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Public Meeting on Possible Regulatory Process Improvements for Advanced Reactor Designs

December 12, 2019

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- Opportunities for public comments and questions at designated times

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Outline

❑ 9:00 – 9:10 am	Opening Remarks
❑ 9:10 – 9:20 am	Advanced Reactors Materials Workshop Dec 9-11
❑ 9:20 – 9:50 am	Overview of NEI Micro-Reactor Paper
❑ 9:50 – 10:20 am	Non-Light Water Reactor Review Strategy
❑ 10:20 – 10:50 am	Advanced Reactor Preparations for Environmental Reviews
❑ 10:50 – 11:00 am	Break
❑ 11:00 – 12:00 pm	Physical Security Proposed Rule for Advanced Reactors
❑ 12:00 – 1:00 pm	Lunch
❑ 1:00 – 2:15 pm	Technology Inclusive Content of Applications Project (TICAP)
❑ 2:15 – 3:00 pm	Canadian Nuclear Safety Commission (CNSC) Licensing Approach
❑ 3:00 – 3:10 pm	Advanced Reactor Export Working Group
❑ 3:10 – 3:30 pm	Future Meetings planning and Open Discussion

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- Advanced Reactors - Materials and Component Integrity Workshop Dec 9-11, 2019
  - Raj Iyengar, NRC

- Overview of NEI Micro-Reactor paper
  - Marc Nichol, NEI

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- Non-Light Water Reactor Review Strategy
  - Jan Mazza, NRC

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- Advanced Reactor Preparations for Environmental Reviews
  - Mallecia Sutton, NRC

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Break

Meeting/Webinar will begin shortly

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- Physical Security Proposed Rule for Advanced Reactors
  - Nanette Valliere/Joseph Rivers, NRC
- Potential Considerations for Physical Security for Advanced Reactors Rulemaking
  - Kati Austgen, NEI

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Lunch

Meeting/Webinar will begin shortly

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- Technology Inclusive Content of Applications Project (TICAP)
  - Joseph Sebrosky, NRC/Thomas Hicks INL

- Technology Inclusive Content of Applications Project (TICAP)
  - Amir Afzali, Southern Co./Steve Nesbit, LMNT Consulting

- Canadian Nuclear Safety Commission Licensing Approach
  - Chantal Morin, CNSC

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- Advanced Reactor Export Working Group
  - Lauren Mayros, NRC

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Open Discussion and Closing

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2020 Tentative Schedule for Periodic Stakeholder Meetings
February 6
March 26
May 7
June 18
August 6
September 24
November 5
December 17

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Micro-Reactors

Regulatory Topics

Marc Nichol, Director New Reactor Deployment

December 12, 2019

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Overview of Micro-Reactors

- Typically 1 MWe to 10 MWe (2 MWth to 40 MWth)
- Very small size
  - Building footprint as small as 1,000 sqft
  - Reactor w/ balance of plant is road shippable, minimal site work
- Non-traditional uses and locations
  - Remote villages (e.g., arctic and islands)
  - Mining operations
  - Defense and other mission critical installations
  - Micro-grids – in populated areas
- Rapidly maturing technology
  - First licensing applications expected in 2020

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Micro-Reactor Safety

- Very small inventory of fission products, as compared to current large reactors
- Key Features*
  - Safety provided entirely by passive and inherent features
  - Fail-safe to shut down automatically
  - Accident and proliferation resistant fuel, enriched below 20% U-235
  - High fission product retention
  - Operator actions are not needed to assure safety of the reactor
  - Reactor can be located completely below ground
  - Operational simplicity with very few instruments and controls, and active SSCs

*General description, all features may not be applicable to all designs

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Micro-Reactor Regulatory Considerations

- Safety profile of micro-reactors fundamentally differ from other power reactors
  - Existing regulations and proposed rule changes are often not well suited
  - Near term - alternative approaches or exemptions, long-term may need rulemaking
- Micro-reactors are more similar to research and test reactors (RTR)
  - Similar in power level and potential consequences
- Some differences between micro-reactors and RTRs are expected
  - Micro-reactors operate at full power more frequently and for longer periods
  - Micro-reactors have balance of plant
  - Micro-reactors have more inherent safety features, such that some accident scenarios may not be relevant
  - Micro-reactors may not require human action for accident response
  - Micro-reactors do not perform test and experiments

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Micro-Reactor Regulatory Issues

Priority Issues	Addressed in Broader Efforts	Other Potential Issues
1. Review Scope, Duration, Level of Effort 2. Operations (auto/remote) 3. Inspections 4. Physical Security 5. Emergency Preparedness 6. Aircraft Impact	• Siting • Environmental Reviews • Fuel Qualification	• QA • PRA • Liability Insurance • Decommissioning Funding • Annual Licensee Fees • Generic License • Transportation

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Review Scope, Duration, Level of Effort

- Recommend NRC establish target for review schedule
  - Less than 12 months
    - from Acceptance to Final Safety Evaluation
    - including environmental review
- Relevant recent NRC experience on level of effort
  - SHINE Construction Permit – 22,000 hours
  - Northwest Medical Construction Permit – 12,000 hours

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Automatic / Remote Operations

- Automatic/remote operations may have very few controls and not require human action
- Applicant evaluation to determine whether there is need for operator actions
  Exemptions from Part 50.54 and Part 55 may be needed
- If no human action needed to protect public health and safety
  - No licensed operators required (numbers, presence, training, requal, simulator)
- If some actions needed to protect public health and safety
  - Applicant propose licensed operator scheme (number, presence, training)
  - Ability to return within an acceptable time could be credited for presence
- Traditional control room may not be necessary
- If safety can be assured without operator action, and if unauthorized individual cannot compromise safety through manipulating controls:
  - No need for requirements relating to the control room, operator initiated shutdown or I&C to be in a restricted area

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NRC Inspection and Oversight

