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

Advanced Reactor Stakeholder Public Meeting

May 23, 2024

Microsoft Teams Meeting
Bridgeline: 301-576-2978
Conference ID: 593 553 61#

Time	Agenda	Speaker
10-10:10am	Opening Remarks	NRC
10:10-10:20	Integrated Schedule Dashboard Update	NRC
10:20-10:30	Advanced Reactor Application Guidance Website	NRC
10:30-10:45	Plans for RG 1.247 Post-Trial-Use	NRC
10:45-11:00	Public Workshop on Technology Inclusive Risk Metrics for Advanced Reactors	NRC
11:00-12pm	Micro-Reactor Licensing and Deployment Considerations	NRC
12:00-1:00	Lunch Break	
1:00-1:30	Update on the National Reactor Innovation Center	DOE/INL
1:30-3:00	ARCAP ISG Documents and TICAP Guidance Final Documents	NRC

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Opening Remarks

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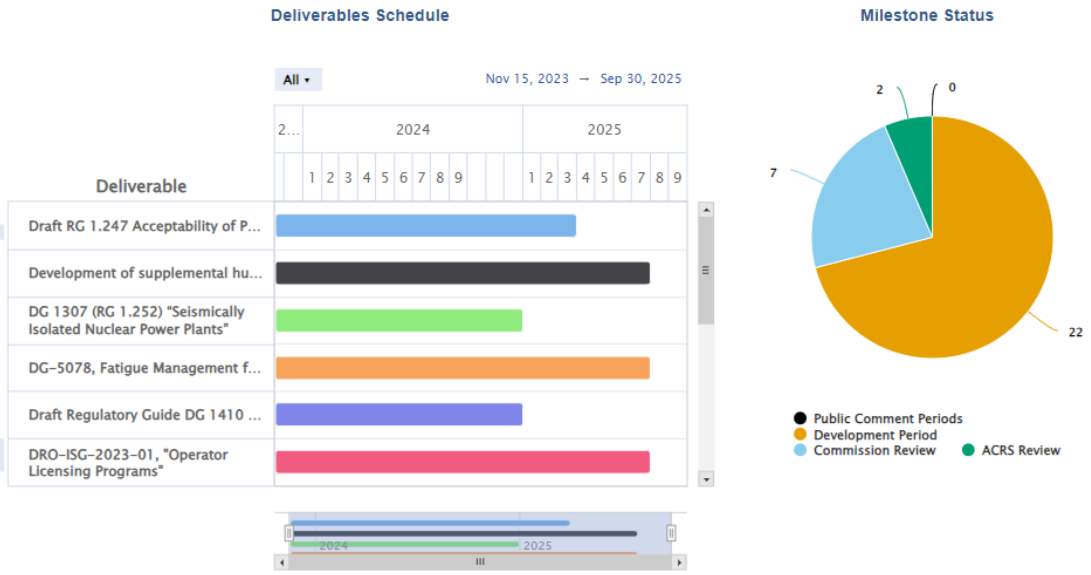
Advanced Reactor Program Recent Highlights

Integrated Review Schedule Dashboard

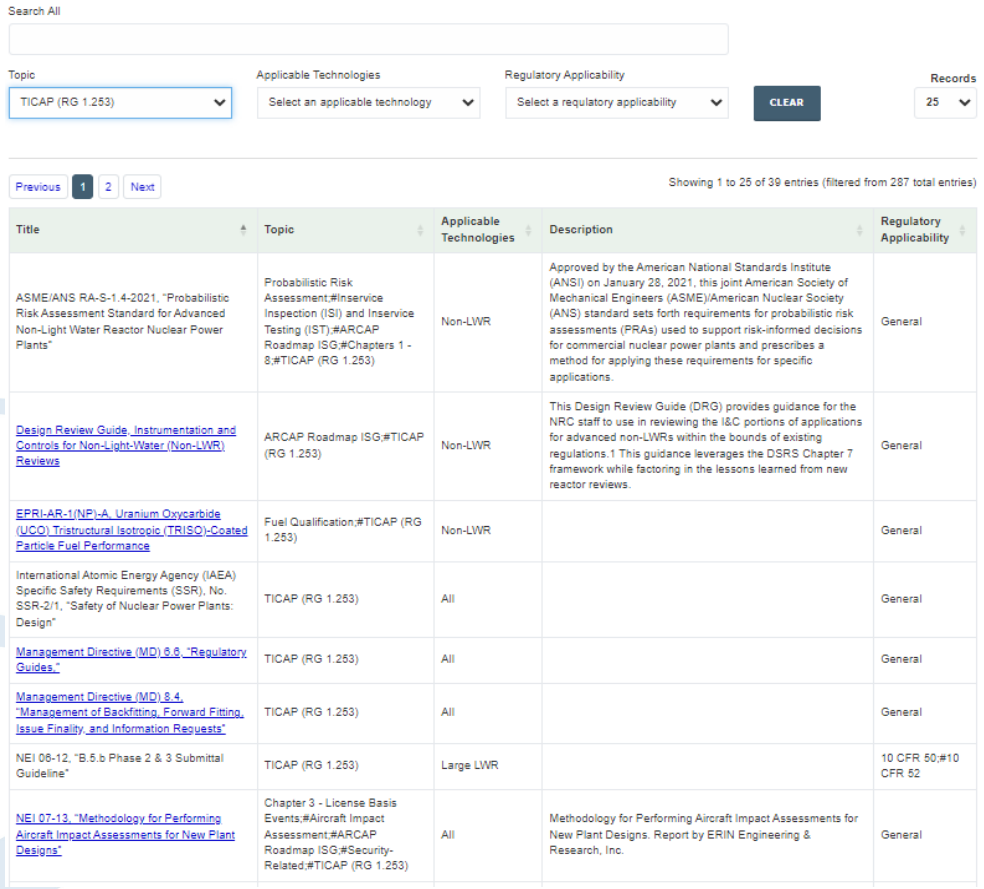
- Graphs update to reflect active projects.
- Colors are Section 508 compliant.
- Ability to email Deliverable PM/POC.
- Cleaned up layout and added link to document in the Summary page.



https://www.nrc.gov/reactors/new-reactors/advanced/how-were-executing/integrated-review-schedule/isd-dashboard.html

Advanced Reactor Application Guidance

- Table provides references for a technology-inclusive, risk-informed and performance-based application.
- Supports applications submitted under:
  - 10 CFR Part 50,
  - 10 CFR Part 52, and
  - Supports the 10 CFR Part 53 rulemaking effort.
- References without links are not official NRC records; user needs to request access from the document owner.
- Draft documents included in the table should not be considered as official NRC guidance, unless otherwise endorsed or published as such.



Search All

Topic: TICAP (RG 1.253) | Applicable Technologies: Select an applicable technology | Regulatory Applicability: Select a regulatory applicability | CLEAR | Records: 25

Previous 1 2 Next

Showing 1 to 25 of 39 entries (filtered from 287 total entries)

Title	Topic	Applicable Technologies	Description	Regulatory Applicability
ASME/ANS RA-S-1.4-2021, "Probabilistic Risk Assessment Standard for Advanced Non-Light Water Reactor Nuclear Power Plants"	Probabilistic Risk Assessment;#Inservice Inspection (ISI) and Inservice Testing (IST);#ARCAP Roadmap ISG;#Chapters 1 - 8;#TICAP (RG 1.253)	Non-LWR	Approved by the American National Standards Institute (ANSI) on January 28, 2021, this joint American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) standard sets forth requirements for probabilistic risk assessments (PRAs) used to support risk-informed decisions for commercial nuclear power plants and prescribes a method for applying these requirements for specific applications.	General
Design Review Guide, Instrumentation and Controls for Non-Light-Water (Non-LWR) Reviews	ARCAP Roadmap ISG;#TICAP (RG 1.253)	Non-LWR	This Design Review Guide (DRG) provides guidance for the NRC staff to use in reviewing the I&C portions of applications for advanced non-LWRs within the bounds of existing regulations.1 This guidance leverages the DSRS Chapter 7 framework while factoring in the lessons learned from new reactor reviews.	General
EPRI-AR-1(NP)-A, Uranium Oxycarbide (UCO) Tristructural Isotropic (TRISO)-Coated Particle Fuel Performance	Fuel Qualification;#TICAP (RG 1.253)	Non-LWR		General
International Atomic Energy Agency (IAEA) Specific Safety Requirements (SSR), No. SSR-2/1, "Safety of Nuclear Power Plants: Design"	TICAP (RG 1.253)	All		General
Management Directive (MD) 6.6, "Regulatory Guides,"	TICAP (RG 1.253)	All		General
Management Directive (MD) 8.4, "Management of Backfitting, Forward Fitting, Issue Finality, and Information Requests"	TICAP (RG 1.253)	All		General
NEI 06-12, "B.5.b Phase 2 & 3 Submittal Guideline"	TICAP (RG 1.253)	Large LWR		10 CFR 50;#10 CFR 52
NEI 07-13, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs"	Chapter 3 - License Basis Events;#Aircraft Impact Assessment;#ARCAP Roadmap ISG;#Security-Related;#TICAP (RG 1.253)	All	Methodology for Performing Aircraft Impact Assessments for New Plant Designs. Report by ERIN Engineering & Research, Inc.	General

https://www.nrc.gov/reactors/new-reactors/advanced/modernizing/rulemaking-and-guidance/adv-reactor-app-guidance.html

Path Forward

Regulatory Guide 1.247

Acceptability of PRA Results for Non-Light Water Reactor Risk-Informed Activities

Publication of the Trial Use RG 1.247

- *Federal Register* notice announcing public availability of the trial use RG 1.247 was published on March 24, 2022 (87 FR 16770)
- Staff conducted a post-promulgation comment period ending on May 23, 2022
- A 2-year trial use period followed the comment period starting on May 24, 2022, and concludes on May 23, 2024

Trial Use Period for RG 1.247

- The purpose of the 2-year trial use period was to help gain additional implementation experience to better inform draft and final staff positions.
- Based on available information at the time, it was expected the trial use RG 1.247 might be used by prospective, near-term, non-LWR applicants.
- To date, no comments have been received on the trial use RG 1.247 during the 2-year trial use period.

Path Forward for RG 1.247

- Staff to finalize the staff positions in RG 1.247 following the conclusion of the trial use period and culminating in the publication of a final staff position in RG 1.247, Revision 0
- The trial use RG 1.247 to be withdrawn following publication of RG 1.247, Revision 0
- Finalization will occur over an extended period to allow consideration of near-term use of the trial use RG 1.247 in non-LWR licensing activities.

