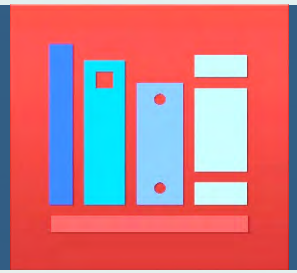
Importance of Standards, Opportunities for Participation and Collaboration



- Opening Remarks by Michele Sampson, NRC Standards Executive; Division Director, RES/DE
- **Session Chair:** Meraj Rahimi, Branch Chief, RES/DE/RGPMB

- **Panelists/Speakers:**
  - Gordon Gillerman (NIST)
  - Frances Pimentel (NEI)
  - Andrew Sowder (ANS)
  - Tom Vogan (ASME)
  - Mark Bowman (IEEE)

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

USG NATIONAL STANDARDS STRATEGY FOR CRITICAL AND EMERGING TECHNOLOGY (USG NSSCET)

Gordon Gillerman

Director

Standards Coordination Office

National Institute of Standards and Technology

USG NSSCET OBJECTIVES

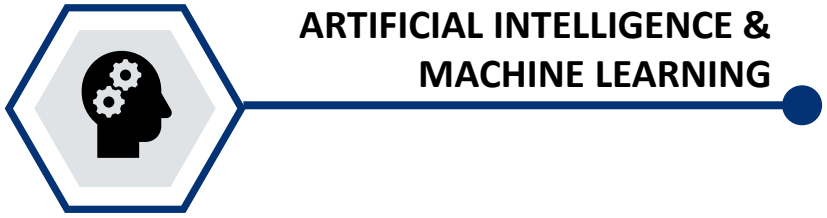
Objective 1: Investment

Objective 2: Participation

Objective 3: Workforce

Objective 4: Integrity & Inclusivity

CRITICAL AND EMERGING TECHNOLOGIES IDENTIFIED IN THE USG NSSCET



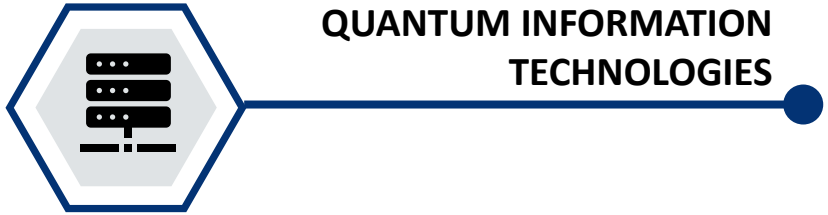
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

COMMUNICATION & NETWORKING TECNOLOGIES

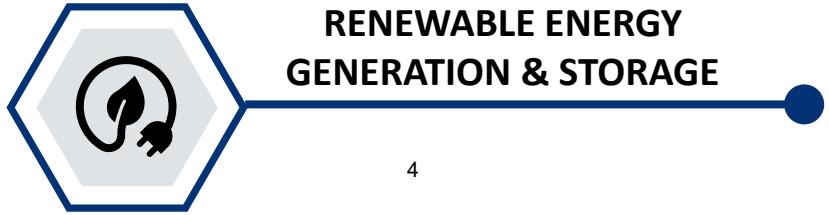
BIOTECHNOLOGIES

SEMICONDUCTORS & MICROELECTRONICS

DIGITAL ID INFRASTRUCTURE & DISTRIBUTED LEDGER TECHNOLOGIES



QUANTUM INFORMATION TECHNOLOGIES



RENEWABLE ENERGY GENERATION & STORAGE

SPECIFIC CET APPLICATIONS

Automated & Connected Infrastructure

Smart cities, Internet of Things, and other novel applications

Biobanking

Involves the collection, storage, and use of biological samples from individuals

Automated & Connected Transportation

Autonomous vehicles, unmanned aircraft systems, automated subway systems, smart cities, internet-of-things, and other possible applications

Electric Vehicles (EVs)

Standards to integrate EVs with the electrical grid

Critical Mineral Supply Chains

Cross-cutting issues that are critical to enabling the development and deployment of emerging technologies and data security

Cybersecurity & Privacy

Cross-cutting issues that are critical to enabling the development and deployment of emerging technologies and data security

USG NSSCET LINES OF EFFORT

Greater Investment in Pre-Standardization Research

- Increase R&D funding for CETs
- Support development of standards that address risk, security, and resilience

Participation in Standards Development

- Remove and prevent barriers to private sector participation
- Improve communication between public and private sector
- Enhance USG representation and influence in international standards governance and leadership

Workforce Development

- Educate and empower the new standards workforce

Ensuring Integrity in Standards Development

- Deepen standards cooperation with partners and allies
- Facilitate broad representation in standards development

DEVELOPING A USG NSSCET IMPLEMENTATION PLAN

NIST as point of entry to engaging on the USG National Standards Strategy for Critical and Emerging Technology

- Communication and coordination information on **standards.gov**
- **Listening Sessions** and additional stakeholder engagement workshops
- NIST Visiting Committee on Advanced Technology **Subcommittee on International Standards Development**
- **Request for Information** on barriers to increased standards engagement (Sept 2023)

Advanced Reactors Codes and Standards Collaborative (ARCSC)

Frankie Pimentel– Sr. Project Manager, Engineering and Risk, NEI

Advanced Reactors Codes and Standards Collaborative (ARCSC) Background

- **NEI/EPRI North American Advanced Reactor Roadmap**
  - Nuclear Energy Institute (NEI) and Electric Power Research Institute (EPRI) in conjunction with industry partners have developed a roadmap that identifies key challenges, gaps and opportunities to be addressed to enable deployment of advanced reactors.
  - Advanced reactor designs and a new generation of nuclear reactor construction challenge the context and assumptions upon which current consensus Codes and Standards are based. Success will require a huge shift in Codes and Standards development and regulatory processes.
- **Advanced Reactors Codes and Standards Collaborative** established to realize the Codes and Standards building block of the Roadmap

