Advanced Reactor Codes and Standards Collaborative

Advanced Reactor Digital I&C Workshop

Richard Wood
IEEE NPEC Representative
ARCSC Team

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What is Purpose of the Advanced Reactor Codes and Standards Collaborative (ARCSC)

ARCSC Engages SDOs and AR Community

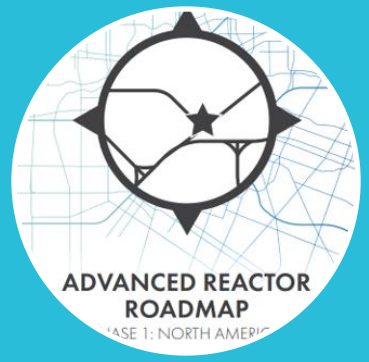
- NEI/EPRI are facilitating the operation of the Advanced Reactors Codes and Standards Collaborative (ARCSC) to implement the Codes and Standards (C&S) actions in conjunction with the Roadmap Implementation Board and identified in the North American Advanced Reactor Roadmap action plans
- ARCSC
  - Has engaged Advanced Reactor developers and industry through a survey to identify and prioritize needed codes and standards, expanding on the work of NEI 19-03
  - Is comprised of U.S. and Canadian organizations to streamline the use of C&S in designs deployed in both countries
  - Facilitates harmonization of international codes and standards to support the export of advanced reactor designs, offering potential participation to organizations in other countries partnering with the U.S. and Canada on ARs

ARCSC Charter and Goals

Share information on AR standards development among SDOs and stakeholders

Identify needs: gather stakeholder input; identify gaps being addressed by SDOs; assess remaining gaps and identify actions and resources needed

Inform and complement relevant international & national efforts (e.g., IAEA NHSI, WNA CORDEL)

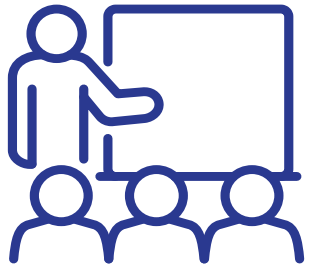


Input to Roadmap Implementation Board to **align actions** with NEI/EPRI North American Advanced Reactor Roadmap

Objectives

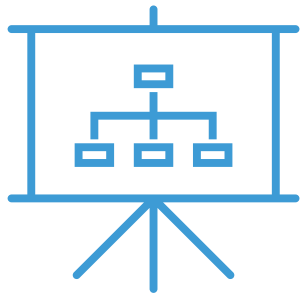
Advanced Reactor Roadmap

Phase 1: North America (Published May 2023)



Serving government, academic, industrial, and public **stakeholders**

Almost 100 GWe of **new nuclear** will be needed by 2050. This means around **300 ARs** in the next **30 years**

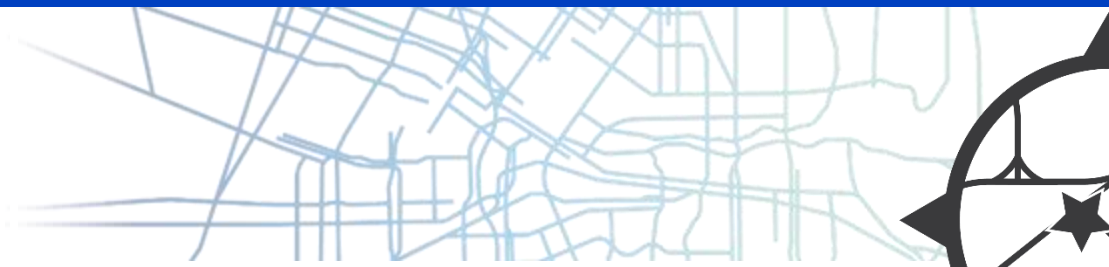


7 Enablers and **46 key actions** chart our path towards a **net-zero future**

Convening the industry for **strategic action**

Industry's roadmap to the future fleet

Strategic Elements



Regulatory Efficiency

- **Licensing** — 7 Actions
- **Environmental** — 7 Actions
- **Oversight** — 2 Actions

Technology Readiness

- **Fuel Cycle** — 3 Actions
- **Plant/SSC Design** — 3 Actions
- **Supply Chain** — 7 Actions
- **Nuclear Beyond Electricity** — 3 Actions
- **Codes & Standards** — 2 Actions

Project Execution

- **Project Management** — 4 Actions
- **Engineering & Procurement** — 2 Actions
- **Construction & Commissioning** — 3 Actions
- **Initial Operations & Maintenance** — 1 Actions
- **Workforce Development** — 4 Actions