Finalization Schedule for RG 1.247

- May 2024 – Staff start development of the proposed draft regulatory guide (DG)
- March 2025 – Staff publish DG, as informed by:
  - Periodic public meetings to provide and discuss development status
  - Consideration of near-term use of trial use RG 1.247
- April to May 2025 – Public comment period on DG
- Mid-calendar year (CY) 2025 to mid-CY2026:
  - Resolution of public comments
  - Internal and ACRS reviews
- Mid-CY2026 – Publication of RG 1.247, Revision 0

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Public Workshop on Technology Inclusive Risk Metrics for Advanced Reactors

NRC Working Group on Technology Inclusive Risk Metrics

Office of Nuclear Regulatory Research (RES)

- **Jeffery Wood**
- Matt Humberstone
- Gerardo Martinez-Guridi

Office of Nuclear Reactor Regulation (NRR)

- Hanh Phan
- Marty Stutzke

Periodic Advanced Reactor Stakeholder Meeting
May 23, 2024

NRC Considering Needs for Non-LWR Risk Metrics and Reliability Data

In 1990, the Commission established three risk metrics for new reactors and associated quantitative goals:

- **Core Damage Frequency (CDF) < 1×10^{-4}/year** – A measure of overall safety performance in prevention of severe accidents
- **Large Release Frequency (LRF) < 1×10^{-6}/year** – A measure of prevention of significant offsite consequences
- **Conditional Containment Failure Probability (CCFP) < 0.1** – A measure of the capability of design to mitigate a severe accident

Traditional risk metrics, e.g., CDF, have been used effectively in NRC's risk-informed decision-making processes

- *May not be applicable to all advanced reactor designs*

SRM SECY-23-0021 provides direction on applicant proposed risk metrics

"The staff should revise draft 10 C.F.R. 53.220 to specify that applicants must propose a comprehensive plant risk metric (or set of metrics) …"

Need to consider alternative risk metrics that:

- Are applicable to Non-LWR designs
- Support NRC licensing and regulatory processes

Public Workshop on Risk Metrics and Reliability Data for Non-LWRs

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- Summarize NRC staff's ongoing efforts on risk metrics and supporting reliability data
- Gather input from stakeholders
- Consider how risk metrics can be applied to:
  - Licensing
  - Oversight
  - License amendment requests
  - Other risk-informed regulatory processes
- Contact if interested in presenting your thoughts on risk metrics
  - jeffery.wood@nrc.gov
- Planning to schedule workshop, tentative mid-July 2024

Nth-of-a-Kind Licensing Considerations for Micro-Reactors

ADVANCED REACTOR READY

NeXT LICENSING

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Mission: Licenses and regulate the Nation's civilian use of radioactive materials to provide reasonable assurance of adequate protection of public health and safety and to promote the common defense and security and to protect the environment.

NeXT Licensing

Enabling safe and timely decisions for advanced reactors.

- Execute safety-focused regulatory actions
- Optimize regulatory framework
- Advance technology readiness
- Maximize benefits of standardization
- Enable efficient stakeholder engagement

What is NeXT Licensing?

An approach by which a robust up-front approval of a common design enables efficient, predictable licensing of "nth-of-a-kind" reactors

Up-Front Approval of the Common Plant

- Standard design approved in a manufacturing license, design certification, construction permit and operating license, or combined operating license
- Technical issues resolved
- Standardized operational programs (as appropriate)
- Generic environmental review (as appropriate)
- Hearing covering the common design

Nth-of-a-Kind Licensing

- Address administrative processes
- Confirmation of site suitability for design
- Closure of ITAAC/license conditions
- Confirmatory site-specific inspection
- Hearings on site-specific issues
- Operating decision

The NRC staff is proactively enhancing clarity, reliability, and efficiency for licensing and regulation of micro-reactors

Clear

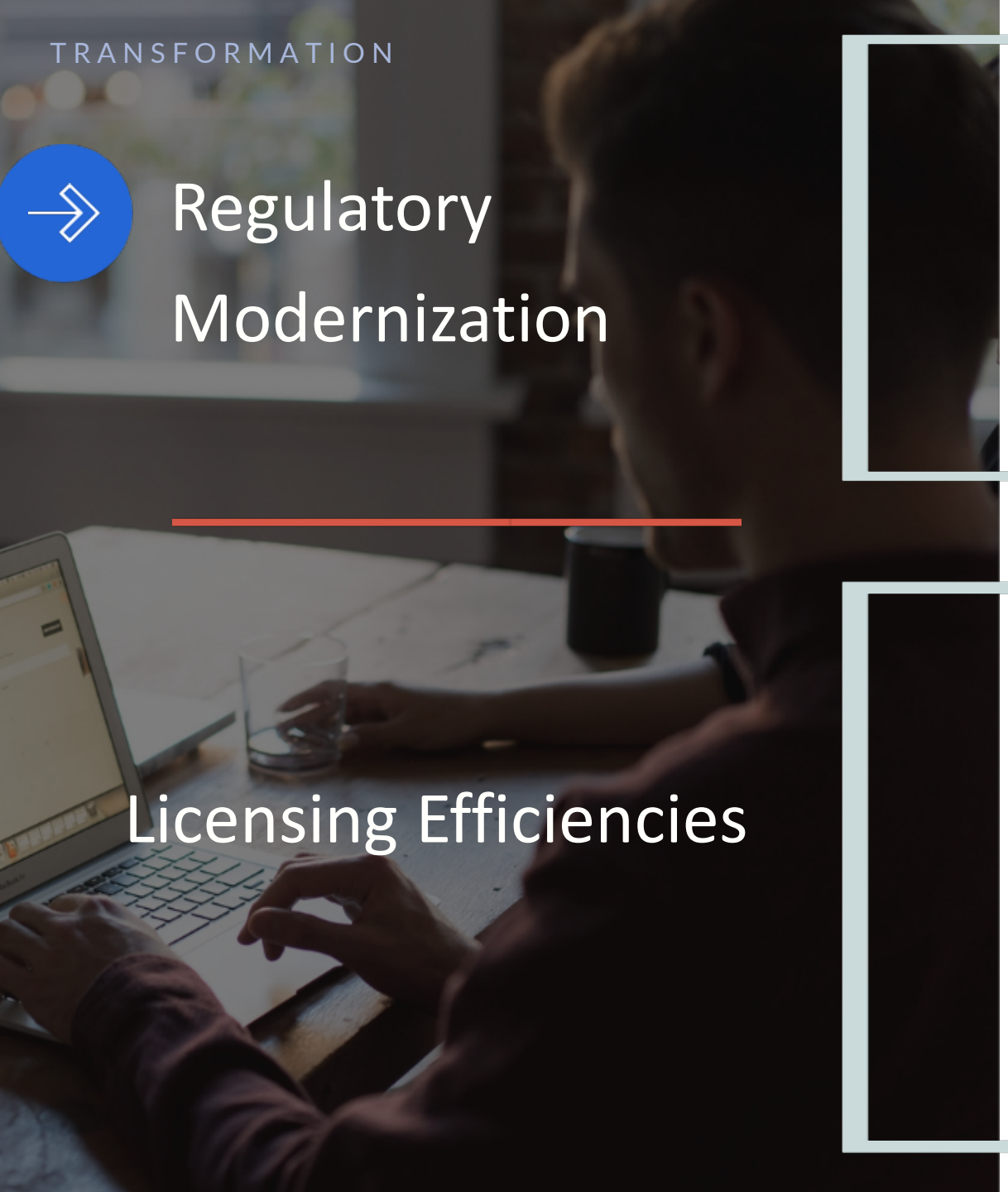
Coherent, logical, and practical regulatory approaches that will allow for safe and secure deployment

Reliable

Prompt, fair, and decisive regulation that lends stability to licensing and deployment

Efficient

Risk-informed and performance-based regulation that delivers timely results and uses resources effectively



Regulatory Modernization

- Risk-informed licensing
- Consequence oriented approaches
- Advanced Reactor Generic Environmental Impact Statement
- Fees, ARCOP, Policy Issues, Guidance (ARCAP)
- Emergency Preparedness rule

Licensing Efficiencies

- Pre-application
- Staged licensing
- Core teams
- International engagement
- Direct communication (audits)
- Focused ACRS interactions
- Streamlined documentation
- Optimized environmental reviews

The NRC staff is taking actions to prioritize and address licensing and deployment considerations related to micro-reactors.

- SECY-24-0008: “Micro-Reactor Licensing and Deployment Considerations: Fuel Loading and Operational Testing at a Factory” (ML23207A252)
- “Micro-reactors Licensing Strategies” White Paper (ML21235A418)
- SECY-20-0093: “Policy and Licensing Considerations Related to Micro-Reactors” (ML20254A363)

SECY-24-0008

SECY-24-0008, “Micro-Reactor Licensing and Deployment Considerations: Fuel Loading and Operational Testing at a Factory,” seeks Commission policy direction on regulatory approaches related to three topics:

(1) Features to preclude criticality

(2) Fuel loading at a factory

(3) Operational testing at a factory

Catalyzing Micro-Reactors

- Loading Fuel and Operational Testing
- Transportation of fueled reactors
- Standardization of operational programs (as appropriate)
- Environmental review
- Site characterization
- Timeframe for authorization to operate at the deployment site
- Physical and Cyber Security
- Emergency Preparedness
- Decommissioning process and decommissioning funding assurance
- Staffing, training, qualification requirements
- Commercial mobile micro-reactors
- Licensing replacement reactors
- Autonomous operation and remote operation
- Storage of fuel after irradiation in a power reactor
- Siting in densely populated areas
- Aircraft impact assessment
- Commercial maritime and space applications

WHAT'S NEXT?

Topics of interest:

- Maximal design standardization
- Standardization of operation programs (as appropriate)
- Site characterization
- Streamlined licensing process and safety review
- Environmental review
- Construction inspection

Continued stakeholder engagement

Success Strategies

Optimizing Licensing Reviews

Proactive Stakeholder Engagement

Robust Preapplication Activities

Thank you.