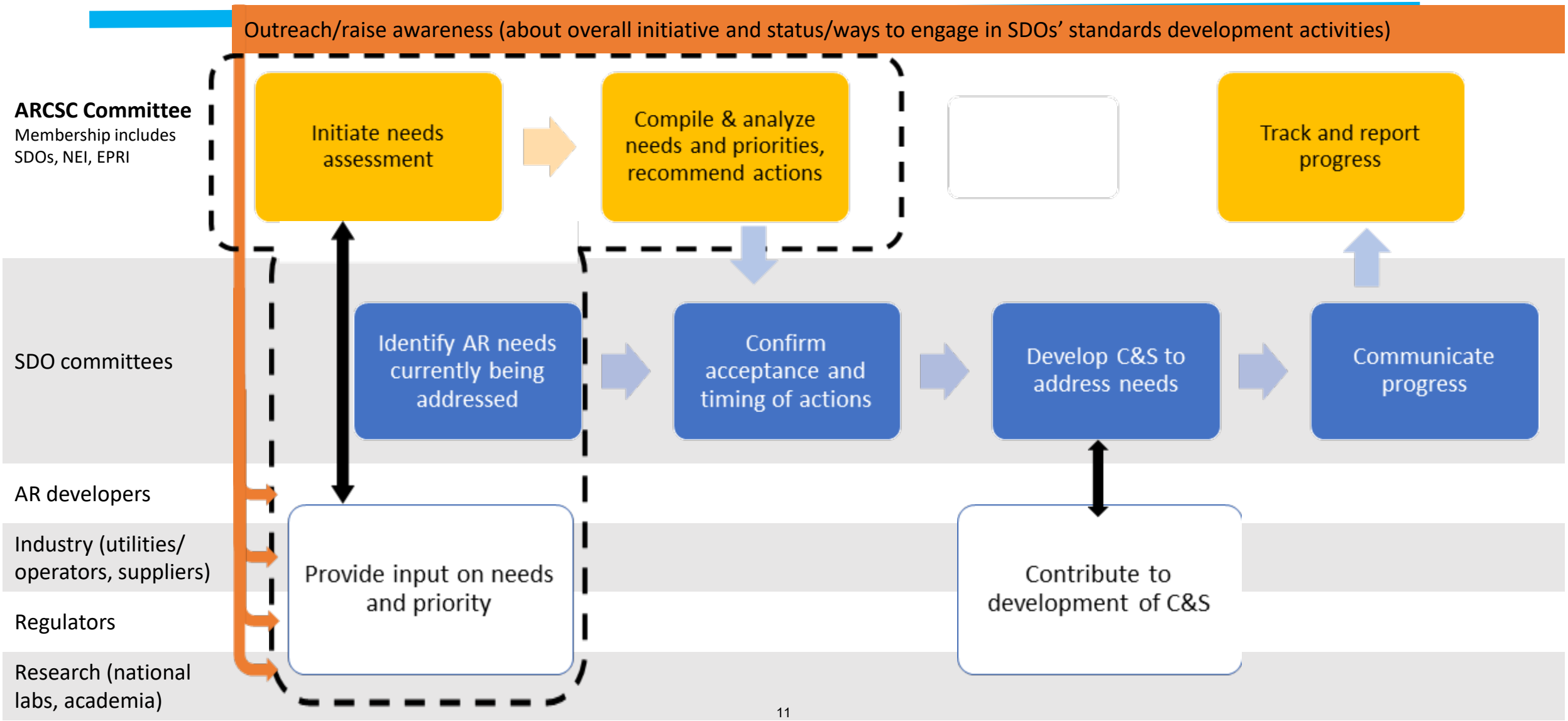
Advanced Reactors Codes and Standards Collaborative Charter

- **Mission:** To ensure the development, alignment and timely availability of U.S., Canadian and international codes and standards needed to support large-scale advanced reactor deployment.

- **Objectives:**
  1. Facilitate information sharing between SDOs and industry
  2. Identify and gather advanced reactor developer standards needs
  3. Inform and complement international and national C&S efforts (e.g., IAEA NHSI, WNA).
  4. Align actions with the NEI/EPRI Advanced Reactor Roadmap Codes and Standards building block.

- **Membership:** Includes individuals from NEI, EPRI, standards development organizations (SDOs) including ASME, ANS, CSA, IEEE, ASCE
  - Information and contributors will be solicited from DOE, WNA, IAEA, regulators, advanced reactor developers, nuclear suppliers and operators, research laboratories, and other stakeholders as appropriate.

North American Advanced Reactors Codes & Standards Collaborative - Overall Process



ARCSC Workshop and Information Collection

- **Provide information -** Developing a list of C&S related to Nuclear Advanced Reactors

- **Engage with the nuclear community** to identify and prioritize C&S gaps for advanced reactor designs
  - Survey/Questionnaire (available soon)
  - Workshops - Next Workshop will be held November 30, 2023 in Washington D.C.

- **Identify appropriate Standards Development Organization (SDO)** to develop C&S to avoid duplication of efforts and expedite standards development.
  - Requests for grant and other funding to create new standards or expand existing standards

Future – Design Once, Build Everywhere

- Codes and Standards play a part in this goal.
- Worldwide acceptance of standards that address Advanced Reactor needs can support design and licensing.
- We need your input!
  - –Advanced Reactor Codes and Standards Survey- please use the link below to provide your input:
    https://forms.office.com/r/H4QjKBjhbs
  - –Attend Workshops to help us develop the Roadmap for Advanced Reactors Codes and Standards
  - –Participate at standards development meetings

American Nuclear Society

U.S. Nuclear Regulatory Commission Standards Forum
September 13, 2023

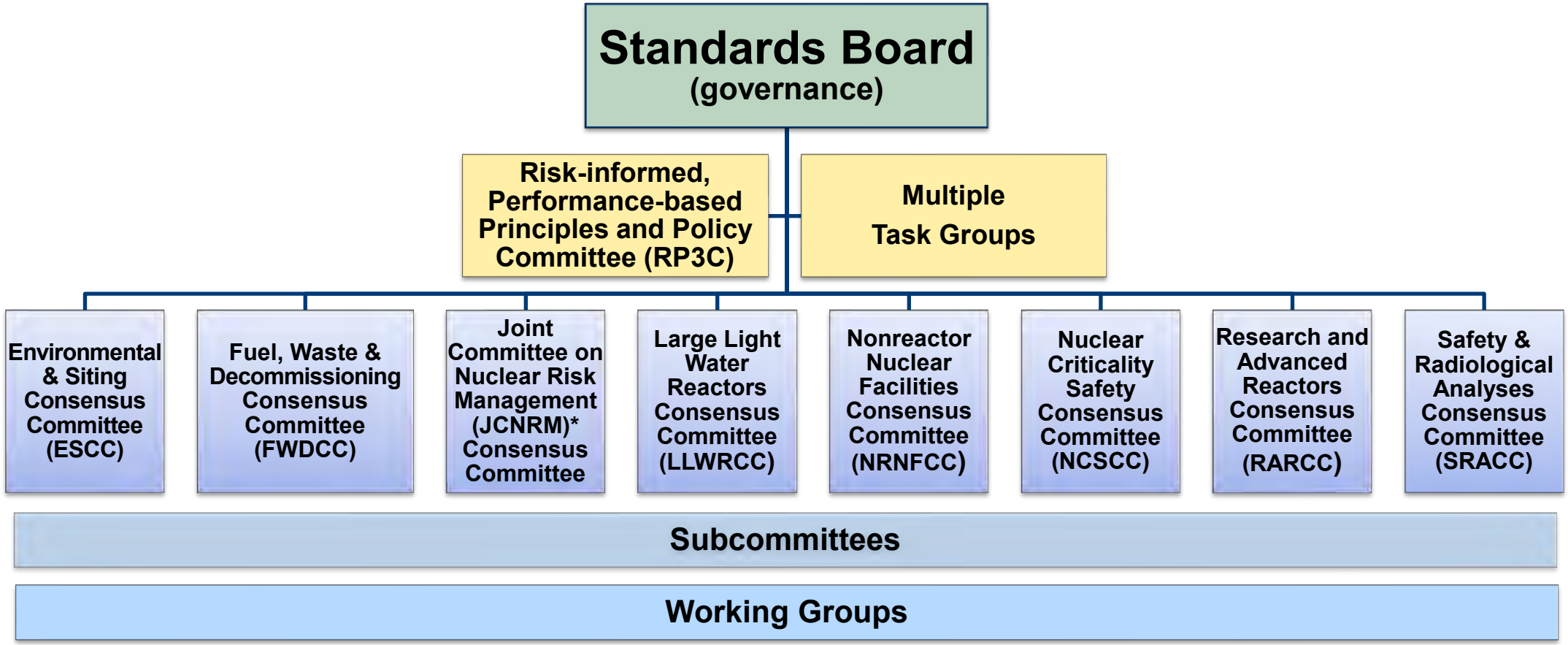
Andrew Sowder, Ph.D., CHP, ANS Standards Board Chair

