



# Standards Development for Advanced Reactors

Workshop on New & Advanced Reactors: Codes & Standards  
April 4, 2024

Todd Anselmi, ANS Standards Board Vice Chair

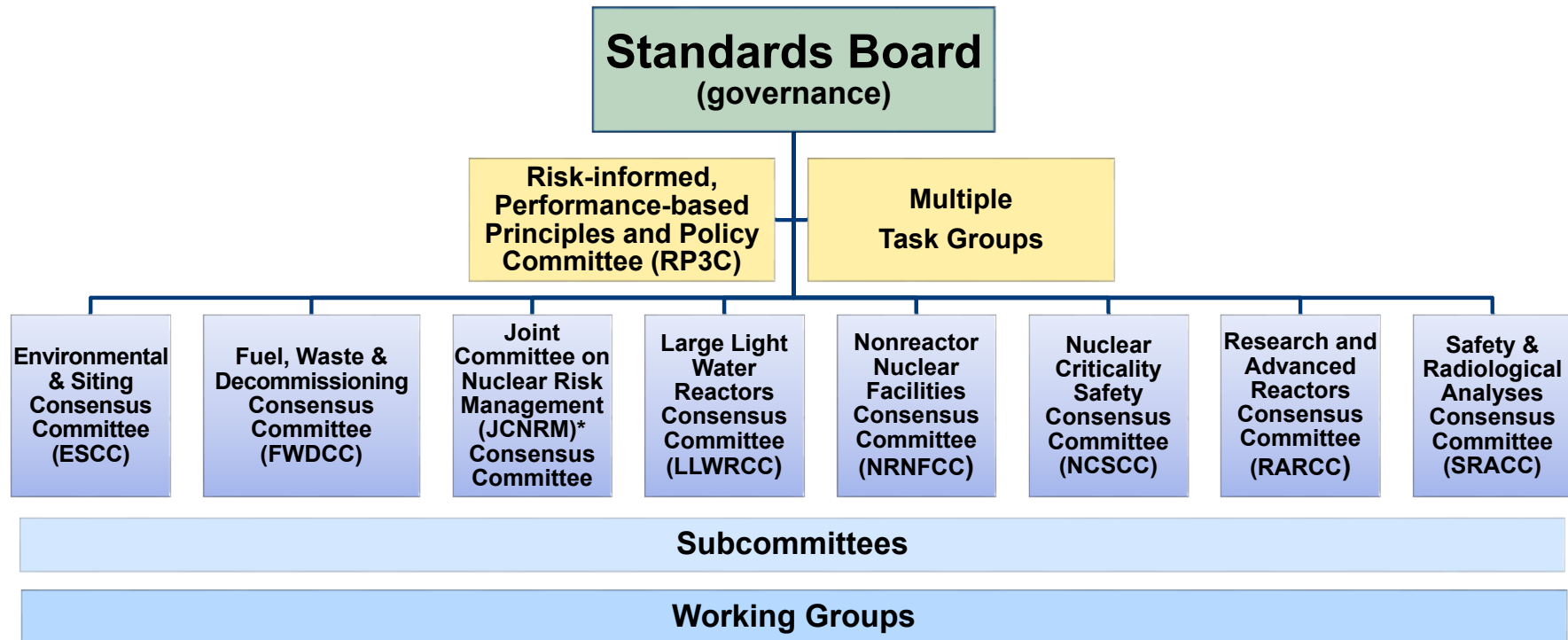
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# ANS Standards – A Key Piece of Nuclear Standards Pie

- ANS Standards Committee established in 1957
  - Produced earliest nuclear industry standards
  - Accredited by American National Standards Institute (ANSI) in 1967
- 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 (except medical applications)
- ANS has long had a focus on advanced reactor standards with an established consensus committee dedicated to advanced reactors and multiple standards on non-LWR designs and operational aspects.
- ANS maintains 90 current ANSI standards across 8 consensus Committees (CCs).



# The ANS Standards Committee

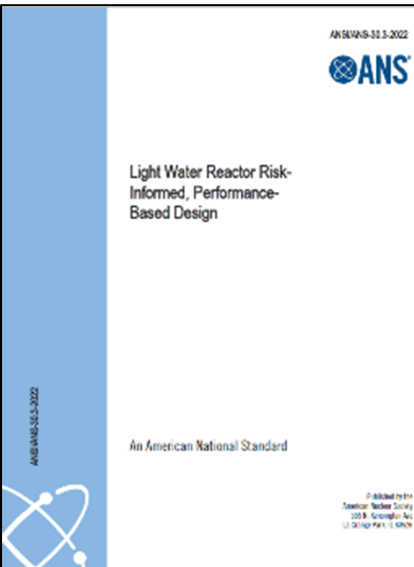


Activities relevant to ARs span all eight consensus committees.

