

SCALE AM2 Accomplishments in FY21

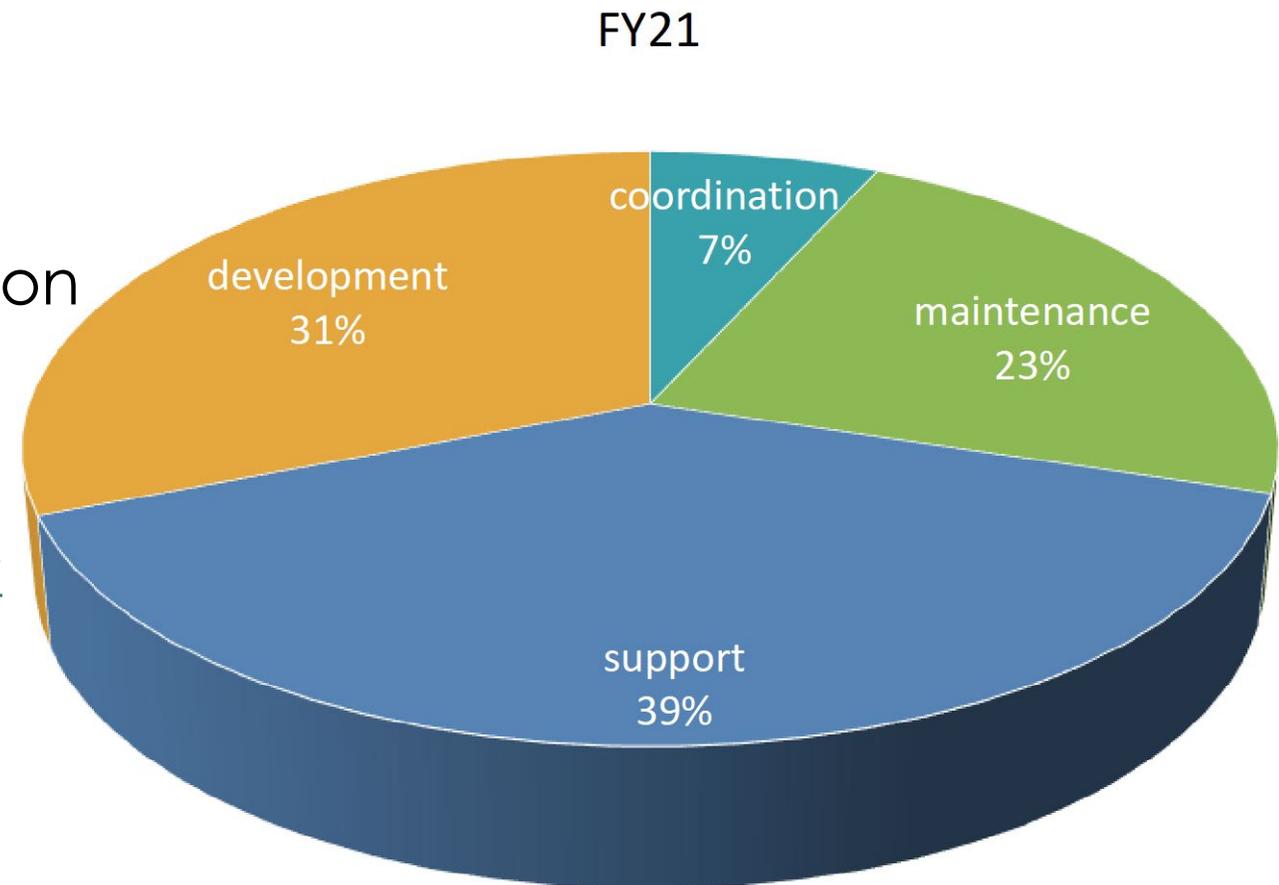
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Director, SCALE Code Suite

