SCALE AM2 Accomplishments in FY21
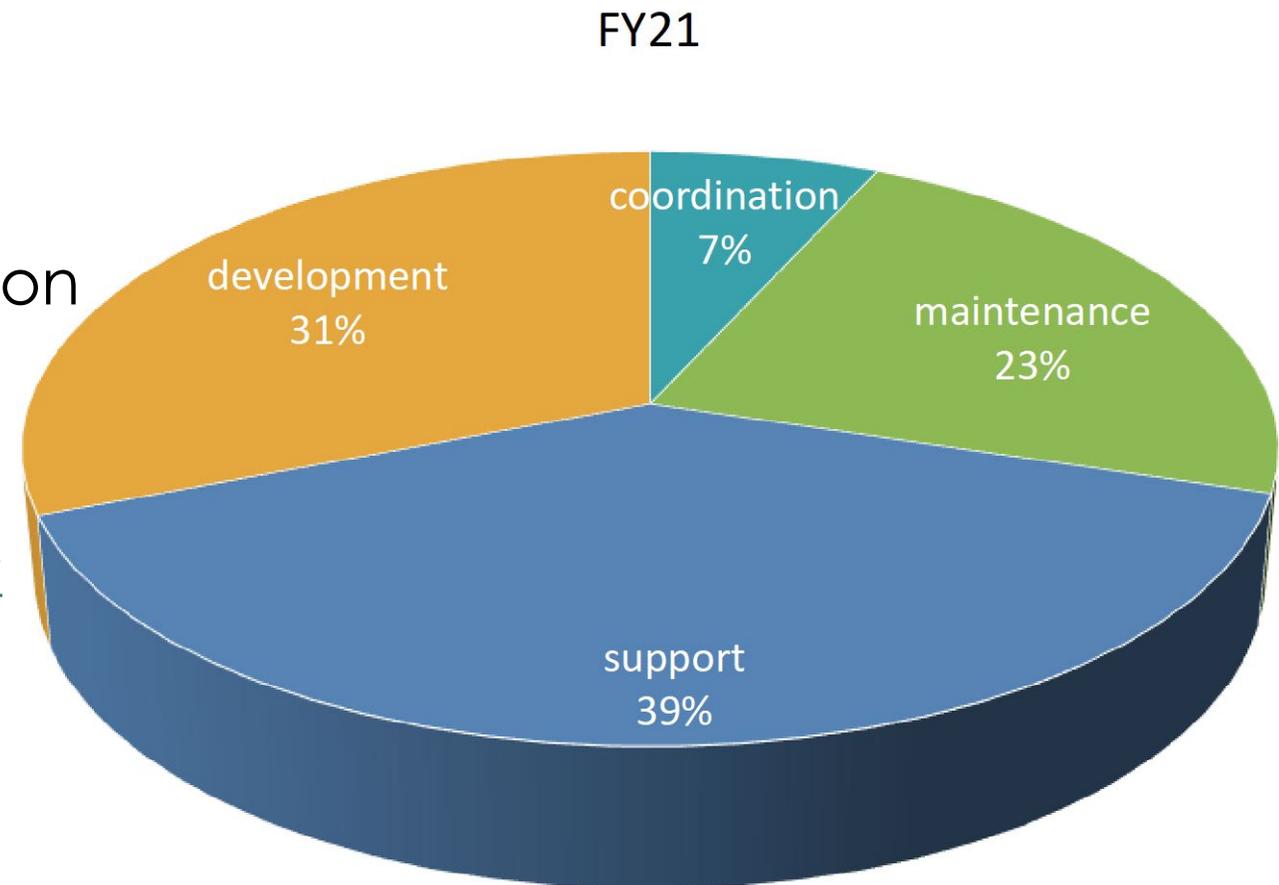
W. Wieselquist, Ph.D.
Director, SCALE Code Suite