ANS Standards – A Key Piece of the Nuclear SDO Pie

- ANS Standards Committee (SC) responsible for standards addressing the design, analysis, and operation of components, systems, and facilities related to the application of nuclear science and technology
  - But NOT for the application of radiation for medical purposes
- Established in 1957
  - Produced earliest nuclear industry standards
  - Accredited by American National Standards Institute (ANSI) in 1967
- Maintains 88 current ANSI standards across 8 Consensus Committees (CCs)

ANS

The ANS Standards Committee

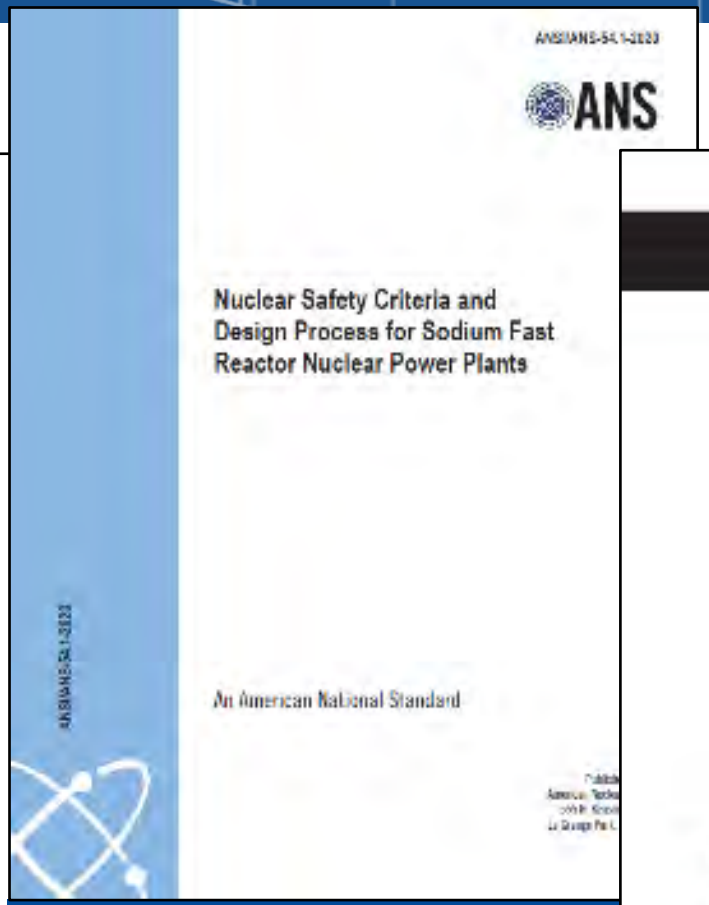


**JCNRM is a joint ANS/ASME consensus committee.*

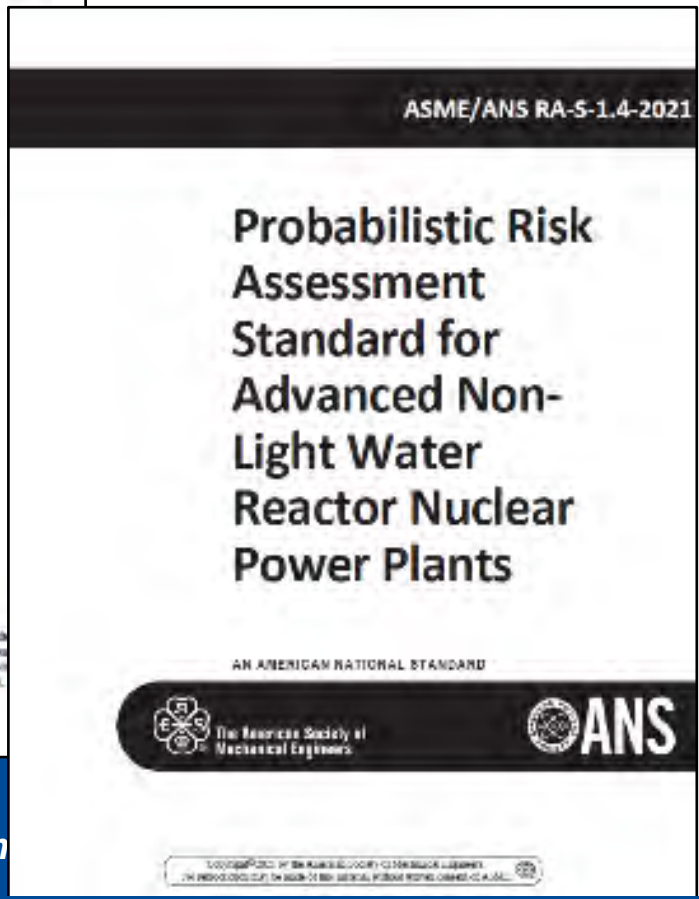
Many Existing Applicable Standards (for ARs)

