NRIC National Reactor Innovation Center

NRIC-NEI-EPRI Nuclear Quality Assurance Challenges Workshop

December 5-6, 2024

Brad Tomer, Acting Director, Chief Operating Officer
National Reactor Innovation Center, Idaho National Lab
nric.inl.gov

NRIC is a DOE program launched in FY'2020

NRIC Enables Nuclear Reactor Tests & Demonstrations

- Authorized by the Nuclear Energy Innovation Capabilities Act (NEICA)
  - DOE-Office of Nuclear Energy; INL Nuclear Science & Tech
- Partner with industry to bridge the gap between research and commercial deployment
- Leverage national lab expertise and infrastructure
- Collaborative approach

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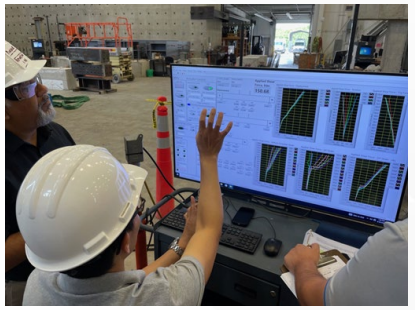
Portfolio Built to Empower Innovators

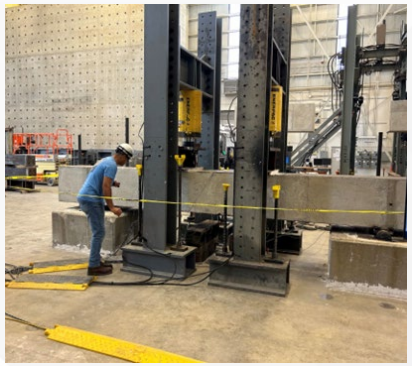
- **Building testing foundation**
  - Advanced Reactor Test Beds
  - Experimental Facilities
  - Virtual Test Bed
- **Addressing Costs & Markets**
  - Advanced Construction
  - Digital Engineering for Nuclear
  - Maritime Applications

Advanced Construction Technologies

Demonstrate technologies that:

- Reduce cost of new nuclear builds by 10%+
- Compress construction schedule by as much as 25%
- Reduce required site work & improve overall quality of structure
- Support long-term structure monitoring





Phase One (Expected completion Dec 2024)

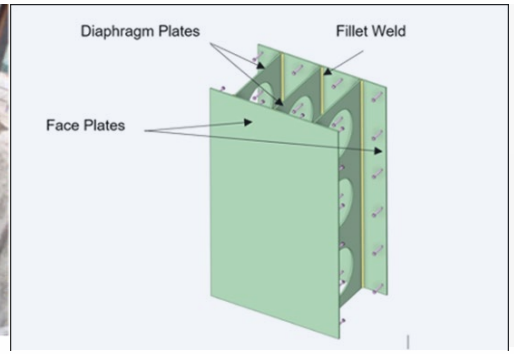
- Prototype modular steel/concrete composite walling system
- Developed non-destructive examination and welding techniques
- Demonstrated strength of wall systems

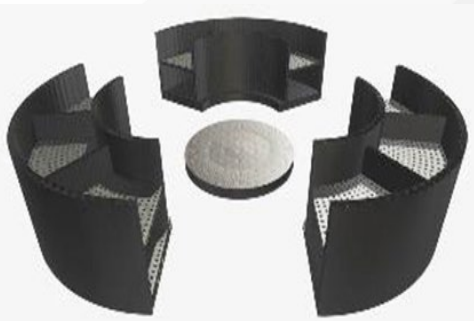
Optional Phase Two (Expected start Jan 2025)

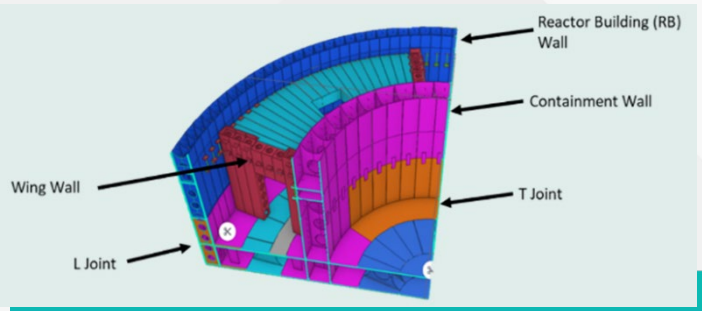
- Demonstrate 60-degree pie shape containment walling system
- Inner and outer walls, base mat integration, multi-story
- Deploy digital twin plus sensor technology for monitoring

