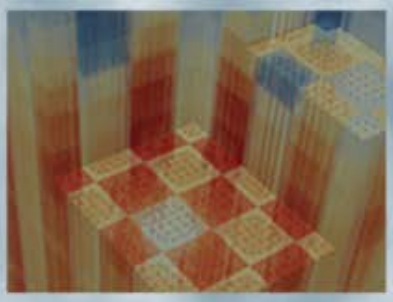
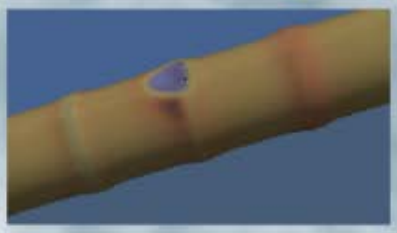
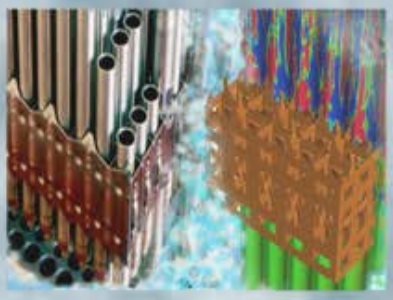
CASL
A DOE Energy Innovation Hub

CASL-U-2015-0236-000

CASL Program Highlights April 2015







Jess C. Gehin
Oak Ridge National Laboratory

April 30, 2015

U.S. DEPARTMENT OF ENERGY | Nuclear Energy

CASL-U-2015-0236-000

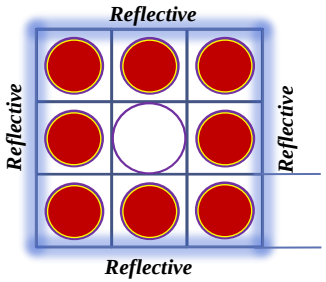
Science Highlight

First Verification/Validation Report Completed for VERA Core Simulator

- VERA Core Simulator (VERA-CS) perform simulation of steady-state reactor operations
- In order for capability to be adopted it's important to document work performed to establish the correctness and accuracy
- This first report fills an important gap in VERA documentation

Verification

Ensure that the models/physics is implemented correctly in the software



k-eff = 1.17933

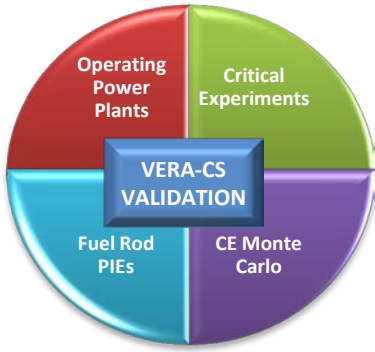
0.9918	1.0082	0.9918
1.0082	0.0000	1.0082
0.9918	1.0082	0.9918

Metric	M_libs	M_Drivers	Total
Unit Tests	123	4	127
Regression Tests	0	159	159
Coverage	80.17%	67.24%	79.69%
Lines of Code	91,006	3,446	94,452
Automated Testing			
Continuous[1]	Yes	Yes	
Nightly[2]	Yes	Yes	
Portability[3]	Yes	Yes	
Verification[4]	Yes	Yes	
Validation	No	Yes	
Memory	Yes	Yes	
Coverage	Yes	Yes	

1 - Test Server checks for changes every 10 minutes
2 - Tests many more regression tests
3 - Test GCC 4.6.1, 4.7.2, 4.8.1, Intel 12.1.5
4 - Unit tests for solver kernels against analytic solutions.

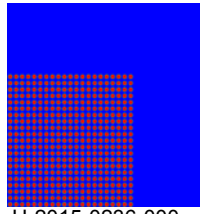
Validation

Comparisons with experimental results from operating reactors and critical experiments



B&W-1484 Core 4:1 and 4:2 MPACT-Calculated Eigenvalues		
Calculated Effective Eigenvalue		
Scattering Method	Core 4:1	Core 4:2
P_2	0.99993	0.99761
TCP_0 (NLC)	0.99838	0.99597
Distance from Critical (pcm)		
Scattering Method	Core 4:1	Core 4:2
P_2	-7	-239
TCP_0 (NLC)	-162	-403

Core 4:1



Linking Shift with MPACT To Expand Validation Capabilties

Science Highlight

Objective

- Provide a mechanism to execute Shift Monte Carlo neutronics at reactor state points generated by MPACT (previously only uniform temperatures with fresh fuel could be considered)
- This capability can be used to validate full-power neutronics calculations