ANSI/ANS-30.3-2022
LWR Risk-Informed, Performance-Based Design

ANSI/ANS-53.1-2011 (R2021)
Nuclear Design Process for MHCRs



ANSI/ANS-54.1-2020
Nuclear Safety Criteria Design Process for SFRs



ANSI/ASME/ANS RA-S-1.4-2021
PRA Standard for Adv. non-LWRs

ANS

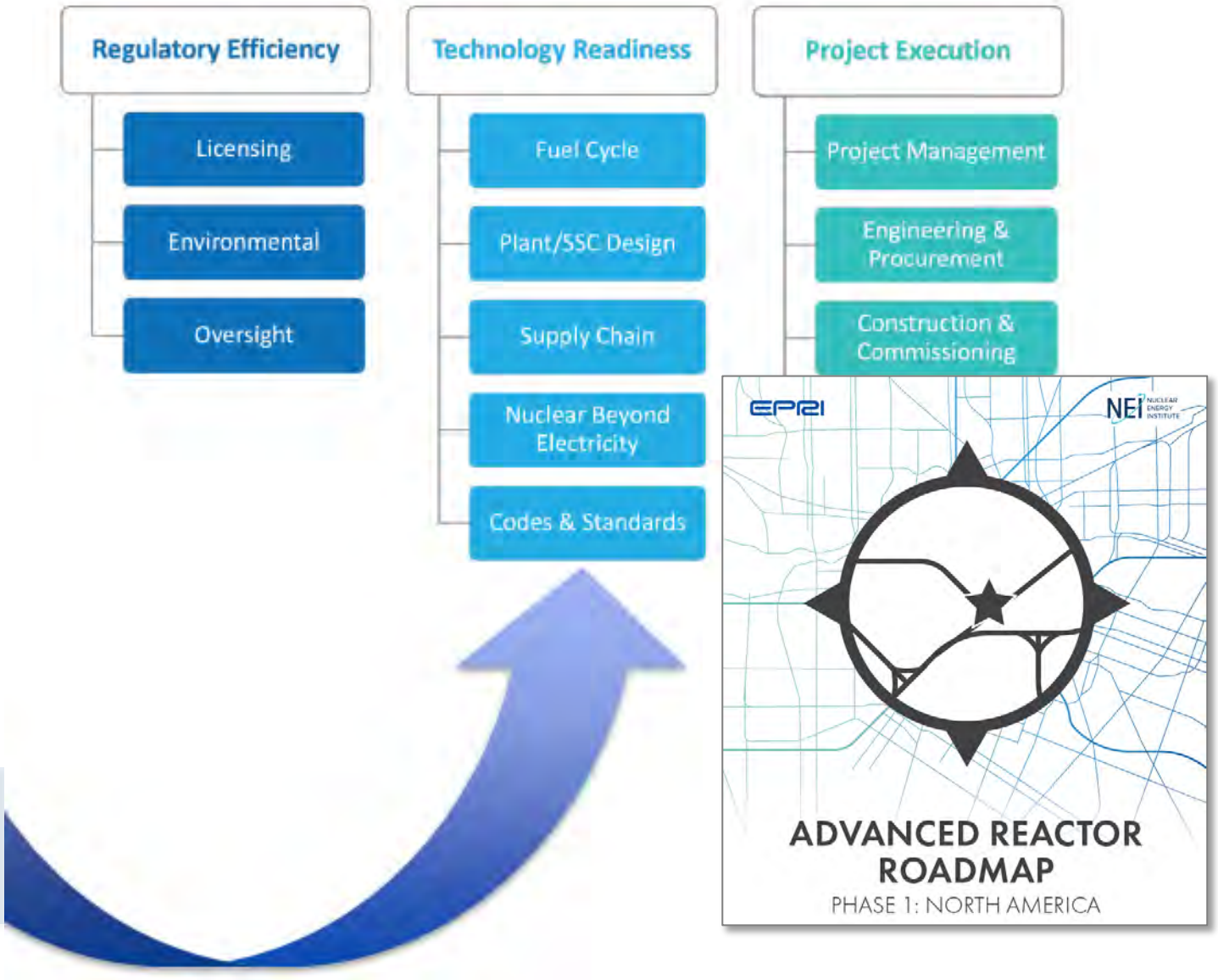
How ANS Informs AR Standard Development

- Leveraging direct engagement through the ANS structure
  - AR sessions at ANS national and topical meetings
  - ANS Advanced Reactor Working Group
  - RP3C Community of Practice seminars
  - Joint Committee on Nuclear Risk Management (with ASME)
- Leveraging engagement with peer organizations and other entities
  - NEI, EPRI, USNIC
  - USDOE and USNRC
  - Other SDOs
- **Leadership on Codes & Standards element under the North American Advanced Reactor Roadmap**

We need your help! What are gaps in standards for ARs? When are the standards needed? Volunteer for an ANS CC, subcommittee or working group!

Leadership on North American Advanced Reactor Roadmap

- Integration and harmonization among nuclear SDOs to support AR community via **timely development of relevant codes and standards**
- Owned and generated by industry, input from partners/stakeholders
- Three pillars:
  - Regulatory efficiency
  - Project execution
  - Technology readiness
- Codes & Standards development a key element under Technology Readiness
- **ANS - a foundational SDO on AR Roadmap development and execution**



ANS Standards Board Leadership

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ASME Advanced Reactor Standards Development Activity

Tom Vogan

ASME Senior Vice President and Chair of Council on Standards and Certification

ASME Facts and Figures

Established in 1880 and headquartered in New York City, the American Society of Mechanical Engineers is a not-for-profit international society.

90,000+

Worldwide Membership

135+

Countries with ASME Members

25+

Conferences Conducted Annually

200+

Technical Courses & Master Classes Offered Annually

Offices: New York, NY; Washington, DC; Little Falls, NJ; Houston, TX; Beijing, China; and New Delhi, India

Setting the Standard

Used in 100+ Countries

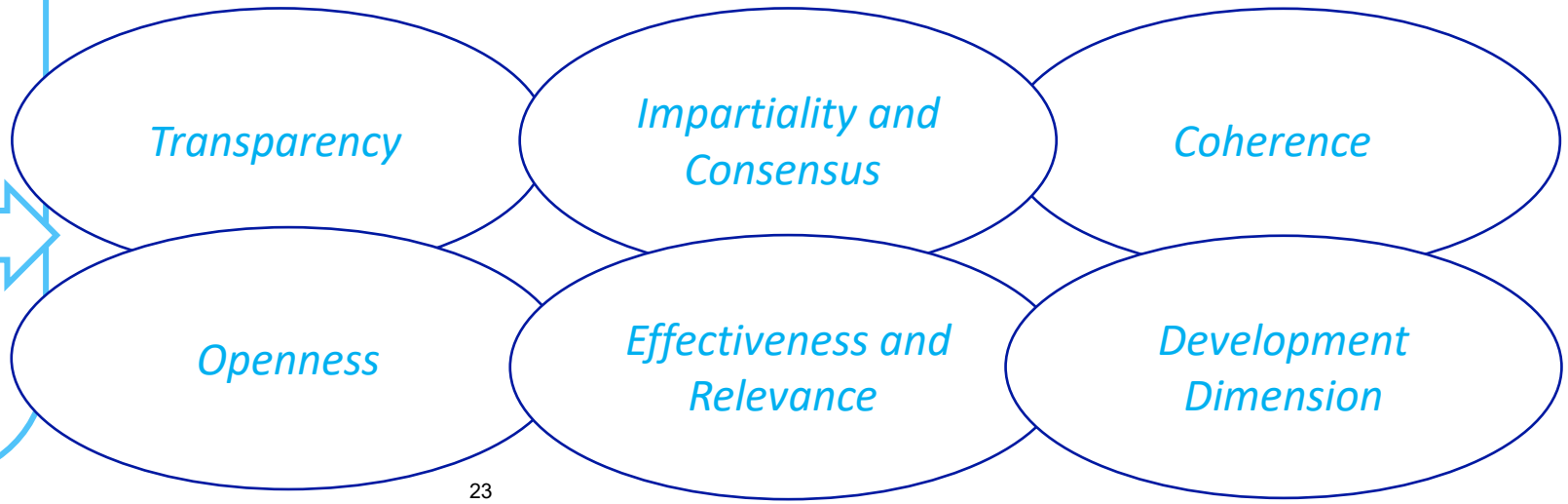
ASME is an international Standards Development Organization
- Accredited by ANSI
- Development process adheres to the principles and procedures outlined in the World Trade Organization's (WTO) Agreement on Technical Barriers to Trade (TBT) for development of international standards

500+ Standards & Products

Pressure Vessels, Piping, Nuclear Technologies, Elevators/Escalators, Cranes, Performance Testing, etc.