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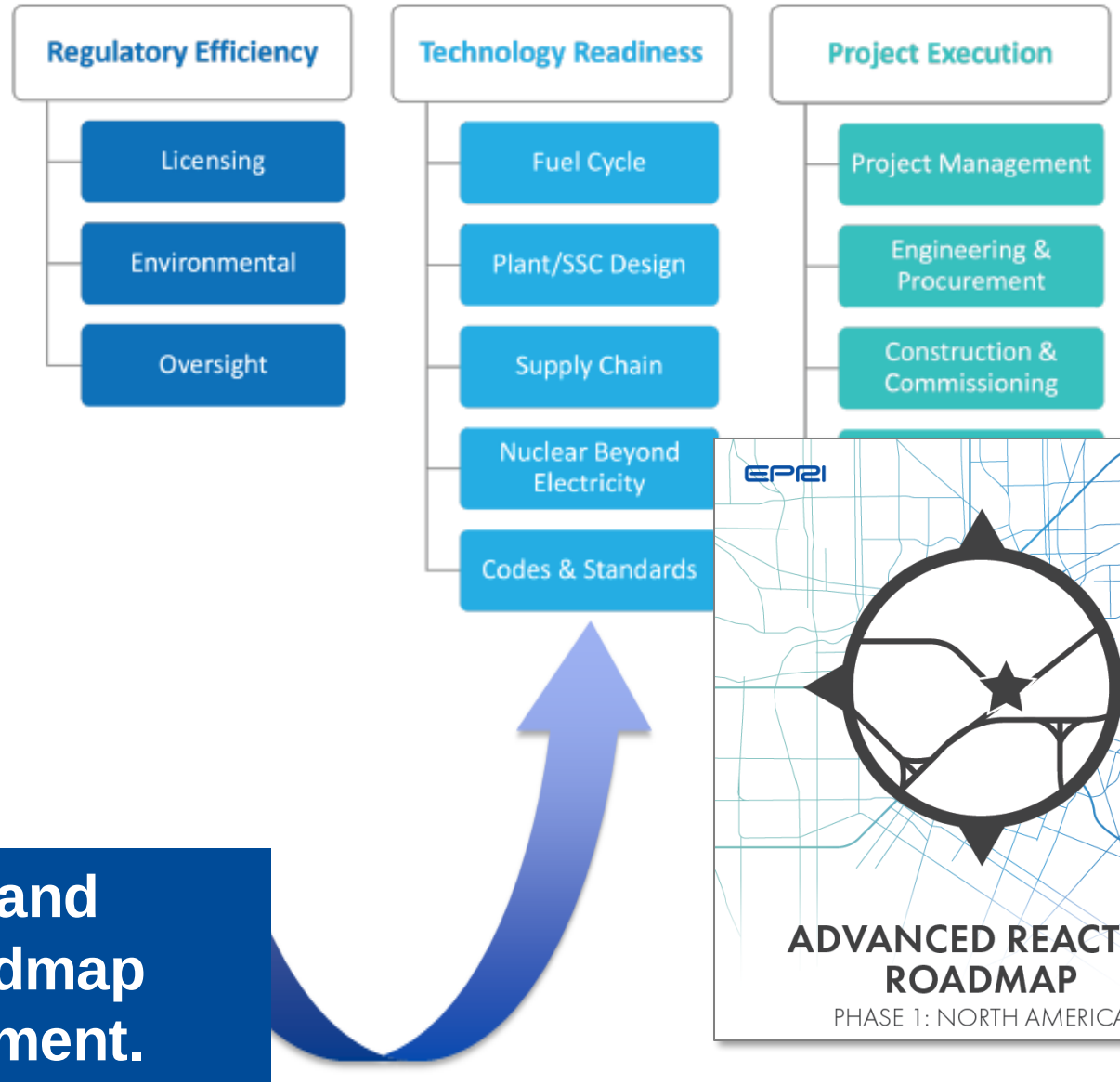
North American Advanced Reactor Roadmap

- Achieve successful deployment of advanced reactors through a shared industry strategy
- Align organizations and foster collaboration to implement the strategy
- Serve government, academic, industrial, and public stakeholders



ARCSC and its constituent SDOs and stakeholders interface with the Roadmap through the Codes & Standards element.

NEI/EPRI North American Advanced Reactor Roadmap

- TR-CS-01 Alignment and Improvement of Codes and Standards

  ACTION for 2024: Identify additional gaps in, and any adjusted timelines for, advanced reactor codes and standards

  - Consolidate and update prior advanced reactor codes and standards gap analysis