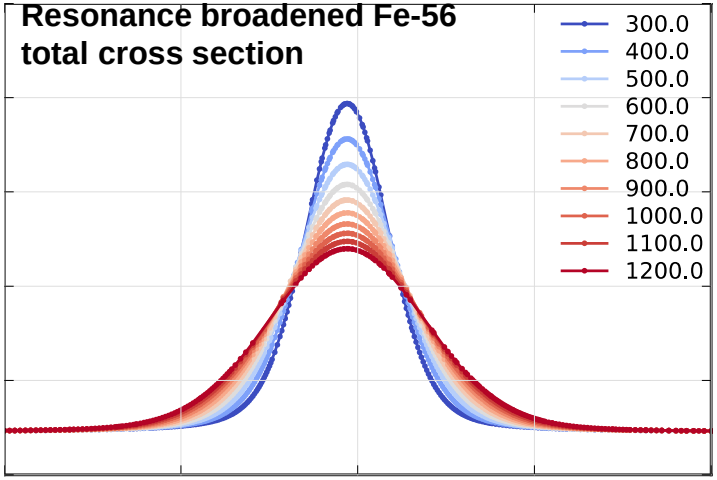
Tasks

☑ Read the CASL-defined HDF5 output and MPACT isotopics files and initialize Shift model inline

☑ Load temperature-broadened continuous-energy cross section data into Shift

Result

Shift can now model user-selected state points in a LWR reactor using temperature-dependent, continuous-energy cross section data