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LUNCH BREAK

Meeting will resume at 1:00 pm EDT

Microsoft Teams Meeting

Bridgeline: 301-576-2978

Conference ID: 593 553 61#

Advanced Reactor Program

NRIC National Reactor Innovation Center

National Reactor Innovation Center

Program Overview

May 23, 2024

Brad Tomer, Acting Director, Chief Operating Officer

nric.inl.gov

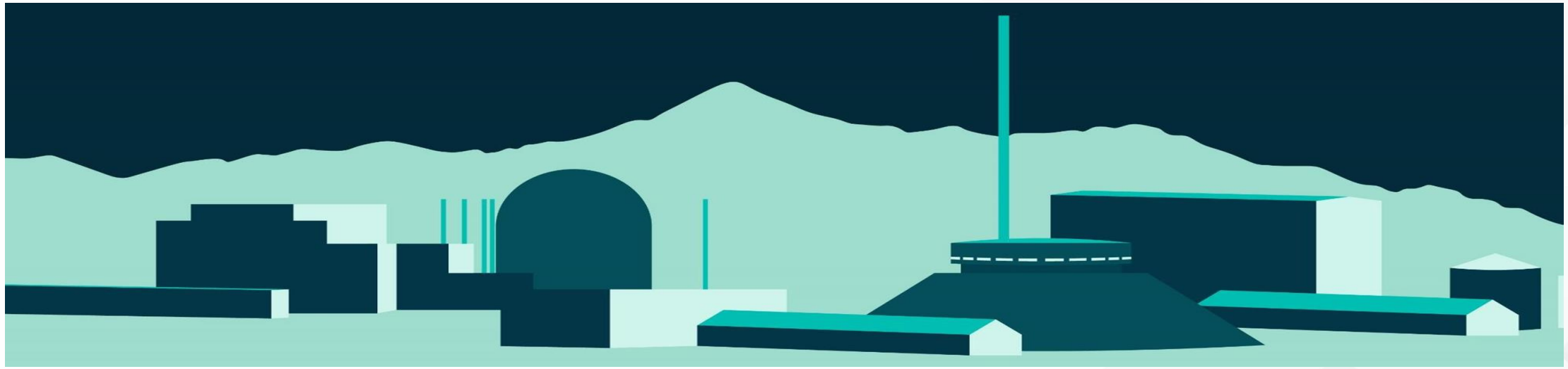
NRIC is a DOE program launched in FY'2020

NRIC Enables Nuclear Reactor Tests & Demonstrations

- Authorized by the Nuclear Energy Innovation Capabilities Act (NEICA)
  - DOE-Office of Nuclear Energy; INL Nuclear Science & Tech
- Partner with industry to bridge the gap between research and commercial deployment
- Leverage national lab expertise and infrastructure

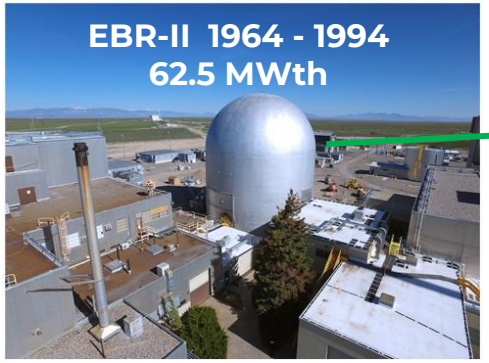
NRIC National Reactor Innovation Center

Portfolio Built to Empower Innovators



- **Building testing foundation**
  - Advanced Reactor Test Beds
  - Experimental Facilities
  - Virtual Test Bed
- **Addressing Costs & Markets**
  - Advanced Construction
  - Digital Engineering for Nuclear
  - Maritime Applications

NRIC Advanced Reactor Testbed Capabilities

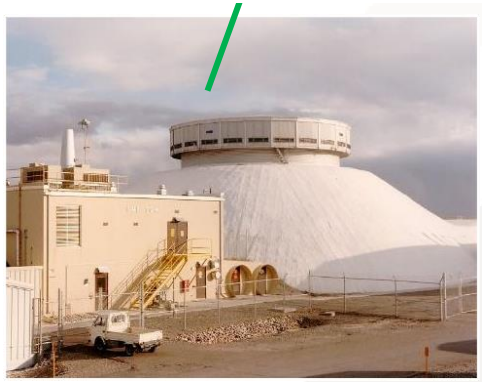


Demonstration of Microreactor Experiments (DOME)

- DOME is the repurposed EBR-II structure
- Designed for Advanced Microreactors up to 20MW_{th}
- Designed for High-Assay Low-Enriched Uranium (HALEU) fuels < 20% enrichment
- Accommodates ISO 668 High-Cube Shipping Containers up to 40ft long.
- 480V / 400Amp electrical Service
- ≈ 78 ft diameter floor space with an 80ft ceiling
- 300kWth of environmental cooling expandable to 500KW_{th}

Materials & Fuels Complex at INL

ZPPR 1969 to 1990
Transuranic and HEU inspection repackaging and experiments

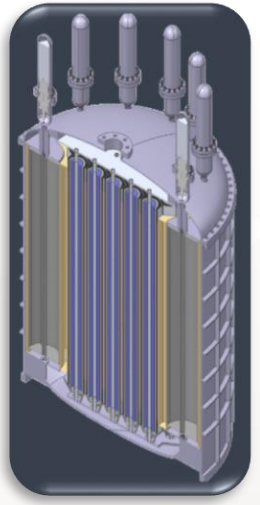


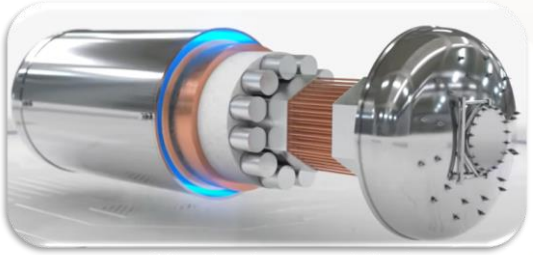
Laboratory for Operations and Testing in the US (LOTUS)

- LOTUS is the repurposed ZPPR structure
- Designed for HEU fuels
- Cell Heat Removal – (2) redundant HVAC packages – 50kWth
- Reactor Heat Removal – Design only – Min: 25KW_{th}; Max: 500 kW_{th}
- In Cell Equipment Power
  - Normal – 480VAC, 450A, 3 phase
  - Auxiliary – 208VAC, 160A, 3 phase
- Cell Provides Radiological Confinement
- Cell Geometry – 30ft usable inner diameter; 16ft 11in (bottom of crane hook); Recessed pit area
- Entry Tunnel – 13ft x 13ft
- Polar Crane Capacity – 5 tons

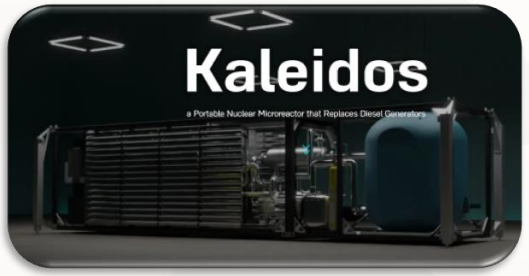
NRIC-DOME Testbed

- Construction Start Q4 2023
- Operational Readiness – June 2026
- First user expected – 2026
- 3 users going through front-end engineering and experiment design



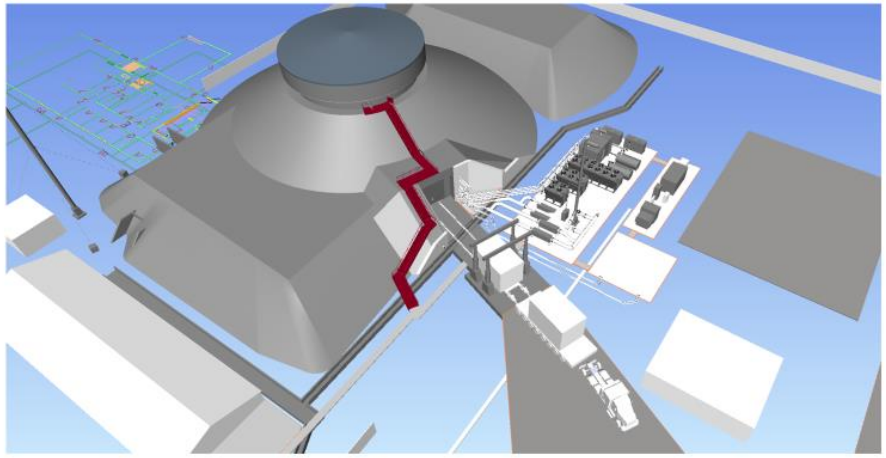


Westinghouse - eVinci

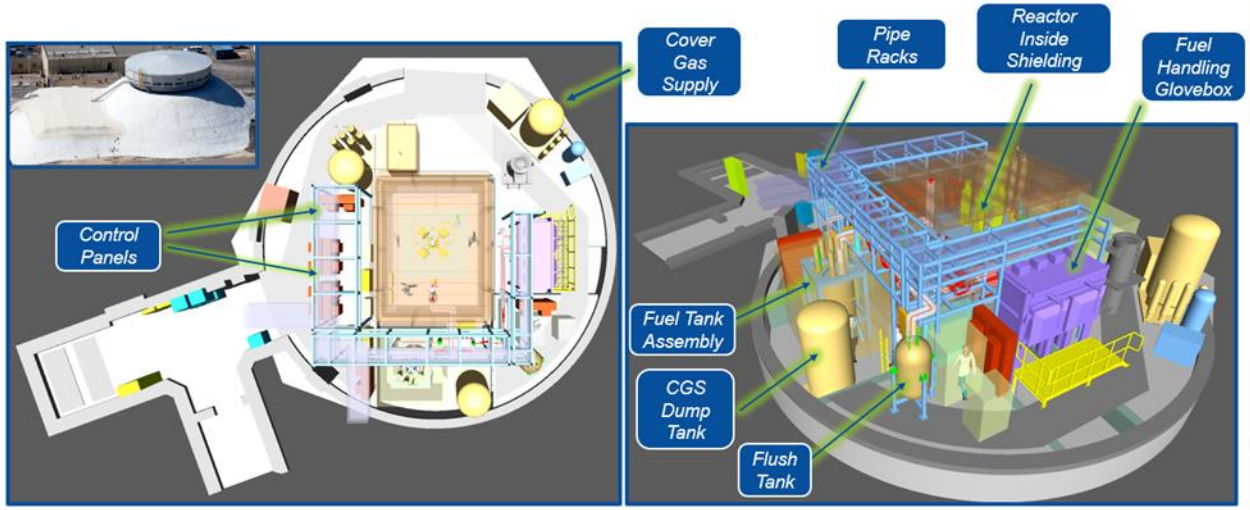


Developer	Reactor Name	Design	Power Mwe	Power MWth	Fuel Type	Fuel Enrichment	Primary Coolant	Moderator	Refueling Interval (Years)	Power Conversion System
Radiant	Kaleidos	HTGR	1.2	3.5	TRISO	19.75%	Helium	Graphite	6	Brayton Cycle
USNC	Pylon	HTGR		1	TRISO	9.90%	Helium	Graphite		Rankine
Westinghouse	eVinci NTR	Heat Pipe	1	3	TRISO	19.75	Sodium	Graphite	8	Brayton Cycle

