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ANS Standards for Advanced Reactors

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Chairman of the ANS Standards Board
Presented to:
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Agenda

- Historical Standards Activities
Supporting Advanced Reactors
- Current Activities
- Future Plans



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History of ANS Advanced Reactor Standards

- ANS has been involved in advanced reactor standards since the mid-1970s.
- ANS issued a standard ANS-54.1 (design standard for liquid metal reactors) in 1989. It was originally developed for trial use in 1975 under the designation of N214.
 - ANS-54.1 was withdrawn in 1999 because there was no longer an indication for need, nor interest by industry to support it.
 - In 2009, a new working group was formed to revise the standard (expand its scope) and make it more risk-informed and performance-based.
- In 2005, work began on a gas reactor design standard which fully incorporated a risk-informed, performance-base approach resulting in ANS-53.1 issued in 2011.



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In Addition to These Two Standards, Planning Took Place for a Large Number of Standards to Eventually be Developed

- There were 21 new standards identified for gas-cooled reactors.
- There were 10 new standards identified for LMRs.
- Lists of these by title are found on the next slides.



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Proposed Gas-Cooled Reactor Standards

- ANS-53.2, “Radioactive Gas System for the Stationary Gas-Cooled Reactor Plant”
- ANS-53.3, “Gas-Cooled Reactor Plant Reactor Core Assembly System”
- ANS-53.4, “Gas-Cooled Reactor Plant Containment System”
- ANS-53.6, “Gas-Cooled Reactor Plant Reactivity Control System”
- ANS-53.8, “High-Temperature Gas-Cooled Reactor Fuel Handling System Design”
- ANS-53.9, “Gas-Cooled Reactor Plant Containment Atmospheric Clean-Up System”
- ANS-53.10, “Gas-Cooled Reactor Plant Electric Power System”
- ANS-53.11, “Gas-Cooled Reactor Plant Protection System”
- ANS-53.12, “Gas-Cooled Reactor Plant Core Auxiliary Cooling System”
- ANS-53.13, “Stationary Gas-Cooled Reactor Plant Helium Purification System”



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Proposed Gas-Cooled Reactor Standards (Cont'd)

- ANS-53.14, “Gas-Cooled Reactor Plant Helium Storage System”
- ANS-53.15, “Design Criteria for the Reactor Cooling Water System of Gas-Cooled Reactor Plants”
- ANS-53.16, “Design Criteria for the Service Water System of Gas-Cooled Reactor Plants”
- ANS-53.17, “Gas-Cooled Reactor Plant New Fuel Storage System”
- ANS-53.18, “Gas-Cooled Reactor Plant Liquid Nitrogen System”
- ANS-53.19, “Gas-Cooled Reactor Plant Chilled Water System”
- ANS-53.20, “Gas-Cooled Reactor Plant Secondary Coolant System”
- ANS-53.21, “Gas-Cooled Reactor Plant Other Structures”
- ANS-53.22, “Gas-Cooled Reactor Plant Control Room”
- ANS-53.23, “Gas-Cooled Reactor Plant Multi-Unit Stations”
- ANS-53.24, “Gas-Cooled Reactor Plant Radioactive Liquid Waste System”



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Proposed LMR Standards

- ANS-54.3, “Principal Design Criteria for LMFBR Containments”
- ANS-54.4, “Nonmetallic Thermal Insulation for Austenitic Stainless Steel in LMFBRs”
- ANS-54.5, “Requirements for Sustaining Safe Shutdown in Liquid Metal Cooled Fast Reactors”
- ANS-54.6, “LMFBR Safety Classification and Related Requirements”
- ANS-54.7, “Source Terms to be Used in Evaluation of Radiological Site Suitability for LMFBR Power Plants”
- ANS-54.9, “Environmental Qualification of Safety Related Equipment in LMFBRs”
- ANS-54.10, “Risk Limit Criteria for LMFBR Design”
- ANS-54.11, “Application of Risk Limit Criteria for LMFBR Design”
- ANS-54.12, “Event Categorization Guidelines for LMFBR Design”
- ANS-54.13, “Requirements for Evaluating the Potential Radiological Consequences of LMFBR Radioactive Gas Process and Storage System Failures”