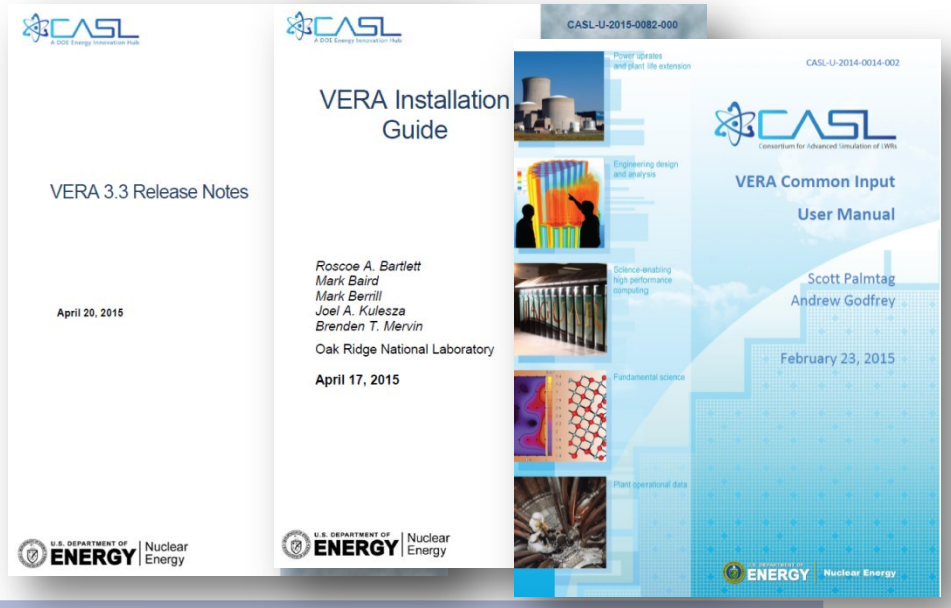


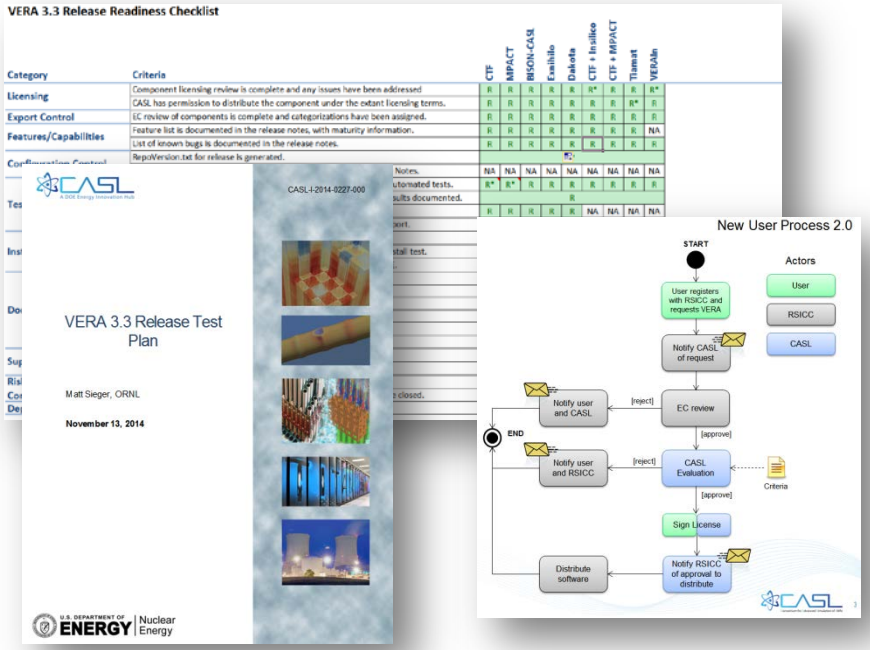
CASL Release of New Version of VERA

Science Highlight

Deploying CASL Technology

- VERA 3.3 is the second major release of key Virtual Reactor components to non-CASL participants
- Available for use outside of CASL under Test & Evaluation and Government Use license terms
- Includes multiple single and coupled physics tools suitable for industrial R&D and research purposes





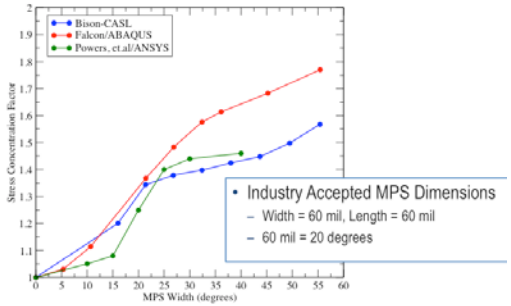
Accomplishments & Lessons Learned

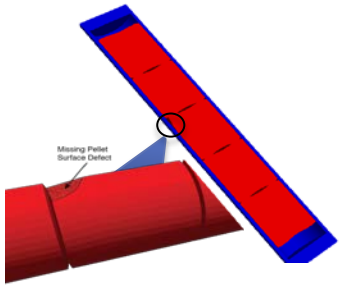
- Extensive testing and improvements to installation procedures
- Many improvements to manuals and documentation, with editorial and export control reviews
- Improved release, distribution, and user support processes
- Much progress in resolving export control and licensing issues

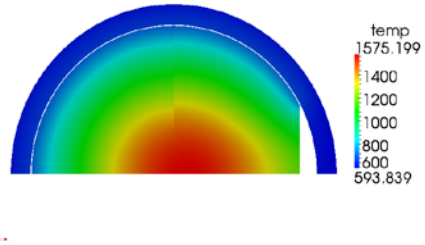
Fuels Material & Chemistry (FMC)/ UCLA Workshop, April 30 – May 2015

CASL

- 2-day workshop held at UCLA:
  - Day 1: revised Zr-O-H planning, cladding mechanics; Day 2: MPS PCI modeling for FY15.CASL.009
- FY15.CASL.009 is on track and data from Exelon is imminent.





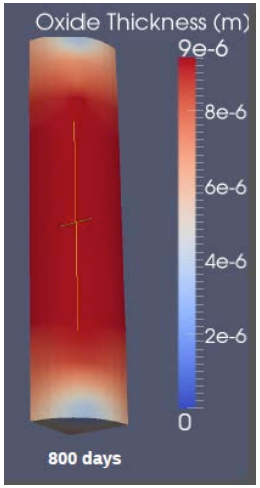


- Revised Zr-O-H framework established and team beginning to connect elements

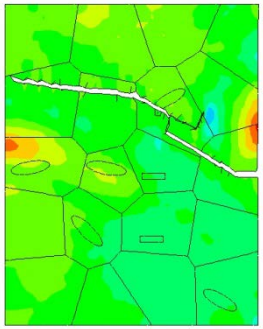
Rate theory (Marian, UCLA)

$$\Delta w = kt^n$$

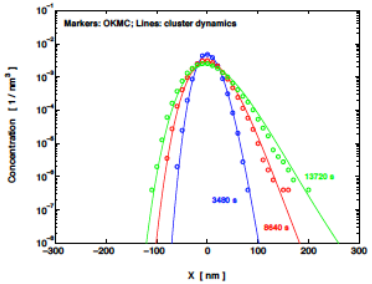
HOGNOSE (Short, MIT)



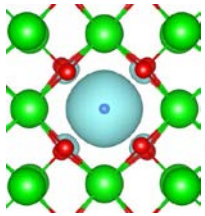
Fracture models (Zikry, Wu, NCSU)



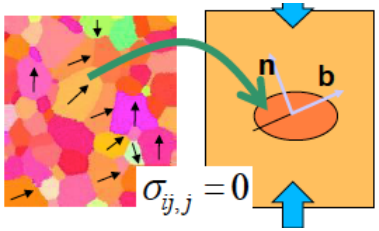
KMC and Cluster Dynamics (Xu, Wirth UTK)



