



CASL Industry Council Meeting
September 11 - 12, 2012 – Oak Ridge, TN

Minutes

The fifth meeting of the Industry Council (IC) for the Consortium for Advanced Simulation of Light Water Reactors (CASL) was held on September 11 and 12, 2012; at Oak Ridge National Laboratory in Oak Ridge, TN. The first day was a joint meeting of the CASL Science Council and the Industry Council and was co-facilitated by Paul Turinsky of NCSU and John Gaertner of EPRI. The Industry Council met separately on the second day which was chaired by John Gaertner.

Attendance was by invitation only. Fifteen representatives from 14 of the 19 Industry Council member organizations attended. Eight of nine Science Council members attended. In addition, members of the CASL project team participated in the meetings as indicated on the agenda. The Agenda and the list of attendees are [Attachment 0](#) to these minutes.

Doug Kothe, CASL Director, began the agenda by reporting significant operational and organizational highlights of the CASL program in the past 12 months. He stated the 10 challenge problems – 5 operational, 3 transients affecting safety, and 2 long-term vessel integrity issues. He explained the relationship of CASL activities to key industry drivers – power up-rates, lifetime extension, higher burn-up, and improved safety. He discussed key milestones for CASL in 2012. Finally, he showed how the CASL organization has evolved and focused, especially to provide better technical focus and leadership through “Product Integrators” to coordinate across Focus Area boundaries.

Paul Turinsky, CASL Chief Scientist, reported on progress of the CASL science programs in the past 12 months. For each science area, he illustrated how the Challenge Problems were driving R&D priorities and development plans. In each area, he identified the specific needs that were critical to Challenge Problem success. Paul then highlighted key science and technology outcomes from the six Focus Areas for the year ending September 2012. He categorized these accomplishments as 1) new analytical capabilities, or 2) applications and assessments. Accomplishments included advanced CRUD modeling, CFD integration into VERA and initial advanced multi-phase flow capability, a detailed GTRF mode, structural mechanics capability in VERA, progress on benchmark calculations for high resolution 3D radiation transport modeling of Watts Bar Unit 1, initial benchmarking of CASL’s fuel performance code, demonstration of uncertainty quantification methods, and more. Paul finished with a



list and status of the most difficult technical challenges to be addressed in the current CASL work scope. Doug's and Paul's presentation is [Attachment 1-1](#) to these minutes.

Zeses Karoutas, CASL AMA Deputy Lead, and Paul Turinsky presented the status and plans for the ten Challenge Problems. Importantly, he described objective "success targets" that will focus the scope and define expectations. The plans for the Safety Challenge Problems are a recent accomplishment of CASL – much of the work to date has focused on operational Challenge Problems. Zeses' presentation is [Attachment 1-2](#).

Jim Stewart, CASL VUQ Lead, described work on validation and uncertainty quantification. He described the CASL VUQ team. He cited a new National Research Council study on Verification and VUQ to highlight the most important issues facing the CASL project, and he introduced the essential elements of predictive simulation. He then presented the four VUQ thrust areas: enabling validation and uncertainty considerations in VERA, enabling verification in VERA, issues of validation data, and predictive maturity assessments. Jim then provided detailed examples of VUQ investigations for the Challenge Problems. He finished with a discussion of FY 2013 objectives and planned milestones. Jim's presentation is [Attachment 1-3](#).

During lunch, Paul Turinsky discussed potential work scope and priorities for a Phase 2 of the CASL project, should it continue beyond its current work scope. He proposed criteria for scope selection that would advance the benefits of CASL for the nation's needs. He then presented five areas for potential expanded scope: 1) continuation of work on current safety and lifetime extension challenge problems, 2) additional LWR reactor types such as SMRs, BWRs, and other PWRs, 3) modeling beyond the reactor vessel, 4) fuel cycle issues beyond current fuel residence in the vessel, and 5) support of severe accident analysis. Paul's presentation is [Attachment 1-4](#).

John Turner, CASL VRI Lead, and Scott Palmtag, CASL Core Simulator Project Integrator, presented the description, status, and plans for VERA in the five-year Phase 1 of the CASL Program. The emphasis of the presentation was the expected progress on VERA until early 2014. John Turner began by describing the concept of VERA as a flexible suite of tools to address problems with a broad range of coupled phenomena and a spectrum of time and space scales, required resolution, and analysis constraints. An important set of VERA capabilities is encompassed by VERA-CS (Core Simulator). Scott Palmtag carefully described the VERA-CS capabilities, including its vital role to define boundary and initial conditions for detailed analysis such as the CASL Challenge Problems. Scott explained the sequence of ten benchmark problems through FY 2013 that will structure the development and demonstration of VERA-CS. John Turner then discussed deployment options and considerations of future VERA



releases, including computer platforms and deployment mechanisms. He then described the timeline for VERA “Snapshots” and releases through 03/2015. John’s and Scott’s presentation is [Attachment 1-5](#).

