

**NRC 37th Regulatory Information
Conference (RIC)
Codes and Standards for New and
Advanced Reactors**

**ARCSC Prioritization of Codes and
Standards for Advanced Reactors**

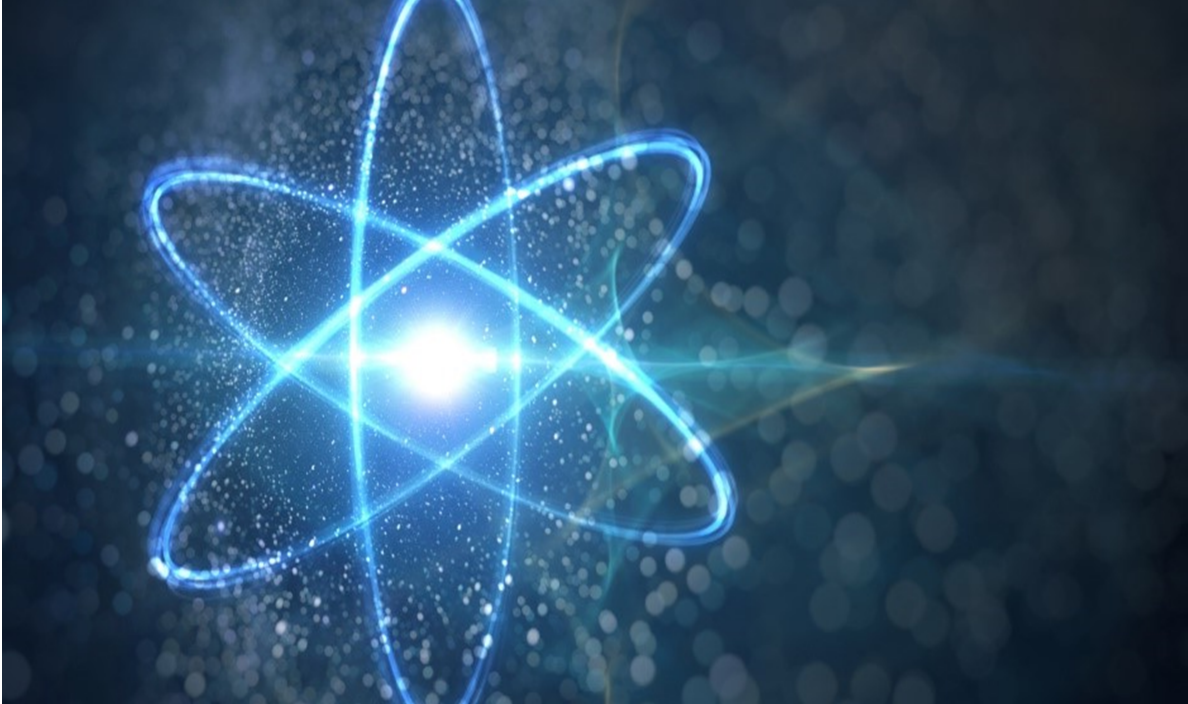
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Clean Energy, and Standardization Codes and
Standards
Immediate Past Chair ARCSC**

**March 12, 2025
Bethesda, MD**



**Advanced Reactor
Codes and Standards
Collaborative**

ARCSC Prioritization of Codes and Standards for Advanced Reactors - RIC - March 12, 2025



NRC ADVANCE Act of 2024 Aligns with ARCSC Objectives

- Accelerates deployment of advanced nuclear technologies, promotes greater efficiency and timeliness in the NRC processes and modernizes the oversight and licensing of the operating fleet of reactors
- Opportunity for NRC to accept existing codes and standards where they can be demonstrated to cover the area of applicability for the intended use in the nuclear industry, augmenting where nuclear requirements and conditions are different
- NRC develops performance-based graded options in its regulatory framework to increase flexibility
- Complimentary to ARCSC objectives and avoids unnecessary duplicate work

ARCSC Prioritization of Codes and Standards for Advanced Reactors

Review of ARCSC Formation,
Objectives, Roadmap Process,
Activities

Identified high priority standards by
standards development organization
(SDO)