NRIC-LOTUS Testbed



LOTUS Conceptual Design Model



Molten Chloride Reactor Experiment integrated into LOTUS

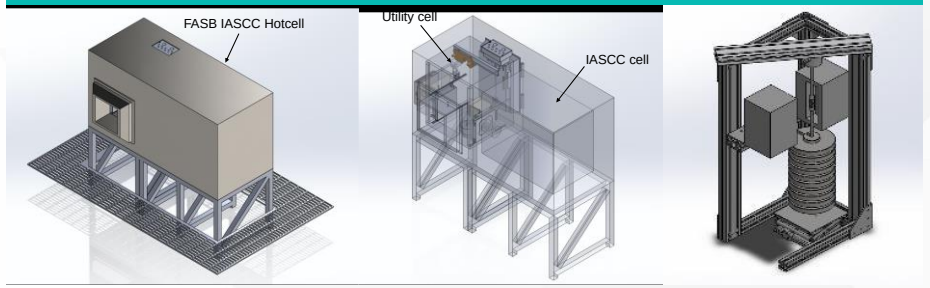
- Line-item project: CD-1 Approved 6/23
- Preliminary design review: Feb 2024
- Complete Construction: FY27
- First User: Molten Chloride Reactor Experiment

- Southern Company & Terra Power
- Funded through DOE Advanced Reactor Demonstration Program Risk Reduction
- Reactor Install: FY27/28

NRIC Experimental Infrastructure

Helium Component Test Facility [*2022*]

In-HotCell Thermal Creep Frame [*2025*]

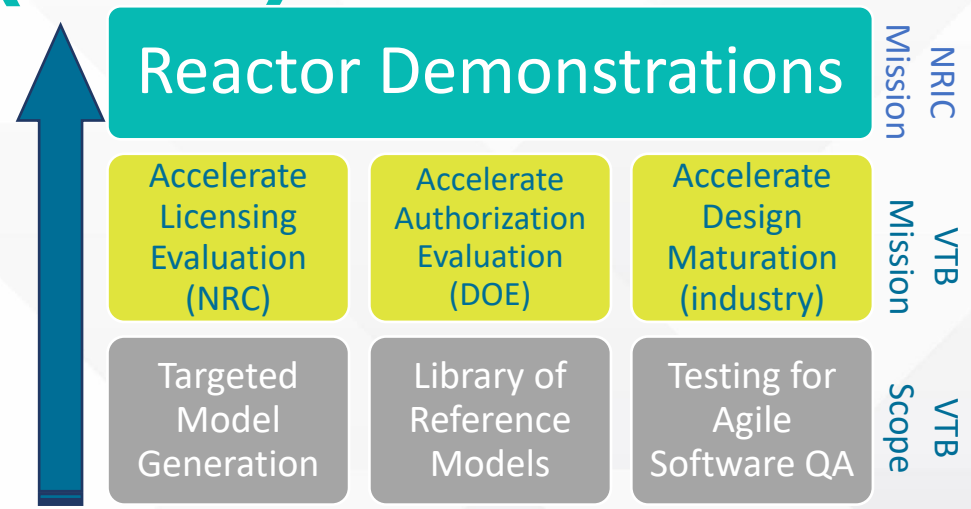


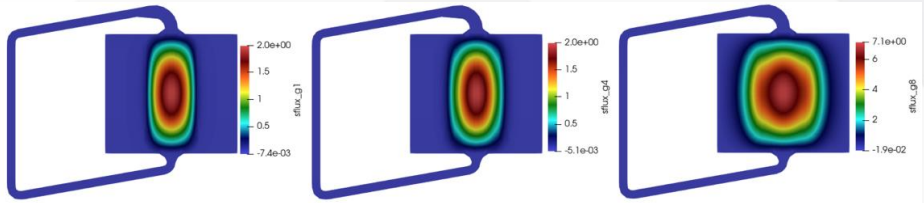
Molten Salt Thermophysical Examination Capabilities (MSTEC) [*2025*]

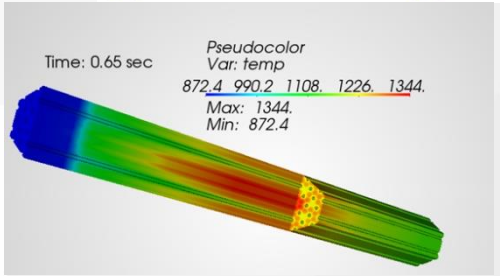
Mechanisms Engineering Test Lab (METL) [Operating since 2018]

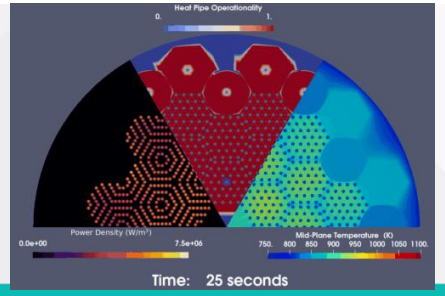
NRIC – Virtual Test Bed (VTB)

- Central location for reactor developers/stakeholders to access and leverage state-of-the art ModSim models of advanced reactors to evaluate performance and safety
- Cross-laboratory and cross-program collaboration between NRIC and DOE Nuclear Energy Advanced Modeling and Simulation (NEAMS) program
- Repository/library of simulations for. Sodium, lead, micro and molten salt reactors (continuously tested)
- Currently hosting 47 distinct models with 15 NEAMS codes
- Averaging 250+ visits/month (period Jan-March 2024)





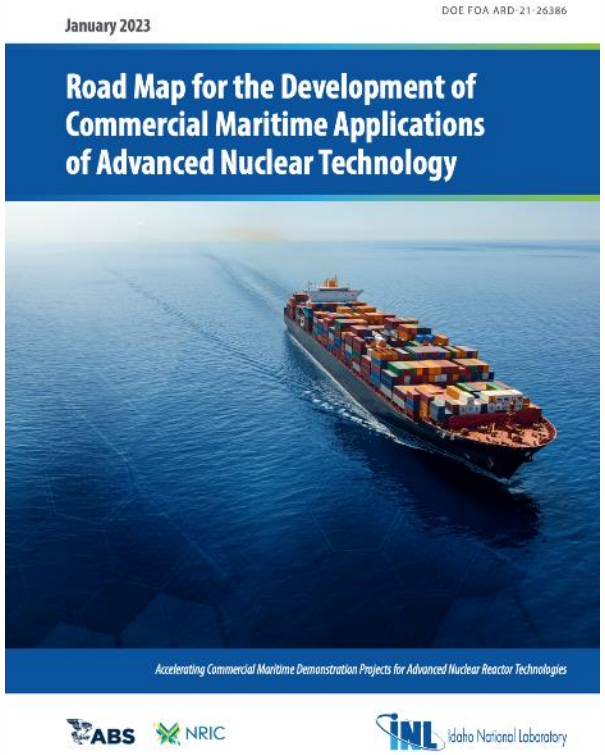


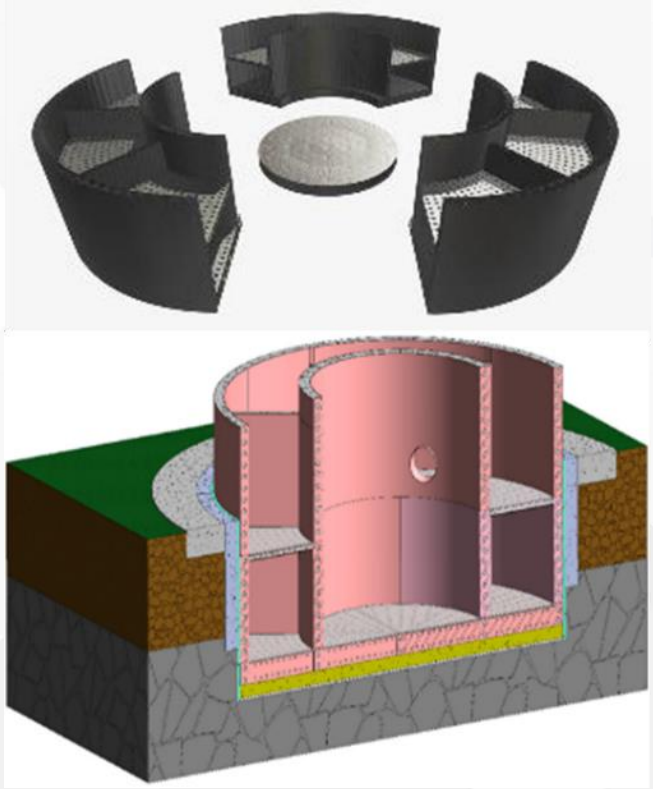


NRIC National Reactor Innovation Center

Addressing Cost and Markets

- Advanced Construction Technologies
- Digital Engineering & Knowledge Sharing/Lessons Learned
- Demonstration/Deployment Opportunities (Maritime)





NRIC National Reactor Innovation Center

Advanced Construction Technologies

Demonstrate technologies that:

- Reduce cost of new nuclear builds by 10%+
- Compress construction schedule by as much as 25%
- Reduce required site work & improve overall quality of structure
- Support long-term structure monitoring

Phase One (Expected completion July 2024)

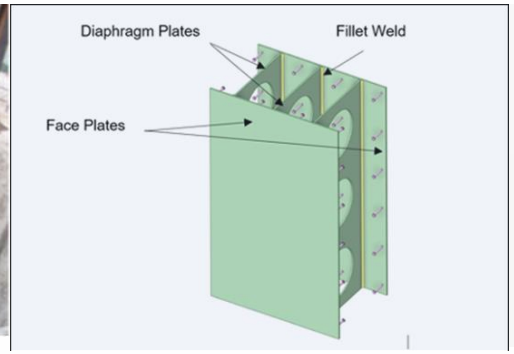
- Prototype modular steel/concrete composite walling system
- Developed non-destructive examination and welding techniques
- Demonstrated strength of wall systems

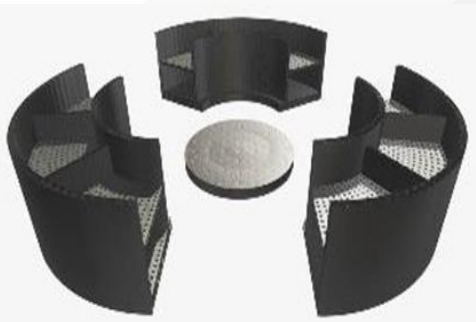
Phase Two (Expected start Sept 2024)