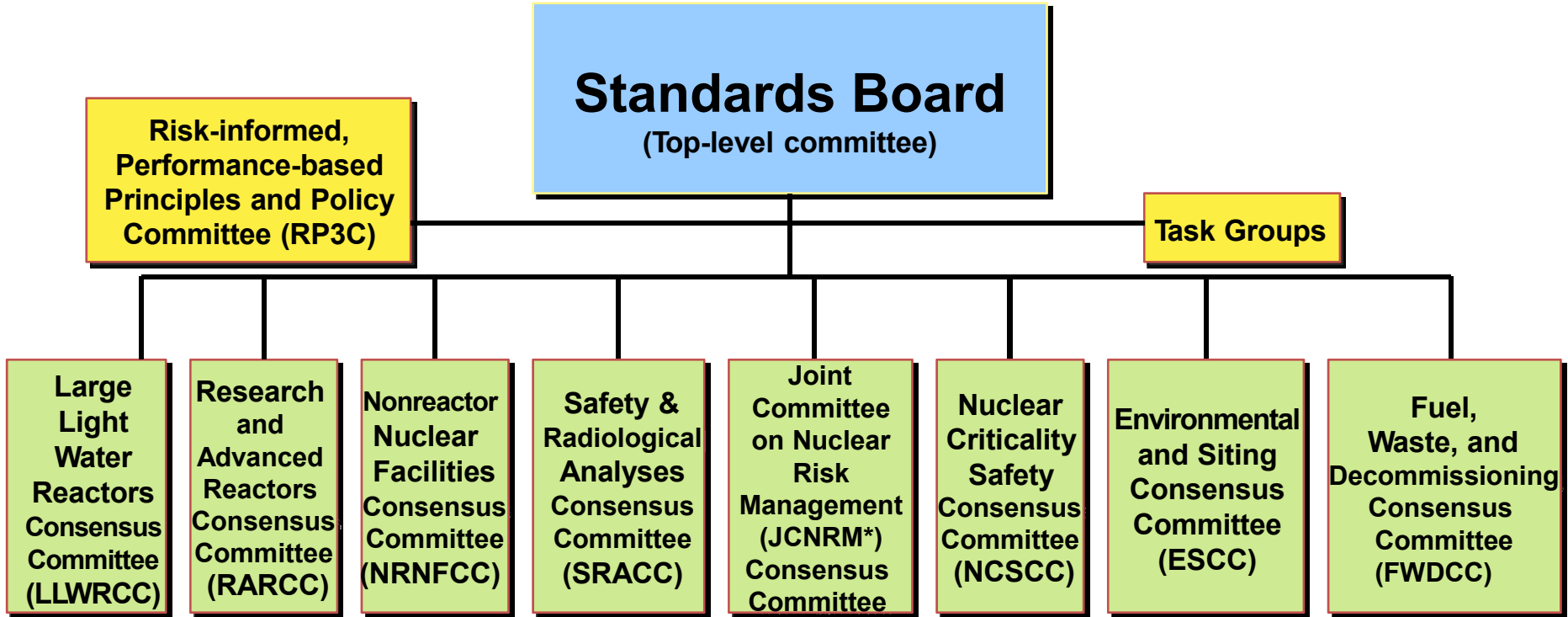
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Current Standards Activities at ANS in Support of Advanced Reactors

- In 2013, the ANS Standards Committee was reorganized.
- The current structure has several consensus committees that would be involved in the development of advanced reactors.
- One in particular (Research and Advanced Reactor Consensus Committee) addresses the development of advanced reactor standards in its scope.
- In addition, the Standards Board setup a Risk-Informed Performance-Based Principals and Policy Committee to assist ANS working groups in developing standards that are more performance-based and risk-informed.
- A description of the committee structure and scopes of the committees that likely would be involved in developing advanced reactor standards is shown on the next slides.



The ANS Standards Committee



Subcommittees

Working Groups

*The JCNRM is a joint ANS and ASME committee



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Research and Advanced Reactors Consensus Committee (RARCC) **George F. Flanagan (Chair), ORNL**

Scope:

The RARCC is responsible for the preparation and maintenance of voluntary consensus standards for the design, operation, maintenance, operator selection and training, and quality requirements for current and future research and test reactors including pulsed critical facilities, reactors used for the production of isotopes for industrial, educational, and medical purposes and current and advanced non-large LWRs. The scope includes but is not limited to: water-cooled and non-water cooled Small Modular Reactors, Generation III+ and IV reactors, and future non-light water cooled/moderated large commercial reactors.

The RARCC standards include but are not limited to the design and operation of the nuclear island, the balance of plant, and other systems within the plant boundary affecting safety and operations. The ANS Standards Committee Procedures Manual for Consensus Committees shall be used to guide the activities of this consensus committee.



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Joint Committee on Nuclear Risk Management (ANS/ASME)

Robert J. Budnitz (Co-Chair), LBNL

C. Rick Grantom (Co-Chair), Individual

Activities performed upon concurrence of the ANS Standards Board and the ASME Standards & Certification Board.

Scope:

The JCNRM Consensus Committee is responsible for the preparation and maintenance of voluntary consensus standards that establish safety and risk criteria and methods for completion of probabilistic risk analysis (PRA) and risk assessments. Additional related standards activities may be performed as upon concurrence of the ANS Standards Board and the ASME Standards & Certification Board. These criteria and methods are applicable to design, development, construction, operation, decontamination, decommissioning, waste management, and environmental restoration for nuclear facilities. Activities of the consensus committee shall be guided by the Procedures for ASME Codes and Standards Development Committees but shall also meet the intent of ANS Standards Committee Procedures Manual for Consensus Committees unless specifically authorized by the ANS Standards Board.



