Oak Ridge National Laboratory

Recent Developments in SCALE

**Nuclear Criticality Safety Program
Technical Program FY18 Review**
March 26, 2019

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U.S. DEPARTMENT OF ENERGY

US DOE Nuclear Criticality Safety Program
Five-Year Execution Plan for the Mission and Vision

ORNL-AM2

"Ongoing, approved task to provide SCALE/KENO/TSUNAMI maintenance and user support for performing Nuclear Criticality Safety (NCS) calculations with the SCALE package. Work tasks include: sustaining and continually improving SCALE NCS features through user-driven enhancements, software quality assurance (SQA) and V&V; assuring adaptability to various computing platforms and compilers; providing improved user interfaces and user documentation consistent with modern engineering software; supporting responsive communication to SCALE criticality safety users through SCALE Newsletters, email notices, and updates on the SCALE website. The task also includes support for modernizing the software infrastructure and capabilities to improve quality and reliability and to ensure long-term sustainability of the NCS capabilities."

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US DOE Nuclear Criticality Safety Program
Five-Year Execution Plan for the Mission and Vision

ORNL-AM2

1. **Sustain/improve SCALE NCS features** through user-driven enhancements, software quality assurance (SQA) and V&V.

2. **Assure adaptability** to various computing platforms and compilers.

3. **Improve user interfaces/documentation** consistent with modern engineering software.

4. **Support responsive communication** to SCALE criticality safety users through SCALE Newsletters, email notices, and updates on the SCALE website.

5. **Modernize software infrastructure and capabilities** to improve quality and reliability and to ensure long-term sustainability of the NCS capabilities.
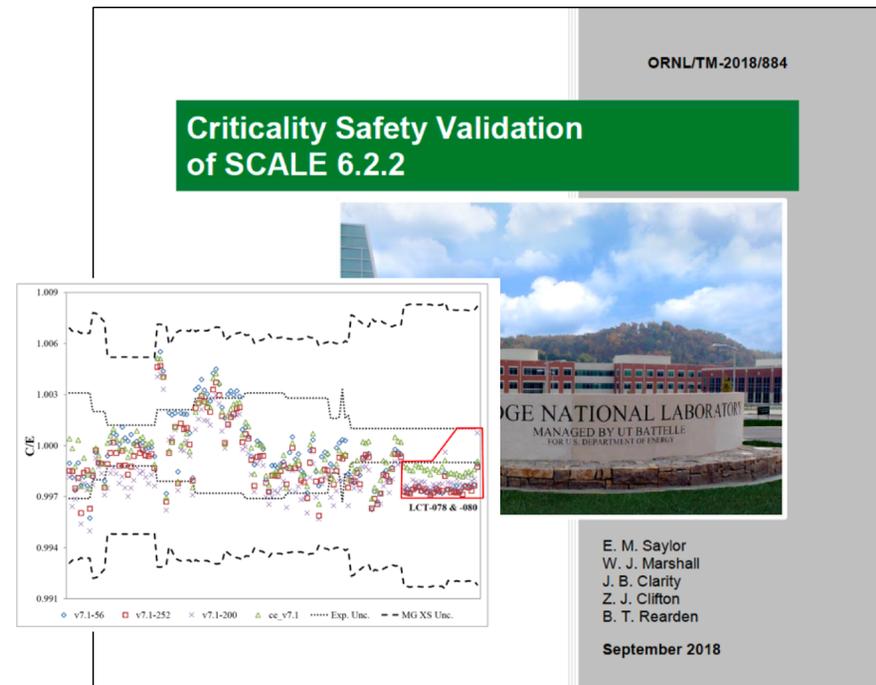
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ORNL-AM2.1

Sustain/improve SCALE NCS features through user-driven enhancements, software quality assurance (SQA) and V&V.

FY18 Highlights

- Produced NCS Validation Report based on SCALE 6.2.2 KENO
  (provides important benchmark for SCALE 6.3 Shift)

- Deployed 6.2.3 update through RSICC

- Created and tested initial ENDF/B-VIII CE and MG nuclear data libraries

https://www.ornl.gov/scale/scale/criticality-safety-reports

ORNL/TM-2018/884

Criticality Safety Validation of SCALE 6.2.2

E. M. Saylor
W. J. Marshall
J. B. Clarity
Z. J. Clifton
B. T. Rearden

September 2018

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ORNL-AM2.2

Assure adaptability to various computing platforms and compilers.

