Overview of the DOE-NE Nuclear Energy Advanced Modeling and Simulation (NEAMS) Program

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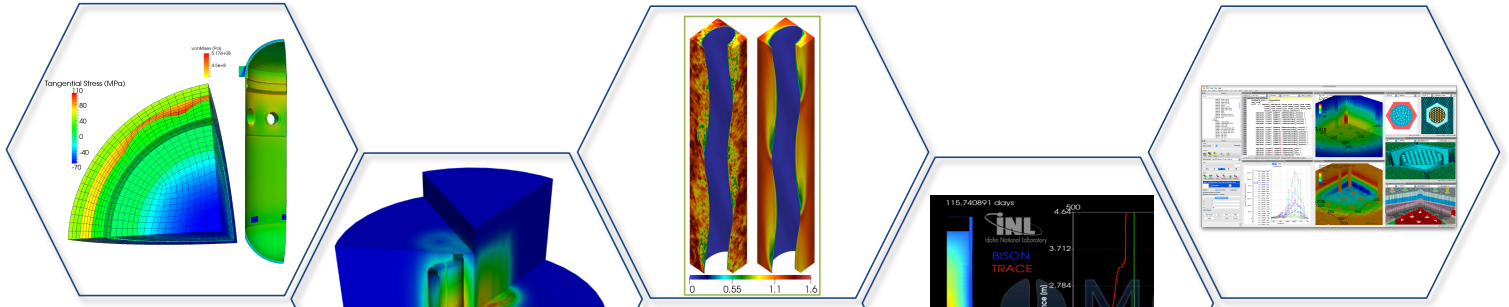
DOE-NE NEAMS Program Overview

Over past decade, DOE-NE has made significant investments in advanced modeling and simulation.

The NEAMS program is a multilab team effort that aims to develop and deploy predictive computer methods for the analysis and design of advanced nuclear reactors. With integration of CASL, LWRs also included in program scope.

NEAMS core competencies:



Multiscale fuel performance and structural materials degradation modeling:
BISON, GRIZZLY

Reactor Physics:
GRIFFIN

Multiscale thermal fluids:
SAM, PRONGHORN, Sockeye, Nek5000

Multiphysics:
MOOSE

Workflow Management:
Workbench

Hallmarks of **advanced mod-sim** are *"multiscale"* and *"multiphysics"* – with the specific goal to be *predictive* through mechanistic insight. Especially important for data poor regimes.

Preferred use of advanced mod-sim is in concert with experiments to solve challenging problems.

Proactive Engagement with Industry

Focus of NEAMS is to balance early stage R&D with industry/NRC relevance.

Overarching goal: Use of NEAMS technology in support of a license application (and/or review), AND the application was submitted(/reviewed) sooner than if NEAMS codes had not been available.

Relationship to GAIN:

- Accurate to think of the NEAMS program as the advanced reactor modeling and simulation arm of GAIN, e.g. a stated core GAIN capability = "Computational capabilities along with state-of-the-art modeling and simulation tools." These capabilities are developed by the NEAMS program.

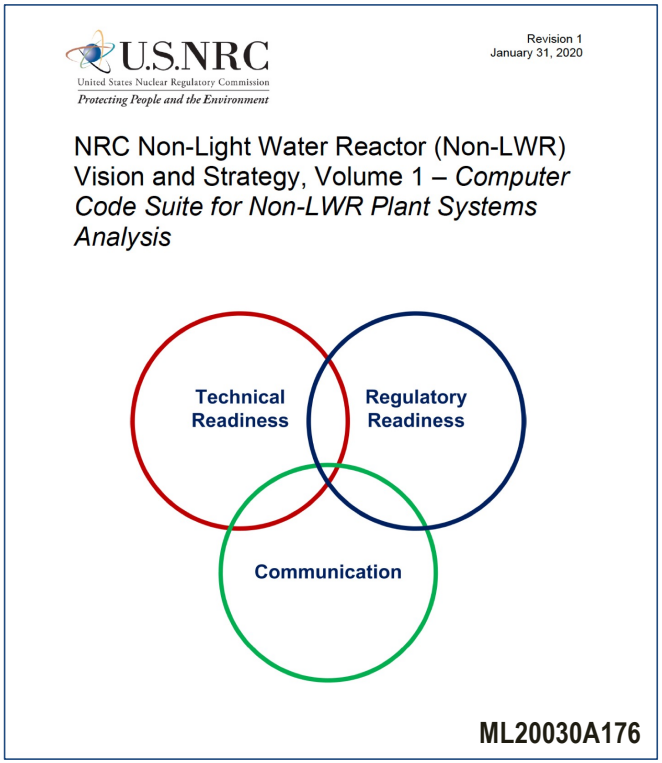
- Furthermore, GAIN Director is a member of the NEAMS Industry Council (chaired by NEI, with additional members from (TWGs, EPRI, Oklo, Framatome, X-energy, Kairos Power, TerraPower, Duke and Southern Company), which aims to continuously engage industry to understand where mod-sim R&D can have most benefit.

