CASL Program Highlights
June 2015

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June 30, 2015
First CASL Simulation of Departure from Nucleate Boiling Challenge Problem with VERA Completed

- PWR Streamline Break (SLB) Event Simulated
  - Broken main steam pipe in one loop at hot zero power (HZP)
  - Core return to power with high peaking factor could lead to departure from nucleate boiling (DNB) on fuel rods

- CASL Modeling Approach
  - Core boundary condition from system transient code
  - Core inlet temperature and flow distributions from CFD prediction
  - Quasi-Steady state VERA-CS (coupled neutronic and thermal-hydraulic code system) for reactor core response

- Simulation Results
  - VERA-CS full core model executed on ORNL Titan supercomputer for Watts Bar Cycle 1
  - Results show code capable of modeling and simulating PWR accident condition for DNB margin evaluation

Significant increase in modeling resolution (at fuel rod level) than industry approach (assembly level)
CASL Director Testifies on Hubs to House Science, Space and Technology Energy Subcommittee

- June 17, 2015 oversight to support authorization of Hubs
  - H.R. 1870 introduce by Rep Grayson and incorporated into H.R. 1868 Reauthorizing the American Competes Act

- Questions posed in hearing invitation:
  - What are the primary research and development goals of CASL? Since the hub was organized by DOE, what progress has been made towards those goals?
  - How does the integrated research model employed at the hubs advance research goals within the Office of Science and applied energy programs at DOE?
  - How does the private sector interact with CASL? In what way does CASL prioritize technology transfer of technologies developed at the hub?
CASL Completes First Five-Year Phase

• First five-year award phase completed on June 30, 2015

• CASL Achieved Phase 1 goals:
  – Virtual reactor established and models operating lifetime of Watts Bar Nuclear Plant (18 years of operation)
  – Significant progress made on simulation of CASL Challenge Problems
  – Hub industry – university – national laboratory partnership successful demonstrated
  – CASL’s VERA virtual reactor successfully deployed to industry

• Phase 2 extension begins with focus on broader and deeper applications of CASL technology
CASL Participates in ANS Panel on Breaking the Barrier Between Research and Industrial Implementation

- American Nuclear Society Annual Meeting Panel focused on bringing research to industry
- Panelists from Industry, Universities, and National Laboratories
- CASL contributed discussion and examples of key aspects of energy innovation hubs that are breaking barriers
Radiation Transport Methods and Physics Integration Focus Area Planning and Meeting held at ORNL
June 15-16, 2016

- Joint meeting of RTM and PHI PIs, research staff, and students to discuss status of projects, Phase 2 plans, and FY16 milestones

- 39 attendees
  - 30 at ORNL and 9 virtual attendees via Vidyo
  - CASL Science Council (Elmer Lewis and Kord Smith)
  - Other Focus Areas: FMC (Stanek, Powers), TDO (Sieger)
  - CASL leadership (Gehin, Kothe, Turinsky, Burns)

- The Agenda included 27 technical talks on FY15 progress and plans for FY16.

- Discussions on Phase 2 plans and L2 milestones for FY16.

- Key outcomes
  - VERA core simulator performance has increased by 17x in the past year and another 4x improvement is likely possible.
  - Joint VERA core simulator development effort between institutions (UM and ORNL) and between Focus Areas (RTM and PHI) has been very successful.
  - Excellent progress is being made to integrate crud deposition with thermal hydraulics capability to support challenge problems.
  - On schedule to deliver the L1 milestones to (1) qualify VERA core simulator for multi-cycle PWR simulation capability and (2) qualify a core-wide PWR CRUD induced power shift challenge problem capability.
CASL Simulates 12 Fuel Cycles of Watts Bar Nuclear Plant

- VERA used to model 18 years of operation, up to current cycle
  - MPACT+CTF+ORIGEN w/Bison-CASL fuel temperatures
- Measured data provided by TVA for benchmarking
  - Zero Power Physics Tests results
  - Critical boron concentrations
  - In-core power distributions
- Required 4307 computer cores and < 1 day per cycle
- Good agreement with measured data

**Significant Contribution from RNSD Staff:**
- Ben Collins
- Andrew Godfrey
- Kang Seog Kim
- Jeff Powers
- Bob Salko
- Will Wieselquist
- Shane Stimpson

**Cycle 11 Rod-wise Exposures**

**Highest Fidelity Simulation of Reactor Operation Ever Performed**
CASL Education Summer Student Workshop, 2015

Creating a New Generation of LWR Designers, Scientists, and Nuclear Power Professionals

Workshop Purpose:
- Orient and integrate graduate students into the CASL project, providing a hands-on experience with the VERA software in an intense two day setting
- Feature student presentations of CASL work

Workshop Activities:
- Presentations by CASL leadership and key researchers on VERA
- Structured, hands on tutorials utilizing VERA software
- Featured speakers from ORNL
- Tours of SNS, Graphite Reactor, & TITAN
- Student presentations, awards and feedback sessions

Workshop Highlights:
- Organized by Education Program: J. Michael Doster, Sherry Bailey, Rose Montgomery, John Turner, and Linda Weltman
- 27 graduate students representing 9 universities
- 11 Students participated in a student poster session highlighting their own CASL research. Three winners were selected for their outstanding work.
- Exposure to national lab environment with strong participation by ORNL Staff
- Student access to VERA on two computing platforms (LEZA and TITAN)
CASL June 2015 Activities

Collocation

- PHI/RTM Focus Area Planning Meeting, June 15-16
- Focus Area L1/L2 Milestone Planning Meeting, June 17-18
- Focus Area Status Reports, June 25
  - Senior Leadership
  - Physics Integration
  - Validation & Modeling Applications
  - Thermal Hydraulics Methods
  - Fuel Materials & Chemistry
  - Technology Deployment Outreach
  - Radiation Transport Methods

VOCC Tours

- Dr. Huban Gowadia, Director, Department of Homeland Security (DHS), Domestic Nuclear Detection office
- Nuclear Legislature Working Group
- Spent Nuclear Fuel Working Group
- NSED Summer Students
- Light Water Reactor Sustainability Summer Students
- ITER Organization and nHance Technologies
- Virginia Tech Deans and Department Heads

Meetings

- ANS Annual Meeting, June 7-10
- 2015 Summer Student Workshop, June 18-19