  - Define development timelines for commercial relevance
  - Prioritize gaps and associated actions
  - Secure resources to address gaps in and timelines for advanced reactor codes and standards development

- Action Owners: ARCSC, SDOs, NEI, EPRI, AR Vendors

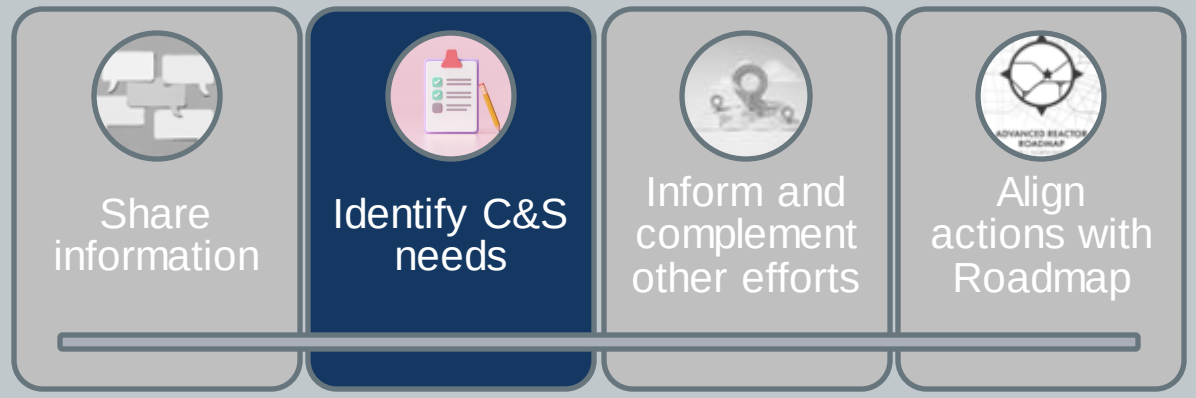
- Need Date: Gaps identified by end of 2024

NEI/EPRI North American Advanced Reactor Roadmap

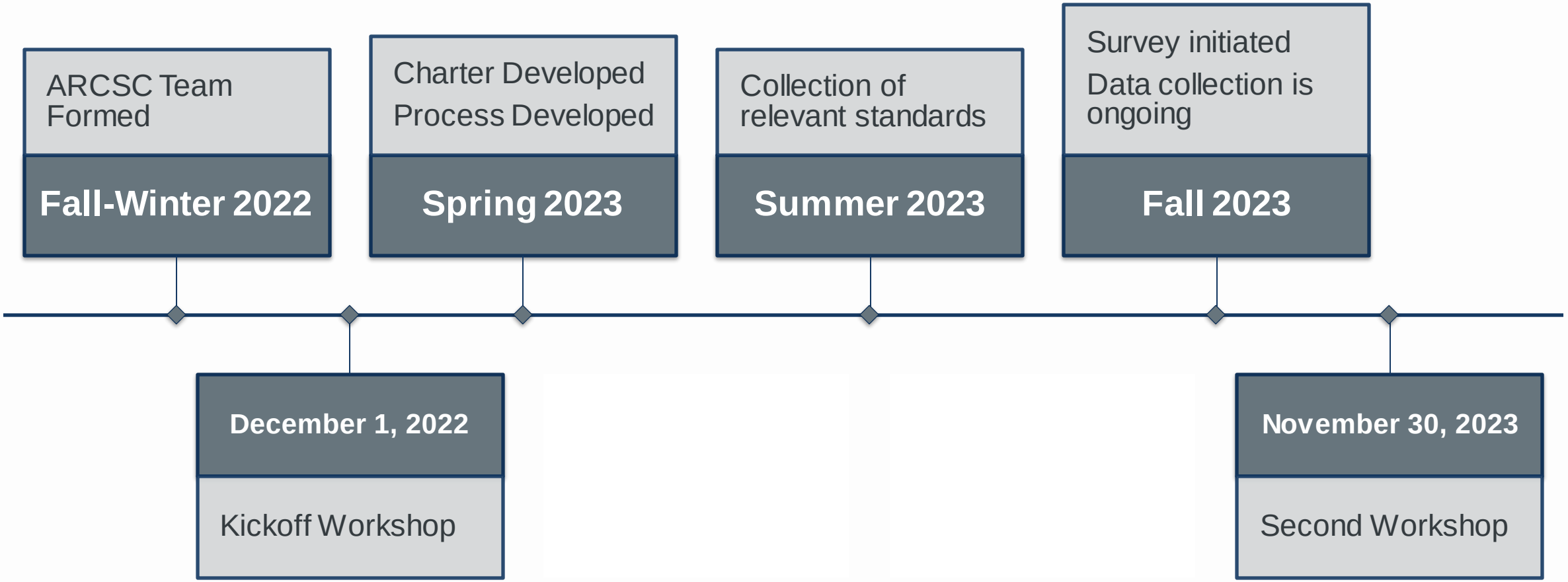
- TR-CS-02 Risk-Informed and Performance-Based Approach
  - Demonstrate Risk-Informed and Performance-Based Approach Standard
  - Develop and execute a pilot project that applies Risk-Informed and Performance-Based (RIPB) methods in development of a new AR standard jointly with US and Canada-based SDOs (potential cross-cut with International Harmonization actions).
- Action Owners: ARCSC
- Need Date: 2025