6,500+ Dedicated Volunteers

Engineers, Researchers, Government officials, etc. enhancing public safety, health, and quality of life



ASME Nuclear Codes & Standards and SMR Activity

The Boiler & Pressure Vessel Codes (BPVC)

- **Construction Codes**
  - BPVC I, Power Boilers
  - BPVC IV, Heating Boilers
  - BPVC VIII, Pressure Vessels
  - BPVC X, FRP Pressure Vessels
  - BPVC XII, Transport Tanks
- **Service Codes**
  - BPVC II, Materials
  - BPVC V, Nondestructive Examination
  - BPVC IX, Welding, Brazing and Fusing
  - BPVC VI, Care and Operation of Heating Boilers
  - BPVC VII, Care of Power Boilers
  - BPVC XIII, Rules for Overpressure Protection
- **Nuclear Construction & In-Service Inspection Codes**
  - BPVC III, Construction of Nuclear Facility Components
  - BPVC XI, Nuclear In-service Inspection
- **Code Case Books**
  - Boilers and Pressure Vessels
  - Nuclear Components

BPVC Section III - SMR Activity

- Section III is a technology neutral standard which can be applied to SMRs. The committee continuously works to evolve the standard to remain applicable to the advanced reactor needs.
- Section III Groups involved with AR activity

WG on Advanced Manufacturing	TG on Division 5 Advanced Manufacturing Components	TG on BPV III/XI Interface	TG on Alt. Requirements for components comm ensurate with Safety & Risk

- Code Case development underway to support all advanced reactor types.
- Section III, Division 1 - Seismic Requirements in process of general update
- Section III, Division 4 – Fusion Devices published July 1, 2023
- Section III, Division 5 - High Temperature Reactors updated July 1, 2023
- Section III, Division 5 – Graphite Materials updated July 1, 2023

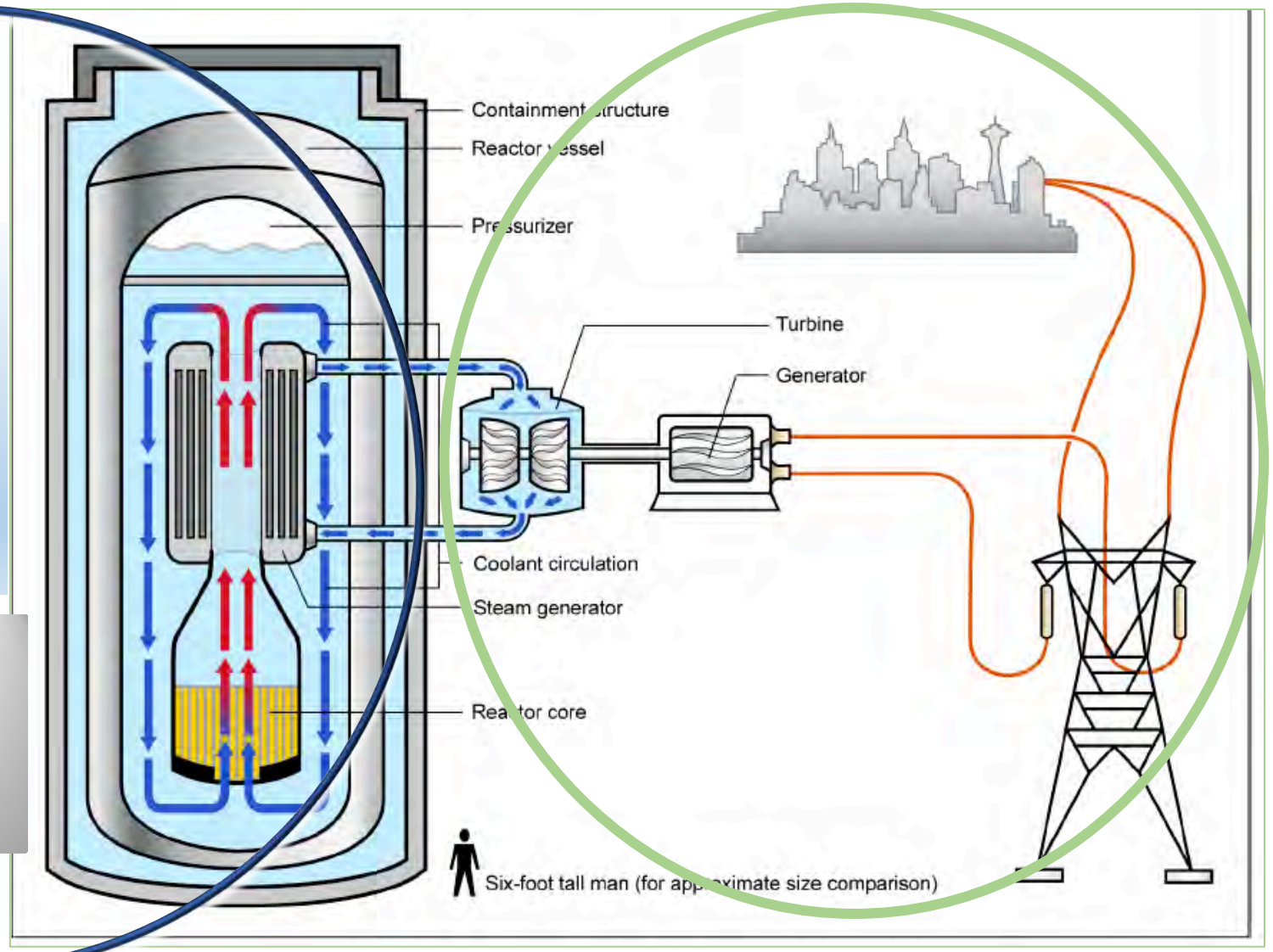
Section III DIV. 1 Light Water SMR
Construction of Nuclear Facility Components

ASME NQA-1–2019
(Revision of ASME NQA-1–2017)

Quality Assurance Requirements for Nuclear Facility Applications

Division 1: Metallic vessels, heat exchangers, storage tanks, piping systems, pumps, valves, core support structures, supports, and similar items.