Verified high priority standards with AR
Developers

ARCSC Future Actions

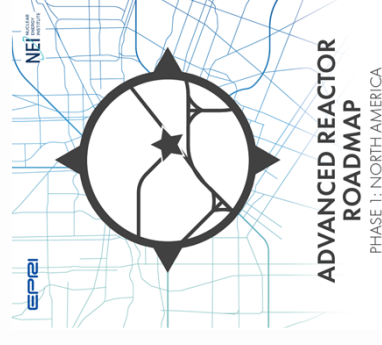
Review of ARCSC Formation, Objectives, Roadmap Process, Activities



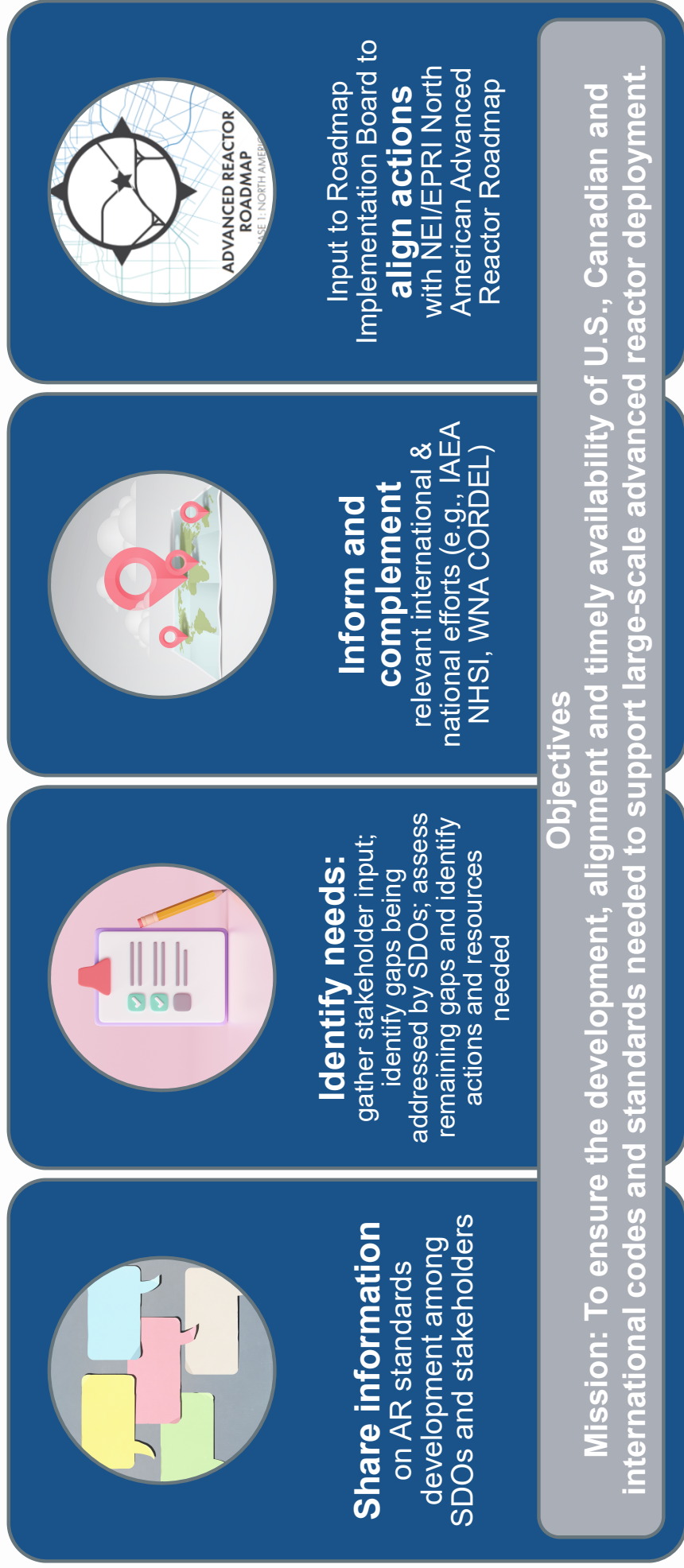


Advanced Reactor Codes and Standards Collaborative

- Need for ARCSC came out of the NEI/EPRI North American Advanced Reactors Roadmap to enable and expedite commercialization of advanced reactors.
- ANS, ASME, and CSA Group are founding members of ARCSC with support from NEI and EPRI.
- ARCSC has grown considerably and now includes representatives from ASCE, IEEE/NPEC, AISC, NRC, DOE, ISO, INPO, COG, WNA, CNSC, IAEA, IEC/ISA, INL, CANDU Owners Group, Deep Fission, Westinghouse eVinci Nuclear Test Reactor, X-energy, TerraPower, and General Electric and growing