# NRC, DOE, and National Lab Participation

Committee	NRC Participation	DOE Participation	National Lab Participation
Standards Board	YES	NO	YES
Environmental and Siting Consensus Committee	YES	YES	YES
Fuel, Waste, and Decommissioning Consensus Committee	YES	NO	YES
Joint Committee on Nuclear Risk Management	YES	NO	YES
Large Light Water Reactor Consensus Committee	YES	NO	YES
Nonreactor Nuclear Facilities Consensus Committee	NO	YES	YES
Nuclear Criticality Safety Consensus Committee	YES	YES	YES
Research and Advanced Reactors Consensus Committee	YES	YES	YES
Safety and Radiological Analyses Consensus Committee	YES	NO	YES

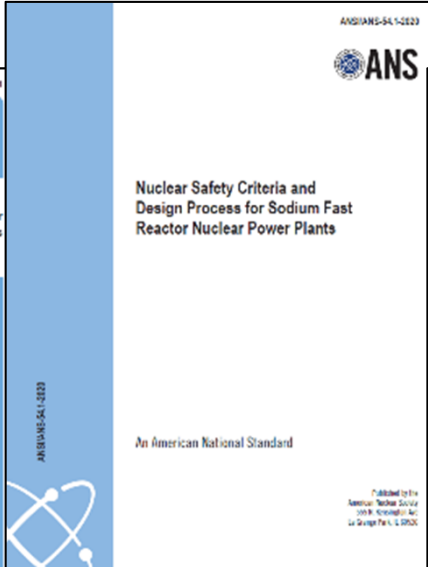
# A Sample of Standards for ARs



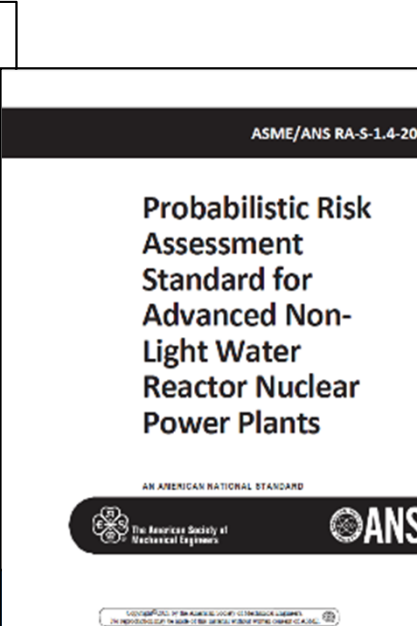
**ANS-30.3-2022**  
*LWR Risk-Informed, Performance-Based Design*



**ANS-53.1-2011 (R2021)**  
*Nuclear Design Process for MHCs*



**ANS-54.1-2020**  
*Nuclear Safety Criteria Design Process for SFRs*



**ASME/ANS RA-S-1.4-2021**  
*PRA Standard for Adv. non-LWR*



**ANS-20.2-2023**  
*Nuclear Safety Design Criteria and Functional Performance for LFMSRs*

# New ANS Advanced Reactor Standards on the Horizon

## ANS-19.13, Initial Fuel Loading and Startup Tests for FOAK Advanced Reactors

This new standard

- specifies the content of the minimum acceptable initial fuel loading and startup physics test program for first-of-a-kind advanced reactors
- provides the basis for each of the tests
- provides previously used acceptable methods for performing the individual tests in the appendix
- does not address reloads of advanced reactors where the initial core has already been validated by previous tests

**STATUS:** Draft completed in readiness review before starting multi-level approval process.

## ANS-30.2, Categorization and Classification of SSCs for New Nuclear Power Plants

This new standard

- provides a process for SSCs for new nuclear power plants that is, where possible, risk informed and performance based
- Provides process to determine special treatment of SSCs to meet the safety basis.
- This standard applies only to those new design facilities (i.e. greater than Generation III) that must obtain an operating license from the proper regulatory authority.

