

# Advanced Reactor Stakeholder Public Meeting

March 16, 2022

[Microsoft Teams Meeting](#)

Bridgeline: 301-576-2978

Conference ID: 556 455 490#



Time	Agenda	Speaker
10:00 – 10:20 am	Opening Remarks / Adv. Rx Integrated Schedule / Source Term Public Website	NRC
10:20 – 10:45 am	Update on NRC TRISO Project Involving a CNSC-NRC Joint Interim Report (Tim Drzewiecki and Kelly Conlon)	NRC/CNSC
10:45 – 11:30 am	Trial Use Reg Guide (TRG) 1.247, “Acceptability of PRA results for non-LWR Risk Informed Activities” (Donna Williams)	NRC
11:30 – 11:50 am	Advanced Reactor Content of Application Project (ARCAP) and Technology Inclusive Content of Application Project (TICAP) Guidance Development Status (Joseph Sebrosky)	NRC
11:50 am – 12:50 pm	Lunch Break	All
12:50 – 1:20 pm	Part 53: Traditional, Risk-Informed Option (Bill Jessup)	NRC
1:20 – 2:00 pm	Part 53: Perspective on PRA, Process, Concerns, and Going Forward (Cyril Draffin)	USNIC
2:00 – 3:00 pm	Development of Guidance for Evaluating Changes to Facilities Utilizing NEI 18-04 (Mike Tschiltz)	Southern Co.
3:00 – 3:05 pm	Future Meeting Planning and Concluding Remarks	NRC

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# Advanced Reactor Integrated Schedule of Activities

The updated Advanced Reactor Integrated Schedule  
is publicly available on NRC Advanced Reactors website at:

<https://www.nrc.gov/reactors/new-reactors/advanced/details#advSumISRA>





# Advanced Reactor Integrated Schedule of Activities

## UPDATES:

### **Strategy 2, “Computer Codes and Review Tools”:**

- “Reference plant model for Molten-Salt-Cooled Pebble Bed Reactor” – Version 1 complete; Version 2 completion in April 2022
- “Reference plant model for Monolith-type Micro-Reactor” – completion Sep. 2022
- “Reference plant model for Gas-Cooled Pebble Bed Reactor” – completion Sep. 2022
- “Reference SCALE/MELCOR plant model for Molten Salt Fueled Reactor” – Marked complete
- “MACCS radionuclide screening analysis” – Marked complete
- “Code Assessment Report Volume 4 (Licensing and Siting Dose Assessments)” – Two new items – Phase 2 (Effluent Code Consolidation) current target completion April 2023 and Phase 3 (Habitability Code Consolidation) current target completion FY24

### **Strategy 3, “Guidance”:**

- “Develop Advanced Reactor Content of Application Project (ARCAP) Regulatory Guidance” - Added Federal Register Publication in April, public comment period and a public meeting in May 2022, concurrence in July, ACRS SC/FC in August and September 2022, concurrence in October and November 2022, and final issuance in December 2022.



<https://www.nrc.gov/reactors/new-reactors/advanced/details#advSumISRA>

# Advanced Reactor Integrated Schedule of Activities

## UPDATES (contd.):

### Strategy 3, “Guidance” (contd.):

- “Develop Advanced Reactor Inspection and Oversight Framework Document” – Final Draft of framework document submitted to NRC in March 2022
- “Develop MC&A guidance for Cat II facilities (NUREG-2159)” – Issue final by March 2022
- “Final MSR Fuel Qualification guidance” – Currently with staff for review

### Strategy 4, “Consensus Codes and Standards”:

- “Develop Regulatory Guide for endorsement of the non-LWR Probabilistic Risk Assessment Standard”- TRG and FRN to be issued by March 31, 2022

### Strategy 5, “Policy and Key Technical Issues”:

- “Annual Fees for Non-Light Water Reactors and Microreactors” – Added concurrence period from June to August 2022 and Commission review period from September to November 2022



<https://www.nrc.gov/reactors/new-reactors/advanced/details#advSumISRA>

# Nuclear Power Reactor Source Term Public Web Page

The web page contains discussion and listing of documents that could be relevant to the development of non-LWR accident source terms for licensing

The web page is a dedicated location for reasonably finding information useful in the development of a power reactor source term

Applicants are solely responsible for providing to the NRC for approval, their specific reactor design source term associated with the analysis and evaluation of the performance of structures, systems, and components of the facility with the objective of assessing the risk to public health and safety resulting from operation of the proposed nuclear power reactor facility

The screenshot shows the U.S. Nuclear Regulatory Commission (NRC) website. The header includes the NRC logo and navigation links such as 'REPORT A SAFETY CONCERN' and 'SEARCH'. The main content area is titled 'Nuclear Power Reactor Source Term' and includes a list of links: 'History and evolution of Light Water Reactor (LWR) source term', 'NRC analytical tools and past studies', 'SMRs and non-LWRs', 'Accident consequence related regulation activities', and 'Guidance and information for developing advanced reactor source term'. A diagram on the right side of the page illustrates the containment barriers, including 'Containment Barriers', 'SCCs Barriers', 'Primary Barrier', 'Fuel Matrix Barrier', 'Fuel Matrix Enclosure', 'Primary Coolant', 'Primary System Envelope', 'Containment Area', and 'Public Environment'.

## The Power Reactor Source Term Web Page

IS	IS NOT
A tool that provides information from a collection of source term relevant documents	The web page discussion text itself IS NOT Regulatory Guidance

# Nuclear Power Reactor Source Term Public Web Page

Examples of the web page listed information includes the following:

- Regulatory Guides
- NUREGs
- SRM and SECY Papers
- National Labs and Other Reports
- Technical Presentations
- NRC Workshops and Videos

Topics on the web page:

- [History and evolution of Light Water Reactor \(LWR\) source term](#)
- [NRC analytical tools and past studies](#)
- [SMRs and non-LWRs](#)
- [Accident consequence related regulation activities](#)
- [Guidance and information for developing advanced reactor source term](#)

Public access to the web page is available through the Advanced Reactors (non-LWR Designs) web page at: Related Documents, Related Information or Nuclear Power Reactor Source Term

- <https://www.nrc.gov/reactors/new-reactors/advanced/related-documents/nuclear-power-reactor-source-term.html>
- The NRC staff is open to stakeholder feedback and will maintain the web page updated as needed

# CNSC/NRC TRISO Qualification Assessment

First Interim Report  
Advanced Reactor Stakeholders Meeting

Kelly Conlon, Canadian Nuclear Safety Commission (CNSC)  
Tim Drzewiecki, U.S. Nuclear Regulatory Commission (NRC)

# Memorandum of Cooperation (MOC)

- Generic Tristructural Isotropic (TRISO) qualification assessment is supportive of NRC/CNSC MOC ([ML19275D578](#)), Item 2

Area of Cooperation	TRISO Assessment
Development of shared advanced reactor and SMR [small modular reactor] <b>technical review approaches that facilitate resolution of common technical questions</b> to facilitate regulatory reviews that address each Participant's national regulations	Exercise the fuel qualification framework developed in Nuclear Energy Agency (NEA) report, "Regulatory Perspectives on Nuclear Fuel Qualification for Advanced Reactors," ( <a href="#">ML22018A099</a> ) and NUREG-2246, "Fuel Qualification for Advanced Reactors" ( <a href="#">ML22063A131</a> )
Collaboration on pre-application activities to <b>ensure mutual preparedness to efficiently review</b> advanced reactor and SMR designs	Several proposed advanced reactor designs use TRISO fuel and reference the testing performed as part of the Advanced Reactor Fuel (AGR) program as documented in topical report <a href="#">EPRI-AR-1(NP)-A</a>
Collaboration on research, training, and in the development of regulatory approaches to <b>address unique and novel technical considerations</b> for ensuring the safety of advanced reactors and SMRs	Final report will (1) provide evidentiary basis to support regulatory findings for items that are generically applicable to TRISO, (2) identify items that are design dependent, and (3) highlight areas where additional information and/or testing is needed

# Assessment Team and Schedule

- Joint report from CNSC and US NRC
- UK regulator, Office for Nuclear Regulation (ONR) involved as an observer
- Technical support provided by Pacific Northwest National Laboratory (PNNL)
- Work plan:

## CNSC/NRC Joint TRISO Fuel Assessment Project

### Objective/Scope

CNSC and USNRC staff will work together to establish a common regulatory position on TRISO fuel qualification based on existing knowledge and to identify any potential analytical or testing gaps which would need to be addressed to enable TRISO use in advanced reactor licensing applications.