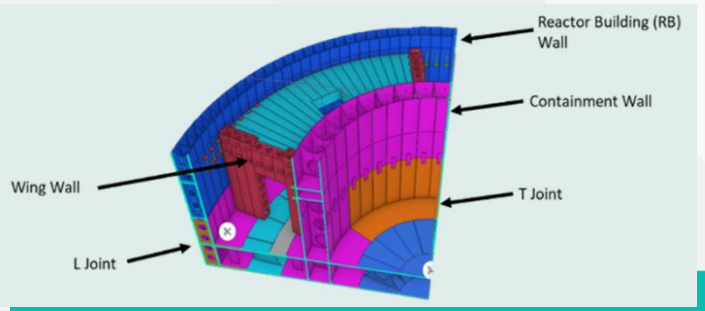
- Demonstrate 60-degree pie shape containment walling system
- Inner and outer walls, base mat integration, multi-story
- Deploy digital twin plus sensor technology for monitoring

Team – General Electric Hitachi

EPRI, Black & Veatch, Purdue, UNCC, Nuclear Advanced Manufacturing Research Centre, Caunton Engineering w/Modular Walling Systems Ltd, Aecon and Tennessee Valley Authority







NRIC National Reactor Innovation Center

Digital Twin – Advanced Construction

- State of the art replica of the structure to integrate sensor data, artificial intelligence, machine learning, and data analytics. Cradle to grave monitoring
- EPRI, University of North Carolina Charlotte, Nuclear AMRC
- Organizes all project data by component and by life-stage
  - Each module with its own rich information, models and sensors
    - Flow of information through the modules - Back and Forth
    - Ability to query, investigate, assess conditions of individual Steel Bricks™ in the structure.
  - Semi-automated procedures to update Building Information Modeling & Finite Element Analysis models from field measurements
  - Long-term monitoring combining structural models with:
    - Earth pressure sensors (lateral stress)
    - LiDAR scans of base, shaft walls and ground surface
    - Procedures to stream data from the field for real-time decision-making via wireless transmission of sensor data

NRC Collaboration

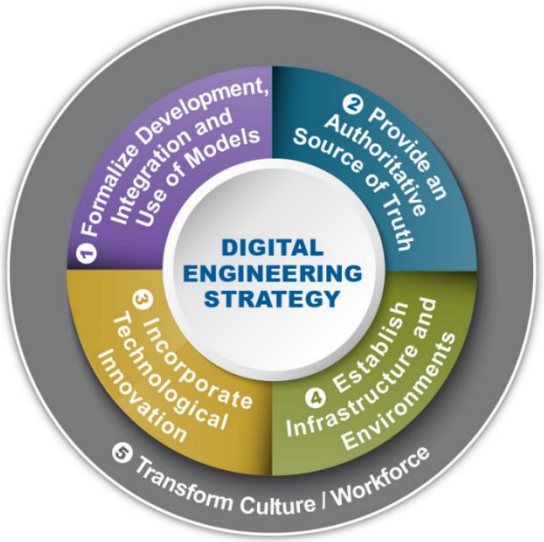
- Congress recognized the importance of agency coordination in the Nuclear Energy Innovation Capabilities Act
- DOE/NRC MOU to “coordinate DOE and NRC technical readiness and sharing of technical expertise and knowledge on advanced nuclear reactor technologies and nuclear energy innovation, including reactor concepts demonstrations, through the [NRIC].”
  - NRIC Rotations

Fred Sock
Office of Nuclear Regulatory Research

Allen Fetter
Office of Nuclear Reactor Regulation

- Monthly Coordination Calls – DOE/NRC/NRIC

Digital Engineering (DE)



- **What?** An integrated digital approach that uses authoritative sources of truth for data and models across disciplines to support project lifecycle activities from concept through disposal
- **Why?** With typical industry project **cost overruns** of 241% and 180% in **schedule delay**, digitization of the overall processes can have a significant impact on nuclear deployment and cost viability
- **Implementation Process & Progress to Date**
  1. Transform the way organizations generate design data by deploying **model-based tools**: IBM DOORS Next, Innoslate MBSE, PTC Creo, Autodesk Revit, etc. [Complete, TRL 9]
  2. Transform the way organizations manage, store, and connect data using **digital threads** to form a comprehensive **digital ecosystem**: PTC Windchill, INL Deep Lynx Warehouse, software adapters & APIs, etc. [In Process, TRL 6]
  3. Transform the way organizations leverage data using **digital twin** technology: extended reality (XR), Unity game engine, real-time data acquisition (DAQ), machine learning (ML), artificial intelligence (AI) [In Process, TRL 3]
- **Next Steps**:
  - Progress digital ecosystem development and release “playbook” and open-source code repository
  - Develop first nuclear facility digital twin at DOME incorporating physics-based modeling, predictive machine learning, real-time data feedback, etc.

NRIC National Reactor Innovation Center

Evaluating Maritime Applications NRIC & American Bureau of Shipping (ABS)

Maritime Nuclear Application Group

- Collaboration with ABS and Morgan & Lewis Law Firm
- Research Hub and Resource Center
- 120 members representing 40+ companies
- Gap assessment of testing capabilities for maritime nuclear applications

ABS iFOA Award

- DOE Readiness Report (Task 3)
- Upcoming: Overcoming Barriers to Nuclear-Maritime Demonstrations (Task 4)

Nuclear Energy University Program

*MNAG is a **research hub** and **resource center** that brings together experts from the maritime and nuclear energy sectors to facilitate the demonstration of advanced nuclear technologies for a range of marine applications.*

THE UNIVERSITY OF TEXAS AT DALLAS

NRIC National Reactor Innovation Center

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5/21/2024

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Advanced Reactor Content of Application Project (ARCAP) Interim Staff Guidance (ISG) Documents and Technology Inclusive Content of Application Project (TICAP) Guidance Final Documents

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Purpose and Agenda

- Provide a high-level overview of the Technology Inclusive Content of Application Project (TICAP) Regulatory Guide 1.253 and the nine Advanced Reactor Content of Application Project (ARCAP) Interim Staff Guidance Documents
  - Include overview of the comments received and the NRC's disposition of these comments
- Agenda
  - High-level overview of ARCAP and TICAP structure
  - Discussion of Regulatory Guide 1.253 (TICAP Guidance)
  - Discussion of ARCAP interim staff guidance documents

ARCAP/TICAP Background

- Overview of ARCAP/TICAP draft guidance documents provided during an advanced reactor stakeholder public meeting on June 7, 2023
  - Overview included a discussion of changes to draft guidance documents from white paper versions of the documents
  - See slides 96 through 144 at ML23157A018
    - Includes both NRC staff slides and Nuclear Energy Institute slides
  - Meeting occurred during the open comment period for the documents
    - Included information on how to provide comments on documents

- Public meeting held on August 22, 2023 (after public comment period ended), to provide commenters an opportunity to discuss their comments
  - Meeting summary available at: ML23236A481

ARCAP/TICAP Background

- Public meeting held on September 26, 2023, to discuss DG-1404, Revision 1
  - DG-1404, Revision 1, included additional guidance related to construction permit probabilistic risk assessment development
  - Meeting held during public comment period
    - Purpose was to facilitate stakeholder understanding of guidance and to provide information on how to provide comments on the draft guidance
  - Meeting slides available at: ML23265A185

- ACRS Meetings
  - Future Plant Designs Subcommittee briefing held on November 16, 2023, provided an overview of the comments received and the staff's disposition of these comments.
    - Meeting transcript available at ML23352A396
  - ACRS Full Committee Briefing held on December 6, 2023, provided a high-level overview of the ARCAP and TICAP structure, and guidance documents
    - Meeting transcript available at ML24017A222
    - ACRS letter issued on December 20, 2023, is available at ML23348A182
    - Staff response issued on March 18, 2024, is available at ML24024A025

ARCAP/TICAP Background

- Final ARCAP ISG documents issued on March 31, 2024.Document package available at: ML24073A229 that includes 28 documents:
  - Nine final versions of the ISGs,
  - Nine comment resolution tables,
  - Nine redline strikeout versions
    - Provides a comment identification that includes a reason for the change
  - The ACRS letter response

- TICAP RG 1.253 issued in March 2024. Document package available at: ML23269A047 includes:
  - Final version of RG
  - Comment resolution table
  - Redline strikeout version
    - Provides a comment identification that includes a reason for the change

- ARCAP/TICAP Public Webpage provides links to key meetings and documents associated with the development of these documents (see: https://www.nrc.gov/reactors/new-reactors/advanced/rulemaking-and-guidance/advanced-reactor-content-of-application-project.html)

Background – How to Access Final Documents and Comments

- All of the documents are available in Table 1 of the public ARCAP/TICAP webpage https://www.nrc.gov/reactors/new-reactors/advanced/rulemaking-and-guidance/advanced-reactor-content-of-application-project.html

ARCAP ISG Title	ADAMS Accession #	Regulations.gov Docket ID	# of Comments
DANU-ISG-2022-01, Review of Risk-Informed, Technology-Inclusive Advanced Reactor Applications – Roadmap	ML23277A139	NRC-2022-0074	68
DANU-ISG-2022-02, Chapter 2, "Site Information"	ML23277A140	NRC-2022-0075	12
DANU-ISG-2022-03, Chapter 9, "Control of Routine Plant Radioactive Effluents, Plant Contamination and Solid Waste	ML23277A141	NRC-2022-0076	13
DANU-ISG-2022-04, Chapter 10, "Control of Occupational Doses"	ML23277A142	NRC-2022-0077	2
DANU-ISG-2022-05, Chapter 11, "Organization and Human-System Consideration"	ML23277A143	NRC-2022-0078	12
DANU-ISG-2022-06, Chapter 12, "Post Construction Inspection, Testing and Analysis Program"	ML23277A144	NRC-2022-0079	9
DANU-ISG-2022-07, "Risk-Informed ISI/IST Programs"	ML23277A145	NRC-2022-0080	43
DANU-ISG-2022-08, "Licensing Modernization Project-based Approach for Developing Technical Specifications"	ML23277A146	NRC-2022-0081	8
DANU-ISG-2022-09, "Risk-Informed, Performance-Based Fire Protection Program (for Operations)"	ML23277A147	NRC-2022-0082	23
Regulatory Guide 1.253, "Guidance for a Technology Inclusive Content of Application Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Advanced Reactors"	ML23269A222	NRC-2022-0073	73, 30*

* 73 Comments on DG-1404 Rev 0, 30 comments on DG-1404 Rev 1

ARCAP/TICAP Background

- Guidance is for developing and reviewing technology-inclusive, risk-informed, and performance-based non-light water (non-LWR) applications

- Developed to support 10 CFR Part 50 and 10 CFR Part 52 applications
  - Needed to support expected near-term non-LWR Part 50/52 applications using the licensing modernization project (LMP) process in NEI 18-04, Revision 1

- The NRC staff intends to revise the guidance per the final Part 53 rulemaking language

ARCAP Background

- Broad in nature and intended to cover guidance for non-LWR applications for:
  - combined licenses
  - construction permits
  - operating licenses
  - design certifications
  - standard design approvals*
  - manufacturing licenses*
- Encompasses TICAP
  - TICAP is guidance for off-normal reactor states only.
    - ARCAP encompasses everything needed for a license application.