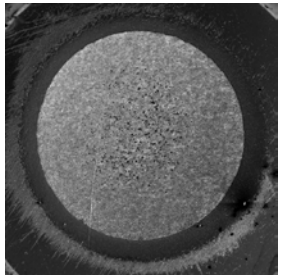
O and H transport in ZrO_2 (Yildiz, MIT)



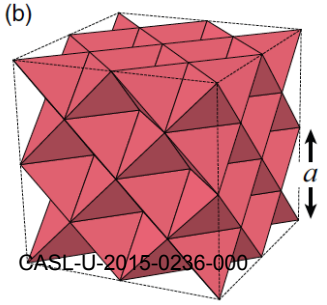
VPSC (Tome, Patra, LANL)



Oxidation experiments (Was, Wang, UM)



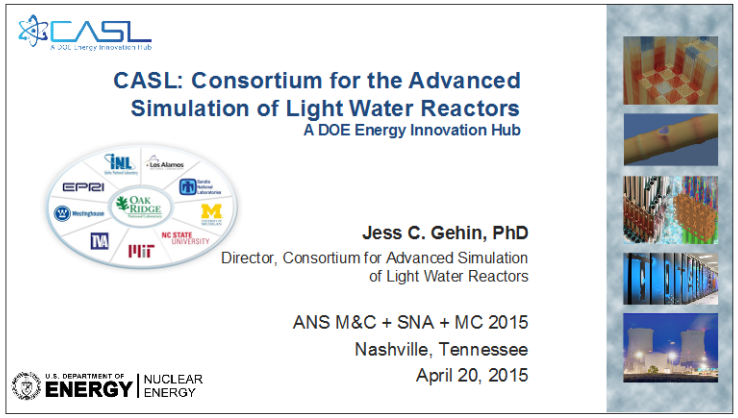
Zr-O and Zr-H thermodynamics (van der Ven, Thomas, UCSB)



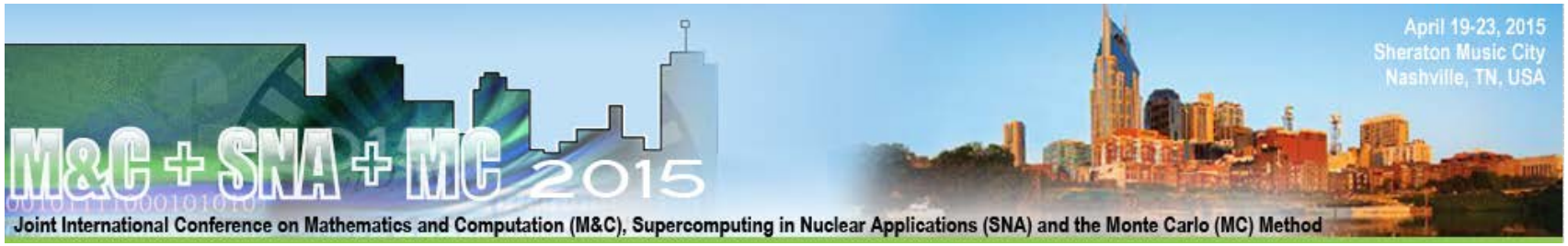
CASL Research Highlighted at 2015 M&C + SNA + MC 2015 Conference

CASL

- Meeting focused on Mathematics & Computation, Supercomputing in Nuclear Applications and Monte Carlo
- This meeting is a primary outlet for for CASL research



- CASL Director plenary presentation on CASL Progress and Plans
- CASL researchers presented 20 papers and posters covering a wide range of topics
- Additionally, 12 non-CASL papers cited CASL and CASL research



CASL US/ROK I-NERI Meeting Provides Exchange on Research

CASL

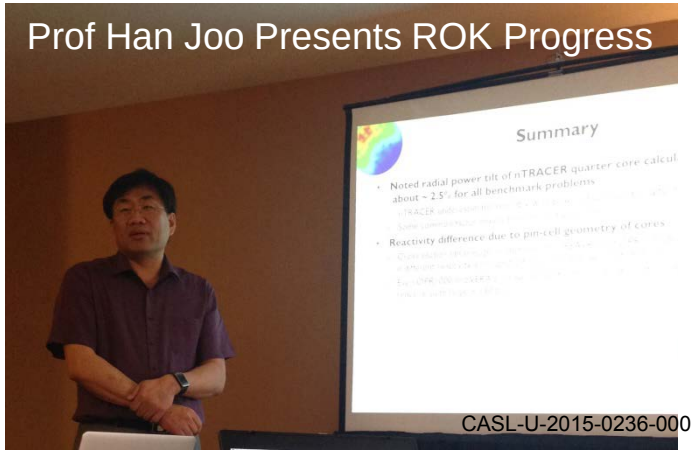
- Meeting held on April 19th, 2015 in Nashville in conjunction with M&C meeting
- US participants from ORNL, Univ. of Michigan and MIT
- ROK participants from Seoul National University and Ulsan National Institute of Science and Technology (UNIST)
- Detailed technical exchange on I-NERI project tasks:
  - Benchmarking of methods
  - Neutronics/TH coupling
  - Cross section libraries and processing
  - Efficiency improvements
- Action items for next six month period identified

