Development of Standard For SC Composite Walls in Safety-Related Nuclear Facilities: Current Progress

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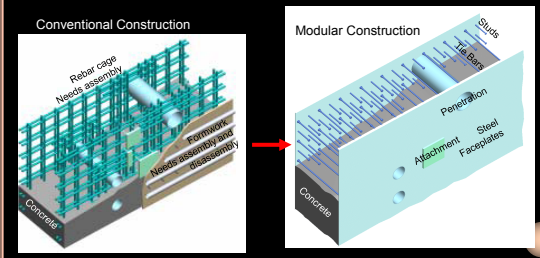
Introduction

- Modular SC Construction



Motivation

- Modular construction
- Construction efficiency
- Structural effectiveness
- Impact resistance
- Used in AP1000(R), US-APWR(R) as part of containment internal structures, and external shield building

AP1000, Sanmen, PRC

(c)WEC

Motivation

- Licensing challenge
- Lack of US Standard or Design Code
- Project specific design criteria, methodology
- Confirmation of design assumptions and performance using large-scale tests and numerical simulation
- Rigorous review requiring significant technical expertise on both sides

Lessons Learned and Success Gained

- New and innovative, but proprietary technologies are being developed by industry to harness economy, efficiency, and safety
- NRC reviewers and regulators have to assess the safety and feasibility of these technologies, but details are available only when submitted on the docket.
- Reviews are rigorous, extensive, and technically complex requiring a common understanding between the NRC and industry regarding the performance expectations of the design. This requires iterative communication until consensus is reached.

Success Gained

- NRC regulators and industry have successfully completed major reviews and licensing of structures with SC composite walls.
- There has significant development and communication through RAI process, public meetings, and audits etc.
- Although project specific, this has paved the way for the development of standard for SC walls in nuclear structures.

Advantages of Having a Standard

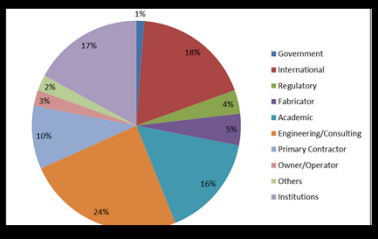
- Documented consensus regarding minimum requirements and performance objectives for the design
- Opportunity for NRC to review and take official position. Accept the standard with documented exceptions
- Clarity of communication, expectations, and performance requirements between regulators, industry, and owners
- Expedites review process, assists during construction review → path to success

Objective of SC Standard

- Develop a US Standard or design code based on experimental and numerical research performed in Japan, Korea, and the US including findings from the project specific tests done during the licensing process
- AISC N690 – Specification for Steel Structures in Safety-Related Nuclear Facilities
- Appendix N9 – Specification for SC Composite Walls
- Supplement to AISC N690 - 12

AISC TC 12 Ad-Hoc Subcommittee

- First Meeting Nov. 2006. Conducted a total of 15 meetings and many conference calls
- Has 20 active members. Attendees include guests from a variety of institutions as well as international participation



Schedule to Completion

- The standard has been balloted by the AISC TC12 Committee on Nuclear Structures.
  - 1st Ballot – June 2012
  - 2nd Ballot – Nov. 2012
- Balloting by the AISC Committee of Specification ongoing
  - Reformatting and preparation – June 2013
  - 1st Ballot – Nov. 2013 (Passed successfully)
  - 2nd Ballot – May 2014 (Scheduled)
  - Public review – April 2014 (Scheduled)
  - 3rd ballot and public review – September 2014
  - Final standard to AISC Board – December 2014
  - ANSI Certification – Feb. 2015

Schedule to Completion

- 1st Ballot shared with NESCC. Distributed to members and partners for comments.
- Collaboration will continue. NRC will review public documents as well.
- RG for composite SC walls will be developed.
- SMR applications.

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Layout and Organization of App N9

- N9.1 Design Requirements
- N9.2 Analysis Requirements
- N9.3 Design of SC Walls
- N9.4 Design of SC Wall Connections
- N690-12 Specification Additions
  - NA3 – Materials
  - NB2 – Loads and Load Combinations
  - NM2 – Fabrication, Erection, and Construction
  - Inspection of Composite Construction

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Acknowledgments

- AISC
- NRC
- Purdue University
- DOE