- Licensee is responsible for safety and regulatory compliance
- NRC independently verifies licensee's compliance through inspection
  - Performance based, focused on activities important to safety
  - Emphasis on observing activities over reviewing documents
- Micro-reactors have very few activities
- Recommended NRC inspection paradigm
  - Inspection frequency – once every one or two years
  - No need or requirement for resident inspectors
  - Construction inspection program emphasize vendor inspections
  - Significance determination process and performance indicators not needed

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Emergency Preparedness

- EP rulemaking for SMRs and other nuclear technologies
  - Performance based, technology inclusive, consequence oriented
  - Do not explicitly refer to micro-reactors
- Draft rule 10 CFR 50.60
  - Appears flexible enough for micro-reactors
- DG-1530
  - Does not contemplate extremely low potential consequences of micro-reactors
- Need guidance on emergency plans for micro-reactors
  - Model after NUREG-0849 (for RTRs)

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Physical Security

- Security rulemaking for SMRs and other nuclear technologies
  - Not very performance based, technology inclusive, consequence oriented
  - Results in excessive burden on micro-reactors
- For micro-reactors where most severe scenarios do not result in undue risk to public
  - Should not be required to have additional design features or protective action to protect from DBT
  - Could determine DBT not applicable
- Requirements for micro-reactor security principally focused on theft and diversion
  - Access control, Intrusion detection, Communications with law enforcement
- Requirements related to protecting against DBT would not be necessary, e.g.,
  - Certain considerations for physical barriers
  - Force on force evaluation
  - May not require personnel on-site

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Aircraft Impact Assessment

- Impact of large aircraft is beyond-design-basis-event
  - Requirements on design, construction, testing, ops and maintenance for design-basis events do not apply
- Aircraft impact on micro-reactors are highly unlikely
  - Not easily impacted: building is small in size, some may be below grade
  - Not high-value target: could not cause mass casualties
- Impact does not pose hazard to public: very little radionuclide inventory
- For micro-reactors where aircraft impact unlikely to pose substantial hazard to public
  - Meet intent of Part 50.150, but not specific criteria
  - Near-term - exemptions to 50.150 appropriate

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Conclusions

- First micro-reactor application expected in 2020
- Key Policy and Technical issues to address promptly
  - Review duration and level of effort
  - Automatic / remote operations
  - NRC Inspection
  - Emergency Preparedness
  - Physical Security
  - Aircraft Impact
- Additional work would be helpful
  - Details on design and performance of key safety features
  - Characterization of radionuclide inventories and source terms
  - Generic assessments (e.g., operator actions, likelihood of aircraft impact)

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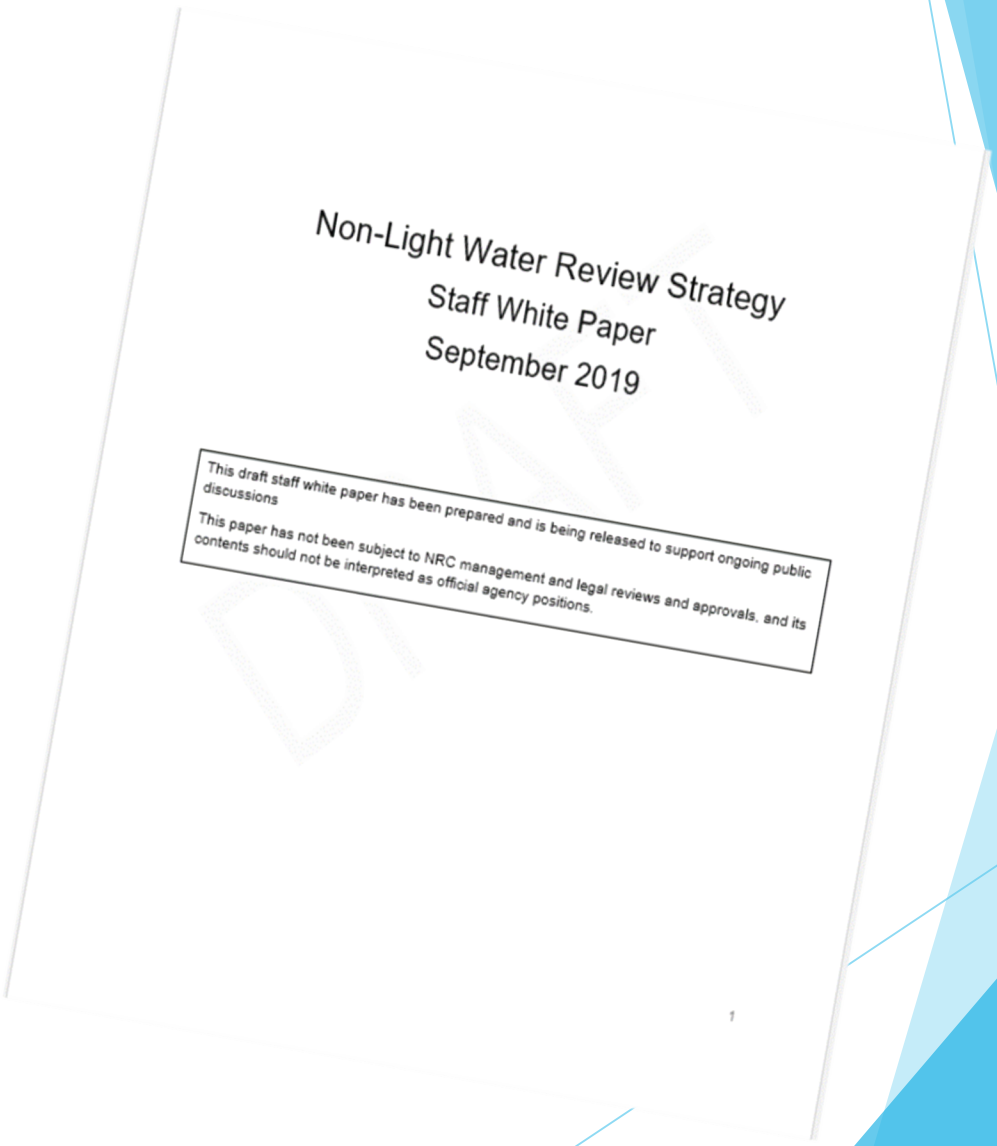
Non-Light Water Reactor Review Strategy – Staff White Paper

December 12, 2019

Introduction

- Background
- Purpose
- Contents
- Status



Non-Light Water Review Strategy
Staff White Paper
September 2019

This draft staff white paper has been prepared and is being released to support ongoing public discussions

This paper has not been subject to NRC management and legal reviews and approvals, and its contents should not be interpreted as official agency positions.

