ORNL/TM-2012/234

NEAMS
NUCLEAR ENERGY ADVANCED MODELING & SIMULATION PROGRAM

Recommendations for NEAMS Engagement with the NRC

Preliminary Report (NEAMS Milestone M4MS-12OR0608115)

Version 1.0 (June 2012)

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Version History

Version	Date	Changes
0.9	2012-06-12	Initial draft
0.95	2012-06-22	Incorporated comments from Trevor Cook
1.0	2012-06-30	Incorporated comments from Brent Rini

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1 Executive Summary

The vision of the Nuclear Energy Advanced Modeling and Simulation (NEAMS) program is to bring a new generation of analytic tools to the nuclear engineering community in order to facilitate students, faculty, industry and laboratory researchers in investigating advanced reactor and fuel cycle designs. Although primarily targeting at advance nuclear technologies, it is anticipated that these new capabilities will also become interesting and useful to the nuclear regulator Consequently, the NEAMS program needs to engage with the Nuclear Regulatory Commission as the software is being developed to ensure that they are familiar with and ready to respond to this novel approach when the need arises. Through discussions between key NEAMS and NRC staff members, we tentatively recommend annual briefings to the Division of Systems Analysis in the NRC's Office of Nuclear Regulatory Research. However the NEAC subcommittee review of the NEAMS program may yield recommendations that would need to be considered before finalizing this plan.

2 Background

The vision of the NEAMS program is to bring truly *predictive* modeling and simulation (M&S) capabilities to the nuclear engineering community in order to enable a new approach to the analysis of nuclear systems. This vision leverages advances in high-performance computing, as well as computational science and engineering to change the relationship between experiment and simulation – as has already happened in many other fields of science and engineering. The goal is not to eliminate experiments, but rather to optimize how the measurements are used to gain scientific insight or solve problems of interest. In order to significantly influence the trajectory of nuclear M&S capabilities, NEAMS emphasizes increasing accuracy and fidelity, and broadening the range of applicability of methods. Uncertainty quantification is also considered extremely important to predictive capabilities. At the same time, there is an emphasis on ease of use and integration into current design and safety analysis processes, as well as ease of maintenance and future development of the software. The NEAMS predictive modeling approach is substantially different from current practice in the nuclear industry, which relies much more heavily on models parameterized by experiments. NEAMS anticipates issuing in FY 2018 a full release of its computational toolkit aimed at advanced reactor and fuel cycles.

2.1 Why NEAMS Needs to Engage the NRC

Although the NEAMS program is primarily focused on the DOE R&D community as its primary user base, there is a desire and expectation that, over time, the M&S capabilities being developed by NEAMS will become interesting and useful to the commercial nuclear energy industry as well. A natural consequence of the adoption of NEAMS codes by industry would be their eventual use in a licensing case made to the Nuclear Regulatory Commission (NRC). Therefore, although the NEAMS program is not, directly, producing software for licensing, it behooves us to consider this possibility in order to facilitate adoption of NEAMS software products in industry. In meetings with industry representatives, we have been advised that the most important aspect of this is to ensure that the NRC is not "surprised" by our software or our approach to predictive M&S when the license application is filed. Therefore, NEAMS needs to engage with the NRC as the software and methodology are being developed and matured so that the NRC has the necessary visibility into our work to understand it, and its implications on the licensing process.

2.2 NRC Organization and Structure

The Nuclear Regulatory Commission is an independent federal agency with oversight over commercial nuclear power plants, and other uses of nuclear materials through licensing, inspection, and enforcement activities. Within the NRC, the Office of Nuclear Regulatory Research (RES) is tasked with proposing and coordinating improvements to the agency's regulatory research programs and processes to achieve enhanced safety, efficiency, and/or effectiveness, and develops the technical basis of risk-informed, performance-based regulations in all areas regulated by the NRC. As such, this is the natural point of engagement for NEAMS.

The Office of Nuclear Regulatory Research is further divided into Divisions and Branches, as follows:

- Program Management, Policy Development and Analysis Staff
    - Financial and Performance Management Branch
    - Human Capital and Communications Branch
    - Information Technology and Infrastructure Branch
- Division of Engineering
    - Component Integrity Branch

    - Corrosion and Metallurgy Branch
    - Regulatory Guide Development Branch
    - Instrumentation, Controls, and Electrical Engineering Branch
    - Structural, Geotechnical and Seismic Engineering Branch
- Division of Systems Analysis
    - Reactor Systems Code Development Branch
    - Reactor Systems Analysis Branch
    - Radiation Protection Branch
    - Fuel and Source Term Code Development Branch
    - Accident Analysis Branch
- Division of Risk Analysis
    - Probabilistic Risk Assessment Branch
    - Fire Research Branch
    - Operating Experience and Generic Issues Branch
    - Performance and Reliability Branch
    - Human Factors and Reliability Branch
    - Environmental Transport Branch

3 Strategy

3.1 Discussions with NRC Staff

Our primary strategy for the development of these recommendations came from discussions with NRC staff. Initially, Jim Peltz and David Bernholdt engaged Brett Rini, Technical Assistant to the Director of the Office of Nuclear Regulatory Research. With Brett's help, we organized a teleconference to bring together key NRC and NEAMS staff in which we presented the organization and goals of the NEAMS program, and provided deeper dives on the Fuels and Reactors Integrated Performance and Safety Code activities. NRC staff included representatives from all three technical divisions, with deeper participation from the Division of Systems Analysis. (Details of the teleconference agenda and participants can be found in Appendix A.) That teleconference was considered by the participants to be sufficient to assess the needs and expectations for on-going engagement between the two organizations.