ARCSC Activities

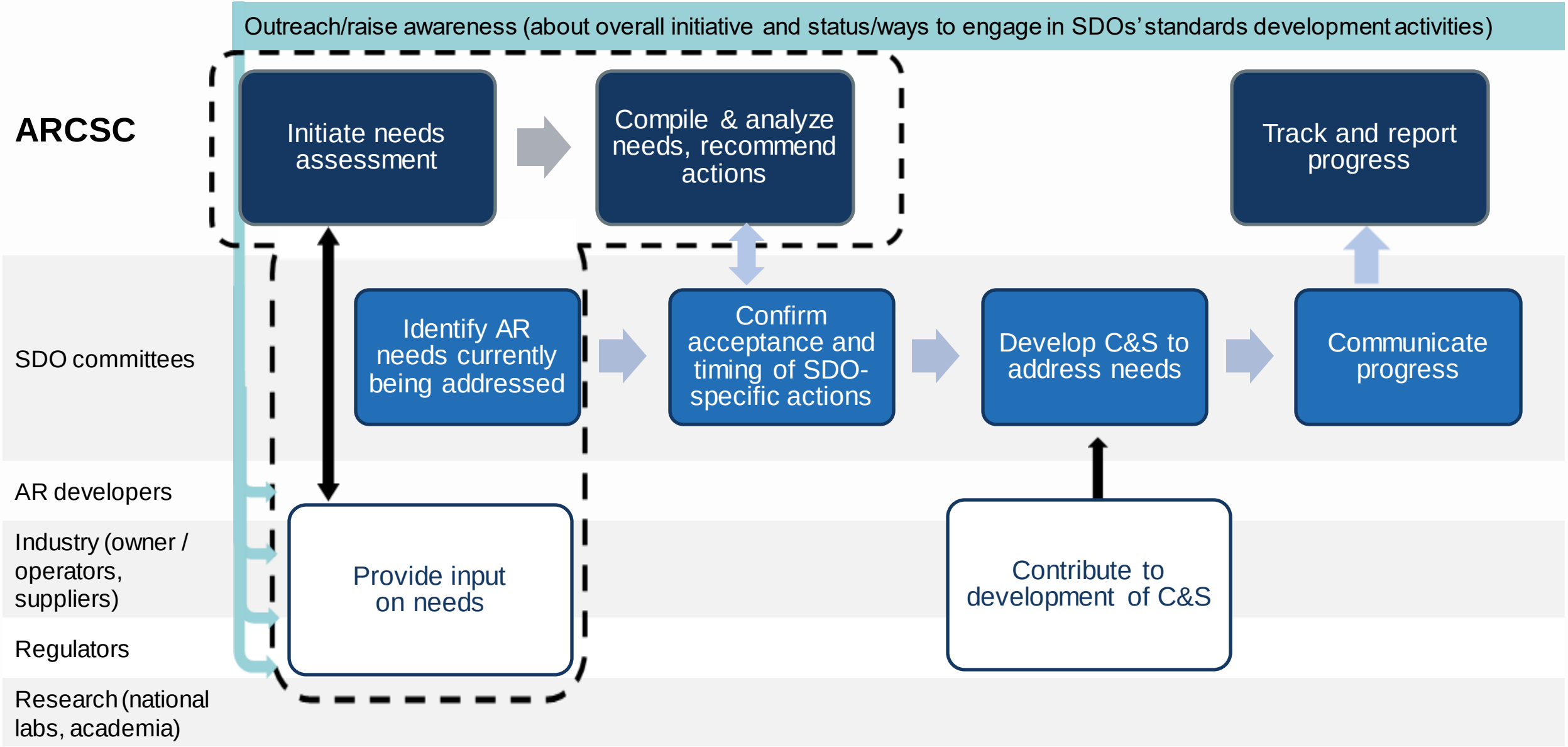
Collection of Relevant Standards
Engagement of Stakeholders



ARCSC Activities since kickoff meeting



Overall Process



Collection of Relevant Standards

18 Standards Development Organizations (SDOs) Contacted

1. American Concrete Institute (ACI)
2. American Institute of Steel Construction (AISC)
3. American Nuclear Society (ANS)
4. American Society of Civil Engineers (ASCE)
5. American Society of Mechanical Engineers (ASME)
6. ASTM International (ASTM)
7. American Society for Quality (ASQ)
8. American Welding Society (AWS)
9. CSA Group (CSA)
10. Health Physics Society (HPS)
11. Institute of Electrical and Electronics Engineers (IEEE)
12. Institute of Environmental Sciences and Technology (IEST)
13. Institute of Nuclear Materials Management (INMM)
14. International Society of Automation (ISA)
15. Manufacturers Standardization Society (MSS)
16. National Fire Protection Association (NFPA)
17. National Electrical Manufacturers Association (NEMA)
18. Nuclear Information and Records Management Association (NIRMA)

