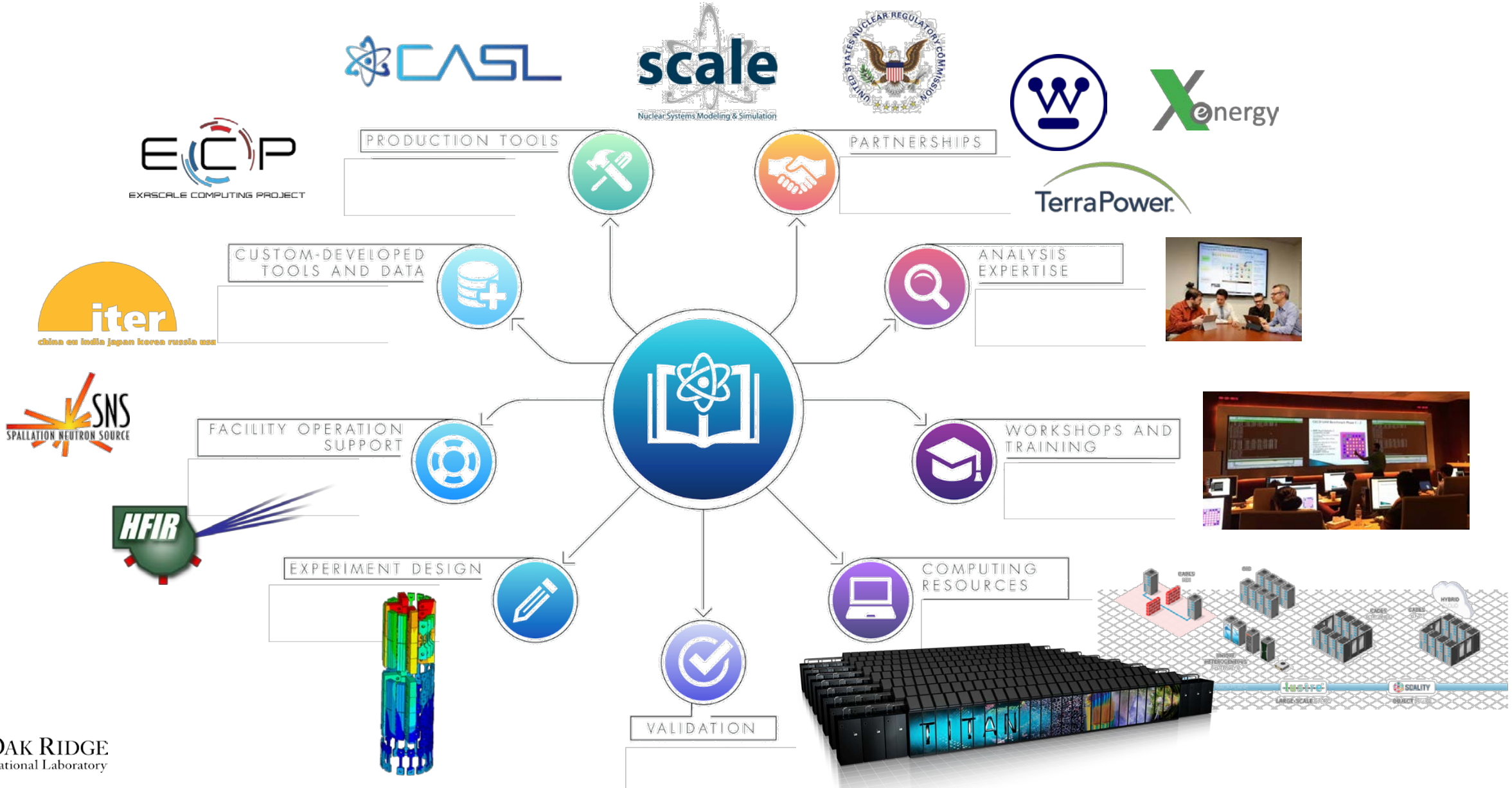
Andrea Beatty[1]

Abi Adeniyi[5]
Kaushik Banerjee
Bruce Bevard[1]
Stylianos Chatzidakis
Kevin Connolly
Riley Cumberland
Matt Feldman
Rob Howard
Robby Joseph, II
Oscar Martinez
Rose Montgomery
Bill Reich

[1] Dual Capacity
[2] Subcontractor
[3] Joint Faculty
[4] Postdoctoral
[5] ORISE Post Master's
[6] Part-time
[7] CASL ORISE Post BS

OAK RIDGE National Laboratory

ORNL Nuclear Modeling and Simulation Portfolio



OAK RIDGE National Laboratory

Updated SCALE Leadership

Will Wieselquist
Director, SCALE Code System
Doug Bowen
Group Leader, Nuclear Data and Criticality Safety
Kevin Clarno
Group Leader, Reactor Physics
Bob Grove
Group Leader, Radiation Transport
Rob Lefebvre
Software Development Coordinator
Matt Jessee
Senior R&D Staff

Brad Rearden (ex officio)
Leader, Modeling and Simulation Integration