Division 2: Concrete containment vessels with metallic liners



Section III DIV. 5 Liquid Metal SMR Construction of Nuclear Facility Components

ASME NQA-1–2019
(Revision of ASME NQA-1–2017)

Quality Assurance Requirements for Nuclear Facility Applications

Division 5: High temperature reactors providing rules suitable for construction of gas and liquid cooled reactors and are under a more active development to meet the evolving needs of our advanced reactor stakeholders

Division 2: Concrete containment vessels with metallic liners

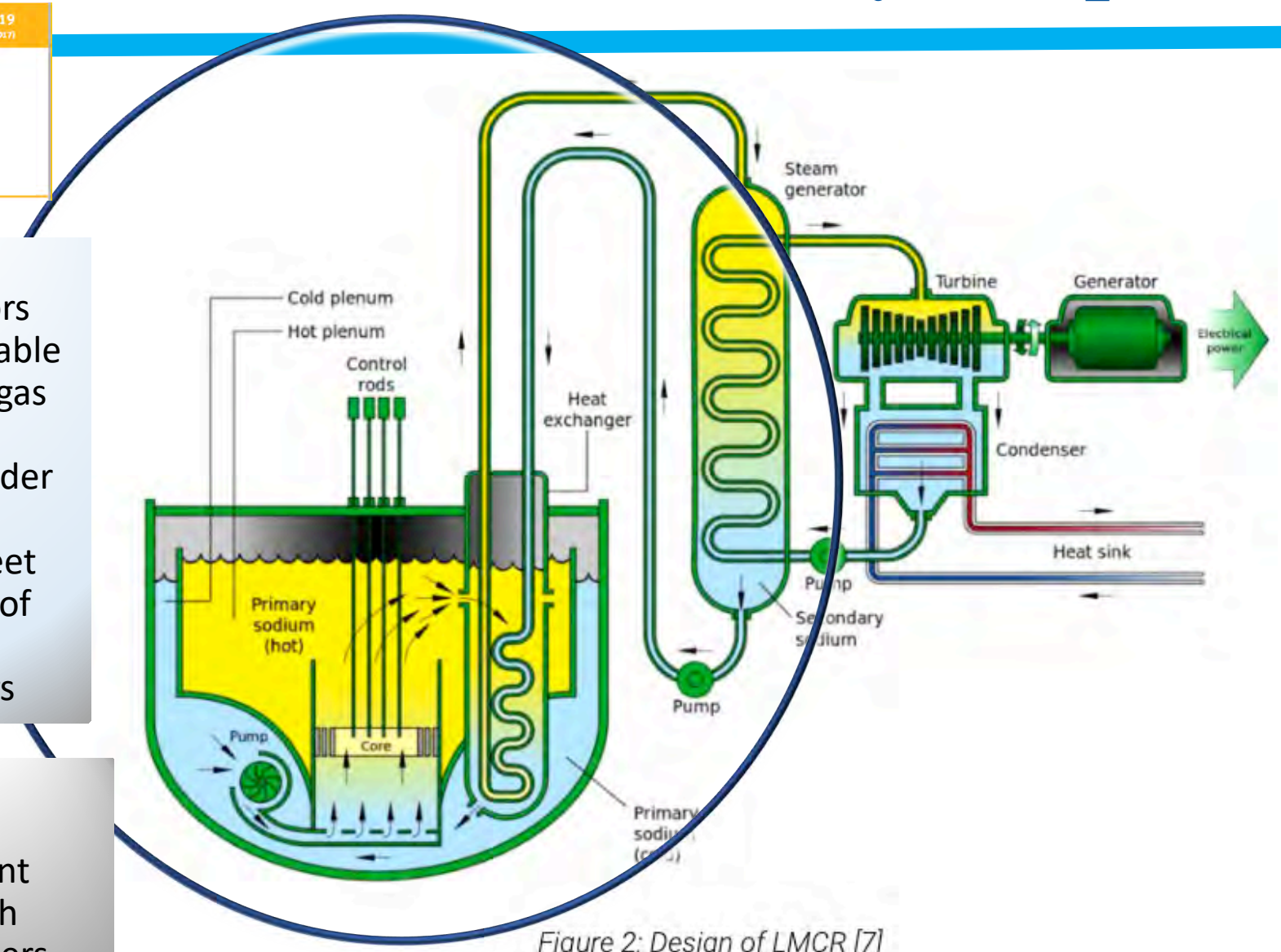


Figure 2: Design of LMCR [7]

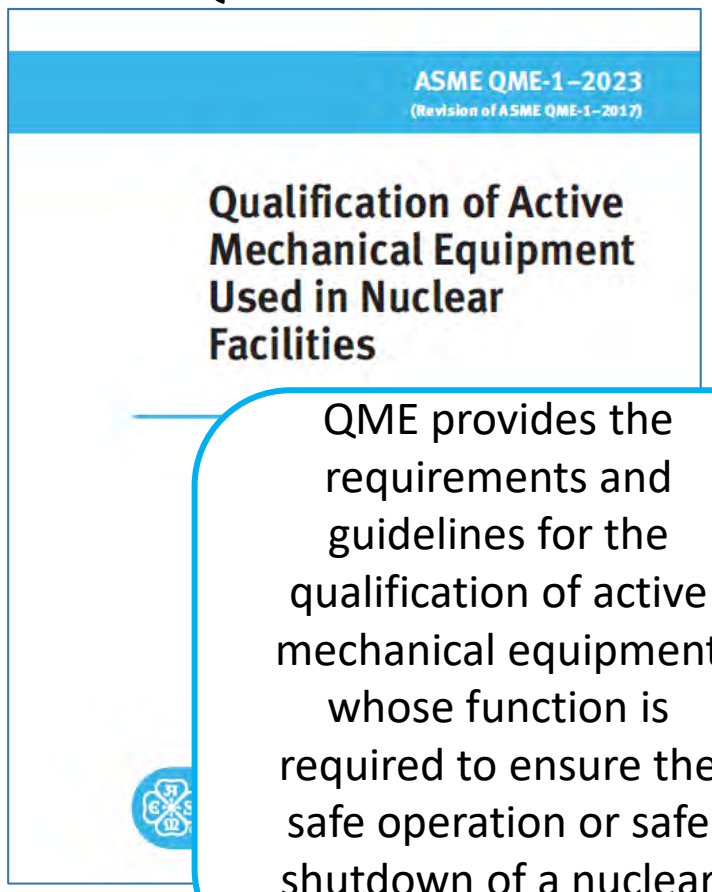
BPVC Section XI Nuclear Inservice Inspection

- **Division 1:** Inspection and Testing of Components of Light-Water-Cooled Plants

- **Division 2:** Reliability Integrity Management (RIM)
  - A methodology to establish Inservice Inspection criteria independent of the SMR technology (e.g., Molten Salt, HTGR, Liquid Metal, etc.)
  - Technology neutral – applicable to all reactor designs
  - Alternative approach to current ISI activities, needed to accommodate new technologies.