Nuclear Energy and Fuel Cycle Division
Oak Ridge National Laboratory

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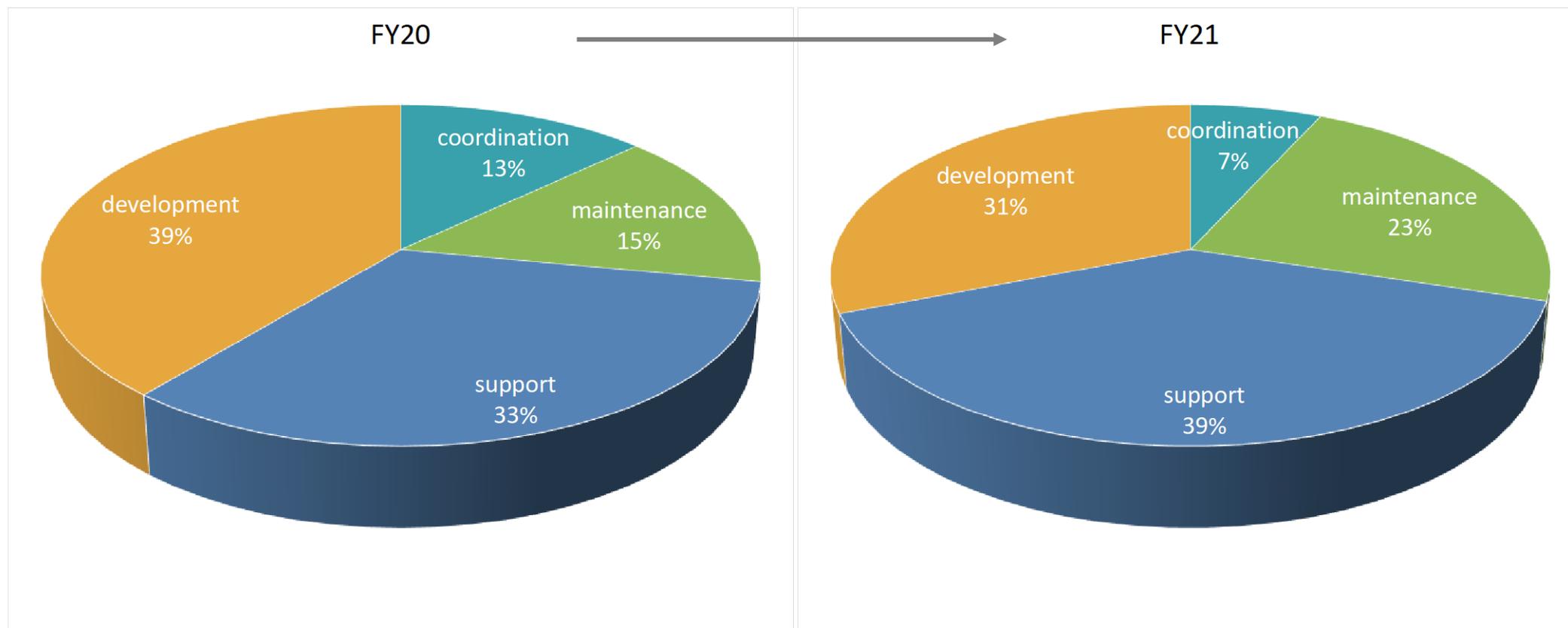
ORNL AM2 SCALE: Overview

- NCSP-facing codes
 - crit. safety (CSAS)
 - sens./unc. (TSUNAMI and **Sampler**)
 - bias analysis (**VADER**)
- Maintain current production version (v6.2 series)
 - coordination - management, SQA
 - support – interact with users, documentation, scalehelp@ornl.gov
 - development – make new things
 - maintenance - fix bugs
- Develop next version (v6.3 series)



FY21 Goals

- Development and maintenance focus for SCALE 6.3.0 release
- Support focused on SCALE 6.3.0 manual and validation expansion
- Infrastructure upgrades (maintenance: 15%→23%)



2022 SCALE Team

Director
Will Wieselquist

Leadership Team

Production Coordinator
Rob Lefebvre

User Support Coordinator
Germina Ilas

Sponsor Representatives
Seth Johnson, HPC
Ugur Mertuyrek, NRC
B.J. Marshall, NCSP