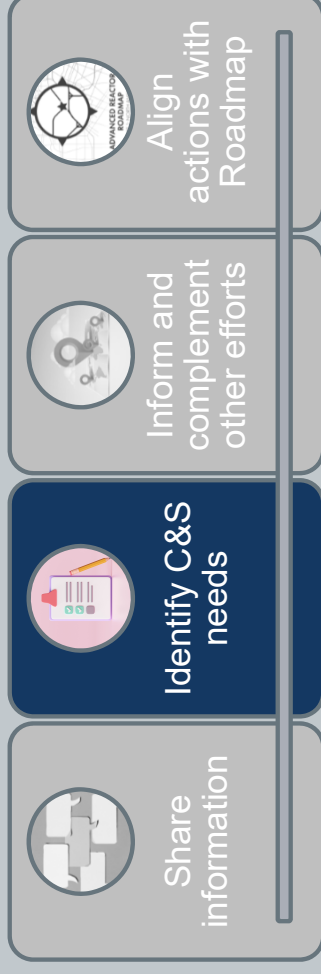


ARCSC Charter and Goals



Needs Assessment Survey #1 Process and Results

CS-01: Identify gaps in and
timelines for advanced
reactor codes and standards



Identify C&S Needs: Next steps - SDO committee(s) disposition of survey results

Outreach/raise awareness (about overall initiative and status/ways to engage in SDOs' standards development activities)