- Available on NRC advanced reactor website <https://www.nrc.gov/reactors/new-reactors/collaboration-with-canada.html>

### Task A, Project Planning

- Timeline: Fourth Quarter 2021
- End Product: Initial project plan finalized with resources in place (PNNL contract awarded)

### Task B, Draft Fuel TRISO Fuel Assessment Report

- Timeline: Fourth Quarter 2021 through Fourth Quarter 2022
- End Product: Four interim draft reports. The final draft will be a comprehensive draft report addressing the goals within the fuel qualification framework from NEA report, "Regulatory Perspectives on Nuclear Fuel Qualification for Advanced Reactors," and NUREG-2246.

### Task C, Finalize Report

- Timeline: Fourth Quarter 2022 to Second Quarter 2023
- End Product: The final report will be a joint NRC/CNSC report providing a generic assessment of TRISO fuel

# Input



[ML21175A152](#)

PNL-31427

**TRISO Fuel: Properties and Failure Modes**  
June 2021

IAEA-TECDOC-1645

[TECDOC-1645](#)

**High Temperature Gas Cooled Reactor Fuels and Materials**



[ML20336A052](#)

Uranium Oxycarbide (UCO) Tristructural Isotropic (TRISO) Coated Particle Fuel Performance  
Topical Report EPRIAR-1 [NP]

INTERNATIONAL

2019 TECHNICAL REPORT

# Framework



[ML22018A099](#)

NEA/CNRA/R(2020)1  
Unclassified English text only

NUCLEAR ENERGY AGENCY  
COMMITTEE ON NUCLEAR REGULATORY ACTIVITIES



**Regulatory Perspectives on Fuel Qualification for Advanced Reactors**

**Fuel Qualification for Advanced Reactors**

Final

[ML22063A131](#)

NUREG-2246

Office of Nuclear Reactor Regulation

# Interim Report




**US-NRC – CNSC Memorandum of Cooperation**  
**INTERIM SUMMARY JOINT REPORT**  
concerning  
**Tristructural Isotropic (TRISO) Fuel Qualification**

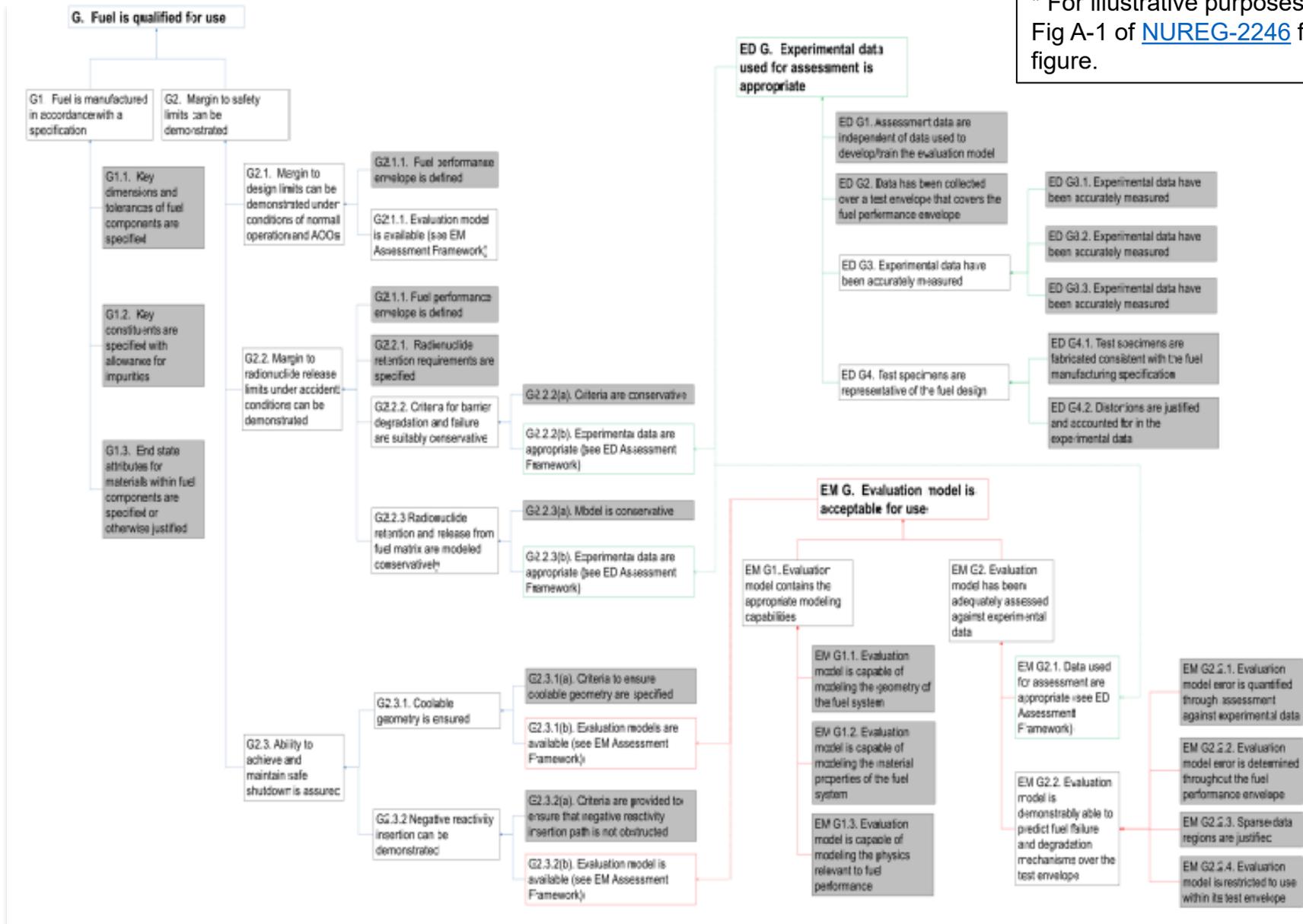
February, 2022

**DISCLAIMER:** The NRC and CNSC have prepared this interim report to inform stakeholders of the current project status for performing a generic assessment of TRISO fuel. The information contained in this document has not been subject to NRC and CNSC management and legal review, and its contents are subject to change and should not be interpreted as official agency positions.

[ML22030A000](#)

US-NRC ML22030A000 Page 1 of 11 CNSC e-Docs 6738729

# Assessment Framework



\* For illustrative purposes only. See Fig A-1 of [NUREG-2246](#) for legible figure.

# Focus of First Interim Report

GOAL	Fuel is qualified for use
G1	Fuel is manufactured in accordance with a specification <ul style="list-style-type: none"> <li>G1.1 Key dimensions and tolerances of fuel components are specified</li> <li>G1.2 Key constituents are specified with allowance for impurities</li> <li>G1.3 End state attributes for materials within fuel components are specified or otherwise justified</li> </ul>
G2	Margin to safety limits can be demonstrated <ul style="list-style-type: none"> <li>G2.1 Margin to design limits can be demonstrated under conditions of normal operation and AOOs               <ul style="list-style-type: none"> <li>G2.1.1 Fuel performance envelope is defined</li> <li>G2.1.2 Evaluation model is available (see EM Assessment Framework)</li> </ul> </li> <li>G2.2 Margin to radionuclide release limits under accident conditions can be demonstrated               <ul style="list-style-type: none"> <li>G2.1.1 Fuel performance envelope is defined</li> <li>G2.2.1 Radionuclide retention requirements are specified</li> <li>G2.2.2 Criteria for barrier degradation and failure are suitably conservative                   <ul style="list-style-type: none"> <li>(a) Criteria are conservative</li> <li>(b) Experimental data are appropriate (see ED Assessment Framework)</li> </ul> </li> <li>G2.2.3 Radionuclide retention and release from fuel matrix are modeled conservatively                   <ul style="list-style-type: none"> <li>(a) Model is conservative</li> <li>(b) Experimental data are appropriate (see ED Assessment Framework)</li> </ul> </li> </ul> </li> <li>G2.3 Ability to achieve and maintain safe shutdown is assured               <ul style="list-style-type: none"> <li>G2.3.1 Coolable geometry is ensured                   <ul style="list-style-type: none"> <li>(a) Criteria to ensure coolable geometry are specified</li> <li>(b) Evaluation models are available (see EM Assessment Framework)</li> </ul> </li> <li>G2.3.2 Negative reactivity insertion can be demonstrated                   <ul style="list-style-type: none"> <li>(a) Criteria are provided to ensure that negative reactivity insertion is not obstructed</li> <li>(b) Evaluation model is available (see EM Assessment Framework)</li> </ul> </li> </ul> </li> </ul>