FY18 Highlights

- Added "clang" compiler support to continuous testing

- Investigated MPI version updates
  - OpenMPI *(standard used in auto-deployment to ORNL clusters)*
  - MPICH *(anticipated support in FY19)*

- Maintained testing support *(through ORNL system updates/security patches, cluster upgrades)*
  - platforms: Windows, Mac, Linux
  - compilers: Intel, GCC, new Clang

Platform/Compiler Test Result Dashboard

Linux								
Build Name	Update	Configure		Build		Test		
	Files	Error	Warn	Error	Warn	Not Run	Fail	Pass
master-linux-gcc-ampx		0	1	0	21^{+6}_{-6}	0	0	207
master-linux-gcc-bundle		0	1	0	41^{+6}_{-6}			
master-linux-gcc-mpi		0	0	0	200			
master-linux-gcc-mpi-all-packages		0	1	0	200	0	0	2667^{+1}_{-28}
master-linux-gcc-regression-sample		0	1	0	27	0	0	1193^{+1}_{-52}
master-linux-gcc-static		0	1	0	7	0	0	355^{+18}_{-1}
master-linux-gcc-unit-debug		0	1	0	36	0	0	1628^{+2}_{-11}
master-linux-intel-ampx		0	1	0	198	0	0	207
master-linux-intel-mpi		0	1	0	200	0	0	2350^{+1}_{-27}

Darwin								
Build Name	Update	Configure		Build		Test		
	Files	Error	Warn	Error	Warn	Not Run	Fail	Pass
master-mac-clang-unit		0	5	0	200^{+3}	0	0	1106_{-12}
master-mac-gcc-bundle		0	3	0	200			
master-mac-gcc-regression-sample		0	5	0	200	0	0	1195
master-mac-gcc-unit		0	5	0	200	0	0	1106
master-mac-gcc-unit-debug		0	5	0	200^{+4}	0	0	1106

Windows								
Build Name	Update	Configure		Build		Test		
	Files	Error	Warn	Error	Warn	Not Run	Fail	Pass
master-windows-intel-ampx		0	22	0	200^{+32}_{-114}	0	0	200^{+31}
master-windows-intel-bundle		0	21	0	200^{+199}_{-199}			
master-windows-intel-regression-sample		0	21	0	200	0	0	1186_{-52}
master-windows-intel-unit		0	21	0	200^{+3}	0	0	1088_{-12}

http://ci.ornl.gov/CDash/index.php?project=SCALE

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ORNL-AM2.3

Improve user interfaces/documentation consistent with modern engineering software.

FY18 Highlights

- Improved SCALE GUI (Fulcrum) robustness and speed for 6.2.3

- Added initial 3D visualization capability in Fulcrum for 6.3
  - uses new Geometria geometry package (from Shift integration)
  - transparency/cutplanes-with undo!

- Developed new documentation strategy for 6.3
  - based on reStructuredText
 - easy export to HTML & PDF
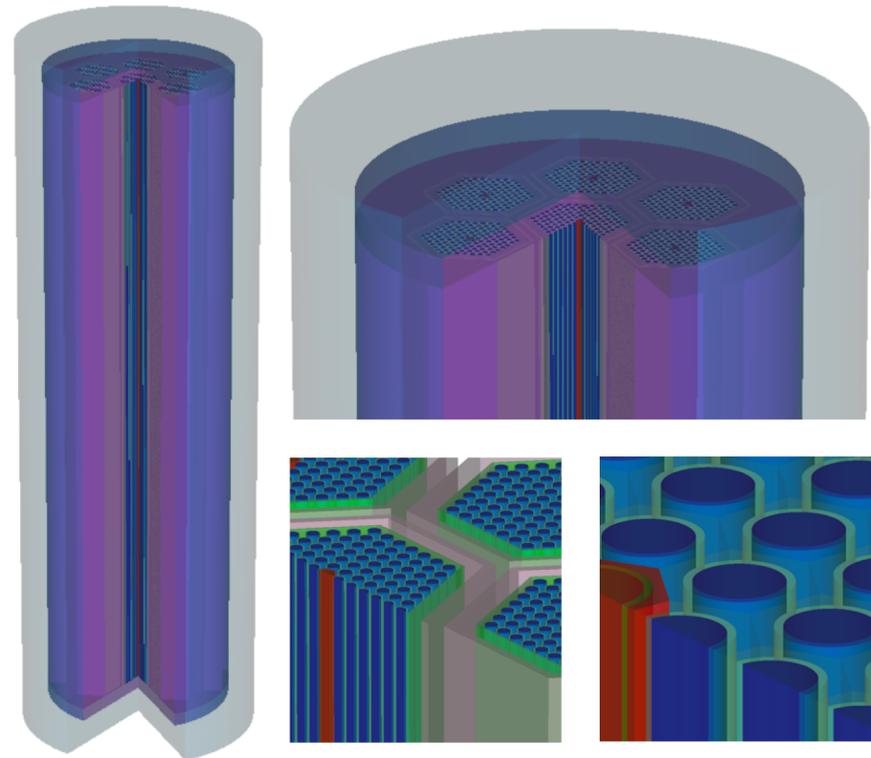
Fulcrum 3D visualization