Advisors
Justin Clarity, UNF Standards Lead
Andrew Holcomb, AMPX Lead
Matt Jessee, NEAMS Reactor Physics Lead
Bob Grove, Section Head: Nuclear Software Development
Doug Bowen, Section Head: Radiation Shielding & Criticality

Project Management
Marsha Henley

Logistics
Sandra Poarch

Product Owners

AMPX	Andrew Holcomb
CSAS	Kursat Bekar
DATA	Andrew Holcomb*
FULCRUM	Rob Lefebvre
MAVRIC	Cihangir Celik
OMNIBUS	Seth Johnson
ORIGAMI	Steve Skutnik
ORIGEN	Will Wieselquist*
POLARIS	Matt Jessee
SAMPLER	Ugur Mertuyrek
STDCOMP	Rob Lefebvre*
TRITON	Rike Bostelmann
TSUNAMI	Jordan McDonnell
VADER	Justin Clarity Shane Hart
XSPROC	Kang Seog Kim

*Interim owner

Dev/Testing/Analysis

Brian Ade	Jianwei Hu
Arzu Alpan	Alex Lang
Goran Arbanas	Brandon Langley
Jin Whan Bae	Austin Lo
Mark Baird	Jordan McDonnell
Ben Betzler	Paul Miller
Elliot Biondo	Tara Pandya
Jesse Brown	Douglas Peplow
Joey Burns	Marco Pigni
Chris Chapman	Georgeta Radulescu
Riley Cumberland	Joel Risner
Gregory Davidson	Kat Royston
Mathieu Dupont	Jose Perez
Tom Evans	Ellen Saylor
Tarek Ghaddar	Alex Shaw
Travis Greene	Ryan Sweet
Steven Hamilton	Ben Taylor
Briana Hiscox	Erik Walker
Israel Huff	

Program Manager **NRC Projects Office**

Bruce Bevard

Business Ops Manager

Lindsey Aloisi

NCSP Execution Manager **NCSP Management**

Doug Bowen

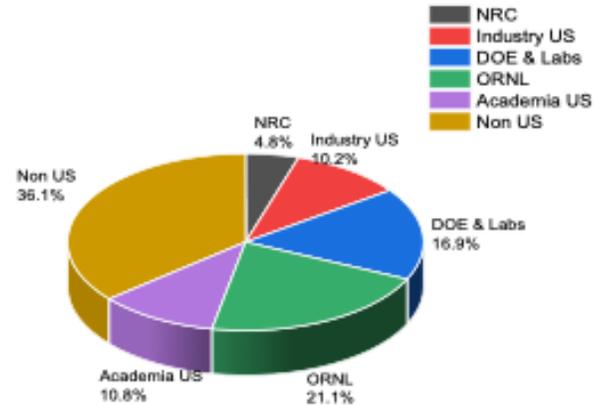
Business Systems

Marsha Henley

Support Highlights: 2021 Users' Group Workshop

- 173 participants

- 21% ORNL
- 11% Academia US
- 35% Non-US
- 5% NRC
- 10% Industry
- 17% DOE & Labs



- SCALE Analysis Input/Output landing page

<https://code.ornl.gov/scale/analysis>

- Archived Users' Group Material

<https://www.ornl.gov/content/2021-scale-users-group-workshop>

SCALE

2022

2022

Month	Project Name	Organization
January	Peter Wolniewicz Dose Rates Outside Shipping Casks	ORNL
February	Rika Bostelmann Molten Salt Reactor Experiment (MSRE)	ORNL
March	Mathieu Dupont Horizontal Split Table Conceptual Design for Advanced Reactor Validation	ORNL
April	Mathieu Dupont Design of a Subcritical Assembly at ORNL	ORNL
May	Matt Jessee PWR 2D Multi-Lattice Fuel Shuffle Model in Polaris	ORNL
June	Larry Wetzel University of New Mexico AGN-201	UNM

<https://www.ornl.gov/file/scale-2022-calendar/display>

Support Highlights: New SCALE NCS Course

- Developed a new SCALE criticality safety calculations course
 - No prior knowledge required
 - Designed for early career professionals entering NCS
- Debut in Fall 2021—max capacity class
- Second run: Feb. 28 – March 3 2022