Team – General Electric Vernova

EPRI, Black & Veatch, Purdue, UNCC, Nuclear Advanced Manufacturing Research Centre, Aecon, and Tennessee Valley Authority







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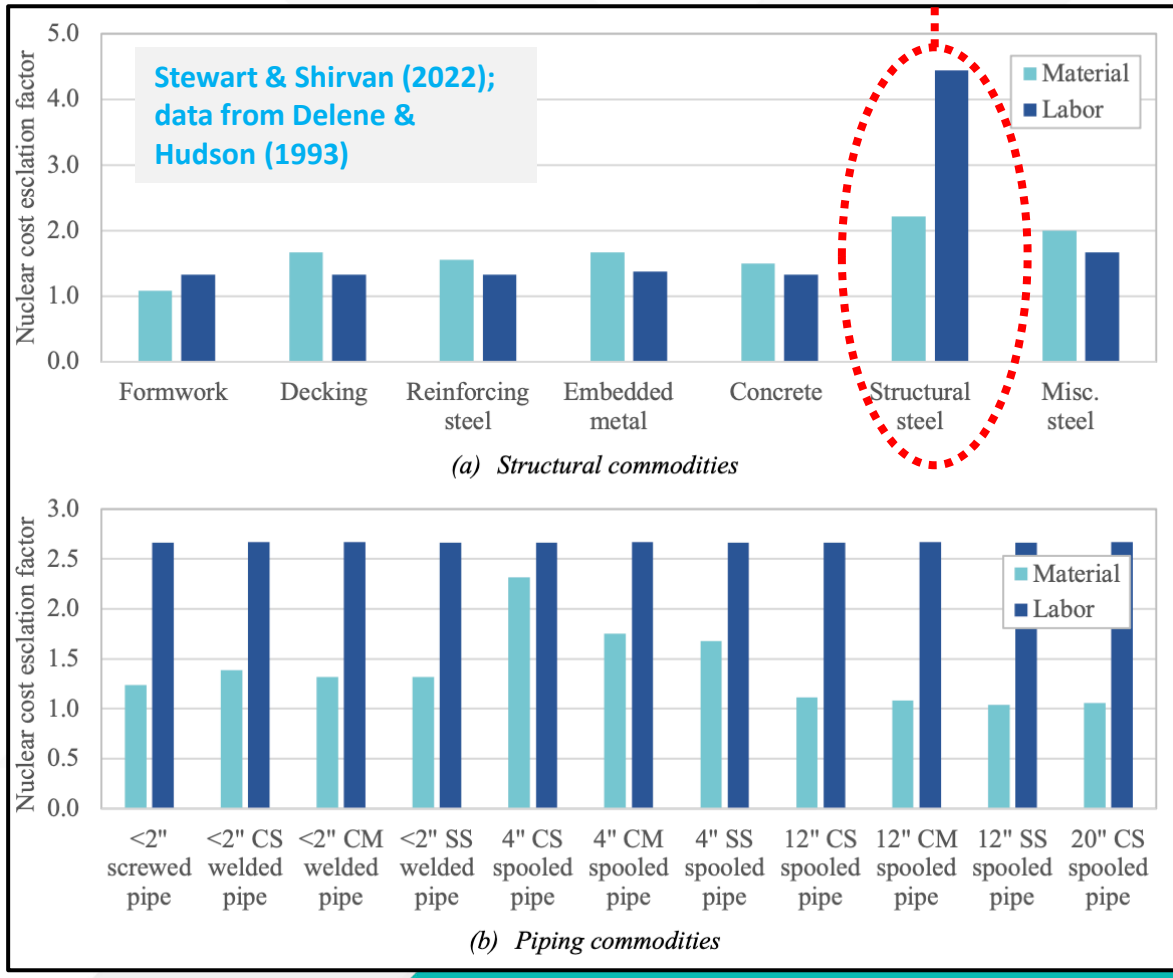
Nuclear Quality Assurance Challenges