# Focus of First Interim Report

GOAL	Evaluation model is acceptable for use		
EM G1	Evaluation model contains the appropriate modeling capabilities		
	EM G1.1	Evaluation model is capable of modeling the geometry of the fuel system	
	EM G1.2	Evaluation model is capable of modeling the material properties of the fuel system	
	EM G1.3	Evaluation model is capable of modeling the physics relevant to fuel performance	
EM G2	Evaluation model has been adequately assessed against experimental data		
	EM G2.1	Data used for assessment are appropriate (see ED Assessment Framework)	
	EM G2.2	Evaluation model is demonstrably able to predict fuel failure and degradation mechanisms over the test envelope	
		EM G2.2.1	Evaluation model error is quantified through assessment against experimental data
		EM G2.2.2	Evaluation model error is determined throughout the fuel performance envelope
		EM G2.2.3	Sparse data regions are justified
EM G2.2.4	Evaluation model is restricted to use within its test envelope		

GOAL	Experimental data used for assessment are appropriate	
ED G1	Assessment data are independent of data used to develop/train the evaluation model	
ED G2	Data has been collected over a test envelope that covers the fuel performance envelope	
ED G3	Experimental data have been accurately measured	
	ED G3.1	The test facility has an appropriate quality assurance program
	ED G3.2	Experimental data are collected using established measurement techniques
	ED G3.3	Experimental data account for sources of experimental uncertainty
ED G4	Test specimens are representative of the fuel design	
	ED G4.1	Test specimens are fabricated consistent with the fuel manufacturing specification
	ED G4.2	Distortions are justified and accounted for in the experimental data

# Contents

- Technologies considered (partially addresses G2.1.1, “Fuel performance envelope is defined”)
- Regulatory basis in the US and Canada
- Degradation mechanisms and failure modes for TRISO (partially addresses EM G1.3, “Evaluation model is capable of modelling the physics relevant to fuel performance”)
- Transient behavior of TRISO fuel

# Technologies Considered

Coolant	Structural Form	Time Averaged Volume-Averaged Temperature*	Peak Burnup*	Peak Fast Fluence*
Helium Air or dry-nitrogen FLiBe (molten salt)	Pebble Bed Prismatic	955 – 1296 °C	19.6 percent fissions per initial metal atom (FIMA)	$4.3 \times 10^{25}$ n/m (E > 0.18 MeV)

- Other parameters being considered (e.g., power density)
- Performance envelope is specific to UCO-TRISO
- Currently reviewing manufacturing parameters:
  - Table 5-5 of EPRI-AR-1
  - Fuel kernel composition (e.g., carbon-to-oxygen ratio)
  - Fuel kernel size and porosity
  - Fuel compact packing fraction (overcoating thickness)

# Degradation Mechanisms and Failure Modes

- Partially addressed EM G1.3, “Evaluation model is capable of modeling the physics relevant to fuel performance”
- Identified through past experience, legacy data, and expert panels (PIRTs)
- Some degradation mechanisms and failure modes have been addressed by the development of UCO-TRISO (i.e., can be addressed through controlled manufacturing) or have not been observed in testing
- 10 failure mode identified:
  - Pressure vessel failure of standard (“intact”) particles
  - Pressure vessel failure of particles with defective or missing coatings
  - Irradiation induced IPyC cracking failure
  - SiC thermal decomposition failure
  - Debonding between IPyC and SiC layers failure
  - Kernel migration failure
  - Fission product attack failure
  - Non-retentive SiC failure
  - Creep failure of PyC
  - Kernel-coating mechanical interaction failure

# Transient Conditions

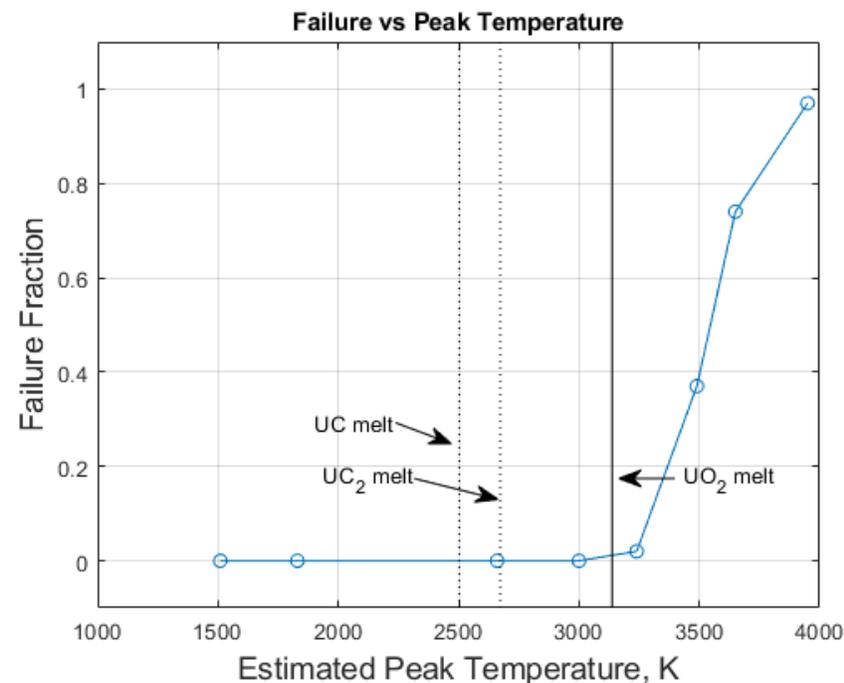
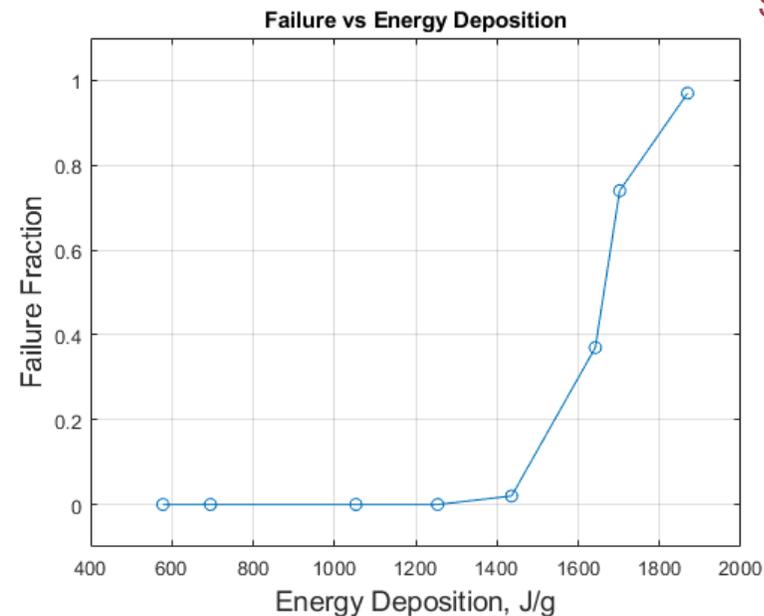
- The specification of a performance envelope, G2.1.1, includes the identification of representative transient conditions
- Rapid reactivity insertions, sufficient to make the reactor prompt-critical, may not be considered credible for designs that use UCO-TRISO.
  - MHTGR (NUREG-1338) ([ML052780497](#) and [ML052780519](#)), Fort St. Vrain ([ML100820279](#))
  - Technology Inclusive and Risk-Informed Reviews for Advanced Reactors ([ML21225A101](#))
- Previous studies, using fresh  $\text{UO}_2$  kernels, were investigated