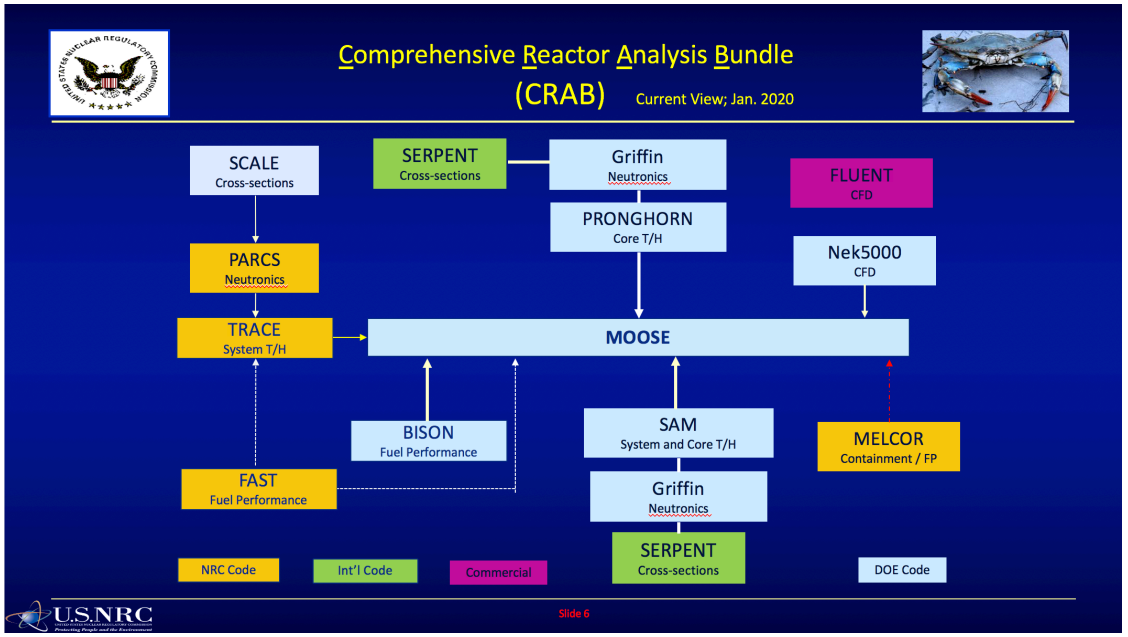
- Recent NEAMS-relevant vouchers with: Framatome, Kairos Power and Oklo – as well as iFOA project with Kairos.

Other funding mechanisms for vendor-specific R&D: NEAMS program develops general capabilities and performs open-literature R&D. However, in addition to GAIN and iFOA, other mechanisms exist for vendor-specific R&D, e.g. NSUF, ARPA-E, etc.

NRC Non-LWR Vision and Strategy, Volume 1:

Computer Code Suite for Non-LWR Design Basis Event Analysis





"The proposed code suite for non-LWR confirmatory analysis makes use of existing NRC codes, and integrates them with several codes developed through the DOE NEAMS program."