* RG 1.253 does not currently address MLs and SDAs. ML and SDA applicants are encouraged to discuss their plans to use the RG with the NRC during the preapplication phase

TICAP Background

- TICAP scope is governed by the LMP-based process
  - LMP uses risk-informed, performance-based approach to select licensing basis events, develop structures, systems, and components (SSC) categorization, and ensure that defense-in-depth is considered

- Industry developed key portions of TICAP guidance
  - See NEI 21-07, Revision 1, "Technology Inclusive Guidance for Non-Light Water Reactors Safety Analysis Report Content for Applicants Utilizing NEI 18-04 Methodology," (ADAMS Accession No. ML22060A190)

- RG 1.253 (issued as DG-1404) endorses NEI 21-07, Revision 1, with clarifications and additions
  - There are no proposed exceptions

ARCAP and TICAP - Nexus

Outline Safety Analysis Report (SAR) – Based on TICAP Guidance

1. General Plant Information, Site Description, and Overview
2. Methodologies and Analyses and Site Information*
3. Licensing Basis Event (LBE) Analysis
4. Integrated Evaluations
5. Safety Functions, Design Criteria, and SSC Safety Classification
6. Safety Related SSC Criteria and Capabilities
7. Non-safety related with special treatment SSC Criteria and Capabilities
8. Plant Programs

Additional SAR Content –Outside the Scope of TICAP

9. Control of Routine Plant Radioactive Effluents, Plant Contamination, and Solid Waste
10. Control of Occupational Doses
11. Organization and Human-System Considerations
12. Post-construction Inspection, Testing and Analysis Programs

Audit/inspection of Applicant Records

- Calculations
- Analyses
- P&IDs
- System Descriptions
- Design Drawings
- Design Specs
- Procurement Specs
- Probabilistic Risk Assessment

Additional Portions of Application

- Technical Specifications
- Technical Requirements Manual
- Quality Assurance Plan (design)
- Fire Protection Program (design)
- Quality Assurance Plan (construction and operations)
- Emergency Plan
- Security Plan
- Cyber Security Plan
- SNM physical protection program
- SNM material control and accounting
- Fire Protection Program (operational)
- Radiation Protection Program
- Offsite Dose Calculation Manual
- Inservice inspection/Inservice testing (ISI/IST) Program
- Environmental Report and Site Redress Plan
- Financial Qualification and Insurance and Liability
- Fitness for Duty Program
- Aircraft Impact Assessment
- Performance Demonstration Requirements
- Nuclear Waste Policy Act
- Operational Programs
- Exemptions, Departures, and Variances)

* SAR Chapter 2 derived from TICAP guidance as supplemented by ARCAP interim staff guidance Chapter 2, “Site Information”

- Safety Analysis Report (SAR) structure based on clean sheet approach
- Additional contents of application may exist only in the SAR, may be in a separate document incorporated into the SAR, or may exist only outside the SAR.
- The above list is for illustration purposes only.

TICAP and ARCAP Roadmap Common Guidance

- Applicability is only for non-LWRs
  - Recommends that light-water reactor applicants wanting to use ARCAP/TICAP guidance engage in pre-application discussions
- All ISGs provide applicant guidance and NRC staff review guidance in separate sections
- Appendices in several ISGs list in-development guidance documents that could affect future revision of those ISGs

TICAP and ARCAP Roadmap Common Guidance

- Importance of Principal Design Criteria (PDC)
  - TICAP guidance covers PDCs associated with the licensing modernization project (i.e., those associated with off-normal conditions)
  - ARCAP Roadmap ISG and associated ISGs (e.g., ARCAP Chapter 9) contains PDC guidance for normal operations
  - RG 1.232, “Guidance For Developing Principal Design Criteria For Non-light-water Reactors,” (ML17325A611) provides additional guidance for reviewer consideration
  - ARCAP Roadmap ISG recommends discussion of PDC during preapplication phase

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RG 1.253, Revision 0

Guidance for a Technology-Inclusive Content-of-Application Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors

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Staff Endorsement of the

Technology Inclusive Content of Application Project

TICAP – High Level Overview

- Establishes technology-inclusive guidance proposing an optional formulation of advanced reactor application content based on a risk-informed, performance-based approach for demonstrating plant safety meets the underlying intent of the current requirements.

- Intended to increase efficiency of developing and reviewing an application

- Scope is governed by the LMP methodology to facilitate a systematic, technically acceptable, and predictable approach for developing key portions of a design's SAR
  - The LMP methodology provides processes for identifying LBEs, classifying and establishing special treatments for certain SSCs, and ensuring DID adequacy

- The LMP methodology is based on a full-scope probabilistic risk assessment (PRA)
  - All sources of radiological material,
  - All hazards,
  - All plant operating states,
  - Full analysis of scenario progressions (i.e., analyzed from initiator to radiological consequence)

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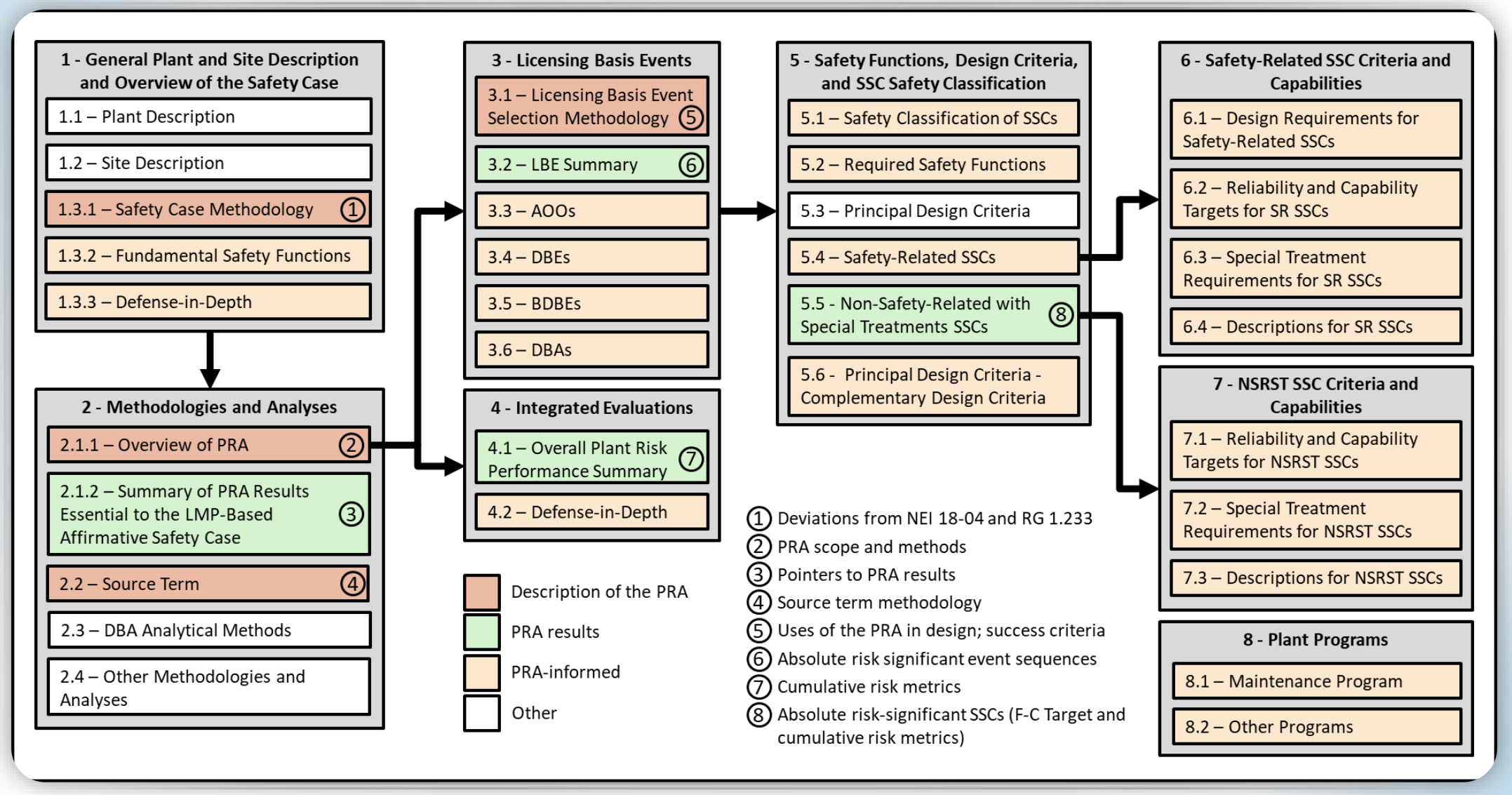
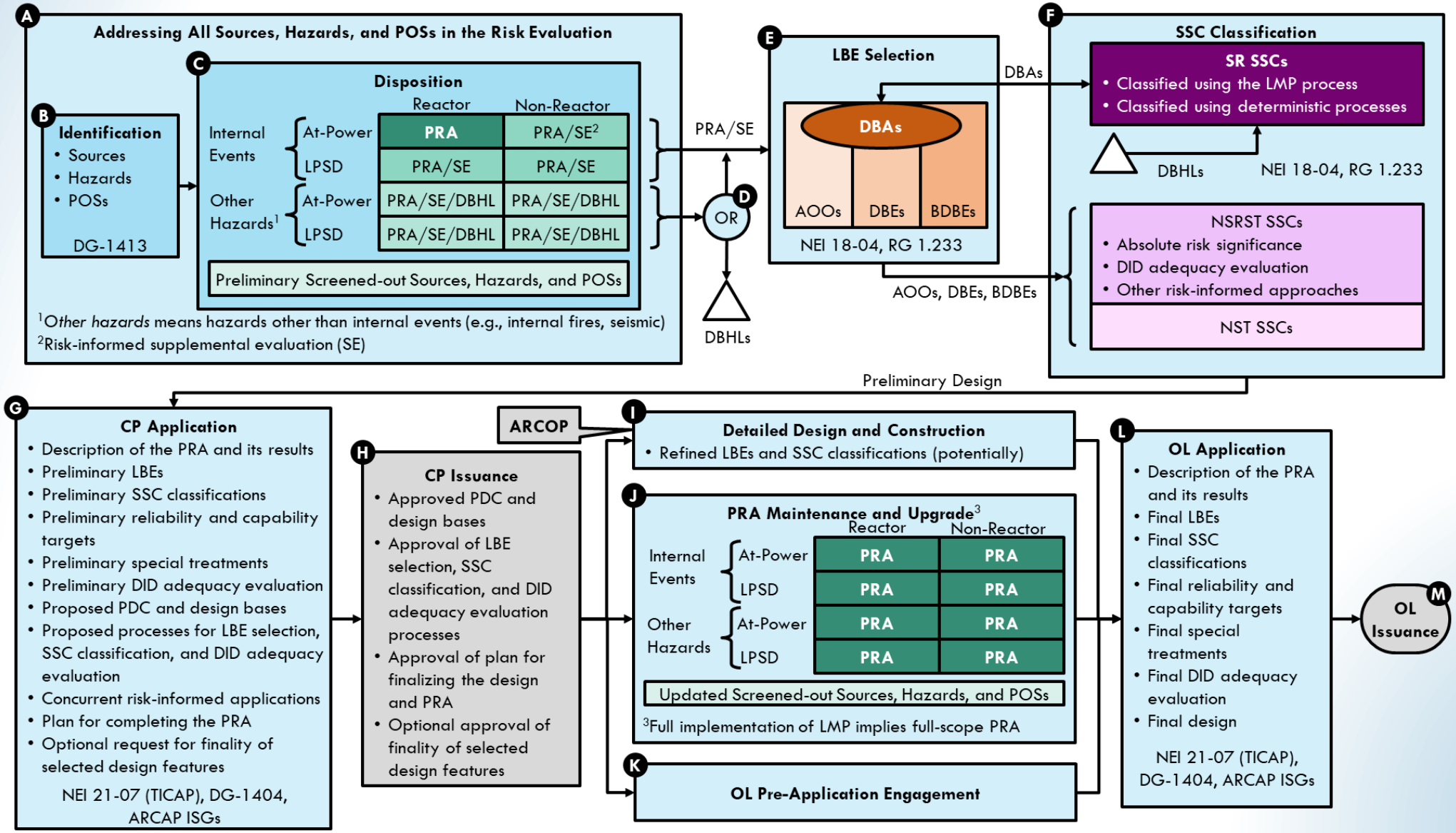
TICAP Guidance