# Reactivity Initiated Accident (RIA) Testing

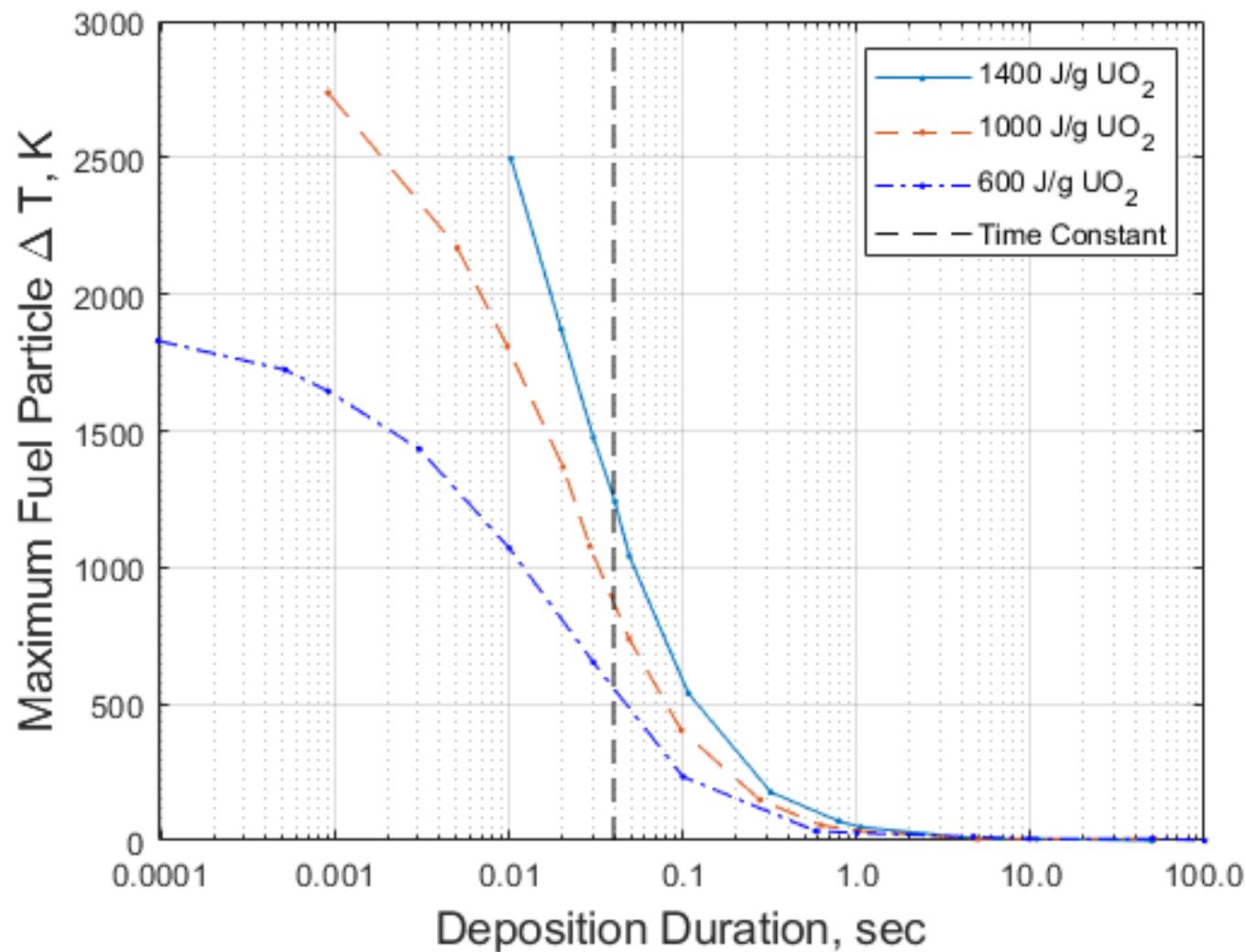
Reactor	Kernel	Type	Energy Deposition	Pulse Width	Fuel Failure
Nuclear Safety Research Reactor (NSRR - Japan) (Fukeda)	UO <sub>2</sub>	Compact and loose particles	500-2,300 J/g-UO <sub>2</sub>	5 ms	> 1,400 J/g
NSRR (Umeda)	UO <sub>2</sub>	Loose particles	500-1,700 J/g-UO <sub>2</sub>	5 ms	> 1,400 J/g
HYDRA (Russia)	UO <sub>2</sub>	Compact and loose particles	100-1,700 J/g-UO <sub>2</sub>	1-2 ms	> 1,300 J/g
Impulse Graphite Reactor (IGR - Kazakstan)	UO <sub>2</sub>	Pebble	> 10,000 J/g-UO <sub>2</sub>	700-30,000 ms	Matrix failure

# RIA Testing

- Particle failure correlates well with kernel melting
- Open questions:
  - How much lower is UCO melting (do we expect a lower failure threshold because of melting)?
  - Is data applicable to UCO TRISO?
    - Failure mechanisms and thresholds likely different for UCO TRISO are higher burnups
  - Is this type of RIA (i.e., millisecond pulse widths) credible?



# RIA Testing



# Questions?

(Questions for CNSC should be directed to [mediarelations-relationsmedias@cnsccsn.gc.ca](mailto:mediarelations-relationsmedias@cnsccsn.gc.ca) or by phone at 613-996-6860)

# Non-LWR PRA Acceptability Trial Regulatory Guide 1.247

March 16, 2022

# Agenda

- ▶ Background
- ▶ Comments Received
- ▶ Changes to Regulatory Guide
- ▶ Next Steps

# Background

- ▶ Preliminary Trial Regulatory Guide (TRG) made public in September 2021
- ▶ ACRS meetings - Subcommittee September 20, 2021; Full Committee October 5, 2021.
- ▶ Staff reviewed all exceptions and clarifications
- ▶ Public meeting November 3, 2021
- ▶ Team revised TRG to address self-assessment findings and comments

# Comments received

- ▶ ACRS FC meeting October 5, 2021
  - ▶ Letter rec'd October 26, 2021 (ML21288A018). Staff response to recommendations (ML21316A000)
- ▶ Public meeting November 3, 2021
  - ▶ JCNRM, NEI presentations (comments also submitted formally)
- ▶ Comments received via letters and emails
- ▶ Process - no formal comment period required prior to publication of a trial RG. Comment resolution will not be included with Trial RG
- ▶ 73 specific comments provided

# Categories of Comments

- ▶ Requested clarification on the motivation for Regulatory Positions
- ▶ Regulatory positions regarding PRA scope and the specification of methods or analytical approaches would be better placed within application-specific guidance.
- ▶ The NRC noted several areas where the NLWR standard could be improved. Such changes should be submitted to the JCNRM for further review.
- ▶ Too much 'how to'
- ▶ Comments on specific exceptions

# Addressing Comments

Staff considered each comment submitted

- ▶ Some comments addressed in trial RG (or no change made if staff didn't agree)
- ▶ Some will be deferred to the trial use period
- ▶ Some will be provided to JCNRM in next revision of standard
- ▶ Some deferred to other efforts (i.e. ARCAP)

# Staff assessment of RG

- ▶ Reviewed all the exceptions with the aim of achieving a consistent and clear voice for every exception we plan to take.
- ▶ Many exceptions deleted (including exceptions related to non-mandatory appendices)
- ▶ Some exceptions rewritten to reflect that exceptions are anchored in a regulatory concern or are in terms of something that the NRC would need for a decision making.

# Changes from draft version

- ▶ 86 exceptions deleted (146 in pre-decisional draft and 60 in Trial RG 1.247)
  - ▶ Significantly fewer number of overall exceptions than in RG 1.200 for the Level 1/LERF LWR PRA standard
- ▶ Editorial changes as result of technical edit review
- ▶ Changes to address stakeholder and ACRS comments
- ▶ Changes resulting from self assessment

# Next Steps

- ▶ Trial RG to be issued by March 31, 2022
- ▶ Federal Register notice will include a 60-day comment period
  - ▶ Submit comments at <http://www.regulations.gov>
- ▶ Staff to address public comments June 2022
- ▶ Public comment period will be followed by a 2-year trial use period. At any time during the trial use period, a member of the public may submit suggestions to the NRC
- ▶ Suggestions will be considered in future updates



# Status of Advanced Reactor Content of Application Project (ARCAP) and Technology Inclusive Content of Application Project (TICAP) Guidance Documents

March 16, 2022

# ARCAP/TICAP Status

- Purpose: To provide current status of ARCAP and TICAP guidance documents and to inform stakeholders of planned next steps in the process
- Key messages:
  - On March 1, 2022, NEI submitted 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
  - Draft White Paper ARCAP and TICAP guidance documents as well as NEI 21-07 Revision 1 are available on NRC ARCAP/TICAP public webpage (see: <https://www.nrc.gov/reactors/new-reactors/advanced/details.html#advRxContentAppProj>)
  - Staff is in the process of developing draft ARCAP and TICAP guidance documents for formal public comment
    - Target date for *Federal Register* Notification for these documents is late April early May 2022
  - As noted on the ARCAP/TICAP public webpage robust public stakeholder interactions have been held for over 2 years to aid in the development of ARCAP and TICAP guidance.

# ARCAP and Technology Inclusive Content of Application Project (TICAP) - Nexus

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

1. General Plant Information, Site Description, and Overview of the Safety Case
2. Methodologies and Analyses
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

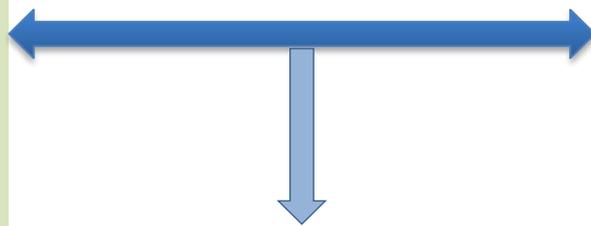
9. Control of Routine Plant Radioactive Effluents, Plant Contamination, and Solid Waste
10. Control of Occupational Doses
11. Organization and Human-System Considerations
12. Post-construction Inspection, Testing and Analysis Programs

## 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
- Physical Security Plan
- SNM physical protection program
- SNM material control and accounting plan
- Cyber Security Plan
- Fire Protection Program (operational)
- Radiation Protection Program
- Offsite Dose Calculation Manual
- Inservice inspection/Inservice testing (ISI/IST) Program
- Environmental Report
- Site Redress Plan
- Exemptions, Departures, and Variances
- Facility Safety Program (under consideration for Part 53 applications)



- Safety Analysis Report (SAR) structure based on clean sheet approach

\*Additional contents of application outside of SAR are still under discussion. The above list is draft and for illustration purposes only.