1

Background

NRC recognized that review guidance was needed:

- to support the near-term reviews of applications for non-LWR designs submitted prior to the development of the technology inclusive – risk informed performance based (TI-RIPB) regulatory framework in 2027, as required by the Nuclear Energy Innovation and Modernization Act (NEIMA).

Purpose

The purpose of the Non-LWR Review Strategy is:

- to provide acceptance criteria for non-LWR reviews
- to provide NRC staff an approach to reviewing the licensing basis information of a non-LWR application independent of the specific design or methodology used.

Contents

Specific topics addressed in the review guide:

- Section 2.0 - Non-LWR Vendor Approaches to Developing the Licensing Basis
- Section 3.0 - Acceptance Criteria and NRC Staff Review Approach
- Section 4.0 - References
- Section 5.0 - Acronyms
- Attachment 1 - Analysis of Applicability of NRC Regulations for Non-LWRs

Contents (Cont.)

Section 2.0 - Non-LWR Vendor Approaches to Developing the Licensing Basis:

- describes the various approaches to developing the licensing basis for non-LWRs
- provides background and references for pre-application interactions
- discusses contents of applications
- discusses the development of the Safety Evaluation Report

Contents (Cont.)

Section 3.0 - Acceptance Criteria and NRC Staff Review Approach

- describes the scope and focus of the staff's technical review
- discusses, in general terms, the acceptance criteria that could be considered by NRC staff during the technical review of a non-LWR application
- provides guidance for the analysis and evaluation of the integrated system design
- provides expectations for probabilistic risk assessments for non-LWRs

Contents (Cont.)

Attachment 1 - Analysis of Applicability of NRC Regulations for Non-LWRs

- Table 1 – Areas of Expected Exemptions
- Table 2 – Part 50 Requirements
- Table 3 – Part 52 Subpart B Design Certification Requirements
- Table 4 – Other Applicable Regulations

Status

- Currently under review by OGC
- Once complete final review by DANU management
- Not formally soliciting public comments – but will consider any feedback that we receive

QUESTIONS?

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Advanced Reactor Preparations for Environmental Reviews

Mallecia Sutton
Senior Project Manager
Division of Advanced Reactors and Non-Power Production and Utilization Facilities

Status on Environmental Activities

- Status update on:
  - Interim Staff Guidance for the environmental review of micro-reactors
  - Guidance on addressing fuel cycle and fuel transportation impacts for non-LWRs
  - Consideration of Generic Environmental Impact Statement for Advanced Reactors

Interim Staff Guidance

- Assist the NRC staff in determining the scope and scaling the environmental reviews associated with micro-reactor applications
- Internal Concurrence
  - ❖ To be issued as a Draft for Comments
- Encourage Pre-application Interactions

Fuel Cycle Impacts

- Developing white paper on fuel cycle impacts for non-LWRs
  - 10 CFR 51.51 only applies to LWRs and does not mention non-LWR license applicants
  - Evaluate fuel cycle impacts to meet obligations under the National Environmental Policy Act (NEPA)
- Developing white paper transportation impacts for non-LWRs
  - 10 CFR 51.52 only applies to LWRs and does not mention non-LWR license applicants
  - Evaluate transportation impacts to meet its obligations under NEPA

GEIS Exploratory Process

- Exploratory Process
  - Public meetings were held November 15th and 20th
  - Extended comment period-January 24, 2020
  - Meeting summary to be issued within 30 days
- Workshop
  - January 8, 2019, 2-4 pm Commission Hearing Room
- Report on Exploratory Process
  - February 15, 2020

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Rulemaking for PHYSICAL SECURITY FOR ADVANCED REACTORS

Proposed Rule (NRC Docket ID: NRC-2017-0227)

December 12, 2019

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Purpose

- Discuss the path forward for the proposed rulemaking "Physical Security for Advanced Reactors."
- Solicit public feedback on the proposed rulemaking approach.
  - NRC will not provide formal comment responses to any oral remarks made at this meeting.

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Background

- SECY-18-0076, "Options and Recommendation for Physical Security for Advanced Reactors," dated August 1, 2018 (ADAMS Accession No. ML18170A051)
  - The staff proposed 4 alternatives and recommended alternative 3:
    1) No change / Status quo
    2) Address possible requests for alternatives via guidance
    3) Limited scope rulemaking
    4) Broader based rulemaking

- Staff Requirements Memorandum, SRM-SECY-18-0076, dated November 19, 2018 (ADAMS Accession No. ML18324A469)
  - The Commission approved a limited scope rulemaking (Alternative 3)
  - The Commission directed the staff to interact with stakeholders to identify specific requirements within existing regulations that would play a diminished role in providing physical security for advanced reactors

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Regulatory Basis

- Issued for public comment on July 16, 2019
  - Comment period closed on August 15, 2019
  - Six entities provided comments: 4 support, 2 oppose the rulemaking
  - Comments on the regulatory basis will be addressed in the proposed rule
- Permits future applicants and licensees to meet alternative requirements for a risk-informed, performance-based approach for designated portions of the physical security program.
- Retains the current overall framework for security requirements while providing alternatives for advanced reactors to certain physical security regulations and guidance.
- Most likely focus of the rulemaking is an alternative to the prescribed minimum number of armed responders currently defined in 10 CFR 73.55 (k) and prescriptive requirements in 10 CFR 73.55 for onsite secondary alarm stations.
- Regulations.gov—Docket No. NRC-2017-0227

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Performance Criteria

The staff identified the following three performance criteria that could be used to identify reactors that could make use of the alternative provided in this proposed rulemaking:

1) The radiological consequences from a hypothetical, unmitigated event involving the loss of engineered systems for decay heat removal and possible breaches in physical structures surrounding the reactor, spent fuel, and other inventories of radioactive materials result in offsite doses below the reference values defined in 10 CFR 50.34(a)(1)(ii)(D) and 52.79(a)(1)(vi); or

2) The plant features necessary to mitigate an event and maintain offsite doses below the reference values in 10 CFR 50.34(a)(1)(ii)(D) and 52.79(a)(1)(vi) cannot reasonably be compromised by the DBT for radiological sabotage; or

3) The plant features include inherent reactor characteristics combined with engineered safety and security features that allow for facility recovery and mitigation strategy implementation if a target set is compromised, destroyed, or rendered nonfunctional, such that offsite radiological consequences are maintained below the reference values defined in 10 CFR 50.34(a)(1)(ii)(D) and 52.79(a)(1)(vi).

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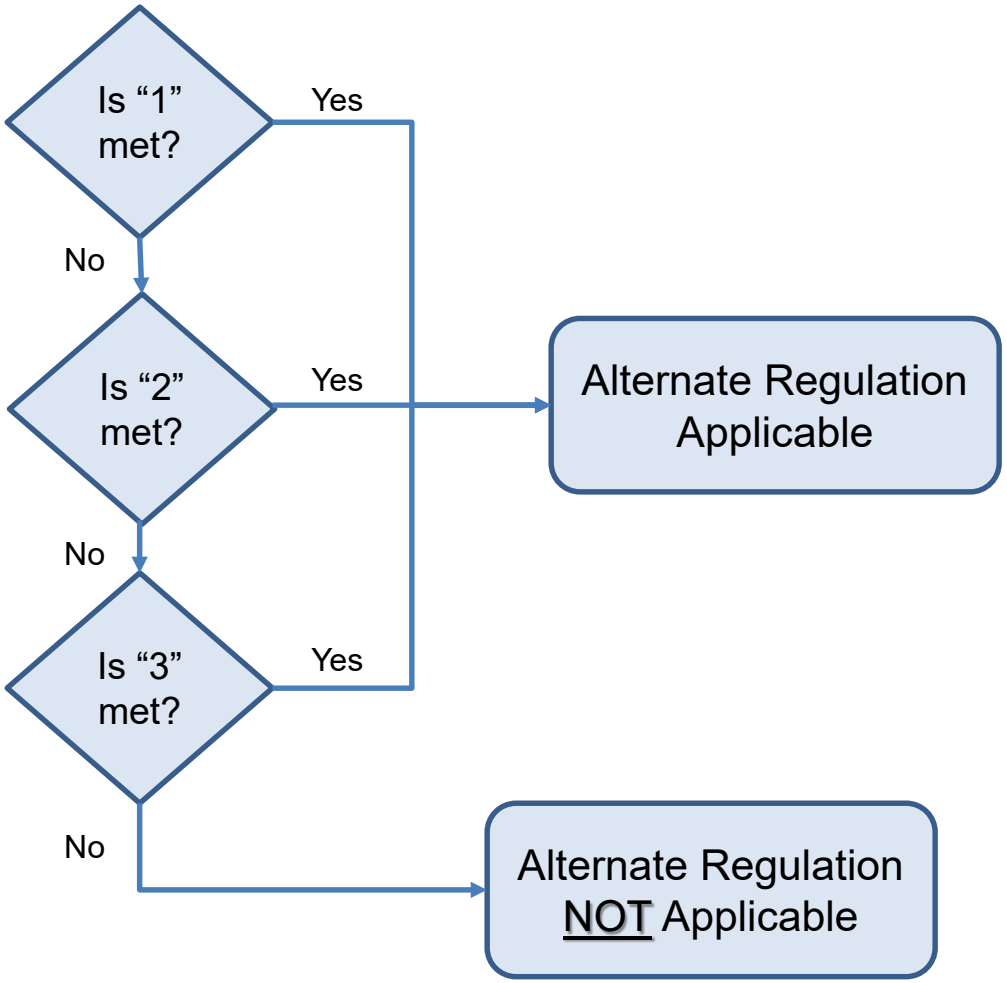
Performance Criteria

Reactor design

Facility design

Mitigation strategies



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Proposed Approach

- Alternative to the prescribed requirement in 10 CFR 73.55(k)(5)(ii) that the number of armed responders shall not be less than ten
- Alternative to the prescriptive requirements for a secondary alarm station in:
  - 10 CFR 73.55(i)(2) [two continuous staff alarm stations]
  - 10 CFR 73.55(i)(4)(i) [single act cannot disable both]
  - 10 CFR 73.55(i)(4)(ii)(F) [cannot change alarm status or access controls without two alarm operators]
  - 10 CFR 73.55(i)(4)(iii) [new operating reactors must be equipped with two alarm stations]

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Additional Potential Areas for Consideration

- The staff is seeking input from the public on whether the performance criteria identified above should be applied to any additional prescriptive requirements, for example those found in:
  - 10 CFR 73.55(e) [Physical barriers]
  - 10 CFR 73.55(i) [Detection and assessment systems]
  - 10 CFR 73.55(j) [Communications requirements]
  - 10 CFR 73.55(k) [Response requirements]

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Open Session / Request Feedback

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Next Steps

- Proposed Rule and Draft Guidance
  - Provide to the Commission in January 2021
  - Issue for public comment in 2021

- Final Rule and Final Guidance
  - Provide to the Commission in May 2022

Contact: Dennis Andrukat, Rulemaking Project Manager

Email: Dennis.Andrukat@nrc.gov

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Potential Considerations for Physical Security for Advanced Reactors Rulemaking

Kati Austgen

NRC Public Meeting

December 12, 2019

Draft Regulatory Basis for Rulemaking for Physical Security for Advanced Reactors