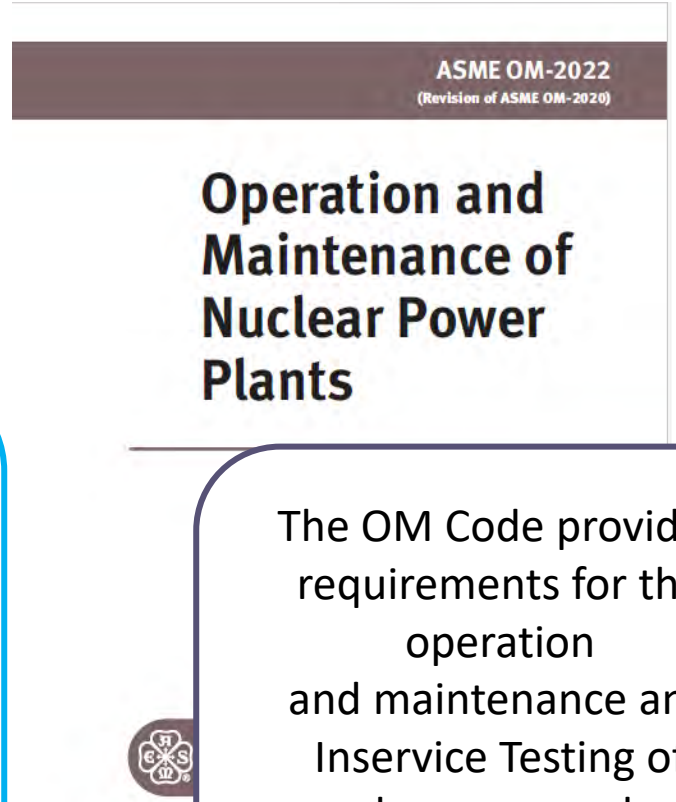
Qualification for Mechanical Equipment and Operations and Maintenance Standards

ASME QME-1-2017



QME provides the requirements and guidelines for the qualification of active mechanical equipment whose function is required to ensure the safe operation or safe shutdown of a nuclear facility.

ASME OM-2022



The OM Code provides requirements for the operation and maintenance and Inservice Testing of nuclear power plant components.

The OM-2 Code will provide similar component testing rules as the current O&M Code. It has been produced to address both regulatory and new reactor owner concerns that they have with utilizing current O&M Code rules with new nuclear facility designs. The new Code rules are tied directly to ASME qualification standards.

ASME HARMONIZATION ACTIVITY

ASME & Nuclear Regulatory Commiss

- **ASME standards are cited in the NRC Regulations as well as Regulatory Guides.**

Rulemaking

Developing and amending regulations that licensees must meet

Guidance Development

Developing and revising guidance documents, such as regulatory guides

Standards Development

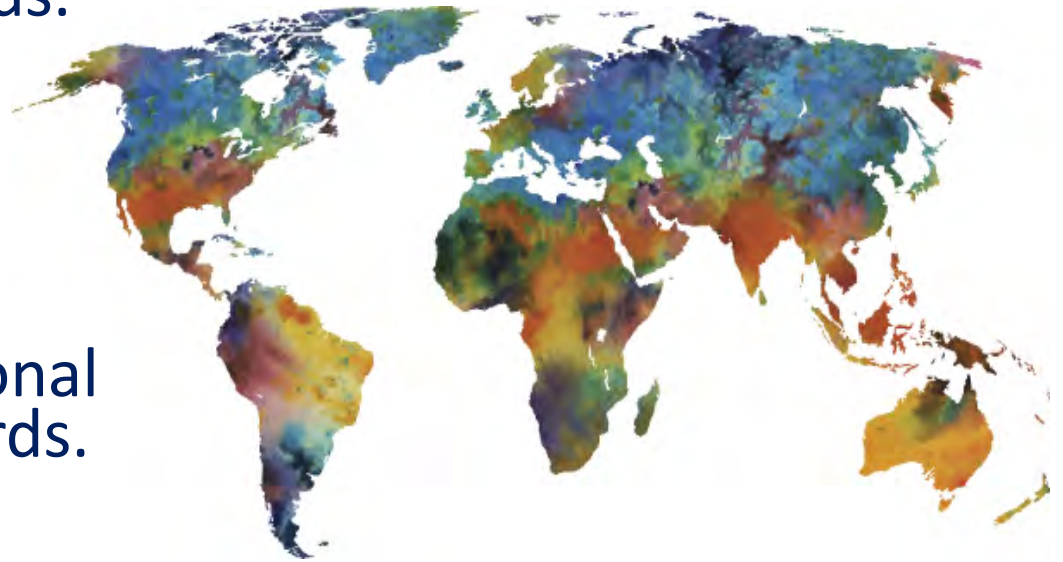
Working with industry standards organizations to develop consensus standards associated with systems, equipment, or materials used by the nuclear industry so that these standards may be referenced in NRC regulations or guidance

Representation on all ASME consensus committees & most subordinate committees at the technical working level

ASME/NRC Management meeting is held twice a year to discuss high level priorities for the consensus committees

ASME International Activity

- SDO Convergence Board meets in conjunction with ASME's Boiler Code Week and contains representation from various countries to align major requirements in the various standards.
- ASME and JSME have a close working relationship, meeting in conjunction with ASME's Boiler Code Week.
- ASME has established numerous International Working Groups (IWGs) for various standards. IWGs allow ASME to gain international perspective and obtain input on how our standards are being used.



ASME Nuclear Conformity Assessment Programs

- **N-type Certificates of Authorization -** This allows Certificate Holders to certify and stamp newly constructed components, parts, and appurtenances used at a nuclear facility with the Certification Mark in accordance with Section III of the ASME BPVC.

N – Vessels, pumps, valves, piping systems, storage tanks, core support structures, concrete containments, and transport packaging
NA – Field installation and shop assembly of all items
NPT – Parts, appurtenances, welded tubular products, and piping subassemblies
NS – Supports
NV – Pressure relief valves
N3 – Transportation containments and storage containments
OWN – Nuclear power plant owner

- **Quality System Certificates (QSC)** issued by ASME verify the adequacy of a Material Organization's quality system program.
- **NQA-1 Certification -** Provides **centralized, independent, third-party certification** for quality assurance programs in conformance with the ASME NQA-1 standard, "Quality Assurance Requirements for Nuclear Facility Applications".

ASME Events

ASME Events

Nuclear Engineering Division

- ICONE 31 International Conference on Nuclear Engineering – Planned for August 2024 (Location Pending)
- ICEM 2023 International Conference on Environmental Remediation and Radioactive Waste Management Stuttgart, Germany, October 3-6, 2023
- Nuclear Engineering Division SMR Conference – March 2024. EPRI Offices, Charlotte, NC.