ARCSC

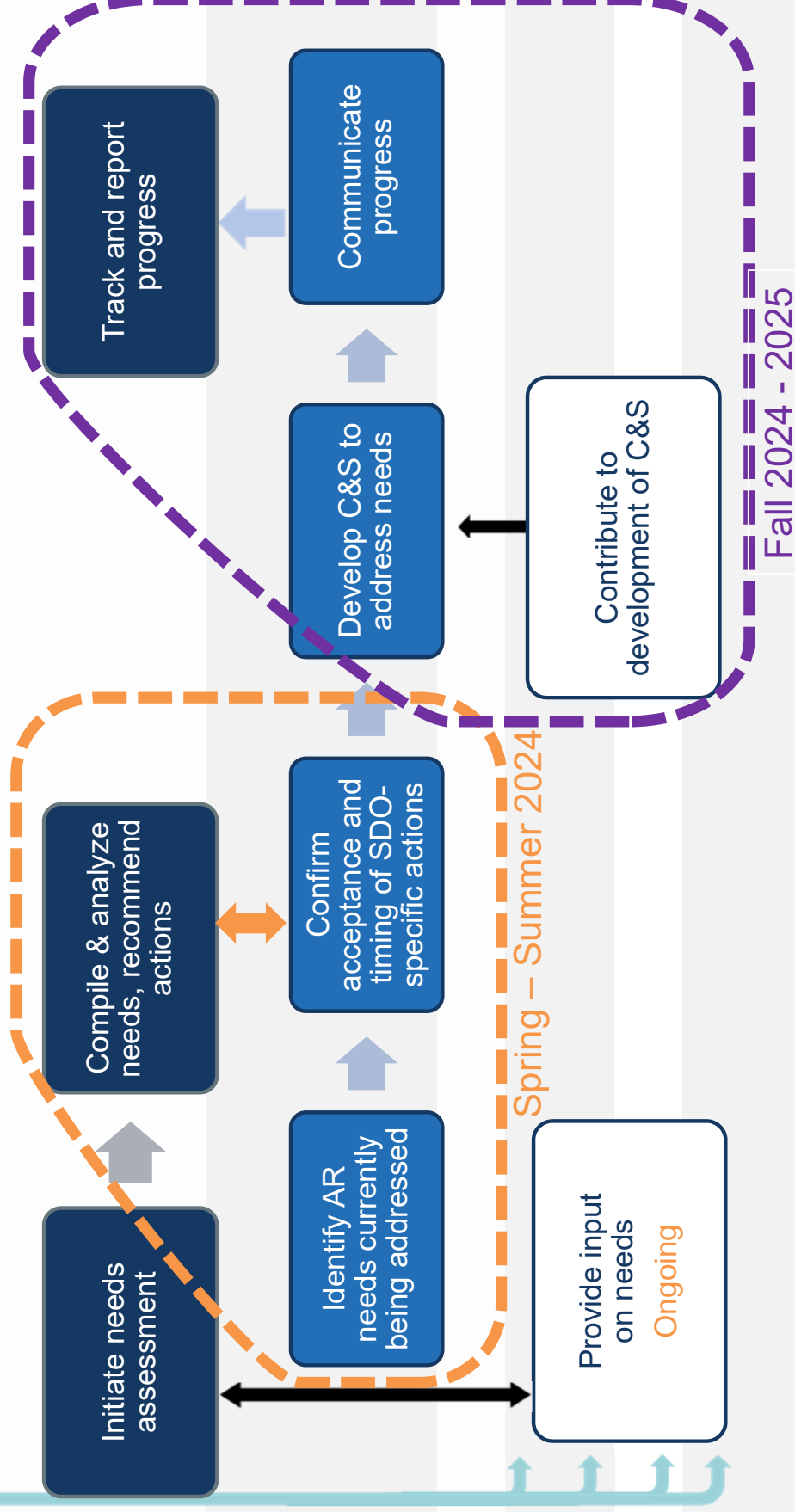
SDO committees

AR developers

Industry (owner /
operators,
suppliers)

Regulators

Research (national
labs, academia)



Process to Translate SDO Committee Responses of Master Spreadsheet

SDO committee questions:

- 1. Is there a **gap identified?** Y/N
- 2. [If Y] **Committee disposition of gap:** Persuasive (P) | Non-persuasive (NP) | Non-germane (NG) | Needs more investigation (NMI)
- 3. [If Persuasive] **Proposed action** to address gap: New standard | Update | Other solution
- 4. [Optional] **Anticipated timeline** for action to address gap: Start date | Completion date
- 5. [Optional] **Anticipated resources** needed for action to address gap: Liaisons | Technical basis | Funding

SDO	Designation	Title	Status	Applicable to ARs?	Relevant topical area	Gap identified from survey?	SDO input: gap disposition (P, NP, NG, NMI)	SDO input: proposed action to address gap	SDO input: timeline to address	SDO input: resources needed (liaisons/input from other SDOs, R&D, RIB, funding)

ANS Priorities from ARCSC Gap Assessment Survey



- *ANS-2.26-202x, Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design [revision of ANSI/ANS-2.26-2004 (R2021)]*

- *ANS-6.4-202x, Specification for Radiation Shielding Materials [revision of ANSI/ANS-6.4-2006 (R2021)]*
- *ANS-15.8-202x, The Quality Assurance Program Requirements for Research Reactors [revision of ANSI/ANS-15.8-1995 (R2023)]*
- *ANS-53.1-202x, Nuclear Safety Design Process for Modular Helium-Cooled Reactor Plants [revision of ANSI/ANS-53.1-2011 (R2021)]*
- *ANS-54.8, Liquid Metal Fire Protection [proposed new standard/supersedes ANS-54.8-1988 (W1998)]*
- *ANS-X (New) generic standard on risk-informed, performance-based design process*

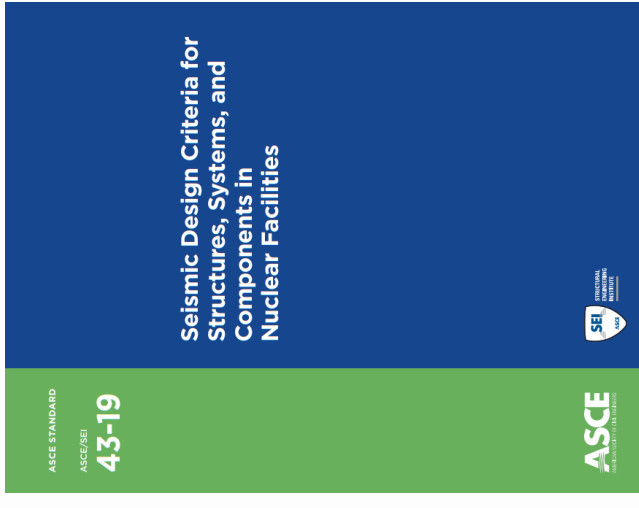
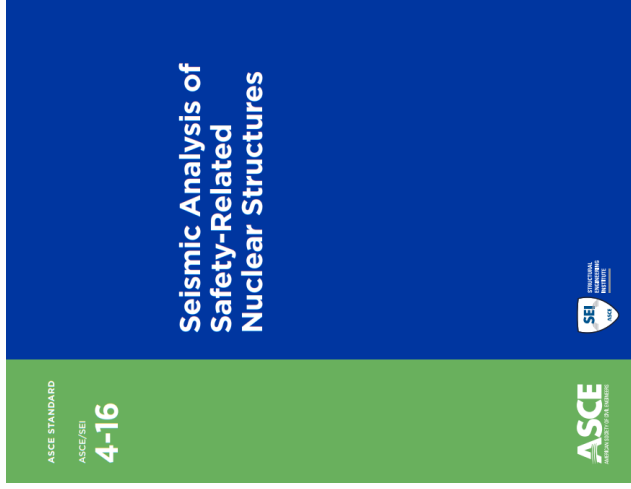
ASME Priorities from ARCSC Gap Assessment Survey