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ORNL-AM2.4

Support responsive communication to SCALE criticality safety users through SCALE Newsletters, email notices, and updates on the SCALE website.

FY18 Highlights

- Delivered Spring 2018 newsletter discussing 6.2.3 updates
  https://www.ornl.gov/scale/newsletter

- Supported user inquiries/reports through scalehelp@ornl.gov
  User-submitted criticality calculation defect resulted in rapid communication and resolution

- Hosted 2nd Annual SCALE Users Group Workshop

A CSAS/KENO V.a check that users enter a required cuboidal outer boundary if using non-vacuum boundary conditions was disabled in SCALE 6.1 through 6.2.2. **Fixed in 6.2.3.**


Reflected

Reflected

2018 SCALE Users Group Workshop

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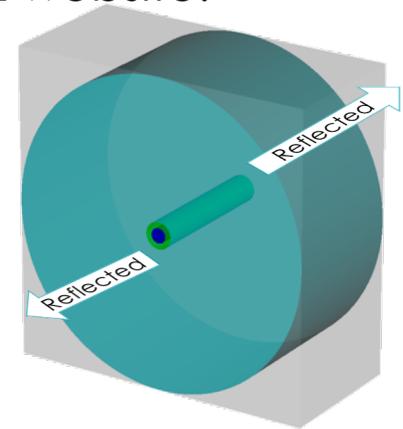
ORNL-AM2.5

Modernize software infrastructure and capabilities to improve quality and reliability and to ensure long-term sustainability of the NCS capabilities.
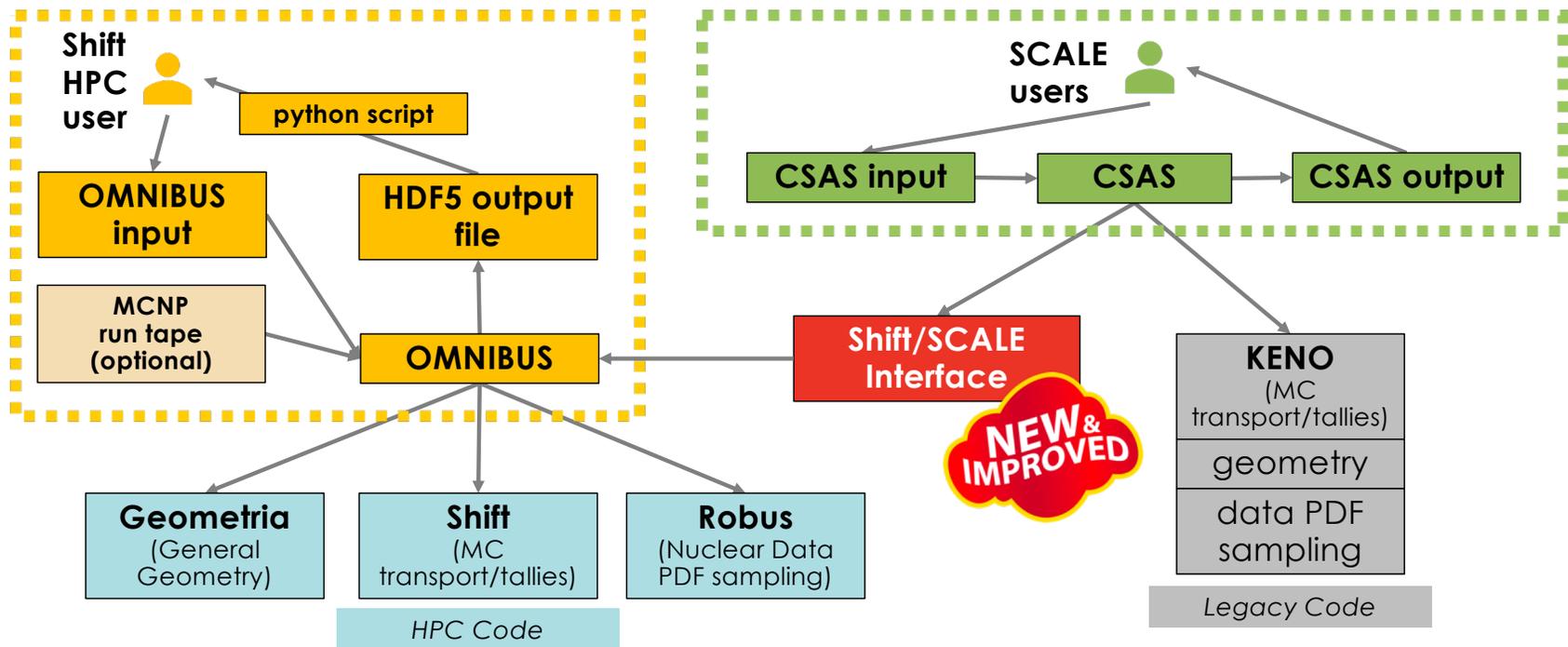
FY18 Highlights