IEEE | NPEC
Nuclear Power Engineering Committee

Mark Bowman

Chair, IEEE Nuclear Power Engineering Committee

IEEE | NPEC

Nuclear Power Engineering Committee

WHO WE ARE

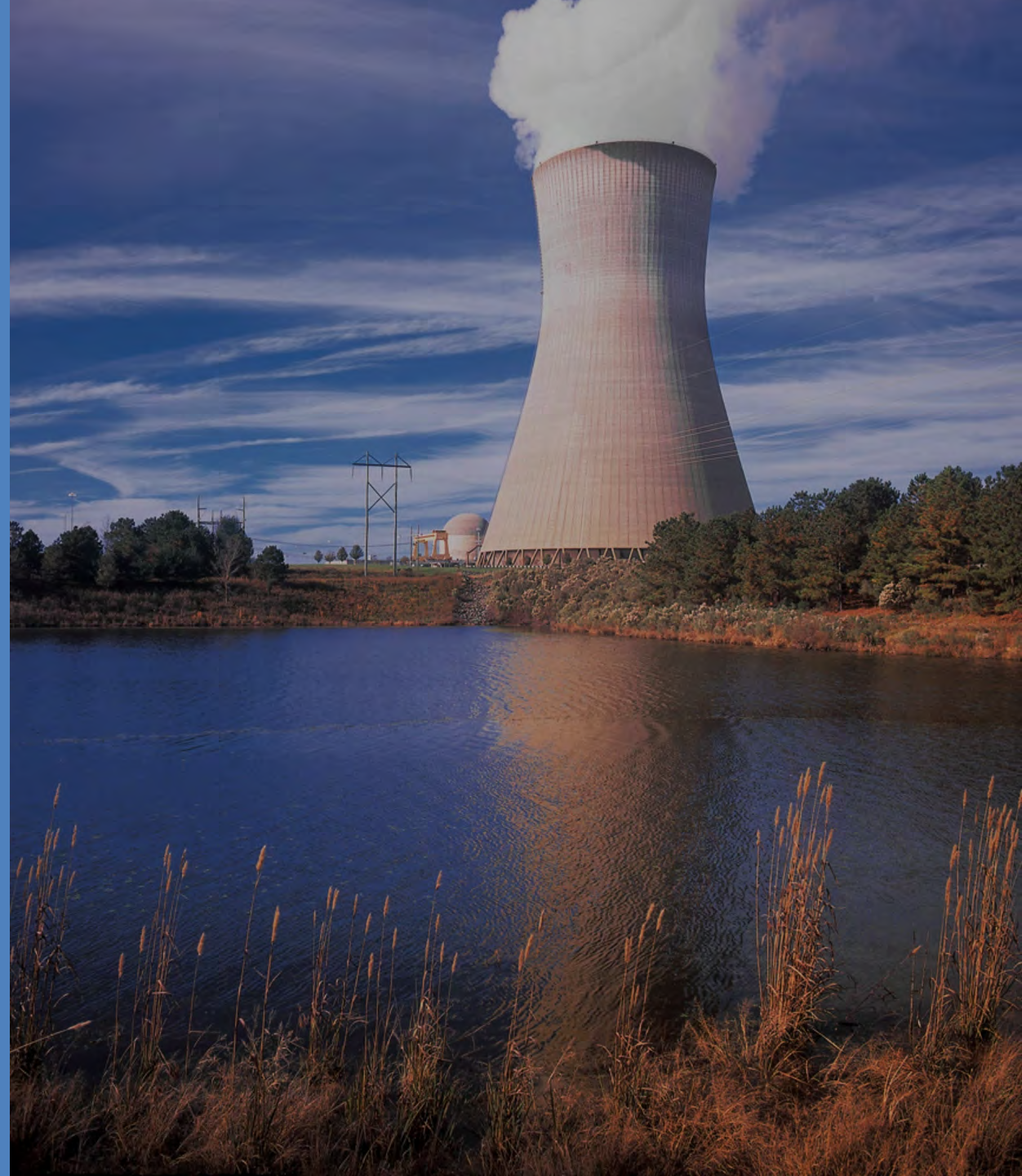
IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

OUR SCOPE

All nuclear power related technical and standards writing activities within the IEEE, including research, development, and advancement of nuclear engineering.

OUR COMMITTEE

We are an international group of technical experts from nuclear utilities, power plants, equipment vendors, engineering companies, and regulators.



IEEE | NPEC
Nuclear Power Engineering Committee

OUR STANDARDS

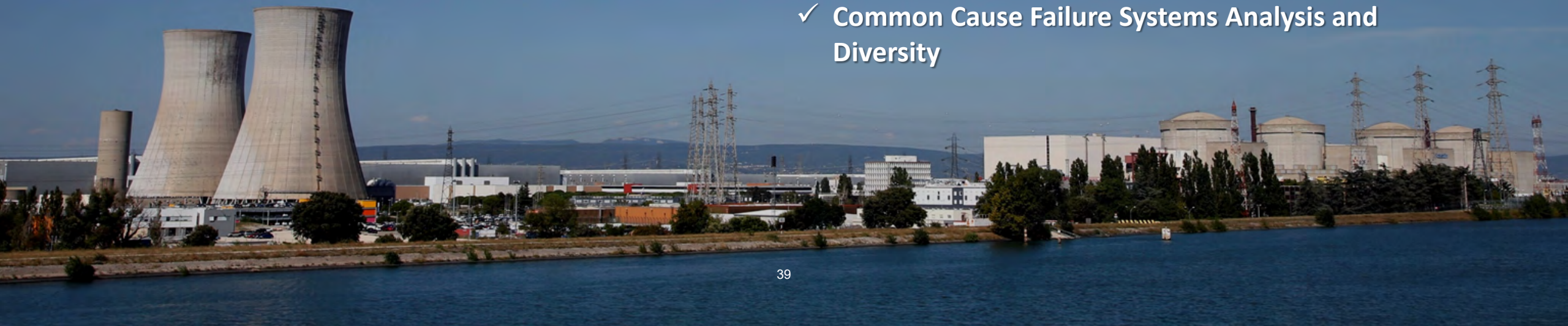
NPEC maintains 51 existing standards, 23 of those standards having full or partial NRC endorsement. NPEC standards are organized within these technical areas:

- Equipment Qualification
- Operations/Maintenance/Aging/Testing/Reliability
- Auxiliary Power Systems
- Human Factors and Control Facilities
- Safety-Related Systems

STANDARDS DEVELOPMENT

NPEC has a total of 25 standards projects currently underway, including 5 new standards:

- ✓ EMC Testing of Electrical and I&C Equipment
- ✓ Computer Based Displays for Monitoring & Control
- ✓ Application of the Single-Failure Criterion
- ✓ Classification of I&C and Electrical Systems
- ✓ Common Cause Failure Systems Analysis and Diversity



IEEE | NPEC
Nuclear Power Engineering Committee

SIGNIFICANT ACTIVITIES

- Recent development/revision of several key nuclear power standards, including:
  - ✓ IEEE/IEC 387-63332, Diesel Generator Units Applied as Standby Power Sources
  - ✓ IEEE Std-352, General Principles of Reliability Analysis
  - ✓ IEEE Std-741, Protection of Class 1E Power Systems
  - ✓ IEEE Std-1819, Risk-Informed Categorization and Treatment of Electrical Equipment
  - ✓ IEEE Std-1205, Aging Effects on Electrical Equipment
  - ✓ IEEE Std-1290 Motor Operated Valve Application, Protection, Control and Testing
- Coordination with NRC for Standards Endorsement
- Development of Joint-Logo Standards with IEC
- Participation in EPRI/NEI Advanced Reactor Codes and Standards (ARCS) Initiative

Learn More

site.ieee.org/pes-npec/