Agenda for the I-NERI Progress Review Meeting (Final)

April 17, 2015, 2015

Date and Time: 1:00pm-5:30pm, April 19, 2015
Location: General Thomas, Sheraton Music City

Task	Presentation & Discussion	Time	Lead
	Opening	1:00 – 1:10	Jess Gehin (ORNL) Han Gyu Joo (SNU)
Task A1	Numerical benchmarks with given conditions	1:10 – 2:10	Jess Gehin (ORNL)
	VERA progression problems & MPACT results		Andrew Godfrey (ORNL)[c]
	Discussion of VERA benchmark 10		Brendan Kochunas (UM)
	nTRACER for VERA progression problems		Han Gyu Joo (SNU)
	Whole Core Benchmark with Korean NPP		Deok Jung Lee (UNIST) [d]
	Technical discussion		
Task B3	Efficient and versatile coupling with CTF	2:10 – 2:50	Han Gyu Joo (SNU)
	Internal TH & CTF coupling in nTRACER		Han Gyu Joo (SNU)
	Internal TH & CTF coupling in MPACT		Benjamin Collins (ORNL)
	Technical discussion		
Task A2	Realistic depletion benchmarks	2:50 – 3:20	Deok Jung Lee (UNIST)
	Depletion benchmark by MPACT		Kang Seog Kim (ORNL)
	Discussion on the pin resolved validation		Thomas Downar (UM)
	Technical discussion		
	Break	3:20 – 3:30	
Task C1	Enhancement of library and XS processing	3:30 – 4:30	Kang Seog Kim (ORNL)
	MPACT library generation		Kang Seog Kim (ORNL)
	nTracer library generation		Han Gyu Joo (SNU)
	ESSM + Quasi 1-D implementation into MPACT		William R. Martin (UM)
	Resonance Interference Factor Method		Deok Jung Lee (UNIST)
	Technical discussion		
Task D1	Cross section processing for thermal feedback	4:30 – 5:20	Benoit Forget (MIT)
	OPENMC		Benoit Forget (MIT)
	MCNP6 OTF analysis of AMA #6, HFP 3D assembly		William R. Martin (UM)
	McCARD		Hyung Jin Shim (SNU)
	Technical discussion		
	Discussion for next meeting Closing	5:20-5:30	Jess Gehin (ORNL) Han Gyu Joo (SNU)



CASL Symposium: Planning underway

July 7-9, 2015 – Asheville, NC

- Registration website is now available for attendees.
- Meeting planning is underway
- Sponsors and speakers are being contacted.

CASL April 2015 Activities

CASL

Collocation

- Focus Area Status Reports:
  - Senior Leadership
  - Physics Integration
  - Validation & Modeling Applications
  - Thermal Hydraulics Methods
  - Fuel Materials & Chemistry
  - Technology Deployment Outreach
  - Radiation Transport Methods
- Challenge Problem Integrators
  - Reactivity Insertion Accident (RIA)
  - Loss of Coolant Accident (LOCA)
  - Grid-to-Rod-Fretting (GTRF)
  - Corrosion-Related Unidentified Deposits (CRUD)
  - Pellet-Cladding Interaction (PCI)
  - Departure from Nucleate Boiling (DNB)
  - Validation Data
- Focus Area & Challenge Problem Wrap-up

VOCC Tours

VOCC
Virtual Office, Community, and Computing

- NSED Advisory Committee
- Bureau of Engraving & Printing
- American Nuclear Society President
- NSED Advisory Committee
- GE Hitachi Nuclear Energy
- NSED Administrative Assistants
- Canadian Civil Nuclear Energy Delegation

Meetings

- NSED Advisory Committee Meeting April 15-16
- Advanced Test/Demonstration Reactor Criteria, April 23-24
- Massachusetts Institute of Technology & University of Michigan Senior Leadership Partner Review, April 29-May 1