- Performance-based alternatives to prescribed physical security regulations
  - Minimum number of onsite armed responders [*10 CFR 73.55(k)(5)(ii)*]
  - Onsite secondary alarm station [*10 CFR 73.55(i)(4)(iii)*]
- Staff indicated a willingness to identify additional requirements that may be eliminated or modified to reduce the number of exemptions

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Other Requirements for Consideration

- Permit security personnel to have additional duties and/or be located outside the Protected Area provided the NRC-approved security plan can be effectively implemented
- Consideration of requirements applicable to microreactors
  - Appendix E of NEI White Paper, “Micro-Reactor Regulatory Issues,” dated November 13, 2019 (ML19319C497)

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Questions/Discussion

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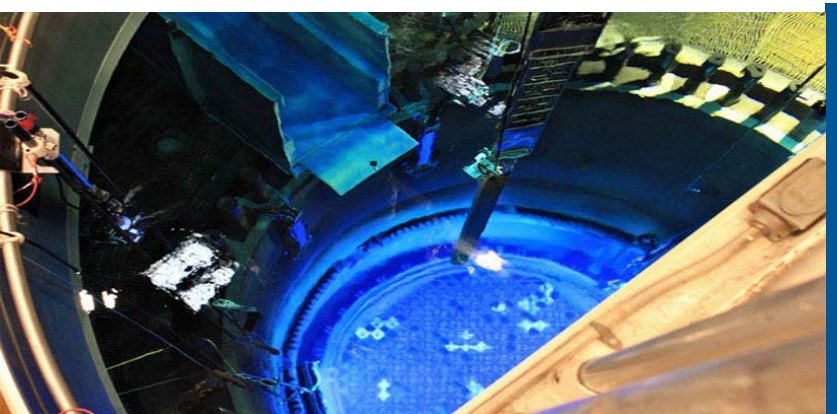
Technology-Inclusive Content of Applications Project (TI-CAP)

NRR/DANU – Advanced Reactor Policy Branch
US Nuclear Regulatory Commission

December 12, 2019



- Purpose
  - Build on progress from licensing modernization project to provide more guidance on content of applications
  - Coordinate activities with utility-led TI-CAP
  - Solicit stakeholder feedback on draft outline for advanced reactor applications based on a technology-inclusive, risk-informed, performance based process
  - Solicit stakeholder feedback on portions of the application outside the scope of a final safety analysis report (FSAR); with initial focus on technical specifications

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Agenda

- Background
- Draft outline of final safety analysis report (FSAR)
- Licensing documents outside the scope of an FSAR
  - Technical specification development
- Discussion
- Next steps
  - Process and timeline for providing comments

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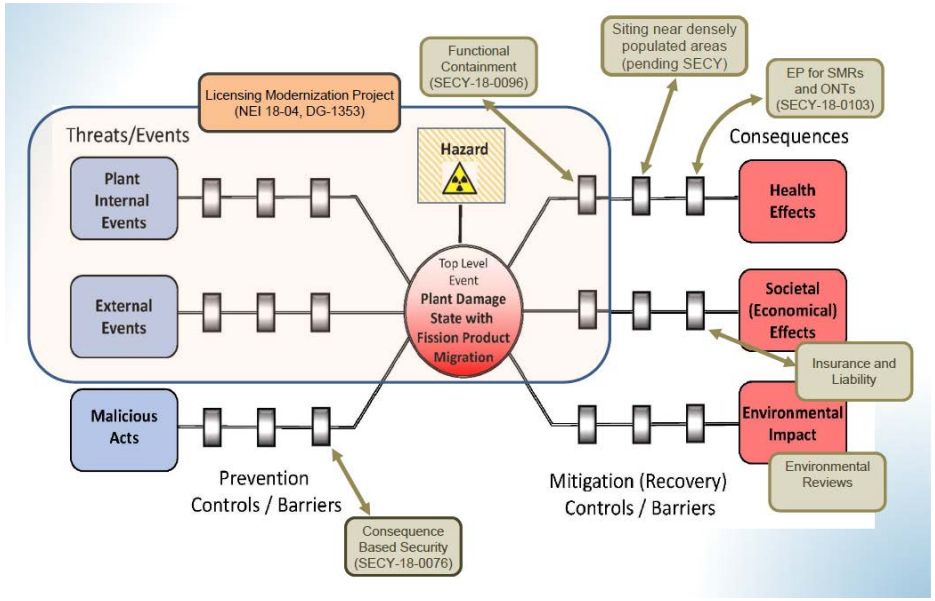
Background – Integrated Approach

- Advanced Reactor Policy Statement
  - …Designs with some or all of these attributes are also likely to be more readily understood by the general public. Indeed, the number and nature of the regulatory requirements may depend on the extent to which an individual advanced reactor design incorporates general attributes such as those listed previously.
- SRM-SECY-10-0121
  - … New reactors with these enhanced margins and safety features should have greater operational flexibility than current reactors. This flexibility will provide for more efficient use of NRC resources and allow a fuller focus on issues of true safety significance.