# ARCAP/TICAP Background

- Status of ARCAP Interim Staff Guidance Draft White Papers

ARCAP ISG Title	Date	Accession No.
Review of Risk-Informed, Technology-Inclusive Advanced Reactor Applications - Roadmap	Dec 2, 2021	ML21336A702
Chapter 2, "Site Information"	July 6, 2021	ML21189A031
Chapter 9, "Control of Routine Plant Radioactive Effluents, Plant Contamination and Solid Waste"	July 6, 2021	ML21189A033
Chapter 10, "Control of Occupational Doses"	July 6, 2021	ML21189A035
Chapter 11, "Organization and Human-System Consideration"	Nov 5, 2021	ML21309A020
Chapter 12, "Post Construction Inspection, Testing and Analysis Program"	Oct 21, 2021	ML21294A266
Licensing Modernization Project-based Approach for Developing Technical Specifications	May 10, 2021	ML21133A490
Risk-Informed, Performance-Based Fire Protection Program (for Operations)	Sept 10, 2021	ML21253A134
Risk-Informed ISI/IST Programs	Aug 4, 2021	ML21216A051

# ARCAP/TICAP Background

- Status of TICAP Guidance Documents

TICAP Title	Date	Accession No.
NEI 21-07, Revision 1, Technology Inclusive Guidance for Non-Light Water Reactors Safety Analysis Report Content for Applicants Utilizing NEI 18-04 Methodology	March 1, 2022	ML22060A190
Regulatory Guide Draft White Paper, “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”	Dec 2, 2021	ML21336A697
NEI 21-07, Revision 0, Technology Inclusive Guidance for Non-Light Water Reactors Safety Analysis Report Content for Applicants Utilizing NEI 18-04 Methodology	August 30, 2021	ML21250A378

# ARCAP Status

- Staff in the process of addressing internal comments on the nine ARCAP interim staff guidance (ISG) documents
- Current plan is to provide separate *Federal Register* Notifications (FRNs) to solicit public comment on these documents
  - Allows for easier binning and addressing of comments received in response to the FRN.
- The staff intends to issue the nine ARCAP ISG FRNs and the TICAP Draft Regulatory Guide FRN on the same day
  - Targeting late April early May for issuance of FRNs
- 45-day comment period
  - Staff intends to hold a public meeting during the public comment period to provide an overview of the documents and to address stakeholder questions before the public comment period closes.

# TICAP Status

- Staff is updating the TICAP Draft Regulatory Guide to reference NEI 21-07, Revision 1 and to address internal comments on the draft document.
- Staff considering the following changes:
  - Appendix A regarding construction permit guidance will be kept
    - Appendix will be updated to address issues highlighted in the December version of the TICAP draft regulatory guide white paper.
    - Staff addressing previous comments (as appropriate) received by industry in April and December of 2021 related to TICAP construction permit guidance
    - Guidance related to the source term to be used for evaluating radiological consequences for non-LWRs will likely be updated and moved to the main body of the guidance document
      - Guidance involves the scope of events to be considered in developing the source term to be used to meet the requirements found in 10 CFR 50.34(a)(1)(ii)(D) or 10 CFR 52.79(a)(1)(vi) for designs following an LMP-based approach
      - Traditionally, the source terms used in evaluating radiological consequences for LWRs have been representative of the source terms that result from a "major accident."

## TICAP Status (continued)

- Changes (continued):
  - Appendix B of the draft white paper TICAP guidance (proposed exceptions, clarification, and additions) to be removed
    - The final set of exceptions, clarifications and additions (based on NEI 21-07, revision 1) will be incorporated into applicable chapter guidance in the main body of the TICAP draft regulatory guide
- As noted in a previous slide, staff plans to issue a FRN requesting public comment on the TICAP draft regulatory guide in the late April early May time frame concurrent with the FRNs for the nine ARCAP interim staff guidance documents

# Next Steps – Milestones

<b>ARCAP/TICAP Near-Term Milestones</b>	<b>Target Date</b>
<b>Issue Federal Register Notice Seeking public comment on 9 ARCAP ISGs and TICAP Draft Regulatory Guide</b>	Late April May 2022
<b>Public Meeting to Facilitate Stakeholder Comment Development</b>	May/June 2022
<b>Advisory Committee on Reactor Safeguards (ACRS) Future Plant Designs Subcommittee Meeting</b>	Fall 2022
<b>ACRS Full Committee Meeting</b>	Fall 2022
<b>Issuance of Final TICAP RG and Final ARCAP interim staff guidance documents</b>	Late Calendar year 2022

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## Advanced Reactor Stakeholder Public Meeting

# Break

*Meeting will resume at 12:50 pm EST*

[Microsoft Teams Meeting](#)

Bridgeline: 301-576-2978

Conference ID: 556 455 490#





# A Traditional, Technology- Inclusive, and Risk-Informed Framework Option in Part 53

# Background

- Part 53 stakeholder feedback included requests to consider international approaches and flexibility in the use of PRA
- Previously released preliminary proposed rule text (“Part 5X”) outlined technology-inclusive, risk-informed alternatives for using the traditional technical requirements in Parts 50 and 52
- Inclusion of a traditional, technology-inclusive, and risk-informed regulatory framework in Part 53 minimizes potential impact on existing requirements and centralizes alternatives for new commercial reactors
- Dedicated staff to develop the traditional licensing framework are integrated with existing Part 53 team
- Aligned with the established Part 53 rulemaking schedule

# Part 53 Licensing Framework

Part 53

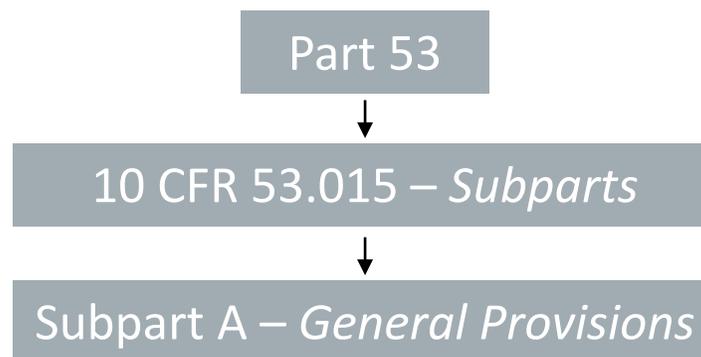


Subpart A – *General Provisions*

- Subpart B - Safety Requirements
- Subpart C - Design Requirements
- Subpart D – Siting
- Subpart E – Construction
- Subpart F – Operations
- Subpart G – Decommissioning
- Subpart H - Licensing Processes
- Subpart I - License Maintenance
- Subpart J – Reporting
- Subpart K - Quality Assurance

# Part 53

## Licensing Frameworks



### Framework A

- Subpart B – Safety Requirements
- Subpart C – Design Requirements
- Subpart D – Siting
- Subpart E – Construction
- Subpart F – Operations
- Subpart G – Decommissioning
- Subpart H – Licensing Processes
- Subpart I – License Maintenance
- Subpart J – Reporting
- Subpart K – Quality Assurance

### Framework B

- Subpart B1 – Purpose/Definitions
- Subpart B2 – Siting
- Subpart B3 – Construction
- Subpart B4 – Operations
- Subpart B5 – Decommissioning
- Subpart B6 – Licensing Processes
- Subpart B7 – License Maintenance
- Subpart B8 – Reporting
- Subpart B9 – Quality Assurance