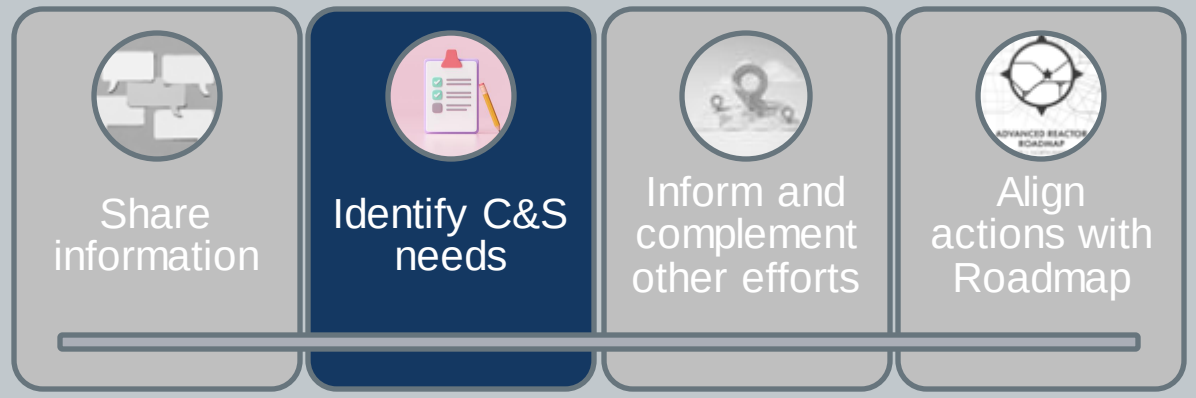
Green (14): List provided
Blue (2): Responded NA
Orange (2): No response
~1000 standards on master list

Sample of Master Spreadsheet

Designation				Title	Status	Applicable to ARs?	Relevant topical area
ANS	2	26		Categorization of Nuclear Facility Structures, Systems, and Components For Seismic Design	current standard approved 2004 (R2021); PINS approved; revision in development	Yes	Safety Systems/Risk analysis
ANS	30	3		Light-Water Reactor Risk-Informed Performance-Based Design	current standard approved 2022	Yes	Design and construction
ASME/ANS	RA S	1	4	Probabilistic Risk Assessment Standard for Advanced Non-LWR Nuclear Power Plants	current standard approved 2021	Yes	Safety Systems/Risk analysis
ASCE	4			Seismic Analysis of Safety-Related Nuclear Structures	Issued last as ASCE 4-16	Possibly	Safety Systems/Risk analysis
ASCE	43			Seismic design criteria for structures, systems, and components in nuclear facilities	Issued last as 43-19 in early 2021	Possibly	Design and construction
CSA	N285.0:23/N285.6 SERIES:23			General requirements for pressure retaining systems and components in CANDU nuclear power plants	Active, current edition published 2023	Possibly	Design and construction
CSA	N286.0.1:21			Commentary on N28612 Management system requirements for nuclear facilities	Active, current edition published 2021	Yes	Management and QA Programs
ASME	NQA-1			Quality Assurance Requirements for Nuclear Facility Applications	Active, current edition published 2022	Yes	Management and QA Programs
ASME	BPVC.III.3			Rules for Construction of Nuclear Facility Components - Containment Systems for Transportation and Storage of Spent Nuclear Fuel and High- Level Radioactive Material	Active, current edition published 2023	Yes	Design and construction
IEEE	334			IEEE Standard for Qualifying Continuous Duty Class 1E Motors for Nuclear Power Generating Stations	Active, current edition published 2006	Yes	Fuel design, manufacturing, qualification
IEEE	627			Standard for Qualification of Equipment Used in Nuclear Facilities	Active, current edition published 2019	Yes	Fuel design, manufacturing, qualification
ANSI/INMM ASC	N14.1-2023			Uranium Hexafluoride – Packagings for Transport	Active, current edition published 2023	Possibly	Operation and Maintenance
ANSI/INMM ASC	N14.5-2022			Leakage Tests on Packages for Shipment	Active, current edition published 2022	Yes	Operation and Maintenance
NFPA	805			Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants	Active - current edition is 2020. First Draft 2025 edition posted on 08/30/2023. Public Comment period closes 01/04/24. First published in 2001, then 2006, 2010, 2015, 2020 (Current).	Possibly	Safety Systems/Risk analysis
AISC	N690-18			Specification for Safety-Related Steel Structures for Nuclear Facilities	Active, current edition published 2018	Yes	Design and construction
ACI	349			Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary	Current edition published in 2013. Committee is actively updating. Revised edition should be published in the next year.	No	Design and construction
AWS	D1.1/D1.1M			Structural Welding Code: Steel	Active (2020 current; 2025 next)	Yes	Design and construction
ISA	37.0201-2021			Nuclear Safety-Related Instrument-Sensing Line Piping and Tubing Standard for Use in Nuclear Power Plants	Current edition published 2021	Yes	Design and construction
ASTM	E509/E509M-21			Standard Guide for In-Service Annealing of Light-Water Moderated Nuclear Reactor Vessels	Current edition published 2021	Yes	Operation and Maintenance
ASTM/ISO	51650-13			Standard Practice for Use of a Cellulose Triacetate Dosimetry System	Current edition published 2013	Possibly	Management and QA Programs
MSS	SP-25			Standard Marking System for Valves, Fittings, Flanges, and Unions			
HPS	N13.1-2021			Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities	Current	Possibly	Inspection and Testing

Needs Assessment Survey

Preliminary statistics and SDO committee engagement process



Survey design: key questions

- Structured around 6 topical areas
  - Design and Construction
  - Inspection and Testing
  - Management and QA Programs
  - Safety Systems and Risk Analysis
  - Operations and Maintenance
  - Fuel
- Within topical areas:
  - What **standards are being used**?
  - What are **gaps in existing standards**?
  - What are **other standards gaps** (e.g., lack of standards)?

Advanced Reactors Codes and Standards Collaborative - Needs Assessment

Thank you for providing your input on needs and gaps for advanced reactors codes and standards (C&S) to the Advanced Reactors Codes and Standards Collaborative ("the Collaborative").

About the Collaborative
The Collaborative came together in late 2022 to ensure the development, alignment, and timely availability of U.S., Canadian, and international codes and standards (C&S) needed to support large-scale advanced reactor deployment. The Collaborative's objectives are to facilitate information sharing between standards development organizations (SDOs) and industry, identify and gather advanced reactor developer standards needs, inform and complement international and national C&S efforts, and align actions with the NEI/EPRI North American Advanced Reactor Roadmap.