TICAP Construction Permit/Operating License Guidance



Construction Permit PRA Acceptability

Key Points from RG 1.253, Revision 0:

- All sources, hazards, and plant operating states (POSs) should be addressed (i.e., identified and dispositioned) in the CP application, where *dispositioned* means each item is either:
  - Modeled in the PRA logic model,*
  - Screened out of the PRA logic model with justification,*
  - Accounted for using risk-informed supplemental evaluations, or
  - Accounted for using design-basis hazard levels (DBHLs) for hazards other than internal events

NOTE: Generally referring to *the PRA* implies these three items

- As a minimum, the LMP-based CP application should be supported by an internal events, at-power, reactor PRA logic model, which represents the fundamental plant response model that:
  - helps demonstrate the applicant's ability to develop an acceptable PRA logic model and
  - establishes an acceptable foundation for upgrading the PRA logic model as the design progresses

- While acceptable for the CP stage of licensing, achieving only the minimum scope of the PRA logic model may not realize the full benefit of the LMP methodology at the CP stage

* The ASME/ANS non-LWR PRA consensus standard, ASME/ANS RA-S-1.4-2021, provides requirements and processes for defining the scope of the CP PRA logic model.

Construction Permit PRA Acceptability

Key Points from RG 1.253, Revision 0 (continued):

- A self-assessment of the PRA logic model, screening analyses, and risk-informed supplementary evaluations helps reduce the need for in-depth NRC review
  - This could be a peer review but is not required as such

- The CP application should provide a preliminary, yet complete**, set of LBEs and SSC classifications

- Further expectations
  - The CP application should provide a plan for maintaining and upgrading the PRA during construction.
    - Example: Replacing a seismic DBHL with a seismic PRA
    - CP holders are encouraged to keep the staff advised of changes to the PRA completion plan that significantly affect the design.

** Consistent with the maturity of design information and relative to the scope of the PRA logic model, screening analyses, and risk-informed supplementary evaluations supporting the CP application.

DG-1404 Comment Resolution

- Seventy-three comments received on DG-1404, Revision 0
- Thirty comments received on DG-1404, Revision 1
- Resolution of public comment on DG-1404 is publicly available (ML23269A223)
- Staff briefed ACRS Subcommittee on Regulatory Rulemaking, Policies, and Practices on the comment resolution on 11/16/23 (ML23352A396)

DG-1404 Comment Resolution

- Staff briefed ACRS Full Committee on comment resolutions on 12/6/23 (ML24017A222).

- Changes resulting from ACRS comments:
  - Guidance added regarding expectation that PSAR identify any design requirements or special treatment of SSCs to prevent or mitigate cliff-edge effects, which should be included in the SSC-specific descriptions in subsequent SAR chapters (See staff response to ACRS Full Committee Letter under ADAMS Accession No. ML24024A025).

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Advanced Reactor Content of Application Project Roadmap – Overview and Discussion of Comments

ARCAP Roadmap Overview

- Provides guidance for other portions of the application outside of ISGs including emergency plan, security, financial qualification and insurance and liability
- Includes four appendices
  - Appendix A – Preapplication Guidance
  - Appendix B – Applicability of Regulations to non-light water reactors
  - Appendix C – Construction Permit Guidance
  - Appendix D – Draft Documents Under Development

Additional Portions of Application

- Technical Specifications
- Technical Requirements Manual
- Quality Assurance Plan (design)
- Fire Protection Program (design)
- Quality Assurance Plan (construction and operations)
- Emergency Plan
- Security Plan
- Cyber Security Plan
- SNM physical protection program
- SNM material control and accounting
- Fire Protection Program (operational)
- Radiation Protection Program
- Offsite Dose Calculation Manual
- Inservice inspection/Inservice testing (ISI/IST) Program
- Environmental Report and Site Redress Plan
- Financial Qualification and Insurance and Liability
- Fitness for Duty Program
- Aircraft Impact Assessment
- Performance Demonstration Requirements
- Nuclear Waste Policy Act
- Operational Programs

ARCAP Roadmap Comments

- Sixty-eight comments received
- Represents second most comments received on ARCAP/TICAP guidance documents
- Changes made because of comments:
  - Expanded the applicability of Appendix B (Applicability of Regulations to Non-LWRs) to Manufacturing License applications.
  - Deleted reference to the Facility Safety Program.
  - Expanded guidance on leaks from coolant systems to specifically address leaks from low pressure systems.
  - Added guidance that applicants need to consider safety concerns beyond those identified by the LMP process when identifying PDCs applicable to their design.

ARCAP Roadmap Comments

- Added guidance that applicants are responsible for identifying needed programs beyond those specified in Section 8.

- Transferred several items (e.g., consideration of LWR GSIs) from DG-1404 to the Roadmap, since they are not part of the LMP process.

- ACRS and other changes
  - In response to ACRS comments
    - Clarified language to eliminate introduction of an undefined term
    - Added a discussion in the financial qualification section regarding decommissioning cost estimates
  - Clarified that the Commission, in response to a request from the applicant, could issue a rule of particular applicability or a case-specific order
    - Expanded discussion on rule of particular applicability
      - Previous mention in Appendix A (preapplication discussion) and brief mention in Appendix B (applicability of regulations) has been expanded
        - Changes include reference to potential for rule of applicability when dealing with 10 CFR 50.2 definition of safety related and basic component
      - See Enclosure 2 to SECY 30-0093 (ML20254A366)

ARCAP Roadmap Comments

- ACRS and other changes
  - Added numbering scheme to base document for ease of reference to various guidance sections

ARCAP Roadmap Comments

Requested changes not incorporated:

- Add a statement that consensus Codes and Standards have more weight and take precedence over regulations.

- Eliminate the design detail required in the SAR. Only identify the hazards for which design measures have been implemented.

- Delete Chapter 11, “Organization and Human-System Considerations”. Commenter indicated that “The relationship with safety is tenuous.”

- Extend the applicability of the documents to LWRs. (NOTE: expanding the applicability to LWRs is under consideration as a future action. The current limitation to non-LWRs is for consistency with NEI 18-04 and 21-07, who’s scope is non-LWRs.)

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Advanced Reactor Content of Application Project Chapter 2 “Site Information” Overview and Discussion of Comments

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Chapter 2 Overview

- Chapter 2 provides guidance on the scope and approach for selecting the external hazards which must be considered in the plant design.
- The selection of external hazards is to be informed by a probabilistic external hazards analysis, when supported by available methods, data, standards and guides.
- Chapter 2 limits the amount of information that needs to be provided in the SAR to that necessary to establish the design basis external hazards.
- Chapter 2 refers to existing site evaluation guidance (e.g., RGs) where appropriate.
- The guidance in Chapter 2 is based upon the requirements of 10 CFR Part 100, Subpart B.
- 12 comments received.

Chapter 2 Comments

- Changes made because of comments:
  - Revised the frequency of occurrence of nearby industrial, transportation and military facility hazards to be considered in the design to be consistent with existing guidance.
  - Allow the use of a combination of probabilistic and deterministic methods to select external hazards.
  - Eliminated the need to submit comparative information on slope stability.