Alternate  
Evaluation for  
Risk Insights

# NRC Staff Are Using a Systematic Development Process

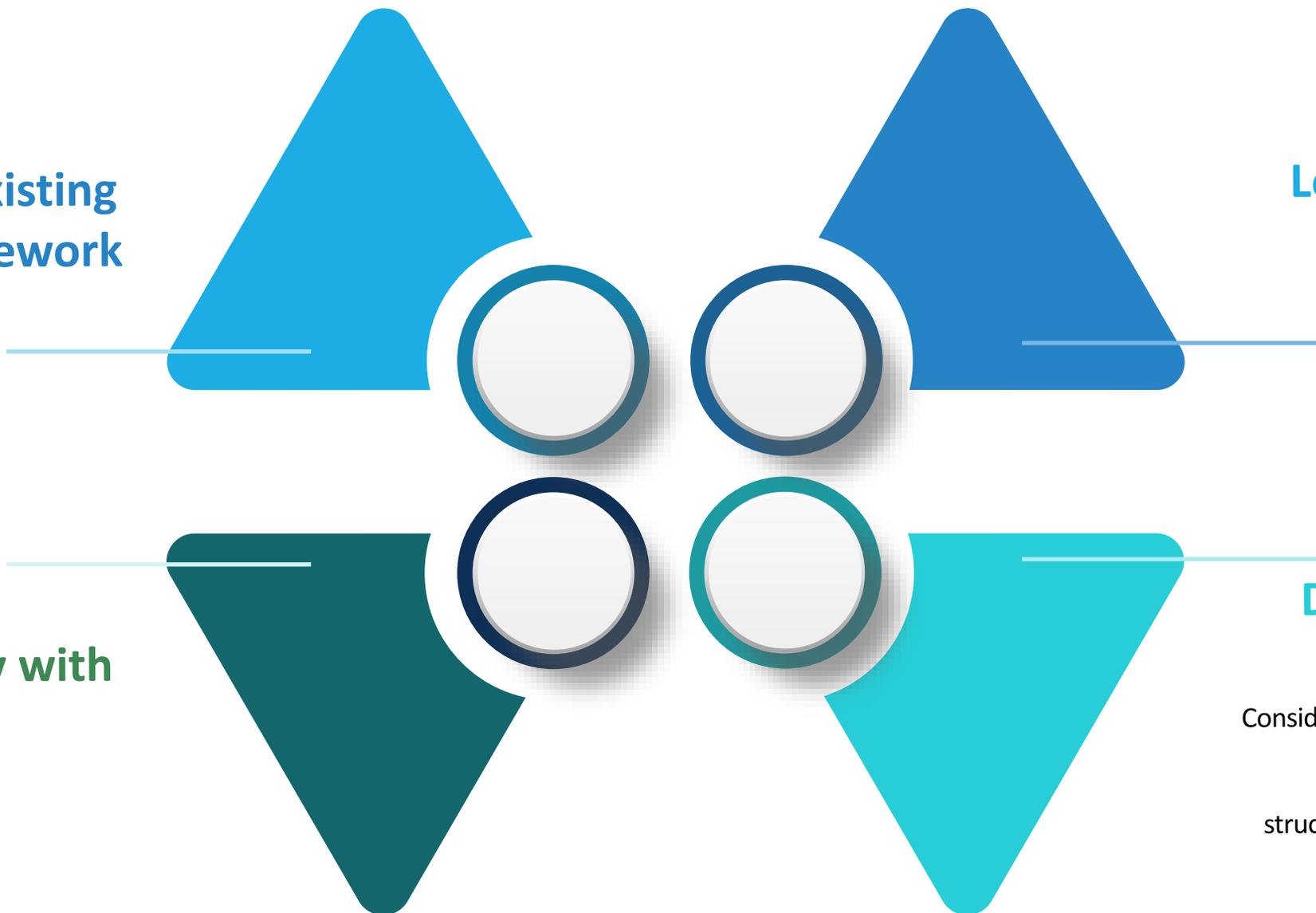
**Incorporate  
Applicable Existing  
Part 53 Framework  
Innovations**

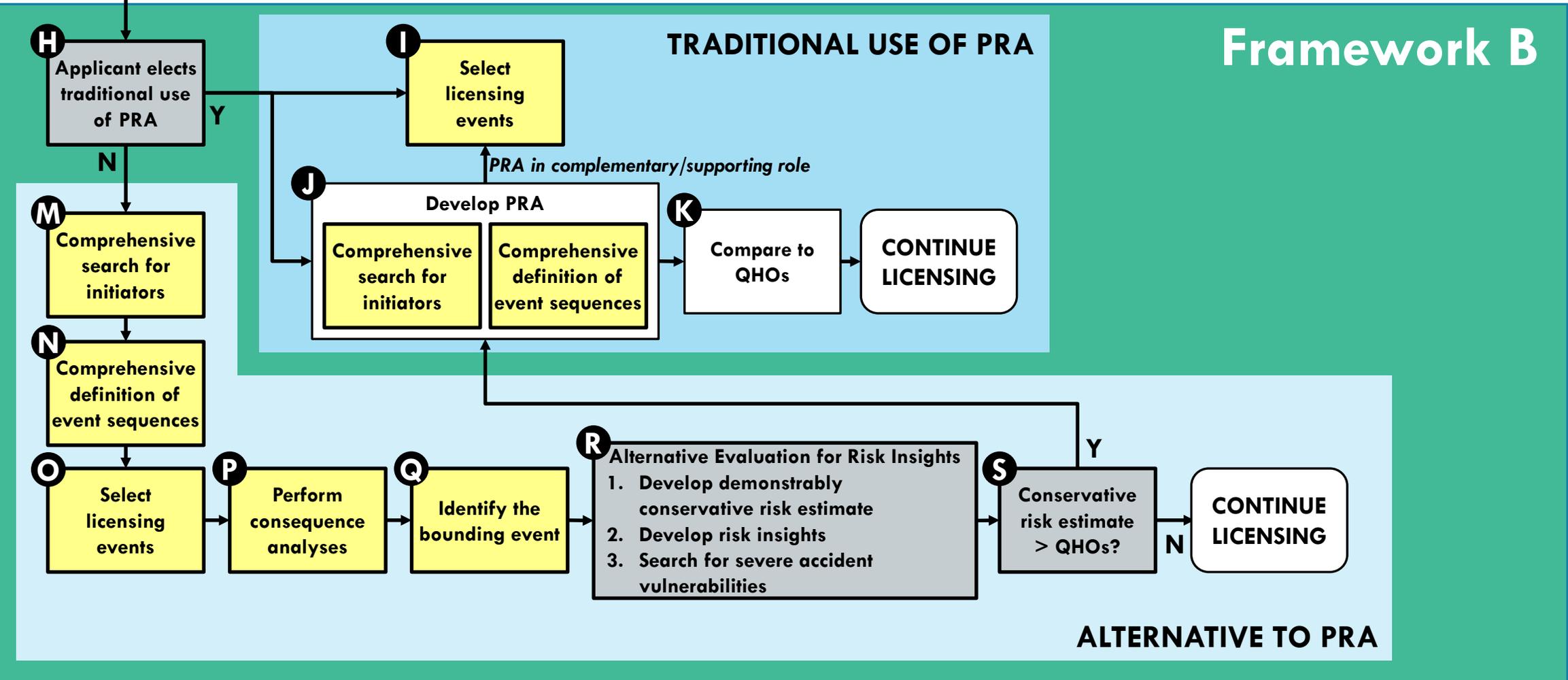
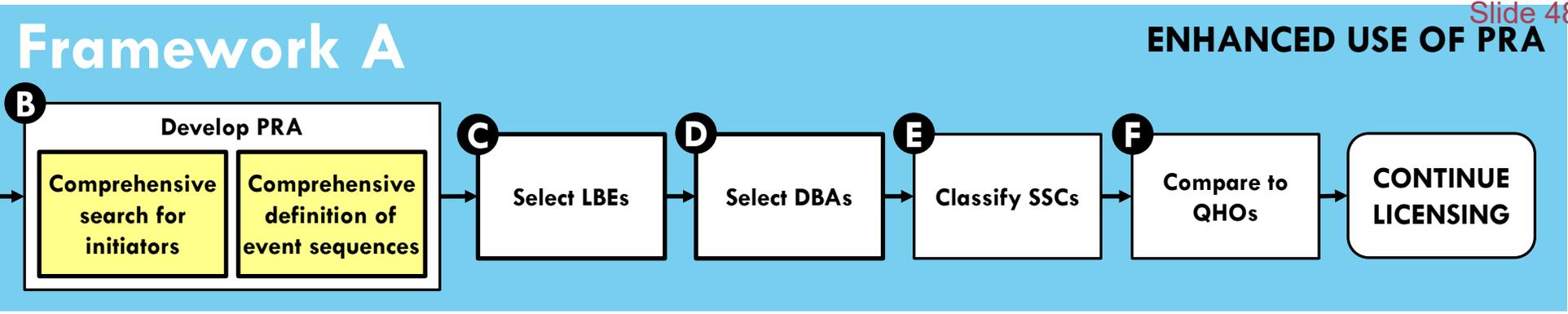
**Leverage Part 50  
and 52 Rule  
Language**

**Consider  
Compatibility with  
International  
Standards**

**Develop Unique  
Rule Language**

Consider state-of-practice research and experience with other improvements to regulatory structure and licensing processes