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Fuel, Waste, and Decommissioning Consensus Committee (FWDCC) **Donald R. Eggett (Chair), Eggett Consulting**

Scope:

The FWDCC is responsible for the preparation and maintenance of voluntary consensus standards for the design, operation, maintenance, operator selection and training, quality requirements of new and used fuel transport, storage and related handling facilities; including high level/TRU, greater-than-Class C, low level, and mixed waste processing and facilities, and for the decommissioning of commercial, educational, research and government facilities. The ANS Standards Committee Procedures Manual for Consensus Committees shall be used to guide the activities of this consensus committee.



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Environmental and Siting Consensus Committee (ESCC)

**Carl A. Mazzola (Chair), CB&I Federal
Services**

Scope:

The ESCC is responsible for the preparation and maintenance of voluntary consensus standards for all aspects of nuclear power plant and non-reactor nuclear facility siting, environmental assessment, environmental management, environmental monitoring, and the categorization and evaluation of natural phenomena hazards at these public and private sector nuclear facilities.

Many of the ESCC standards presently support the siting and environmental needs of the civilian nuclear industry and the Department of Energy (DOE) in meeting 10 CFR 50, 10 CFR 51 and 10 CFR 52 licensing requirements and assisting with compliance to 40 CFR enabling regulations associated with the Clean Air Act, Clean Water Act, Safe Drinking Water Act, Resource Conservation and Recovery Act, Comprehensive Environmental Response Compensation and Liability Act, Toxic Substances Control Act, and National Environmental Policy Act. The ANS Standards Committee Procedures Manual for Consensus Committees shall be used to guide the activities of this consensus committee.



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Safety and Radiological Analyses Consensus Committee (SRACC) **Andrew O. Smetana (Chair), SRNL**

Scope:

The SRACC is responsible for the preparation and maintenance of voluntary consensus standards for physics methods and measurements for nuclear facilities, shielding materials and methods for shielding analyses, safety analyses and for the associated computational methods and computer codes. Input data for calculations and codes, such as nuclear cross sections, are included in this scope. The ANS Standards Committee Procedures Manual for Consensus Committees shall be used to guide the activities of this consensus committee.



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The Research and Advanced Reactor Consensus Committee Has Six Standards that Directly Support Advanced Reactors

- ANS-53.1, “Nuclear Safety Design Process for Module Helium-cooled Reactor Plants (approved 2011)
- ANS-54.1, “Nuclear Safety Criteria and Design Process for Sodium Fast Reactor Nuclear Power Plants” (awaits balloting)
- ANS-20.1, “Nuclear Safety Design Criteria for Fluoride Salt-Cooled High-Temperature Reactor Nuclear Power Plants” (in development)



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The Research and Advanced Reactor Consensus Committee Has Six Standards that Directly Support Advanced Reactors (Cont'd)

- ANS-20.2, “Nuclear Safety Design Criteria and Functional Performance Requirements for Liquid-Fuel Molten Salt Reactor Nuclear Power Plants” (in development)
- ANS-30.1, “Integrating Risk and Performance Objectives into New Reactor Nuclear Safety Designs” (in development)
- ANS-30.2, “Categorization and Classification of Structures, Systems, and Components for New Nuclear Power Plants” (in development)
 - Membership solicited from IEEE and ASME



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Joint Committee on Nuclear Risk Management JCNRM (ANS/ASME) Has a Standard for Non-LWRs Issued for Trial Use

- ASME/ANS RA-S-1.4-2013 "Probabilistic Risk Assessment Standard for Advanced Non-LWR Nuclear Power Plants", December 9, 2013



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Future Plans

- ANS conducted a survey to receive input from its members regarding new standards that need to be developed.
- The Standards Board is working to address the top 10 list and initiating work on the next 10 standards on the list.
 - Only one is directly related to advanced reactors—which was already being addressed under ANS-30.1.
 - Several other standards are focused on LWRs but would be generally applicable to advanced reactors.
- Priorities based on the survey results are incorporated into the new strategic plan for the Standards Committee.



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Future Plans (Cont'd)

- Joint NRC/DOE Advanced Reactor Framework Program has identified design criteria to be used as guidance for development of Principal Design Criteria for advanced reactors; results to be issued as a Regulatory Guide.
- Specific guidance for SFRs and mHTGRs
- ANS standards ANS-54.1, ANS-20.1 and ANS-20.2 directly support this activity.
- This year, the NRC/DOE program performed a gap analysis for Chapter 4 of the SRP (SFR and mHTGR).
- The gap analysis identified several standards contained in the reference section that will need revision or a new standard in order to address advanced reactors.