SCALE Criticality Safety Calculations

This course provides instruction on the use of the KENO Monte Carlo codes for criticality safety calculations and is appropriate for beginning through advanced users. KENO V.a is a fast and easy-to-use code that allows users to build complex geometry models using basic geometrical bodies such as cuboids, spheres, cylinders, hemispheres, and hemicylinders. KENO-VI is a 3-D generalized geometry Monte Carlo code that allows for versatile modeling of complex geometries. Both versions of KENO provide convenient, efficient methods for modeling repeated and nested geometry configurations such as lattices. Both versions of KENO use ENDF/B-VII.0 or ENDF/B-VII.1 cross-section data distributed with SCALE to perform either continuous energy (CE) or multigroup (MG) calculations. KENO includes a 2D color plotting capability and produces easy-to-navigate HTML output. This class uses the Fulcrum user interface for interactive model setup, visualization, computation, and output review. The KENO3D tool is still used in SCALE 6.2 for 3-D visualization. Instruction is also provided on the SCALE material input and resonance self-shielding capabilities and Fulcrum capabilities for visualizing fluxes, reaction rates, and cross-section data.

No prior knowledge of SCALE is required.

<https://www.ornl.gov/scale/training>

SCALE 6.3.0

- Currently in export control review
- New features of interest to NCS
 - ENDF/B-VIII.0 data
 - VADER trending analysis code
 - New ORANGE geometry engine
 - Used by Shift-based sequences, e.g. CSAS-Shift
 - Used in 3D Visualization
 - Paves way for GPU-based tracking
 - Will publish with unrestricted access
 - Shift-based IFP method
 - Easy TRISO modeling
 - HDF5 format for sensitivity coefficients
- Online Manual

SCALE

Search docs

SCALE

1. Introduction
2. Criticality Safety
3. Reactor Physics
4. Radiation Shielding
5. Depletion, Activation, and Spent Fuel Source Terms
6. Sensitivity and Uncertainty Analysis
7. Material Specification and Cross Section Processing
8. Monte Carlo Transport
9. Deterministic Transport
10. SCALE Nuclear Data Libraries
11. Utility Modules for SCALE Libraries
12. Installing and Building SCALE
13. Version History

Docs » SCALE 6.3.0 User Manual [View page source](#)

SCALE 6.3.0 User Manual

SCALE is a comprehensive modeling and simulation suite for nuclear safety analysis and design developed and maintained by Oak Ridge National Laboratory under contract with the [U.S. Nuclear Regulatory Commission](#), [U.S. Department of Energy](#), and the [National Nuclear Security Administration](#) to perform reactor physics, criticality safety, radiation shielding, and spent fuel characterization for nuclear facilities and transportation/storage package designs.

Visit the [SCALE website](#) for additional information.

SCALE

- 1. Introduction
 - 1.1. Organization
 - 1.2. SCALE 6.3 Updates by Product
 - 1.2.1. Fulcrum
 - 1.2.2. CSAS
 - 1.2.3. VADER

Future Developments

- With the online manual, we will post
 - known issues in 6.3.0 as they are discovered
 - fixes in maintenance releases, e.g. 6.3.1
 - New capabilities in 7.0 betas
- 7.0 release with ENDF/B-VIII.1 (~2024)
 - will pursue a role in beta data testing
 - any large feature requests by NCS users, now is the time at beginning of SCALE 7 development cycle

SCALE

Search docs

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13. Version History

13.1. Known Issues in 6.3.0

13.2. Fixed Issues in 6.3.0

13.3. Fix Descriptions in 6.3.0

Docs » 13. Version History [View page source](#)

13. Version History

The following sections describe fixes that have been made in recent versions of SCALE. In addition current issues for the released version of SCALE are listed, along with any mitigation or work arounds.

13.1. Known Issues in 6.3.0

These are the known issues/bugs in SCALE 6.3.0. As part of our QA plan, this list will be amended if new issues are found.