NRC Non-LWR Vision and Strategy, Volume 1 (continued):

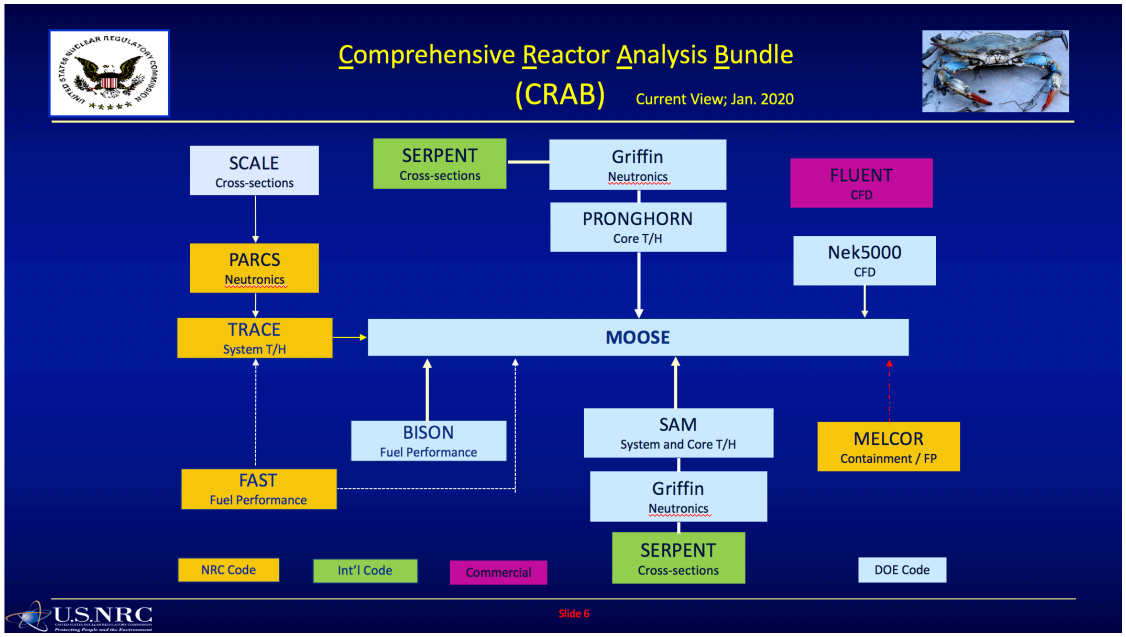
Computer Code Suite for Non-LWR Design Basis Event Analysis

Key takeaways from Volume 1 (and associated presentations) for NEAMS:

NRC has signaled intent to rely on DOE codes for Design Basis Event analysis of non-LWRs

The NRC has stated rather clearly that it is possible for an applicant to maintain independence if NRC and applicant use the same code.

Need for experimental testing may be reduced by high fidelity codes.



First of a kind collaboration with NRC, which if successful will contribute to accelerated deployment of advanced reactors. From program perspective:

failure is not an option.

NEAMS - NRIC Collaboration

Mod-Sim can enhance NRIC's ability to support demonstration projects

- Design analysis
- Confirmatory safety analysis
- Operations and shielding

NRIC is catering to a diverse set of nuclear reactor designs with variation in:

- Power
- Size
- Coolant
- Fuel-form

Therefore, a flexible mod-sim architecture is needed - and pluggable set of tools from NEAMS fits perfectly

- Utilizing MOOSE, all tools can couple seamlessly to each other
- Can be mixed/matched to achieve desired simulations

NEAMS and NRIC have formed a partnership

- NRIC will utilize and extend NEAMS-developed tools
- NEAMS will view NRIC as a stakeholder and receive feedback
- A Virtual Test Bed (VTB) will be created by NRIC to house simulations of demonstration reactors and provide a repository of examples of combining the NEAMS tools for vendor use

Microreactor Example

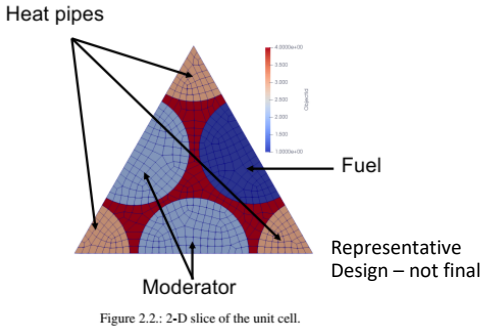
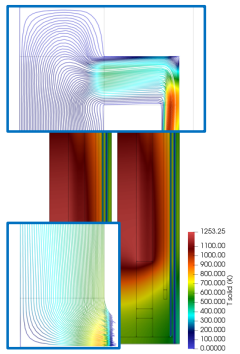


Figure 2.2.: 2-D slice of the unit cell.

Griffin + Sockeye + BISON

HTGR Example



Griffin + Pronghorn + RELAP-7 + BISON