- **Economics**: Studies have shown significant cost escalation associated with meeting nuclear quality assurance standards (10 CFR Part 50 Appx B and ASME NQA-1)
- **Supply chain**: Due to lack of recent activity, nuclear-certified suppliers are sparse, causing supply-chain bottlenecks (and further cost escalation)
- **Leveraging other Industries/modernization:** Nuclear quality requirements were developed independently from the non-nuclear industry, which has evolved significantly in their QA/QC processes (e.g., manufacturing, software)
- **Recognition of Advanced Reactor Intrinsic Safety:** the designs of advanced reactors mitigate many of the risks associated with LWRs through innovative or intrinsic features. Risk informed quality requirements are lacking due to cultural issues and lack of guidance.



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Potential Solutions

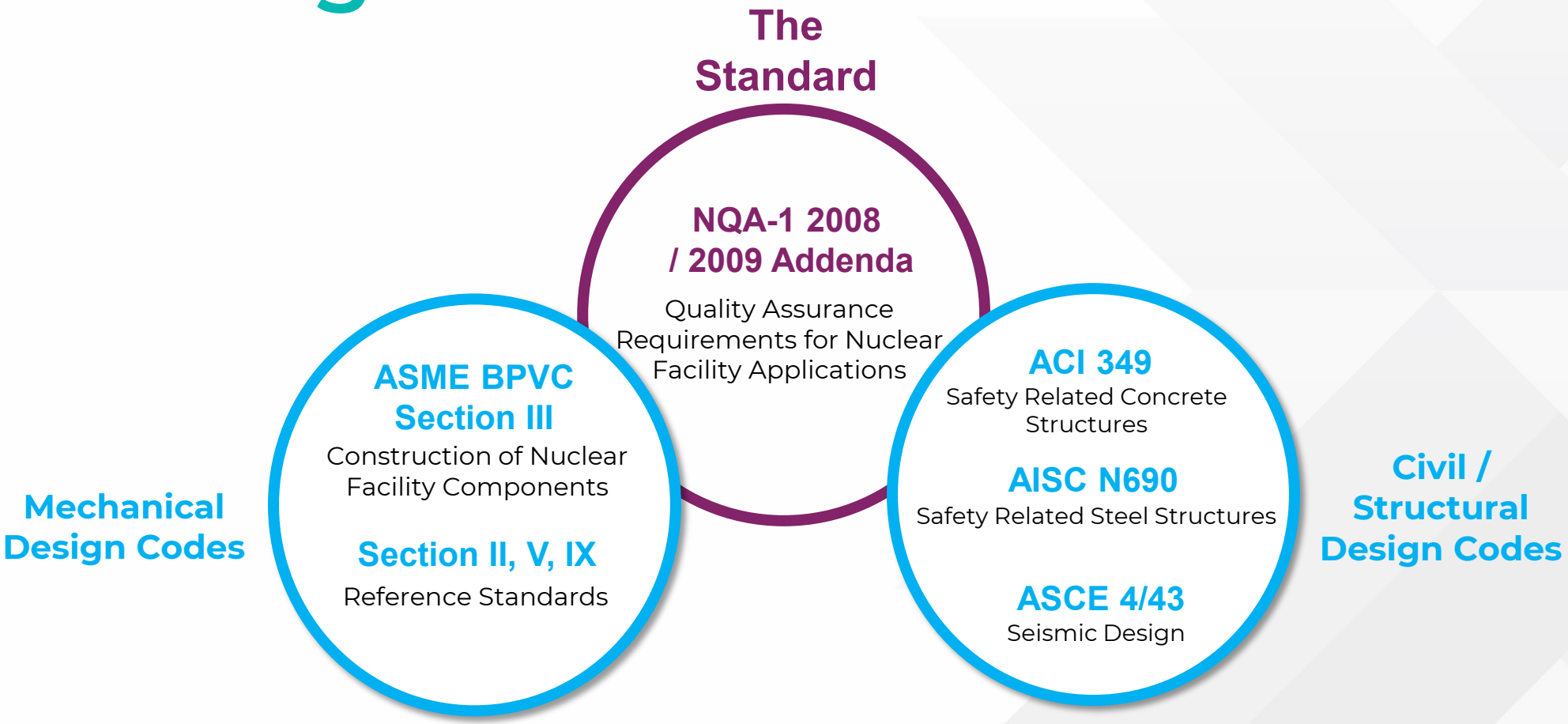
- Use Risk-Informed Performance-Based (RIPB) approaches to minimize the number of safety-related systems and components in the plant
- Develop organized trainings, workshops, and guidance for an efficient implementation of NQA-1, code quality requirements, and RIPB methods
- Use of non-nuclear supply chain: Improve use of commercial grade dedication (CGD) processes or develop a pathway to meet Part 50 Appx B requirements using ISO 9001 / ISO 19443
- Develop pathway to apply non-nuclear design codes to nuclear industry (e.g., BVPC section III vs section VIII)
- Use of digital engineering and digital twins to manage and ensure quality as well as other requirements