The meeting participants then moved to the CASL VOCC facility to observe demonstrations of selected VERA applications. Andrew Godfrey of the CASL AMA staff and Scott Palmtag demonstrated VERA-CS with a live application on the Jaguar HPC including problem setup, submittal, and review of results. Jeff Secker of the CASL AMA staff demonstrated application of VERA to the CRUD Challenge Problem. He described an integrated VERA analysis using legacy codes for the Vogtle plant, advanced features that will be available in the MAMBA CRUD analysis code, initial coupling of advanced codes including CDF, and the CASL goal of a VERA model for a full assembly with coupled, advanced VERA physics codes. Mark Christon, CASL THM Lead, presented an application of Hydra-TH to a GTRF analysis demonstrating each step of the workflow – problem design, boundary and initial conditions including meshing, representation of material properties, running on Jaguar, representation of results, and comparison with experimental data. Presentations used for Jeff’s and Mark’s demonstrations are Attachments [1-6](#) and 1-7 respectively.

The meeting was adjourned for the day.

The next day, Zeses Karoutas reviewed progress on the Industry Council sponsored pilot study: CFD Analysis of Fibrous Debris Blockage for a 4 Loop PWR Reactor Vessel. Zeses explained the generation of boundary conditions and the simplified physical assumptions for the preliminary runs. Preliminary VERA results were produced for a high resolution (1.1 billion cells) full core model using STAR-CCM+ on the INL HPC. The model simulated velocities and temperatures for 185 seconds using a pressure drop curve derived from experiment. Next steps will add a two-phase boiling model, more realistic initial conditions, and optimized meshing to allow longer modeling time. Work will be complete by the end of 2012. Members cautioned that these results are insightful but are as yet unrealistic, so they must not be represented as a prediction of actual expected conditions during a real LOCA event. Zeses’ presentation is [Attachment 2-1](#).

The next session considered the CASL strategy for Test Stands and for testing and applications of early releases of VERA in 2013 and early 2014. Suzy Tichenor, ORNL Director of Industry Partnerships, presented options for Industry Council members to use ORNL’s high performance computers for CASL applications. She described three programs available – Director’s Discretionary Awards, ALCC competitive awards for broadening the user base of HPC, and INCITE awards for applications that can only be done at the largest HPC facilities. She explained the processes and requirements



for each option. Sharing of results is generally a requirement unless ORNL is fully compensated for its contributions; therefore, protection of IP must be resolved in advance. It was concluded that Industry Council partners could potentially benefit from each program for beta testing, applications of early VERA releases that require large computer resources, and later applications of VERA that will demonstrate their value on more commercially practical HPC configurations. Suzy's presentation is [Attachment 2-2](#).

Steve Hess, CASL Deputy AMA Lead, and Rose Montgomery, CASL Applications Coordinator, then presented the strategy for deployment of VERA on Test Stands, alpha and beta testing of VERA releases, and early applications of VERA as Industry Council sponsored pilot studies or as applications by CASL industrial partners or Industry Council members. Rose Montgomery presented the planned schedule for availability of VERA for testing and application in 2013 through early 2015. An important element of this strategy is the specifications of computer resources for Test Stands. Steve Hess explained that the goal is to have VERA capabilities that can be used on cluster-class computers that are commercially practical to purchase or access. Some advanced VERA applications would still require leadership class HPCs. The members discussed the potential options for computer resources – ORNL partnership agreements for HPC use, access to cluster-class computers, and potential use of commercial cloud-computing resources. It was agreed that CASL should continue its development and deployment of VERA with consideration of this Test Stand and applications strategy and keep the Industry Council informed of progress on the plan. Steve's and Rose's presentation is [Attachment 2-3](#).

Walter Schwarz, Industry Council member from ANSYS, then presented a perspective on CASL from the point of view of a commercial provider of analysis and simulation software and services. His talk had three objectives: to overview related ANSYS products, to identify complementary interests, and to suggest opportunities for interface of ANSYS tools and CASL. Walter suggested three specific opportunities:

- Critically compare CASL products from a usability perspective with commercial products to deliver similar capability or take advantage of what is available.
- Provide for inclusion of other tools – commercial, proprietary, or openly available -- into VERA. Specifically, demonstrate the ability to include the ANSYS simulation tools.
- Investigate a system to manage the large amounts of simulation data and capture the engineering expertise embedded in these analyses and/or take advantage of the ANSYS EKM capabilities.