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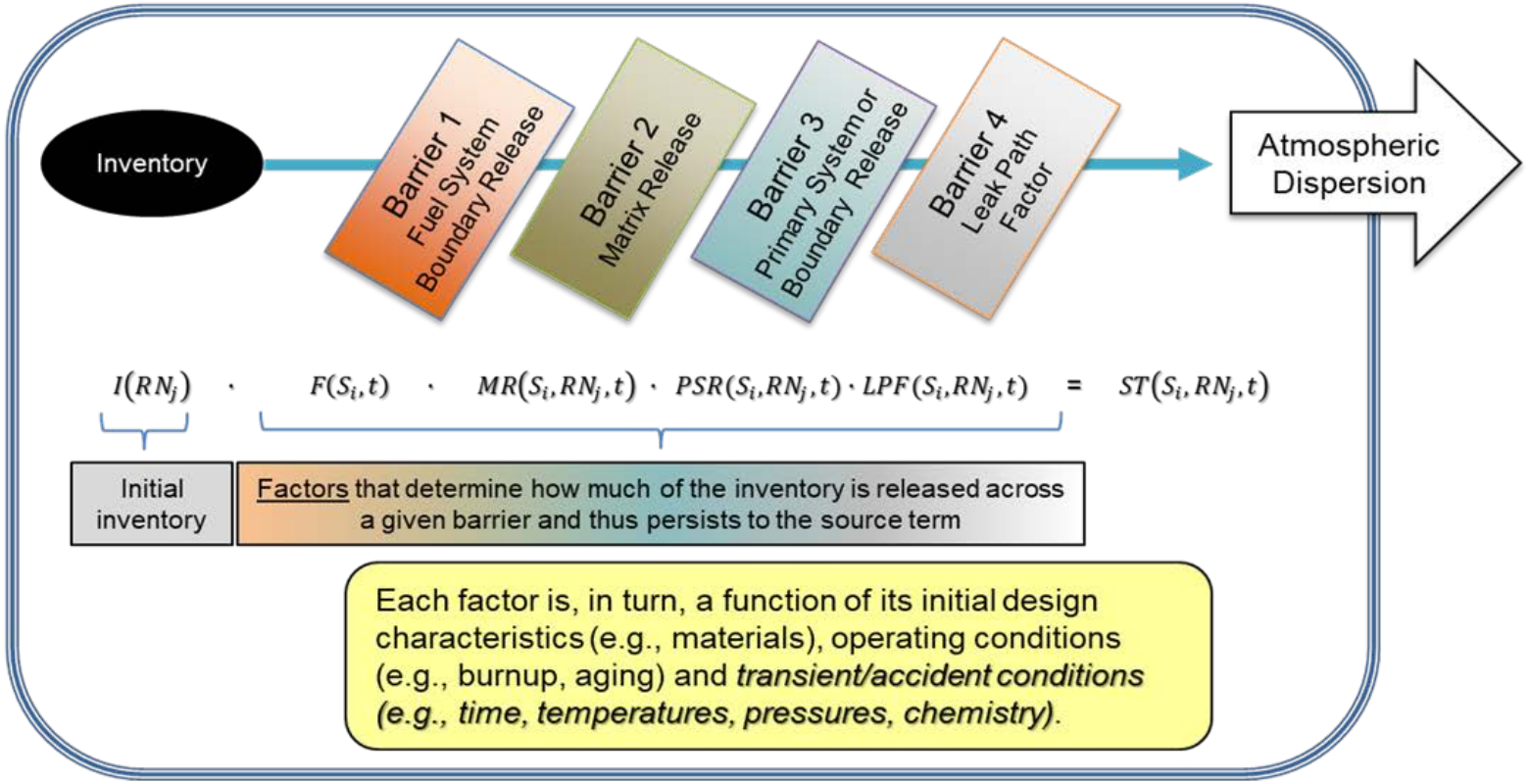
Return to first principles

Recent NRC activities related to advanced reactors (e.g., functional containment performance criteria, possible changes to emergency planning & security, and DG-1353) recognize the limitations of existing LWR-related guidance, which requires a return to first principles such as fundamental safety functions supporting the retention of radionuclides



See SECY-18-0096, "Functional Containment Performance Criteria"

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Fundamental Safety Functions

- General Design Criteria (light water reactors)
  - Protection and Reactivity Control Systems
  - Fluid Systems
  - Reactor Containment
  - Fuel and Radioactivity Control
- IAEA SSR 2/1, “Safety of Nuclear Power Plants: Design”
  - Fulfilment of the following fundamental safety functions for a nuclear power plant shall be ensured for all plant states: (i) control of reactivity; (ii) removal of heat from the reactor and from the fuel store; and (iii) confinement of radioactive material, shielding against radiation and control of planned radioactive releases, as well as limitation of accidental radioactive releases.
- SECY-18-0096, “Functional Containment Performance Criteria”
  - …. fundamental safety functions such as controlling reactivity and reactor power, removing heat, and limiting the release of radioactive materials from a reactor facility.
- Utility-led TI-CAP white paper on fundamental safety functions