- Requested changes not incorporated:
  - Development of a standardized process for screening out external hazards

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Advanced Reactor Content of Application Project Chapter 9 – Control of Effluents, Plant Contamination and Solid Waste

Overview and Discussion of Comments

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Chapter 9 Overview

- Applies a performance-based approach for level of detail of information provided in the SAR related to control of routine plant radioactive effluents, plant contamination and solid waste

Chapter 9 Comments

Changes made because of comments:

- Clarified application content for design certifications, manufacturing licenses, and standard design approvals
- Clarified what design information is necessary when an applicant requests an exemption to 10 CFR 50.34 content requirements

Requested changes not incorporated:

- Delete guidance the commenter interpreted as related to draft Part 53
- Delete guidance directing applicants to provide a summary of estimated doses Remove prescriptiveness; only reference industry standards
- Remove references to NEI template documents not previously formally endorsed but previously approved via safety evaluation

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Advanced Reactor Content of Application Project Chapter 10 – Occupational Dose

Overview and Discussion of Comments

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Chapter 10 Overview

- Applies a performance-based approach for level of detail of information provided in the SAR regarding the control of occupational dose

Chapter 10 Comments

Changes made because of comments:

- None

Requested changes not incorporated:

- None, but staff disagreed with a comment statement that the program to control occupational exposure does not extend ALARA into the design

- comment resolution table chapter 10 - ML23277A151
- generic template NEI 07-08A ensuring occupational doses remain alara - ML093220178

Describe important equipment and facility design features that satisfy the design-specific PDC necessary to control occupational exposure, including ensuring occupational radiation exposures are ALARA, such as shielding, ventilation, area radiation and airborne radioactivity monitoring instrumentation, and dose assessment for expected occupancy

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Advanced Reactor Content of Application Project Chapter 11 Organization and Human Systems Interaction

Overview and Discussion of Comments

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Chapter 11 Overview

- Supports Part 50 and 52 non-LWR applications with relatively traditional concept of operations
  - Does not address remote or autonomous operations
- Guidance to applicants and NRC reviewers on:
  - Organizational staffing
  - Qualifications
  - Training
  - Operator Licensing: staffing exemptions, licensing during plant construction (i.e., cold licensing), considerations for new programs, other exemptions
- NRC staff also incorporated human factors engineering (HFE) guidance to supplement LMP and TICAP guidance

Chapter 11 Comments

Changes made because of comments:

- Added references to existing guidance covering level of detail for organizations and procedures (SRP Sections 13.1.1, 13.1.2–13.1.3, 13.5.1.1, and 13.5.2.1)
- Added applicable regulations in the acceptance criteria section
- Clarified acceptance criteria for addressing numbers of licensed and non-licensed operators; added reference to 10 CFR 26.205(c)

Requested changes not incorporated:

- Delete entire ISG or major sections; rely on NEI 18-04, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development"
- Delete guidance related to topics the commenter interpreted as (draft) Part 53 requirements
- Add references to 10 CFR 50.34 (post-TMI requirements) topics
- Add clarification on technology neutral approaches for a site to meet the requirement for engineering expertise

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Advanced Reactor Content of Application Project Chapter 12 – Post Construction Inspection Testing and Analysis Program Overview and Discussion of Comments

Chapter 12 Overview

- Intended to provide guidance to the NRC staff regarding application content that would support making the finding that the constructed plant has met the applicable Part 50 and Part 52 regulations to support issuance of an operating license or authorization to load fuel, respectively
- ISG differentiates between 10 CFR Part 52 applicants that must include inspections, tests, analyses and acceptance criteria (ITAAC) and 10 CFR Part 50 applications that are not required to include ITAAC.
- Requirements to describe preoperational testing and initial operations in OL and COL applications are contained in 50.34(b)(6)(iii) and 52.79(a)(28), respectively.
- Provides guidance for:
  - post-manufacturing and construction inspection, preoperational testing (i.e., tests conducted following construction and construction-related testing, but prior to initial fuel load), analysis verification, and
  - initial startup testing (i.e., tests conducted during and after initial fuel load, up to and including initial power ascension).

Chapter 12 Comments

Changes made because of comments:

- Changed “post-construction…..” text to “post-manufacturing and construction” or just “post-manufacturing” if applicable
- Clarified content requirements for MLs and COLs referencing MLs
- Clarified text regarding pre-operational testing under a CP
- Removed specific reference to test review committee

Requested changes not incorporated:

- Add additional information regarding what ISG sections apply to CPs
- Remove acceptance criteria that the commenter interpreted to go beyond 10 CFR Part 50

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Advanced Reactor Content of Application Project Inservice Inspection/Inservice Testing Overview and Discussion of Comments

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ARCAP ISI/IST Overview

- The ISG provides guidance for developing risk-informed, performance-based ISI/IST programs for non-LWRs.
- The ISG guidance is based upon the use of a plant-specific PRA to identify the SSCs to be included in the programs.
- The ISI guidance is based upon the use of:
  - ASME BPV Code, Section XI, Division 2, “Requirements for Reliability and Integrity Management (RIM) Programs for NPPs,” for developing the ISI program using risk information and an expert panel.
  - ASME BPV Code, Section III, Division 5, “High Temperature Reactors,” for designs using high temperature materials and notes that ASME is developing a flaw evaluation Code Case for high temperature materials.

ARCAP ISI/IST Overview (continued)

- The IST guidance is based upon:
  - Existing IST program approach, with additional guidance for passive components, and notes that ASME is developing a new OM-2 Code for inservice testing of components in new and advanced reactors, including non-LWRs.
  - Using plant-specific risk information to determine the scope of the IST program and proposed testing frequencies.

- 43 comments received.

ARCAP ISI/IST Comments

Changes made because of comments:

- Allow the use of NQA-1 when implementing ASME BPV Code, Section XI, Division 2.
- Allow the use of unissued consensus codes at the CP stage provided they are officially issued prior to submitting the OL application and provided design finality is not being requested on any portion of the design affected by the unissued codes.
- Allow applicants for multi-module plants to apply standard ISI and IST programs to each module, without separate program approvals, provided the modules are identical.

ARCAP ISI/IST Comments

Changes made because of ACRS comments:

- Added discussion in “use of risk information” section regarding expectations to adapt ISI/IST program as operating experience is gained
- Expanded the discussion in the “components that control fluid without mechanically interacting with the fluid,” section to encourage preapplication interactions for designs that could include such components
- Added appropriate references to the reference section.

ARCAP ISI/IST Comments

Requested changes not incorporated:

- Eliminate the discussion of the process to be followed when the ISI program identifies degradation has occurred, because ASME BPV Code, Section XI, Division 2, provides guidance in this area.
- Delete the discussion in the IST section on passive components.
- Include graphite and ceramic composite materials in the scope of ISI, because these materials are included in ASME BPV Code, Section III, Division 5.

  NOTE: The ISG does not preclude the inclusion of these materials because ASME BPV Code, Section III, Division 5, is to be used in the development of ISI for high temperature materials.

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Advanced Reactor Content of Application Project Technical Specifications

Overview and Discussion of Comments

ARCAP Technical Specifications - Overview

- The text in the 10 CFR 50.36 regulations for TS content needs adaptation to correlate to the analysis and outputs of the risk-informed LMP approach described in NEI 18-04.

- Guidance addresses content for TS administrative controls section and recommended TS format

ARCAP Technical Specifications Comments

Changes made because of comments:

- Added reference to NEI 18-04 section that addresses risk metrics for use in developing LCO completion times
- Added guidance for technical specification information in PSARs
- Added guidance regarding the need for an exemption to 10 CFR 50.36 LCO criteria

Requested changes not incorporated:

- Revise RG 1.177 to align with NEI 18-04 risk metrics
- Revise 10 CFR 50.36 to include criteria for non-LWRs

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Advanced Reactor Content of Application Project Fire Protection for Operations

Overview and Discussion of Comments

ARCAP Fire Protection for Operations-Overview

- 10 CFR 50.48(a) requires that each operating nuclear power plant have a fire protection plan that meets the requirements of either 10 CFR Part 50, Appendix A, Criterion 3 for LWRs or the applicant's proposed principal design criteria that have been deemed acceptable by the NRC.
  - Although 10 CFR 50.48(c) – NFPA 805 – does not apply to non-LWRs, concepts associated with this risk-informed approach are included in the draft ISG

- The scope of this ISG addresses the review of the application content regarding the fire protection program for operations including application descriptions of:
  - Management policy and program direction and the responsibilities of those individuals responsible for the program/plan's implementation.
  - The integrated combination of procedures and personnel that will implement fire protection program activities.

ARCAP Fire Protection for Operations-Overview

Change made because of ACRS comment:

- Clarified that preapplication interactions are encouraged and should not be perceived as mandatory
- Added guidance related to designs that may not rely on onsite fire brigades

ARCAP Fire Protection for Operations Comments

Changes made because of comments:

- None

Requested changes not incorporated:

- Add reference to NEI 21-07
- Remove statements that the commenter interpreted to be from draft Part 53 (planned) requirements
- Remove references to general design criteria
- Remove prescriptive guidance regarding fire protection program
- Delete clarifying text regarding acceptability of NFPA 805
- Clarify relationship between PDC 3 and RG 1.232
- Delete reference to RG 1.189
- Remove/relax guidance regarding fire brigades for advanced reactors
- Delete references to verification and validation (V&V) of fire models
- Delete acceptance criteria and replace with only commitments to codes and standards
- Add expectations for fire protection programs in CP applications
- Add endorsement of NFPA 804
- Remove references to the term Authority Having Jurisdiction (AHJ)
- Remove/revise criteria in the guidance that may not apply to SMRs
- Remove references to a monitoring program for a non-NFPA 805 plant

Next Steps

- NRC staff's near-term focus is that the ARCAP and TICAP guidance to support near term 10 CFR Part 50 and 52 non-light water reactor applications
- Longer term, the NRC staff will update the guidance as appropriate to support the 10 CFR Part 53 rulemaking effort

Acronyms and Initialisms

ADAMS	Agencywide Documents Access and Management System
ANS	American Nuclear Society
AOO	abnormal operating occurrence
ASME	American Society of Mechanical Engineers
ARCAP	Advanced Reactor Content of Applications
ARCOP	Advanced Reactor Construction Oversite Process
BDBE	beyond design-basis event
CDC	complementary design criteria
CFR	Code of Federal Regulations
COL	combined license
CP	construction permit
DBA	design-basis accident
DBE	design-basis event
DBEHL	design-basis event hazard level (NEI 18-04)
DBHL	design-basis hazard level (NEI 21-07)
DC	design certification
DG	draft regulatory guide
DID	defense in depth
EAB	exclusion area boundary
FOAK	first-of-a-kind
FR	Federal Register
FSAR	final safety analysis report
GSI	generic safety issue
HFE	human factors engineering
ISG	interim staff guidance
ISI	inservice inspection
ISG	inservice testing
ITAAC	inspections, tests, analyses and acceptance criteria
LBE	licensing basis event
LCO	limiting condition for operation
LMP	Licensing Modernization Project
LPSD	low-power and shutdown

Acronyms and Initialisms (continued)

ML	manufacturing license
NEI	Nuclear Energy Institute
NEIMA	Nuclear Energy Innovation and Modernization Act
NFPA	National Fire Protection Association
NLWR	non-light-water reactor
NPUF	non-power utilization facility
NSRST	non-safety-related special treatment
NST	no special treatment
OL	operating license
PDC	principal design criteria
POS	plant operating state
PRA	probabilistic risk assessment
PSAR	preliminary safety analysis report
RFDC	required functional design criteria
RG	regulatory guide
RSF	required safety function
SAR	safety analysis report
SDA	standard design approval
SE	supplemental evaluation
SR	safety related
SRM	staff requirements memorandum
SSC	structure, system, and component
TEDE	total effective dose equivalent
TICAP	Technology-Inclusive Content of Applications
TIRICE	Technology-Inclusive, Risk Informed Change Evaluation
TIMaSC	Technology-Inclusive Management of Safety Case
TS	Technical Specification

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Closing Remarks