Use of PRA in Part 53

# Alternative to PRA for Gaining Risk Insights

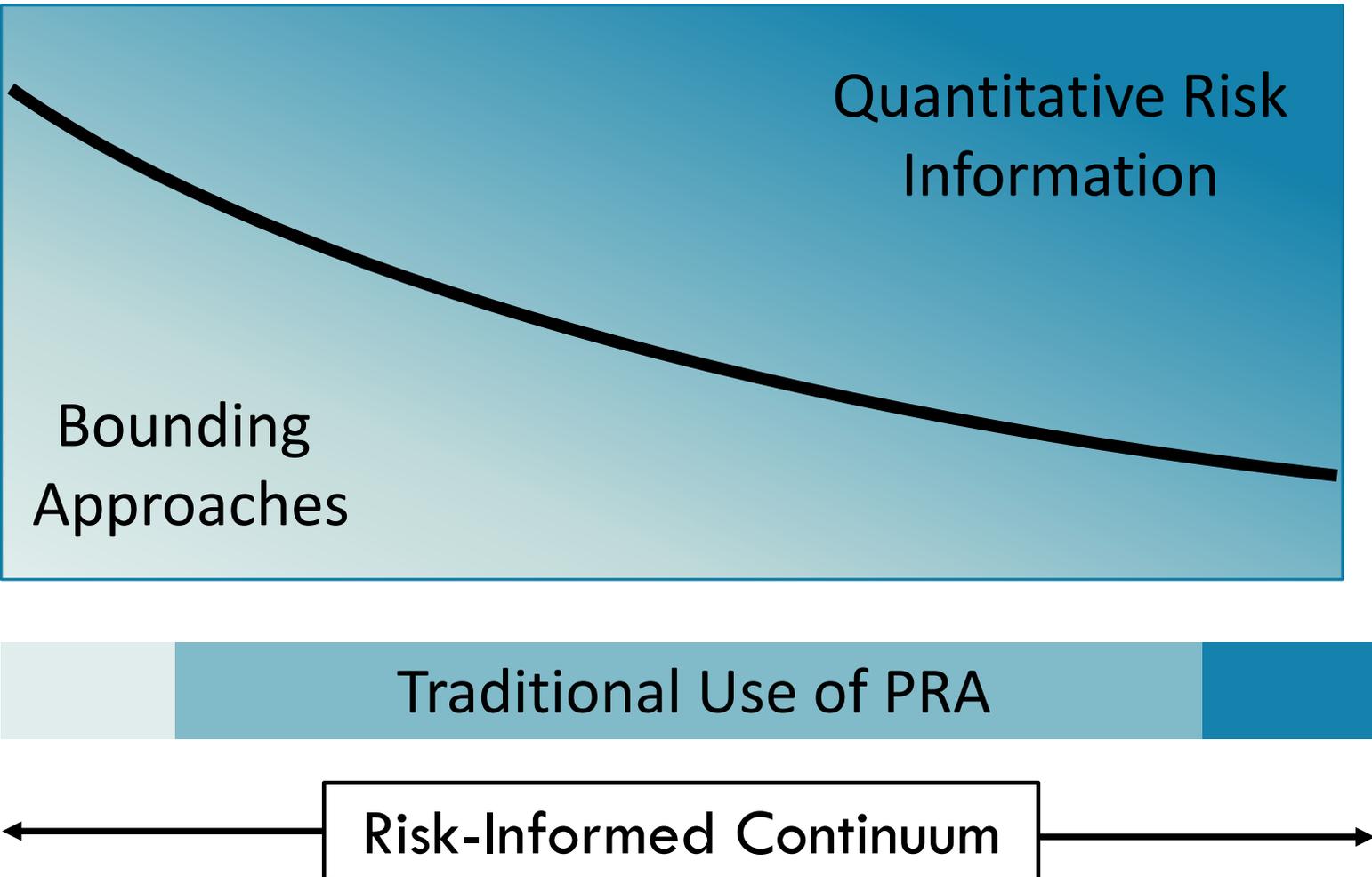
## Preliminary Proposed Rule Text Development

- Working to integrate an alternative to PRA for gaining risk insights in Framework B
- Cannot presume there is a PRA
  - Examples: Risk-informed inservice inspection, etc.
  - Possible resolutions: Use alternative approach to achieve the same level of safety

## Supporting Guidance Development

- Guidance #1: Technology-inclusive identification of licensing events (yellow boxes)
  - Search for initiators and delineate event sequences without preconceptions or predefined lists (i.e., start with a blank sheet of paper) - Boxes B, J, M, and N
  - Group initiators and event sequences into a set of licensing events - Boxes I, O, P, and Q
- Guidance #2: Implementing the alternative to PRA (gray boxes)
  - Entry conditions - Box H
  - Alternative Evaluation for Risk Insights - Box R
  - Off-ramp - Box S

# Key Stakeholder Feedback Is Considered in the Development of a Traditional Approach in Part 53



## Next Steps

- Release preliminary proposed rule language (tentative May 2022)
- Part 53 public meeting presentation (tentative late May)
- Discuss with Advisory Committee on Reactor Safeguards
  - Subcommittee: June 21-22, 2022
  - Full Committee: July 6-9, 2022
- Align with established Part 53 rulemaking schedule for publication of proposed rule

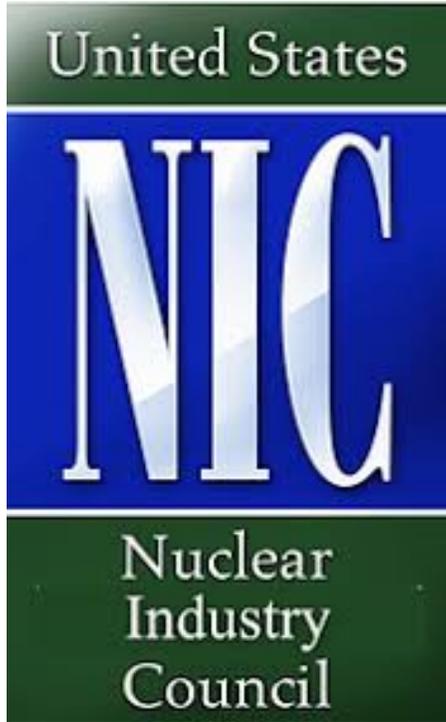
# Additional Information

Additional information on the 10 CFR Part 53 rulemaking is available at <https://www.nrc.gov/reactors/new-reactors/advanced/rulemaking-and-guidance/part-53.html>

For information on how to submit comments go to <https://www.regulations.gov> and search for Docket ID NRC-2019-0062

For further information, contact Robert Beall, Office of Nuclear Material Safety and Safeguards, telephone: 301-415-3874; email: [Robert.Beall@nrc.gov](mailto:Robert.Beall@nrc.gov)





# Part 53: Perspective on PRA, Process, Concerns, and Going Forward

Cyril Draffin, Senior Fellow, Advanced Nuclear, U.S. Nuclear Industry Council

NRC Advanced Reactor Stakeholder Meeting

16 March 2022

# Roles of Probabilistic Risk Assessment (PRA) in Risk-Informed Approach Slide 54

- We support enhanced use of PRA and NRC's efforts to incorporate alternative approaches
- Allowing traditional, risk-informed framework in rule and providing guidance in a graded approach is appropriate
- Fully developed Level 3 PRA at beginning of licensing process not possible for Construction Permit, may be too burdensome for Operating License / Combined License, and well beyond requirements for Part 50/52
- Part 53 must allow for appropriate use of PRA as important tool (for insight)
  - Appropriate for **rule** to allow **risk-informed spectrum** of enhanced PRA and traditional – with **specific guidance** for alternative approaches/frameworks *(2021 industry suggestion)*
- Part 53 should **not** have multiple separate complex parallel frameworks in **rule** language (e.g. (a) Enhanced use of PRA for licensing (similar to TICAP), (b) Traditional use of PRA (similar to approaches previously licensed under Part 52), and (c) MCA approach or alternative PRA approach) *(this was not requested by industry)*

# Process Seeking Stakeholder Comments

- USNIC supports the development of performance-based risk-informed rule that is useful and efficient
  - USNIC appreciates the work being undertaken by NRC on Part 53
- USNIC concerned with very **limited transparency** regarding NRC's reaction to alternatives suggested by industry and other stakeholders
  - NRC staff listens but provides very limited responses
- Part 53 comment review process could be improved by:
  - Seeking more two way interactive dialog
  - Employing similar workshop approach used for developing Regulatory Guide 1.206 (Applications for Nuclear Power Plants) that was more **interactive** and more productive than current Part 53 process
  - Providing a clearer roadmap of what NRC is attempting to accomplish in the rule
    - An overarching framework has not been provided
  - Providing a list of industry-raised issues/concerns (besides PRA) under consideration by NRC staff, and a schedule when they will be addressed