NRIC NQA-1 Feasibility Study

- NRIC is leading a DOE-funded study to develop a feasibility study on potential options for reducing quality assurance related cost escalations. (Sep 2024 – Feb 2025)
- **Scope**
  - Review the differences between nuclear and non-nuclear quality assurance standards and best practices, and how they impact safety, and quality of the final product.
- **Nuclear Quality Assurance Challenges Workshop**
  - Purpose: Gather input on a variety of on pain points in the application of NQA-1, best practices, and potential solutions
  - Stakeholders: Industry groups; advanced and light water reactor developers; nuclear and non-nuclear EPCs, vendors and suppliers; NRC
  - Focus: Civil construction (major cost driver); other safety-related systems, structures and components; software
  - Use workshop input to develop a feasibility study and potential roadmap incorporating various solutions and cost mitigation strategies (Feb 2025)

Quality Source Requirements

Quality Source Requirements Challenge



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Agenda Overview

December 5-6, 2024

Chandu Bolisetti, Senior Scientist

Idaho National Laboratory

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Organizing team

- **NRIC/INL:** Luke Voss, Sanjay Mukhi, Fred Sock, Jen Davlin, Mike Fish, Spencer Daw, Lana Lawrence, Jason Christensen, and Allison Anderson
- **Purdue Applied Research Institute (PARI):** Amit Varma, Sanj Malushte, and Rinaldo Hunt
- **MPR Associates:** Collin Clark, Mike Dunkelberger, and Pete Carlone
- **NEI (co-sponsor):** Mark Richter and colleagues
- **EPRI (co-sponsor)**: Hasan Charkas, Marc Tannenbaum, and colleagues

Idaho National Laboratory

MPR

PURDUE APPLIED RESEARCH INSTITUTE

NEI NUCLEAR ENERGY INSTITUTE

EPRI ELECTRIC POWER RESEARCH INSTITUTE

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Session overview

- **Session 1:** State of Practice in Nuclear Quality Assurance (Chair: Jen Davlin)
- **Session 2a:** Design and Construction Quality Requirements and Specifications: Civil Structures (Chair: Luke Voss; *George Washington University Room*)
- **Session 2b:** Design and Construction Quality Requirements and Specifications: Mechanical Structures and Components (Chair: Mike Dunkelberger; *Georgetown University Room*)
- **Session 3:** Initiatives to Address Nuclear Quality Assurance Challenges (Chair: Jen Davlin)
- **Session 4:** Reactor Developer Perspectives on Opportunities for Improvement (Chair: Sanjay Mukhi)
- **Session 5:** Brainstorming Potential Solutions and their Feasibility (Chair: Jason Christensen)

Note: The workshop is being recorded, and talks will be posted online.

Agenda and Speaker Bios

AGENDA

EVENT WEBSITE
(includes speaker bios)

After the workshop

- Presentations and recordings will be posted on the event website
- A report containing the workshop summary and resulting recommendations will be compiled and published
  - Summaries of discussions in each session
  - With the recommendations made in session 5, a feasibility matrix of potential solutions will be developed
- Timeline
  - Send session summaries for review to speakers and participants (Dec 13th)
  - Collect feedback on session summaries from speakers and participants (Jan 16th)
  - Report will be made public in Spring/Summer 2025

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