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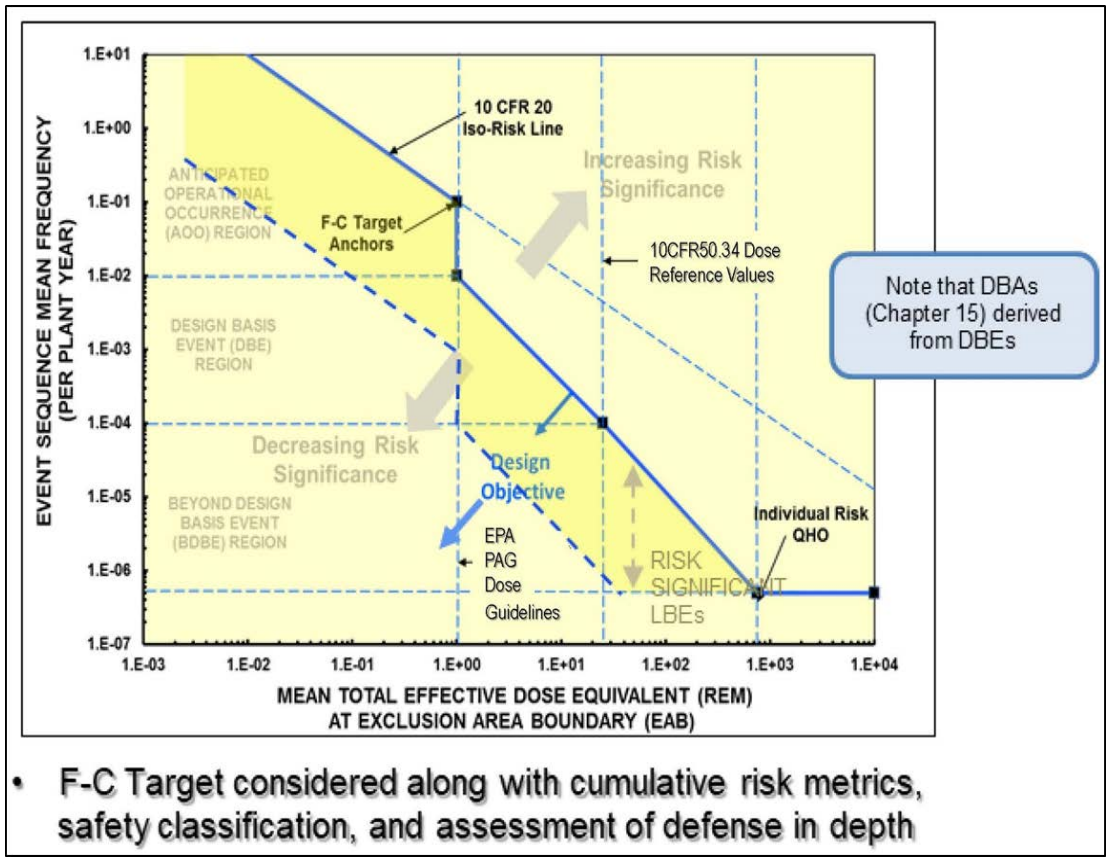
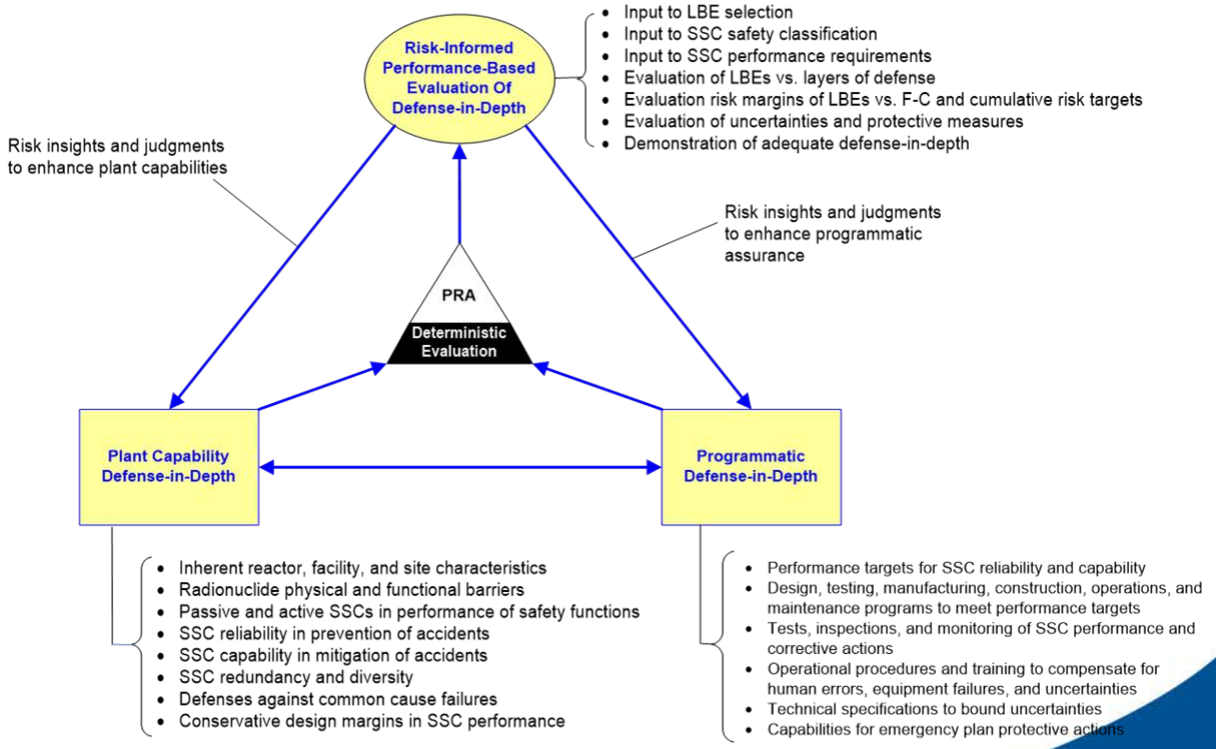
Starting Point is Licensing Modernization Project (NEI 18-04)



- F-C Target considered along with cumulative risk metrics, safety classification, and assessment of defense in depth



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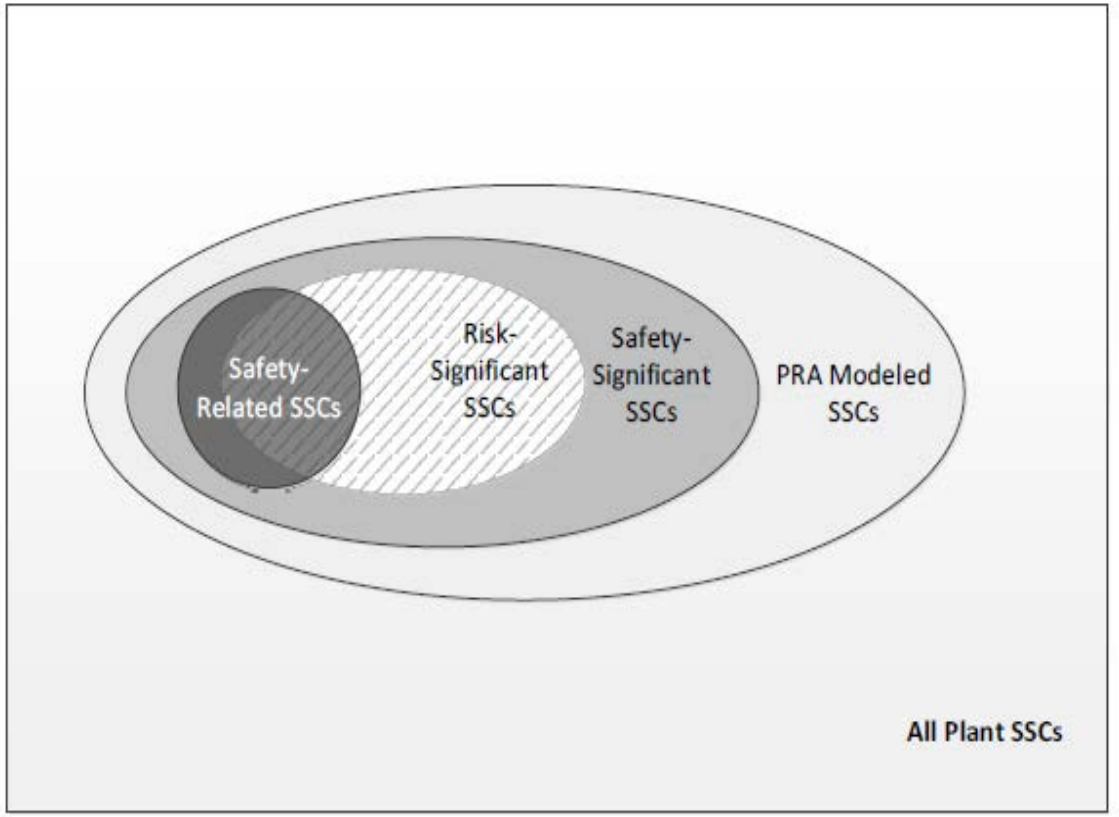
SSC Classification and Level of Information in an Application