# Process of Preparing Language Matching NEIMA Intent

- Congress' Nuclear Energy Innovation and Modernization Act (NEIMA) intent for NRC to create licensing framework under Part 53 that would meet adequate protection standard – in efficient, timely, risk-informed way that enables advanced reactor deployment
  - USNIC concerned that, so far, Commission staff appear to be creating Part 53 in contradiction to NEIMA and Congressional intent-- by adding regulatory burden, making process less efficient, and not streamlining deployment of these technologies
  - Would be helpful to know how NRC staff plans to use 9-month extension to bridge gaps/inconsistencies between staff's current position and NEIMA

# Ongoing Concerns

- **ALARA** – Our members recognize ALARA (as low as reasonably achievable) is a good practice, but Part 20 should be referenced, rather than putting new provisions in rule that affect design
- **QHOs** – Not clear how Quantitative Health Objectives will be met in the rule
  - Currently, there is no guidance on how to implement QHOs and we believe, as proposed by the staff, this is unnecessary expansion of regulatory requirements
- **Subpart F** – Some programs (e.g. Facility Safety program (53.890) and Integrity Assessment Program (53.850)) are redundant, new, and probably unnecessary
- **Defense in Depth**
  - We appreciate DID is an important design philosophy. We suggest that the rule allow sufficient flexibility for applicants to demonstrate how DID is provided (e.g. allow use of programmatic controls as an alternative to additional equipment).

Other specific concerns regarding preliminary language provided in 5 Nov. 2021 112-page document

# More Recent Concerns (increased Regulatory Burden & not risk-informed)

(From February 2022 NRC Part 53 Consolidated text)

## Safety Criteria for LBEs other than DBAs (53.220)

- Wording has changed from the Safety Goals, which focused on deaths (not health effects), to much broader term of "health effects"

## Functional Design Criteria for Occupational Dose ALARA (53.430)

- Significant expansion of current operational ALARA requirements into **design** space

## Special Treatments and QA (53.460)

- Seems to say no graded QA for safety-related SSCs. This is highly undesirable, and seems to be change from what is permitted by NEI 18-04

## Earthquake Engineering (53.480)

- Seems all non-safety-related but safety significant (NSRSS) SSCs must be seismic. Not sure why staff singled out earthquakes for more rigorous treatment that goes beyond NEI 18-04

## Fire Protection Requirements (53.440)

- Deterministic approach, not risk-informed

# Going Forward

- Staff should seek early resolution from Commission of policy issues
  - Staff could offer alternative text for key issues (ALARA, PRA, QHO, DID, programs, etc.) for Commission/stakeholder review in Q2
  - Staff could provide proposed rule framework that encapsulates alternative positions provided by industry besides the staff recommendation
  - Higher level standards and simplicity could benefit the process. Need reasonable balance between predictability and flexibility- guidance helps.
- Rule should enable deployment of advanced technologies and not impose burdens currently **beyond** Part 50 and 52
  - NRC should **demonstrate why new requirements are required**
  - NRC staff should **not** use this rulemaking to incorporate requirements in Part 53 that were **previously part of guidance documents**
- Change future public meetings **from one-way NRC “listening sessions” to open two-way dialog leading to resolution** of topical issues (multiple topics including Role of PRA in risk-informed approach; in April and May)

# Possible Next Steps NRC Could Consider Taking

- Consider **process improvements** in dealing with stakeholders
  - Increase **transparency** regarding NRC's reaction to alternatives suggested by industry and other stakeholders
  - Increase two-way dialog through workshop approach for addressing key Part 53 issues
  - Provide NRC reaction to stakeholder Part 53 comments at next Stakeholders meeting
- Continue **evolving Part 53 language**
  - High level language regarding PRA in rule, with detailed guidance for different approaches/frameworks
  - Provide response to stakeholder comments regarding following concerns:
    - ALARA
    - QHOs
    - Subpart F
    - Defense in Depth
  - Reconsider language based on 5 November 2021 detailed industry comments, and "Most Recent Concerns" slide

# Appendix: Example USNIC Input on Part 53

- 2021-02-03: ([ML21035A003](#))
  - Suggested update to Part 53 Subpart B preliminary language
- 2021-07-15: ([ML21196A499](#))
  - Comments on stakeholder engagement, USNIC Part 53 survey results, lack of roadmap and clarity on safety expectations, rule development, ALARA, QHOs, Quality Assurance, Subpart F, Decommissioning, Defense in Depth, Two Tiers, Reasonable Assurance of Adequate Protection
- 2021-11-05: Joint NEI/USNIC letter ([ML21309A578](#))
  - With three detailed attachments (112 pages)
- 2021-12-17: NEI/USNIC presentation to ACRS (<https://www.nrc.gov/docs/ML2202/ML22024A447.pdf>)
  - Comments on QHO, PRA, ALARA, safety standards/AEA, BDBE in design basis, redundant programs, regulatory efficiency
  - NEI/USNIC Part 53 slides 681-754; transcript of NEI/USNIC Part 53 remarks start at 400

# Evaluation of Changes to Facilities Utilizing NEI 18-04 Methodology

## NRC Advanced Reactor Stakeholder Meeting

March 16, 2022

Mike Tschiltz  
Consultant to Southern Company



Southern  
Company

# Project Description



- Develop guidance for evaluating changes to the facility for ANLWRs

*The objectives of this guidance are to:*

- *Provide regulatory confidence that the basis for the LMP-based safety case will be effectively monitored and any changes will be efficiently managed*
  - *Minimize the unnecessary burden to the regulator and owners/operators for determining if changes require a license amendment*
  - *Establish a clear understanding of how the 50.59 criteria for making facility changes without prior NRC approval may be met*
- Applicable to ANLWR designs that utilize NEI 18-04 and 10 CFR Part 50 or 52
    - *Builds upon the work accomplished by LMP (NEI 18-04) and TICAP (NEI 21-07)*

# Project Description (cont)



- **Southern led team with support from Dept of Energy and the Idaho National Laboratory (DOE/INL)** (cost share)
  - Team members: Southern Company employees, NEI, advanced reactor designers, INL and consultants
- **Schedule:**
  - Guidance is expected to be needed by ARDP applicants within next three years
  - Draft guidance to be developed as a Southern document by late summer
  - Convert to NEI guidance and submit to NRC for formal review and endorsement (September 22)
  - Support NRC review and endorsement (FY 2023)
- **Details on following slides**

# NRC COMMENTS/FEEDBACK



- Does this approach present any significant challenges from NRC perspective?
- Does NRC anticipate challenges with the evaluation of facility changes under 50.59 using risk-informed criteria?

# Project Plan



- **Preliminary High Level Schedule (NRC interactions highlighted)**
  - Identify Key Issues associated with developing guidance for a change evaluation process for designs licensed utilizing NEI 18-04 safety case (status: complete)
  - Develop papers that address key issues associated with the scope of the changes to be addressed in the guidance and the screening and evaluation of changes (status: internal comment resolution ongoing)
  - Develop a white paper that describes the proposed applicability determination and change evaluation process. (**NRC meetings to discuss progress targets: 3<sup>rd</sup> week in April, 3<sup>rd</sup> week May**)
  - NRC Review of white paper that describes the proposed applicability determination and change evaluation process (**proposed NRC review 5/5-5/19**)
  - Develop tabletop exercise objectives and guidelines and identify advanced reactor tabletop participants. NRC review and comment (**NRC Meeting target: 3<sup>rd</sup> week in April**)
  - NRC Review of white paper that describes the proposed applicability determination and change evaluation process and evaluation guidance (**NRC observation, June**)

# Project Plan(cont)



- **Preliminary High Level Schedule (NRC interactions highlighted)**
  - Conduct two ANLWR design tabletop exercises that apply different parts of the screening (**NRC Observation: June 7- 20**)
  - Develop annotated outline for the guidance document. NRC review and comment. (**NRC Meeting target: 2nd week in June**)
  - Develop Guidance Document based on topics included in the Annotated Outline (July – August) (**NRC Meeting targets: mid-July and mid-August**)
  - Tabletop Lessons Learned (**NRC Meeting target: July**)
  - **NRC review of draft guidance** (Southern Company document) (**mid-August**)
  - Convert to NEI guidance and **submit for formal NRC** review and endorsement (**end of Sept**)
  - **NRC formal review and endorsement in FY23**



- Questions ?

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# Future Meeting Planning

- The next periodic stakeholder meeting is scheduled for May 11, 2022.
- If you have suggested topics, please reach out to Steve Lynch at [Steven.Lynch@nrc.gov](mailto:Steven.Lynch@nrc.gov)