**STATUS:** Draft in development.

## ANS-54.8, Liquid Metal Fire Protection

This standard (resurrection of ANS-54.8-1988)

- establishes guidelines and requirements to ensure that the fundamental performance of liquid-metal fire detection, alarm, suppression, control, and structural protection systems are adequate to protect the public health and safety, and facility personnel
- minimizes or limits the economic loss in the event of a sodium/NaK leak.
- applicable to sodium and NaK facilities including commercial reactor facilities, research and test reactors, and research and test loops

**STATUS:** Project Initiation Notification Systems (PINS) form issued for approval.

# ARCSC Engagement

- The rollout of the NEI/EPRI North American Advanced Reactor Roadmap through the Roadmap Implementation Board established codes and standards as a key element supporting the Advanced Reactor Codes and Standards Collaborative (ARCSC).
- ARCSC is working 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.
- ANS is one of the lead SDOs and founding members of the ARCSC along with ASME and CSA Group.
- ANS (and presumably other SDOs) benefits from ARCSC activities such as the recent industry survey and leveraging engagement with peer organizations and other entities to gain a clearer picture on priorities and needs of the advanced reactor developers and end-users.

# ARCSC Needs Assessment Survey Feedback on ANS Standards

- ARCSC survey was launched September 14, 2023, and remains open at <https://forms.office.com/r/H4QjKBjhbs>.
- As of November 1, 2023, the survey received 103 responses.
- Forty-one (41) ANS standards were recognized in use for advanced reactors.
  - Fifteen (15) standards being used “as is.”
  - Twenty-six (26) standards being used “as is” by some with “gaps identified” by others.
- Not all responders provided details on gaps or provided only a generic response.
- First meeting with ANS consensus committee leadership held February 13, 2024; initial review determined need for more details from responders.
- All responders that reported gaps have been contacted for additional details to help determine appropriate action.
- Meetings for each consensus committee planned for April to evaluate provided details.



# ARCSC Needs Assessment Survey Feedback on ANS Standards

- Generic comment examples made on multiple ANS standards include:
  - Gaps found primarily where regulators mandate code compliance, requiring the line-by-line review of ANS equivalent.
  - Historical ANS standards focus on water-cooled solid fueled reactors operating at higher pressures and lower temperatures may lead to gaps for non-water-cooled designs.
  - Standards need to be made risk-informed and/or performance-based as appropriate.
- Examples of more specific comments include:
  - ANS-2.26, *Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design*, is largely incompatible with LMP (NEI 18-04) causing a breakdown when seeking to use ASCE 43, *Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities*, for seismic design for advanced reactors following LMP.
  - ANS-6.4, *Nuclear Analysis and Design of Concrete Radiation Shielding for Nuclear Power*, provides guidance for concrete design used as shielding. However, its interface with ASCE standards could be improved, such as for cases where structural concrete is credited as shielding, or cases where shielding concrete must be designed as if it were a safety-related structure.
  - ANS-54.8, *Liquid Metal Fire Protection in LMR Plants*, has been obsoleted or inactivated and “reinstating it” would be nice as its guidance is still being used. (NOTE: ANS is in the process of initiating this project!)
  - ANS-58.14, *Safety and Pressure Integrity Classification Criteria for Light Water Reactors*, was written specifically for water cooled reactors. Molten salt reactors (MSRs) were never considered when writing the standard and therefore the standard needs to be reviewed to determine whether it can be applied to MSRs and, if so, what changes need to be made.

# Where is ANS Going Next as an SDO

- ANS is continuing to evaluate feedback on gaps identified in its standards identified in the ARCSC survey to determine appropriate actions to move forward.
- ANS is initiating a new series of standards for space applications.
- ANS has issued a survey to its 900 plus standards members in February 2024 to gather feedback on the need for artificial intelligence standards for nuclear applications.
- ANS will use lessons learned on the needs evaluation on standards for artificial intelligence to explore standards needs for digital twins and robotics as resources allow.
- ANS is considering formation of new consensus committees, as needed, to manage work in the areas of space applications, artificial intelligence, digital twins, and robotics.

## ANS Standards Board Leadership

**Andrew Sowder**  
ANS Standards Board Chair  
asowder@epri.com

**Todd Anselmi**  
ANS Standards Board Vice Chair  
todd.anselmi@inl.gov

## ANS Staff

**John Fabian**  
ANS Director of Publications  
jfabian@ans.org

**Pat Schroeder**  
ANS Standards Manager  
pschroeder@ans.org



1111 Pasquinelli Dr., Ste 350  
Westmont IL, 60559  
708-579-8269 (Pat)