HIGH PRIORITY

- BPV Section III, Division 1: Seismic Analysis
- BPV Section III, Division 5: High Temperature Materials for SMRs
- BPV Section III, Division 5: Graphite Materials
- BPV Section XI, Division 2: Inspection Protocols for Graphite and RIM for Sodium Fast Reactor
- Operations & Maintenance Code: OM-2-2024 addresses advanced reactors, including non-LWRs
- Qualification of Mechanical Equipment Standard:
Update for advanced reactors, including non-LWRs and risk-informed qualification processes
- Nuclear Quality Assurance: Considerations for graded QA applications

ASCE Standards Activities

- No specific priorities identified in survey feedback, per se
- Need to update the standards
- Plan to merge ASCE/SEI 4, *Seismic Analysis of Safety-Related Nuclear Structures* and ASCE/SEI 43, *Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities*



Preliminary Results from Advanced Reactor Designers Verification Survey #2

CS-01: Identify gaps in and
timelines for advanced
reactor codes and standards



Survey 2: Example of Survey Questions

6. Check if the following criteria applies to the standard:

- (1) Supports design efforts
- (2) Supports licensing review
- (3) Reduces component fabrication time and costs
- (4) Reduces facility construction time and costs
- (5) Reduces O&M costs

7. How would you prioritize the identified gaps? High/Med/Low

8. Comments on the gaps

9. By when would your organization need changes?

- Within 1 year (2025)
- Within 3 years (2027)
- Within 5 years (2029)
- Within 8 years (2032)
- Within 10 years (2034)
- Not relevant to my organization

ANS-2.26

ANS-2.26 Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design

ARCSC Proposed Prioritization: HIGH

Identified Gaps:

- Harmonization with LWP and limit states (ACI 349)

6. Please check the following criteria that ANS-2.26 meets.

☐

(1) Supports design efforts

☐

(2) Supports licensing review

☐

(3) Reduces component fabrication time and costs

☐

(4) Reduces facility construction time and costs

☐

(5) Reduces O&M costs

7. How would you prioritize the identified gaps in ANS-2.26?

	High priority	Medium Priority	Low Priority
Harmonization with LWP and limit states (ACI 349)	☐	☐	☐

8. Comments on the gaps for ANS-2.26 (if none, please leave blank)

Enter your answer

9. By when would your organization need changes to ANS-2.26?

☐ Within 1 year (2025)