3.2 NEAC Subcommittee Review of NEAMS Program

An additional factor in developing the plan for engagement between the NEAMS program and the NRC stems from the Nuclear Energy Advisory Committee (NEAC) subcommittee, which was commissioned to review the NEAMS program in FY2012. The review subcommittee has not yet completed its final report, but according to an email by Dan Funk[1] headed "NEAC Subcommittee's Preliminary Thoughts/Themes After Review of NEAMS", they expect to call out the need for "stronger industry/regulator interaction and involvement (take a look at what CASL does with its Leadership Team and strategy)" among their recommendations.

[1] Email from Dan Funk to Trevor Cook, Alex Larzelere, James Peltz, and Rob Versluis, dated 24 May 2012, forwarded to the NEAMS PMT by Rob Versluis on 4 June 2012.

4 Recommendations

The consensus of the teleconference participants was that annual briefings by the NEAMS program to primarily the Division of Systems Analysis within the Office of Nuclear Regulatory Research would suffice to keep the NRC informed of NEAMS progress and new developments.

In the context of this recommendation, it is worth noting two other DOE-NRC interactions which bear some relationship to the NEAMS program. First of all, there are quarterly meetings between management of the Office of Nuclear Energy and the NRC. These are fairly broad meetings, spanning a number of offices on the DOE side, including the Advanced Modeling and Simulation Office (AMSO), which oversees NEAMS, and the Offices of New Reactors and Nuclear Regulatory Research on the NRC side. Modeling and simulation is among the many topics that may be discussed at such meetings.

Second is the engagement of the Consortium for the Advanced Simulation of Lightwater Reactors (CASL) engagement with the NRC. CASL engages primarily with staff in the Division of Systems Analysis on a monthly basis through teleconferences, with quarterly face to face meetings planned. Like NEAMS, CASL is managed by AMSO; however CASL was formed specifically to work with the nuclear industry (EPRI, Westinghouse, and TVA) on issues that directly affect the current fleet of commercial reactors in the US. Consequently, CASL's work has an immediate connection to the NRC's regulatory interests and the stronger engagement between them is quite appropriate. Given the cross-leveraging of software between CASL and NEAMS, CASL's more intensive engagement with the NRC will also likely provide them with "previews" of related work in NEAMS.

Prior to finalizing these recommendations, however, we will need to wait for the NEAC review subcommittee's report. Additional discussions may be required to reconcile the review recommendations with the technical assessment based on NEAMS-NRC discussions to date.

4.1 Implications of NEAMS Restructuring

Our discussions with the NRC occurred before the Advanced Modeling and Simulation Office (AMSO) announced its intention to restructure the NEAMS program around reactors and fuels "product lines". However, since the focus of our discussions was on the technical rather than the organizational aspects of the program, the restructuring should not affect the engagement plan.

4.2 Implications for Future Work Package Planning

Because the level of engagement with the NRC is expected to be low – annual briefings, which could be done via teleconference – there is no need to make special accommodations for this activity in planning future NEAMS work packages.

Appendix A Teleconference Agenda and Participants

Monday 26 March 2012

Time	Topic	Speaker/Discussion Leader
3:00-3:30pm	An Overview of the NEAMS Program	Keith Bradley, ANL, National Technical Director
3:30-4:00pm	The Fuels Integrated Performance and Safety Code	Kevin Clarno, ORNL, Alternate Technical Area Lead
4:00-4:30pm	The Reactors Integrated Performance and Safety Code	Tim Tautges, ANL (for David Pointer, ANL, Technical Area Lead)
4:30-5:00pm	Additional Discussion	David Bernholdt, ORNL, Capability Transfer Technical Area Lead

Participants

Name	Affiliation	Role
Kenneth Armstrong	NRC	Technical Assistant, Division of Systems Analysis
David Bernholdt	NEAMS, ORNL	Technical Area Lead, Capability Transfer
Keith Bradley	NEAMS, ANL	National Technical Director
Antony Calvo	NRC	Code Distribution, Reactor Systems Code Development Branch, Division of Systems Analysis
Kevin Clarno	NEAMS, ORNL	Technical Area Lead, Fuels Integrated Performance and Safety Code
Trevor Cook	NEAMS, DOE	Program Manager
Kevin Coyne	NRC	Branch Chief, Probabilistic Risk Assessment Branch, Division of Risk Analysis
Jeanne Dion	NRC	Technical Assistant, Division of Engineering
Chris Hoxie	NRC	Branch Chief, Reactor Systems Code Development Branch, Division of Systems Analysis
Damaris Marcano	NRC	Technical Assistant (Acting), Division of Risk Analysis
Rich Martineau	NEAMS, INL	Principal Investigator, RELAP7
Jim Peltz	NEAMS, DOE	Program Manager
Brett Rini	NRC	Technical Assistant, Office of Nuclear Regulatory Research
Jim Stewart	NEAMS, SNL	Technical Area Lead, Verification, Validation, and Uncertainty Quantification
Xin Sun	NEAMS, PNNL	Technical Area Lead, Fundamental Methods and Models
Tim Tautges	NEAMS, ANL	Reactors Integrated Performance and Safety Code
John Voglewede	NRC	Branch Chief, Probabilistic Risk Assessment Branch, Division of Risk Analysis