About the Needs Assessment
Responses will be used by the Collaborative to inform the identification, prioritization, and assignment of actions to address C&S needs. All responses will be aggregated and will not be attributed when shared beyond the Collaborative, including in future stakeholder workshops. Following this survey, the Collaborative is planning a public workshop tentatively to be held November 30, 2023 in Washington D.C.

Should you have specific questions as to the Collaborative's objectives or this survey, contact either:
Kathryn Hyam (hyamk@asme.org), Collaborative Co-Chair
Larisa Logan (larisa.logan@csagroup.org), Collaborative Co-Chair
Mark Richter (mar@nei.org), Collaborative Facilitator

Thank you in advance for your input and support of this effort.

* Required

Contact information

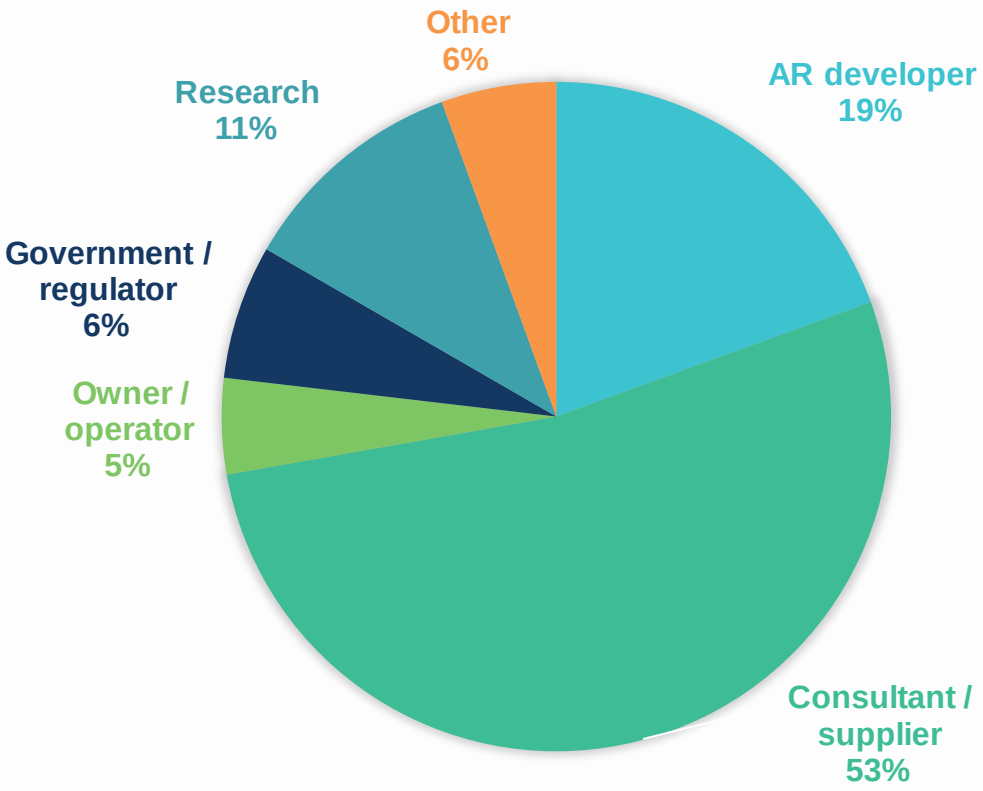
1. Full Name *
Enter your answer

2. Title *
Enter your answer

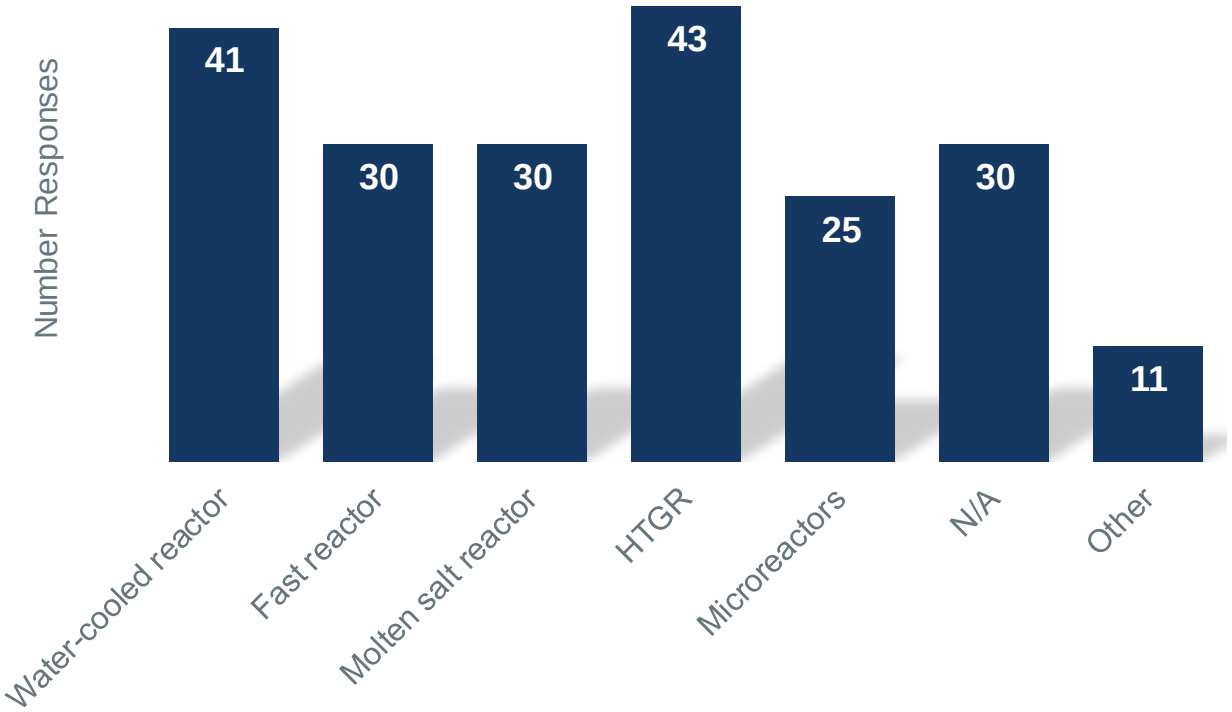
3. Organization *
Enter your answer

Survey Responses – General

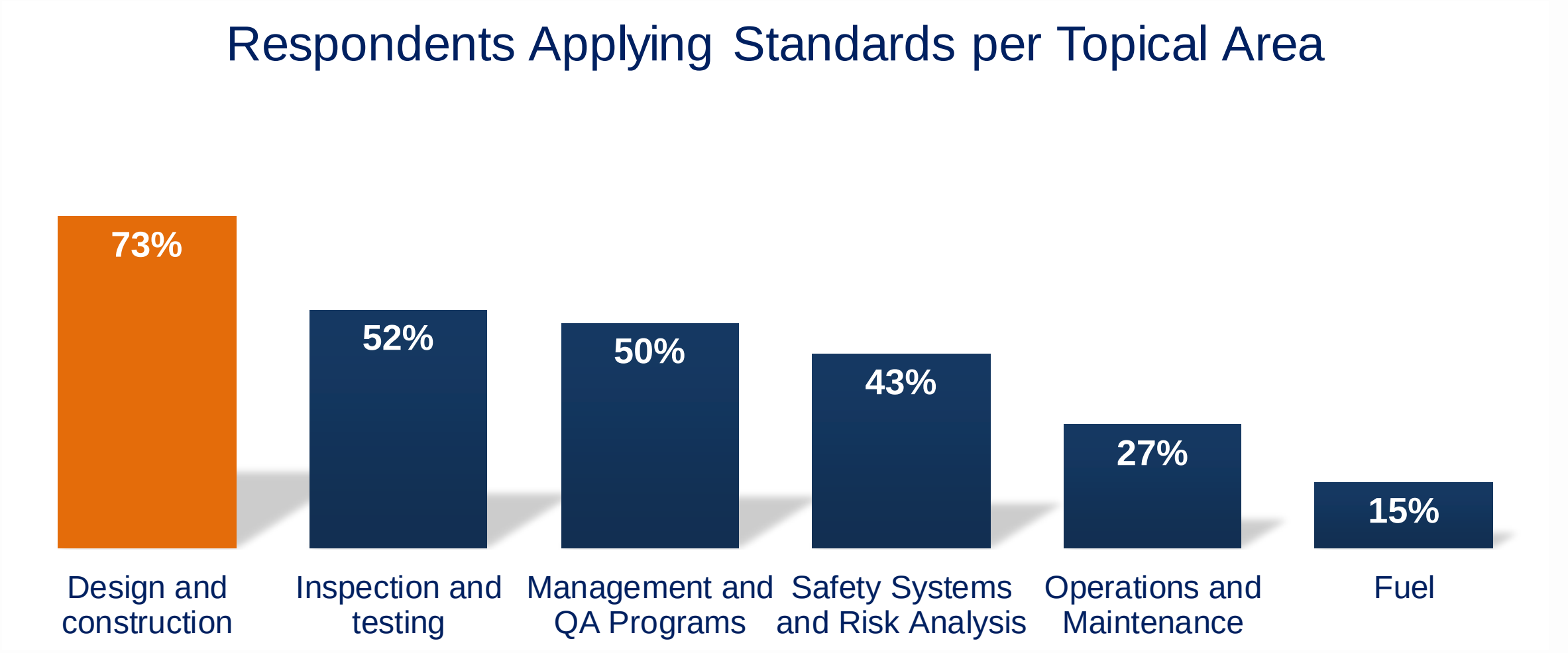
- **113 responses** as of February
- Approximate interest category distribution