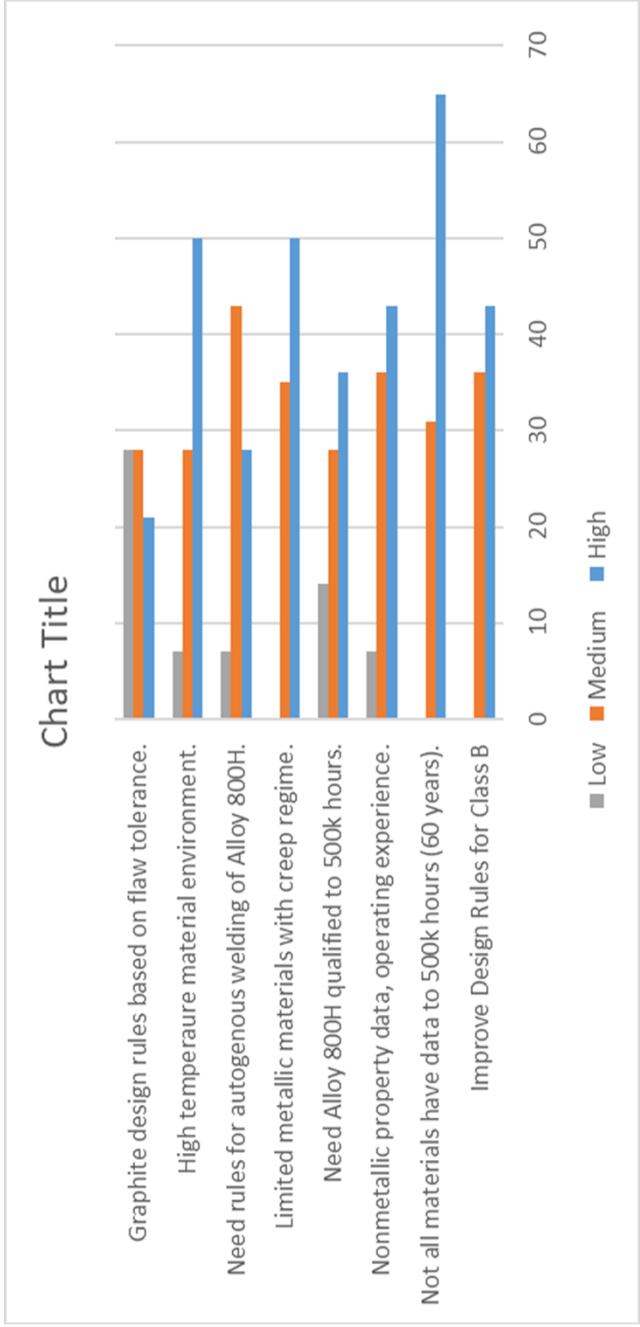
ARCSC Advanced Reactor Validation Survey

- Validation survey issued 10/7/24 targeted to advanced reactor developers to confirm SDO priorities from 2023 Gap Assessment Survey
- Validation survey initial due date of 10/31/24 extended to 11/7/24
- Included 38 advanced reactor developers included representing 20 advanced reactor companies
- 14 responses received as of 11/25/24 from the following:

○ ARC Clean Technology ○ BWX Technologies ○ Framatome ○ General Electric Hitachi (2) ○ General Electric Vernova	○ Nuclear Energy Institute ○ Oklo ○ TerraPower (4) ○ Terrestrial Energy ○ X-energy
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ASME BPVC III Division 5

■ How would you prioritize the



Gaps and comments:

- Agree with the items identified. Of all the standards, this represents our likely highest priority effort.
- Broadening the range of acceptable materials for HTRs and their qualification basis
- Improving code language for fuzzy terms like graphite degradation phenomena/flaw tolerance
- We all should accept there will be at best provisional NRC endorsement pending successful and complete implementation.
- Rules for autogenous welding is a general need, not specific to any alloy (clarification of the suggested gaps), though any rules would require material-specific data.
- The rules for Graphite Material qualification are prohibitively over-constraining. Graphite data is grade-specific – this is a barrier to entry for any new graphite suppliers which don't already have the substantial volume of irradiated data expected.

By when would your organization need changes?

- 5 within 1 year
- 5 within 3 years

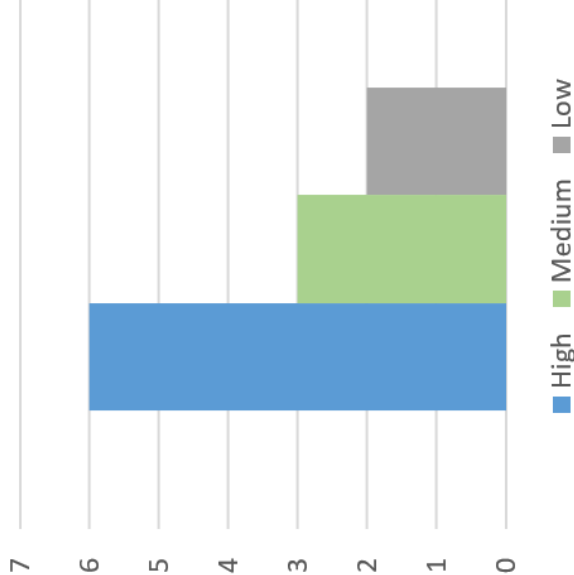
ANS-2.26, Categorization of Nuclear Facility SSCs for Seismic Design

By when would your organization need changes to **ANS-2.26**?