Last updated: 2022-02-10

- [13.1.1. CEResource interface to Robus prevents photon transport below 10 keV for ENDF-8.0](#)
- [13.1.2. Missing HTML output file from SAMS with CE TSUNAMI](#)
- [13.1.3. TRITON-Shift errors out with non user-oriented message when depletable material is not part of the geometry](#)

13.2. Fixed Issues in 6.3.0

These issues have been fixed in SCALE 6.3.0 relative to the last maintenance release in the previous 6.2 series, 6.2.4.

- [13.2.1. Polaris Inconel 718 is actually Inconel 600 \(StdComp Inconel is unspecified which variant it is in the manual\)](#)
- [13.2.2. PMC fails to find the zone temperature in PW library with more than 20 temperatures for matrix materials in double-het](#)
- [13.2.3. Small weighting discrepancy in Polaris and TRITON homogenized delayed neutron precursor decay constant](#)

Coordination Highlight: WPNCS Subgroup 8

- Goal: develop a methodology for collecting and disseminating feedback on evaluations from qualified experts to better serve users of the ICSBEP benchmarks.

- Discussed over TPR in Sante Fe in 2020

- Iteratively, through SG-8 feedback, arrived at a new form for ICSBEP criticality benchmark feedback from experts

- Temporarily staged <https://code.ornl.gov/ww5/wpncs-sg8-feedback-form>

- Send completed form to ww5@ornl.gov

Name	WPNCs SG-8 ICSBEP Benchmark Feedback Collection Form	
Version	v1.0	
Purpose	The Purpose of this Form is to collect expert knowledge regarding the suitability of ICSBEP evaluations to common uses such as modern code validation, nuclear data evaluation, and nuclear data adjustment.	
Instructions	Please fill in your name and email below and then rate benchmarks you are familiar with using the 1-4 rating. For a rating lower than 4, assign one or more issue keys if relevant to the issue you are reporting and provide recommendations for improvements. Please also provide any other additional notes you find useful for others who may use this benchmark. See the Examples tab for a few examples.	
Assessor	J. Doe	Email xy at doe.gov

RATING	4	Meets the highest standard for ICSBEP benchmarks.
	3	Has minor issues that do not significantly affect interpreting code/data bias.
	2	Has issues that should be considered when interpreting code/data bias.
	1	Has major issues that must be considered when interpreting code/data bias.

ISSUE KEYS	M	Issue with Model
	U	Issue with Uncertainty
	B	Issue with Bias

Benchmark			*Comments apply to the additional cases: ALL or a comma separated list e.g. 6,7,8,9,19,20,21,22 OR 6-9, 19-22	**Multiple issue keys can be specified in a comma-separated list, e.g. M,U				
Identifier	Case	Rev.	Add Cases*	Rating	Issue Keys**	Improvements Recommended	Additional Notes	
HEU-COMP-FAST-001	HEU-COMP-FAST-001-001	1						
HEU-COMP-FAST-001	HEU-COMP-FAST-001-002	1						
HEU-COMP-FAST-002	HEU-COMP-FAST-002-001	2						

It's not too late! Results in by end of March for next cutoff!

I will continuously compile new results **quarterly** as part of SCALE NCSP AM2 activities until we determine where to move this (e.g. new service of OECD/NEA or responsibility of ICSBEP TRG)

SCALE Vision

- Provide comprehensive assessment of nuclear data quality through validation across
 - **Criticality Safety**
 - Radiation shielding
 - Spent fuel inventory (**burnup credit**)
 - Reactor physics/operation (**decay heat**)
 - Isotope production
- To be well-known for generating reliable “reference solutions” for challenging problems
 - Accuracy first, speed second
 - Always consider uncertainty
 - Ease-of-use is important and requires constant evolution and communication with users
 - Publish models, results, and scripts—achieve true reproducibility and transparency

SCALE v6.3.0 3D visualization of **Kairos Hermes prototype reactor**

- 2-person team in 3 weeks has set up geometry and generated an equilibrium core inventory
- Will evaluate various **criticality safety** aspects for fresh fuel, materials accountability and safeguards, decay heat & severe accident