Nuclear Energy and Fuel Cycle Division
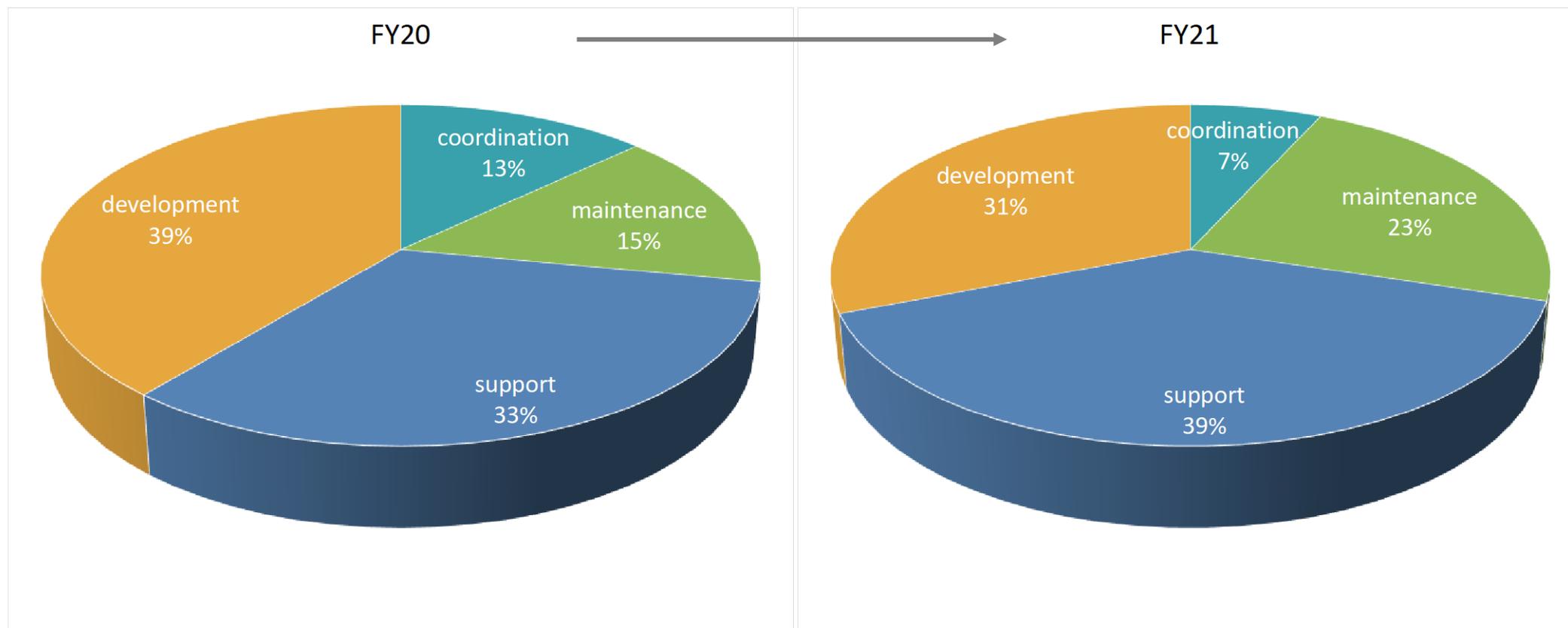
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ORNL AM2 SCALE: Overview

- 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

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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%)

FY20 → FY21

FY20: coordination 13%, maintenance 15%, support 33%, development 39%

FY21: coordination 7%, maintenance 23%, support 39%, development 31%

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2022 SCALE Team

Leadership Team

Director
Will Wieselquist

Production Coordinator
Rob Lefebvre

User Support Coordinator
Germina Ilas

Sponsor Representatives
Seth Johnson, HPC
Ugur Mertyurek, 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 Mertyurek
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	

NRC Projects Office

Program Manager
Bruce Bevard

Business Ops Manager
Lindsey Aloisi

NCSP Management

NCSP Execution Manager
Doug Bowen

Business Systems
Marsha Henley

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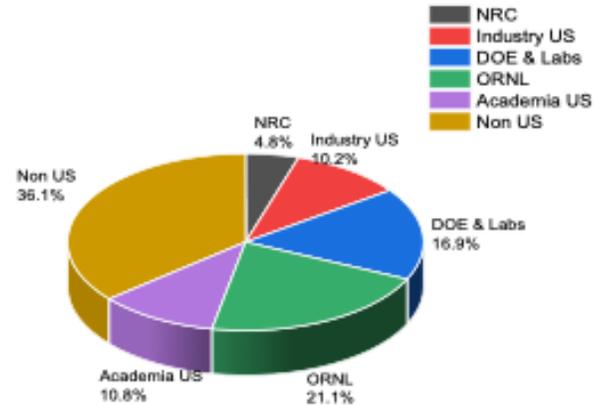
Support Highlights: 2021 Users' Group Workshop

- 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

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

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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

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

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

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)

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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

Blue: FLiBe Coolant
Red: Fuel Pebble
Black: Moderator Pebble

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

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