3 within 1 year; 6 within 3 years

1 within 5 years (but marked high priority)

ANS-2.26 Priority



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Gaps and comments:

- Harmonization with LMP and limit states (ACI 349).
- Graded criteria for reactor risk profile is greatly appreciated. (NEI)
- Agree that further work to clarify risk-informed methods of establishing seismic design criteria will be immensely beneficial to developers. (BWXT)
- Need to coordinate / harmonize all seismic C&S. (GE-H)
- Use of ANS-2.26 is near term but not implementing LMP. (Oklo)

NOTE: The SDC-1 classification originates from ANS-2.26, which establishes the seismic categorization framework for nuclear facilities. This standard serves as a fundamental reference for all nuclear facilities and is incorporated into other nuclear-related seismic design standards, including ASCE seismic standards. ANS and ASCE support each others' working groups.

NRC representatives:

- Mr. Hanh Phan (ANS-2.26 Co-chair)
- Mr. Nicholas Hansing (member)

Target completion of draft:

- 2025

Endorsement:

- Endorsement will be sought

CSA N285.0/N285.6 Series

How would you prioritize the identified gaps in CSA N285.0/N285.6 Series?

● High priority ● Medium Priority ● Low Priority

CANDU and water specific; should be expanded



Gaps and comments:

- Need to update CSA N285 to include ASME Section III Division 1 and Division 5 for new reactor designs outside of CANDU such as BWR and SFR
- Areas that might not align with advanced technologies: classification of systems, special safety systems, registration of pressure boundary and pressure retaining components; Registration of welding and brazing procedures; Quality program implementation; Supplementary construction and installation requirements; rules and testing for specialized materials.
- Areas that might not align with other coolant technologies: Tritium radioactivity criteria, considerations for overpressure protection.
- Need a new system for passive special safety systems

By when would your organization need changes?

- Within 1 year: 3 responses
- Within 3 years: 2 responses
- Within 5 years: 2 responses
- Within 8 years: 1 response

ASCE 92, Performance-Based Seismic Analysis and Design of Safety-Related Nuclear Facilities

- ASCE "92" is a desired number (= atomic number for uranium). The standard is not new but rather a merger of ASCE 4 and ASCE 43.
 - A draft could be ready for public comment by the end of 2025.
 - AR developers are represented on the committee, unlike in prior cycles. We look forward to their active engagement in the process.
-
- ASCE is committed to active engagement with the NRC staff and are grateful that members of the staff (e.g., Dr. Jose Pires and Dr. Thomas Weaver) have connected with us on a very regular basis.
 - Additional NRC engagement with the committee would be beneficial. (Currently, only one NRC rep on the working group.)
 - NRC endorsement will be requested. NRC will be kept informed of developments.
 - ASCE 92 has two audiences (NRC and DOE).
 - NRC may only wish to endorse parts of the standard.
 - ASCE will be written for analysis, design, and construction across multiple scales (i.e., large light water reactors to microreactors), and maybe "ahead" of NRC regulations on some topics.



IEEE Standards for Advanced Reactors

Recently published IEEE standards with criteria to address advanced reactor design needs:

- Standard for Qualifying Alternating Current Class 1E Motors for Nuclear Power Generating Stations
- Instrumentation and Control Important to Safety - Electrical Equipment Conditioning Monitoring
- Standard for Qualifying Class 1E Protective Relays and Auxiliaries for Nuclear Power Generating Stations
- Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations
- Standard for Application of the Single Failure Criterion to Nuclear Power Generating Station Safety Systems
- Standard for the Design and Qualification of Class 1E Control Boards, Panels, and Racks Used in Nuclear Power Generating Stations

- IEEE Nuclear Power Engineering Committee (NPEC) has not published standards that are only applicable to advanced reactors.
- NPEC has made changes to several of its standards to adapt criteria to the concepts being presented by advanced reactor designs.
- Many active working groups already have membership representation from advanced reactor developers.
- NPEC standards follow a set periodic update process; NPEC is currently evaluating to determine if ARCSC survey feedback warrants changes to existing revision schedules.
- NPEC and its working groups have good participation from NRC representatives.
- NPEC periodically writes a letter to the NRC making suggestions on endorsement priorities. A new letter is currently being prepared.