Walter's presentation is [Attachment 2-4](#).



Chris Lewis, Industry Council member from AREVA, then presented a perspective on CASL from the point of view of a major fuel vendor. He categorized the potential areas of use for CASL – product development, evaluation of operational issues, and licensing applications. For each, he proposed the potential benefits, VERA requirements, and specific potential uses. He engaged the other members in discussion of each area. He then proposed a list of the critical issues with CASL application from the AREVA perspective. These issues are 1) what are the potential improvements of advanced analysis, particularly considering limits to reducing uncertainty and costs of computer resources: and 2) can analysis- and run-times support the workflow requirements, particularly for re-load and emergency analyses? Chris concluded that:

- There are several areas for application of VERA; each has unique requirements
- Product development and evaluation of operational issues have fewest hurdles for immediate entry
- Work to validate the code is important and not insignificant.

There was discussion and support by the members on these conclusions. Chris's presentation is [Attachment 2-5](#).

John Gaertner then facilitated a self-assessment of the Industry Council after its first two years of operation. The self-assessment was guided by a questionnaire that was distributed at the meeting and completed by each member. The questionnaire is [Attachment 2-6](#). Generally, the membership gave high marks (3 to 5) to most questions indicating that the Industry Council processes and objectives are effective and that no large changes are recommended. Several insights from the written answers and the discussion by members suggested changes that should be considered. These insights were repeated in the Round Robin discussion, so they are included in the list of Round Robin recommendations below.

The Round Robin allowed each IC member to summarize significant suggestions, concerns, or comments about the meeting agenda items. Comments are captured by the list below. Since the discussion was quite robust and free-form, it was not possible to attribute each comment to a specific IC member:

- Increase CASL focus on validation of VERA and on uncertainty quantification of VERA results. Confirm that quality assurance and verification is of sufficient rigor to support eventual licensing approval.
- Assure that elements of quality assurance in the development process, especially verification and thorough documentation, will support the end-user needs for licensing applications later.
- Ensure modularity of VERA to allow coupling of current proprietary industry codes and commercial analysis codes when desired.



- Continue efforts to provide diverse deployment options for VERA including through the use of CASL Partner Test Stands (at EPRI, TVA, and WEC), through industry partnerships using ORNL computing, and through direct application on Test Stands at non-CASL partners.
- Improve IC access to information from meetings and other public information referenced in meetings.
- Assess VERA product usability and identify value-added for interface with commercial products for data analytics, visualization, structural mechanics, and project configuration control.
- The IC needs more participation from utility end users. Use the IC as a resource to identify potential new members. Include BWR utilities. Include other fuel vendors. Consider a new plant member. Add SMR members.
- Industry is uniquely able to perform benchmark studies because of their access to data, much of which is proprietary. Consider such benchmarks as future pilot studies, including single code benchmarks.
- Deployment of VERA is slower than desired, so much emphasis should be put on this. However, the commenter recognizes that “this is the nature of the beast.”
- IC would like a report on the progress of VERA relative to the VERA Requirements Document.
- Keep the focus of the Post-LOCA Flow pilot study on the benefits of advanced analysis. Move to more realistic models and assumptions. Document lessons-learned.
- CASL needs to identify BWR needs and at least one BWR Challenge Problem.
- Commenter supports the change in focus from micro-scale science to engineering –scale solutions.
- IC should engage more in Challenge Problems for CASL Phase 2 proposal.
- Industry drivers for CASL should be critically reviewed to see if they still reflect the greatest industry needs.

The following Action items were identified as a result of this meeting:

- Consider new IC project: To help prioritize and guide future work, evaluate “value proposition” of CASL products relative to key industry drivers.
- Identify future IC pilot studies that benchmark VERA capabilities against 1) current methods, and 2) industry data.
- Increase IC membership in the areas of 1) nuclear plant operating utilities with strong fuel analysis capability, and 2) small modular reactor vendors.
- Create an information portal on public CASL website to get Industry Council minutes, presentations, and other related documents.



Finally, it was agreed that the next IC Meeting would occur in March of 2013 with consideration of a webcast in January 2013, if needed. It was suggested that the meeting could be at an Industry Council member site. Details on the time, location, and structure of the joint meeting will be developed and sent to the IC members.

The meeting was adjourned at approximately 3:00 pm on September 12.

Prepared: September 26, 2012

By John Gaertner, Industry Council Chairman



Attachments