- Reactor types



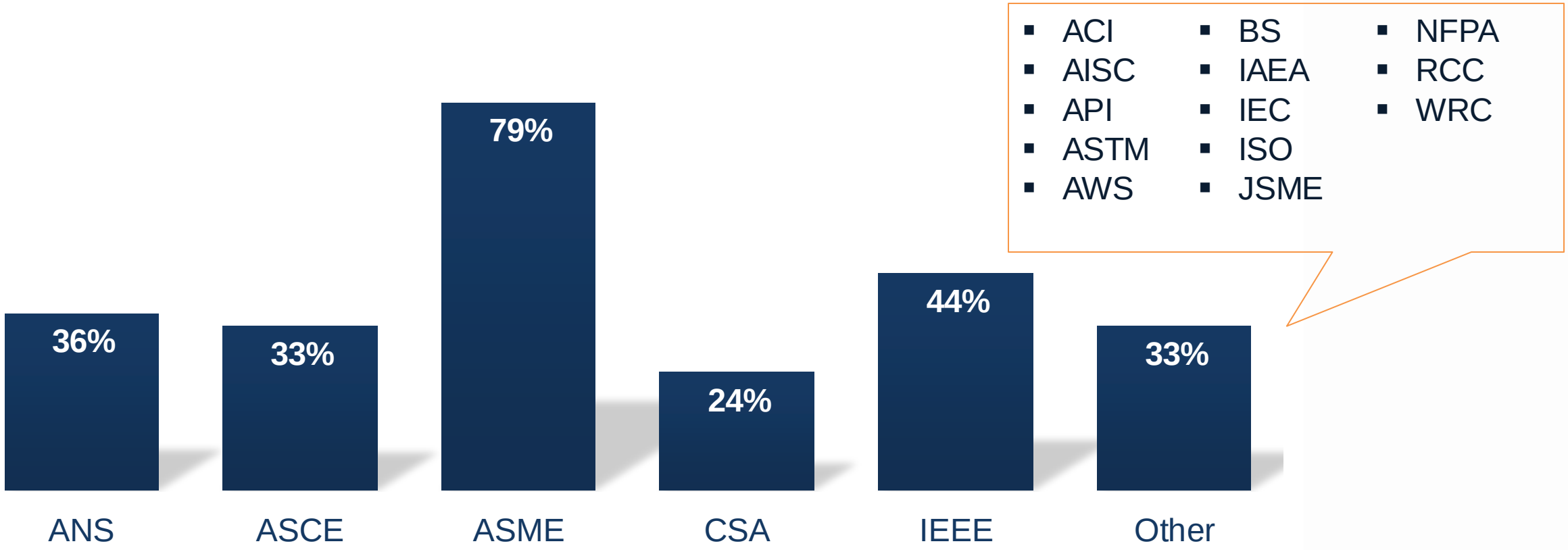
Survey Responses – Topical Areas



Survey Responses – Design and Construction

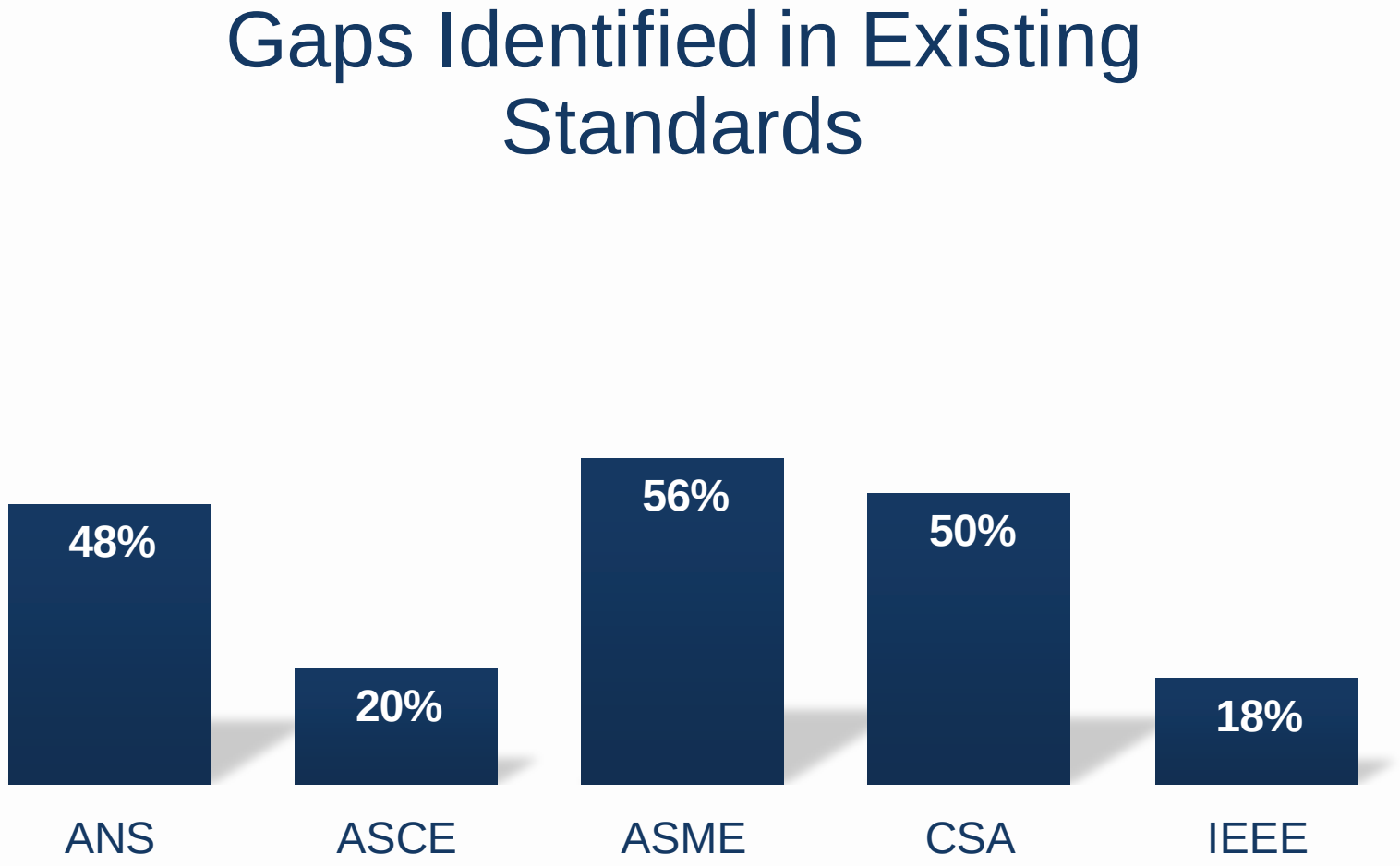
Insight 1: Standards Being Used

Respondents Applying SDOs' Standards for Design and Construction



Survey Responses – Design and Construction

Insight 2: Gaps in Existing Standards

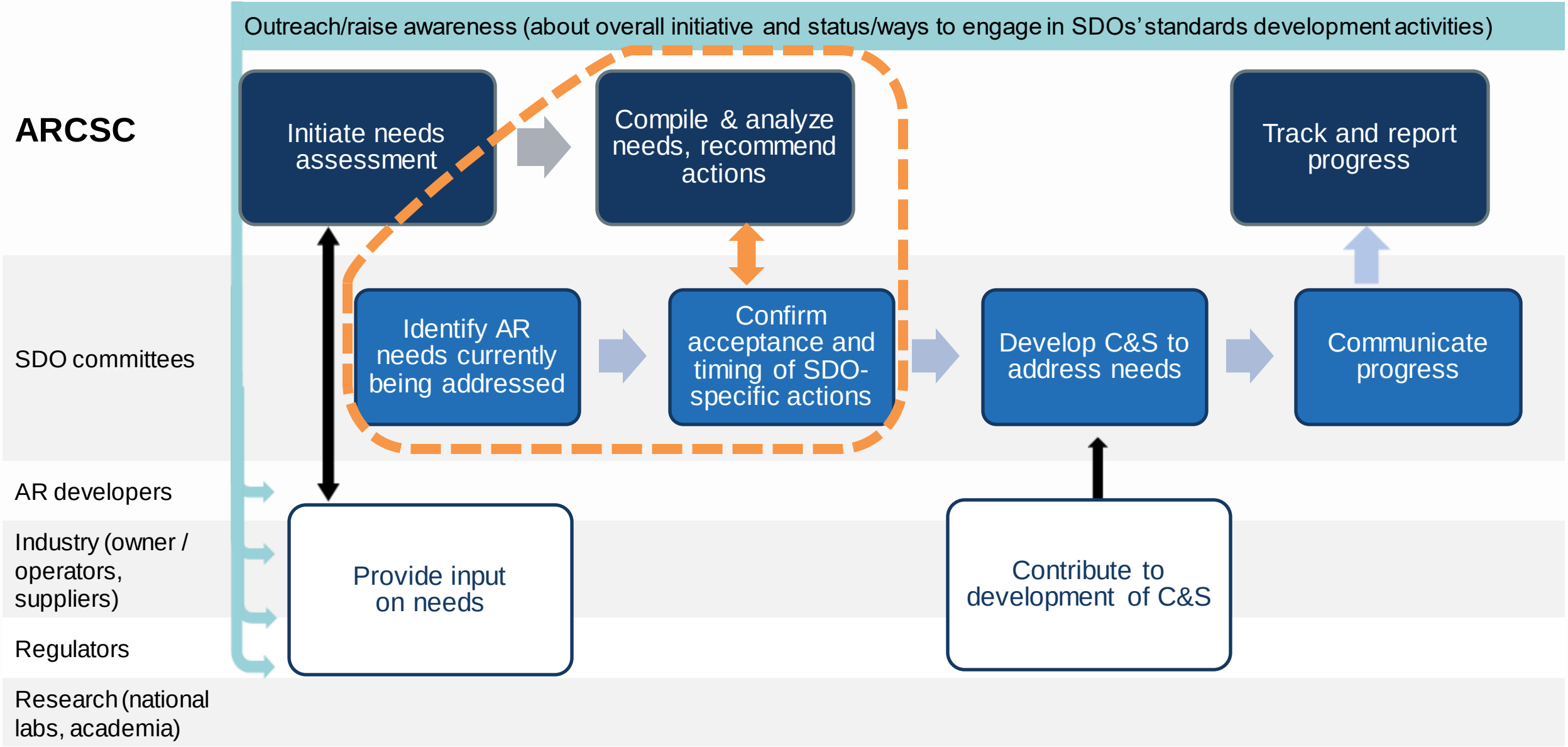


Survey Responses – Design and Construction

Insight 3: Other Standards Gaps

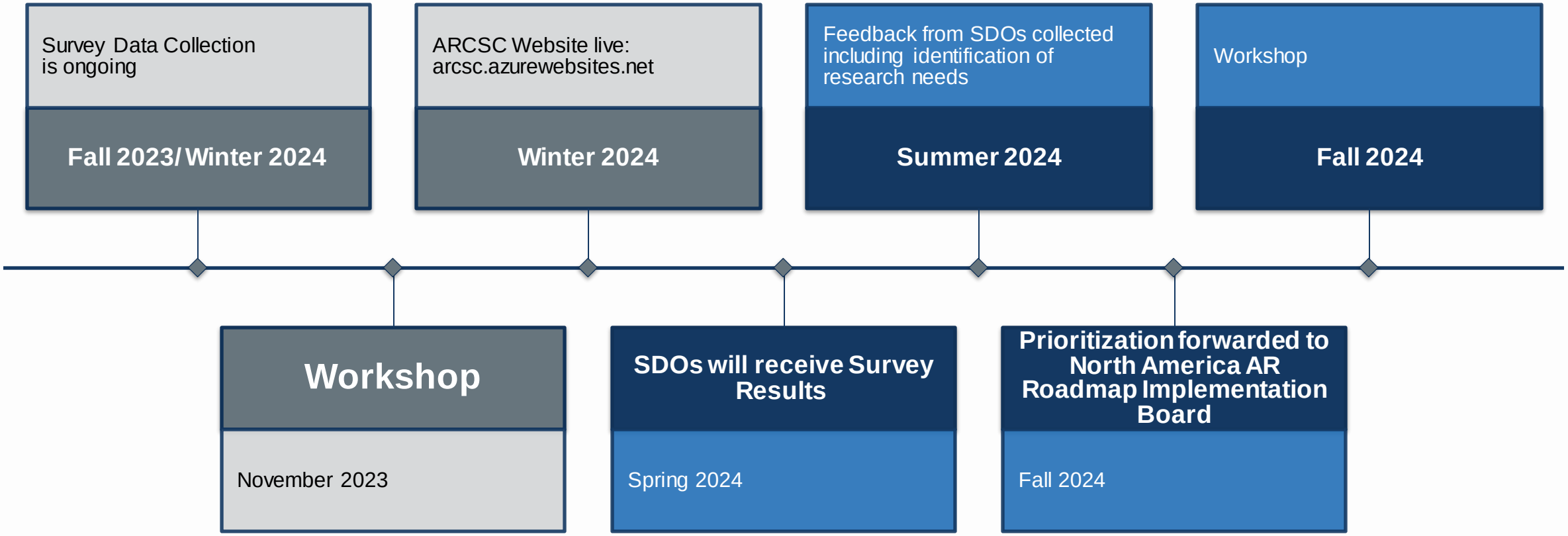
25 comments on lack of standards

Next steps for survey responses



ARCSC Future Actions

Future ARCSC Activities



Overall prioritization approach – with input from RIB

ARCSC Website is Live

http://arcsc.azurewebsites.net

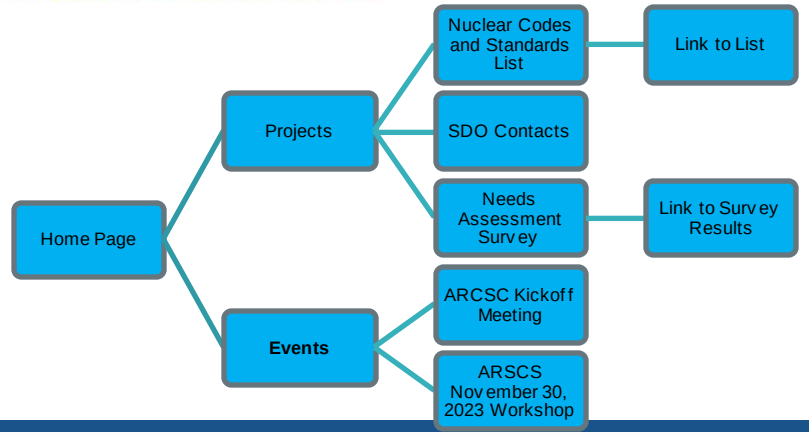
Advanced Reactor Roadmap Codes and Standards Technology Readiness

ARCSC

Advanced Reactor Codes & Standards Collaborative

Consensus codes and standards (C&S) provide acceptance criteria, methodologies, processes, and other data based on the accumulated experience of the industries they serve and documented by subject matter experts. The design of advanced reactors (AR) and a new generation of nuclear reactor construction challenge the context and numerous assumptions that the current consensus codes and standards are based upon. The purpose of this effort is to identify the most critical codes and standards needs, in order to successfully deploy advanced reactors in North America in the 2030s.

Provide your input on the Needs Assessment Survey:



About
Charter
Member Organizations

Projects
Nuclear Codes and Standards List
SDO Contacts
Needs Assessment Survey

Events
ARCSC Kickoff Meeting
ARSCS November 30, 2023 Workshop

Contacts
Larisa Logan, ARCSC Co-Chair
Kate Hyam, ARCSC Co-Chair
Mark Richter, NEI
Frankie Pimental

Questions?