- Migrated to new ORNL-hosted code management, GitLab
  - *converted SQA record from* **mercurial** *version control to* **git**
  - *developed new processes and workflows consistent with SQA plan*
  - *began unifying data library, code, and validation suite storage in GitLab*
- Continued CSAS-Shift effort *(eventually to replace CSAS-KENO)*

Fogbugz (2011-2018)

GitLab

https://code-int.ornl.gov/rnsd/scale
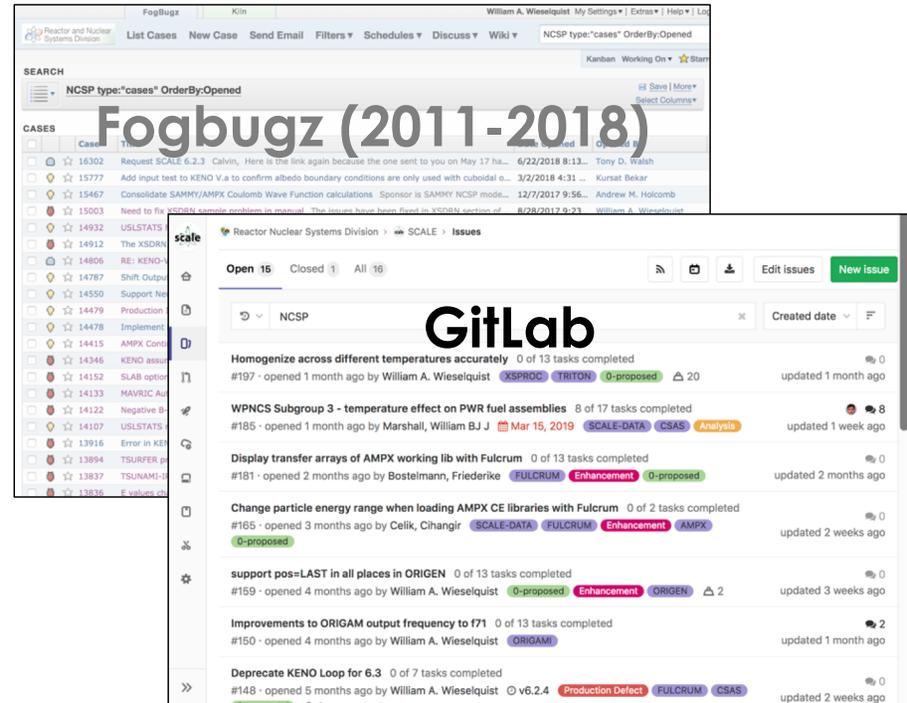
FY18 SCALE Monte Carlo Developments
Simultaneously support **Shift HPC** users and **SCALE** users

FY18 Top Level Highlights

- Improved infrastructure
  - New software management on GitLab
  - Additional testing

- Maintained existing 6.2.* series
  - Criticality validation report
  - 6.2.3 release

- Developed future 6.3.0
  - 3D visualization of geometry
  - CSAS/Shift

Development Management in GitLab

Test Results Dashboard

Criticality Safety Validation of SCALE 6.2.2

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