ARCSC Future Actions



Share
information



Identify C&S
needs



Inform and
complement
other efforts



Align
actions with
Roadmap

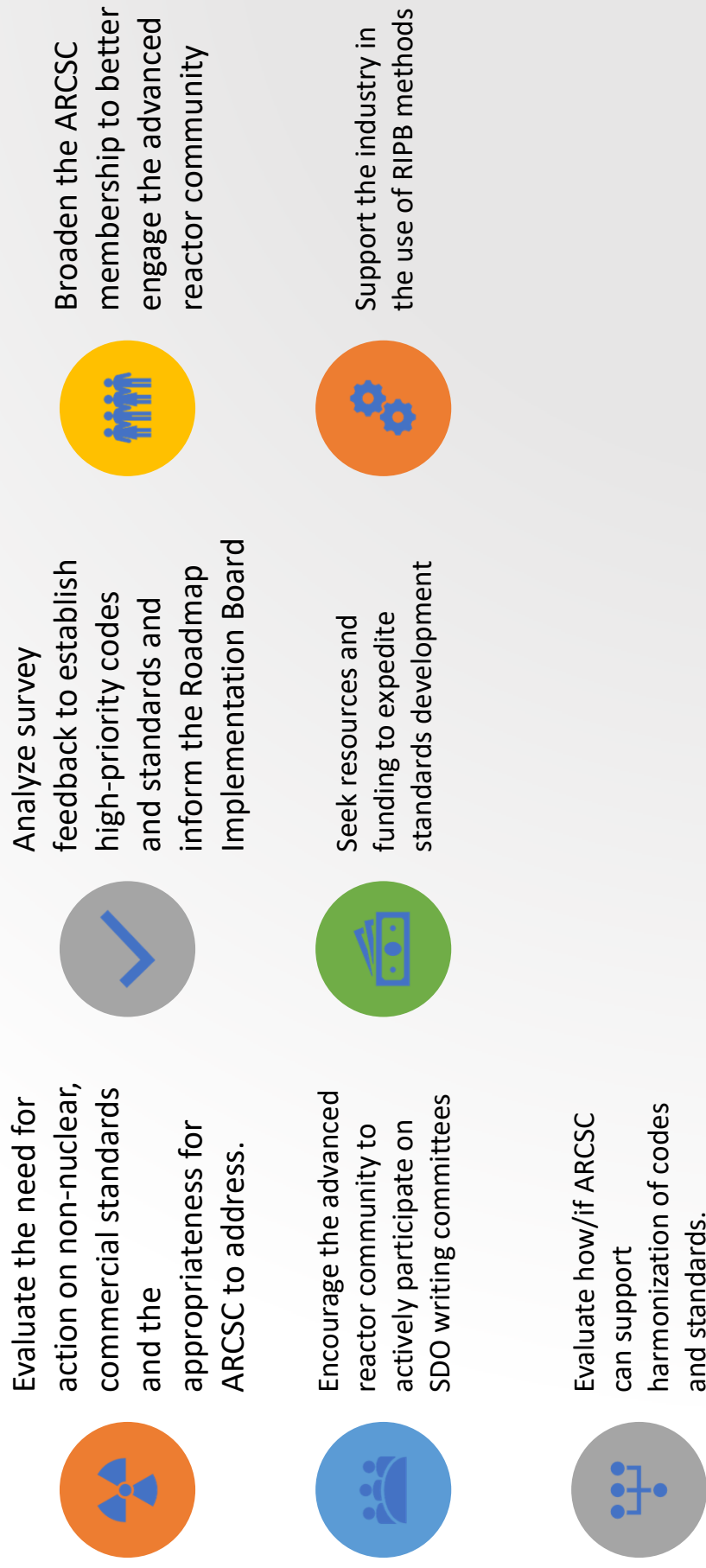


Advanced Reactor Codes and Standards Collaborative

Other topical areas that could require a "gap assessment"

Structural design, construction, materials, inspections	I&C, safety systems	Safety analysis (include nuclear safety basis)	Environmental management	Radioactive waste management	Decommissioning
Emergency management and fire protection	Security including cyber security	Packaging and transport	Human performance/personnel certification	Event/Accident Analysis	Operational Readiness
	Configuration Management	Commercial Grade Dedication	Commissioning	Technical Readiness	

ARCSC Future Actions



Thank you!

Contacts

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