- Expectation is that FSAR portion of an application would be more detailed for safety-related structures, systems, and components (SSCs) and less detailed for other SSCs
- Level of information for non-safety related special treatment (NSRST) and non-safety related with no special treatment (NST) SSCs would be a function of its risk significance



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Informing Content of Applications

- NEI 18-04, “Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development,” Revision 1 (ADAMS Accession No. ML19241A336) considered in developing draft outline sections 1 through 14
  - Staff’s draft outline differs from traditional organization of information (e.g., RG 1.70, RG 1.206)
  - Discussion on appropriate scope and level of detail might be helped by an early agreement on overall organization of information (format)
- Draft outline addresses full scope of a combined license but it could be adapted for other applications including:
  - Construction permit
  - Operating license
  - Design certification
  - Standard design approval
  - Manufacturing license

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Informing Content of Applications

- Staff's draft outline (with assistance from Idaho National Lab) found in ADAMS at Accession No. ML19325C089
- Staff's draft outline Sections 1 through 14
  - Final safety analysis report (FSAR) portion of application
- Draft outline includes proposal for other portions of an application
  - Technical specifications
    - Soliciting feedback on process to develop limited safety systems settings, and limiting conditions for operations or restructure technical specifications to support a more technology-inclusive approach

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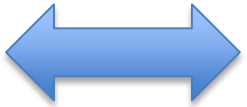
Informing Content of Applications

Outline (FSAR) with major LMP areas highlighted

1. General Information*
2. Site Information
3. Licensing Basis Event (LBE) Analysis*
4. Description and Classification of SSCs*
5. Design Basis Accidents Analysis (10 CFR 50.34)*
6. Integrated Plant Analysis*
7. Defense in Depth (DID)*
8. Control of Routine Plant Radioactive Effluents and Solid Waste
9. Control of Occupational Dose
10. Human Factors Analysis*
11. Physical Security
12. Overview of PRA*
13. Administrative Control Programs* *(special treatment)*
14. Initial Startup Programs* *(special treatment)*



Additional Portions of Application

- Technical Specifications
- Technical Requirements Manual
- Quality Assurance Plan (design)
- Fire Protection Program (design)
- PRA
- Fuel qualification report
- Exemptions
- Quality Assurance Plan (construction and operations)
- Emergency Plan
- Physical Security Plan
- SNM (special nuclear materials) physical protection program
- SNM material control and accounting plan
- Cyber Security Plan
- New fuel shipping 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

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

Summary

- Discussion of staff's draft outline
- Discussion of development of technical specifications
- Next steps
  - Major focus of discussions in upcoming stakeholder meetings and/or dedicated meetings; coordination with industry-led TI-CAP
  - NRC will be interacting with Canadian Nuclear Safety Commission
  - Staff will revise draft outline as appropriate and provide updated draft outline in March 2020 time frame
  - Planned development of a regulatory guide

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

Fundamental Safety Functions (FSFs)

Technology Inclusive Content of Application Project (TICAP)

Steve Nesbit
LMNT Consulting

NRC Stakeholder Meeting
December 12, 2019

Southern Company

FSF Presentation

- Background
- TICAP Goal
- Desired Outcome of FSF Report
- Definition of FSFs
  - Controlling Reactivity
  - Removing Heat from Reactor and Waste Stores
  - Limiting Releases of Radioactive Materials
- Summary

TICAP Overview

Purpose: Develop a technology inclusive process for efficiently generating safety analysis report content at the level of detail that supports the safety case and simplifies the staff review processes

- Reliant on risk-informed, performance based Licensing Modernization Project (LMP) methodology

Success Criteria: Develop a guidance document that can be submitted to the Nuclear Regulatory Commission (NRC) for endorsement by September 2021

TICAP Overview (cont.)

- Product will be a process for developing and organizing the content of an application as opposed to a specific set of required information
- Current content of application requirements reflect the safety case of large light water reactors
  - Active engineered safety systems with multiple trains and many components
  - Required operator actions
- Expectation that advanced reactors will have a simpler and more straightforward safety case due to features such as inherent and passive safety features, slow system response times, etc.
  - No need to describe design features or programs if it is demonstrated they are outside the safety case (e.g., emergency electrical power, human factors)

LMP

Department of Energy-cost shared, Southern Company-led project

Risk-Informed, Performance-Based Approach to

- Selection of Licensing Basis Events
- Classification of Structures, Systems, and Components
- Defense-in-Depth adequacy determination

NEI 18-04, Risk Informed Performance Based Guidance for Non-Light Water Reactor Licensing Basis Development (Sept 2018, Aug 2019)

NRC Draft Guide 1353, Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Approach to Non-Light-Water Reactors (April 2019)

TICAP

Guidance for developing and organizing the content for key elements of the NRC license application Safety Analysis Report (SAR)

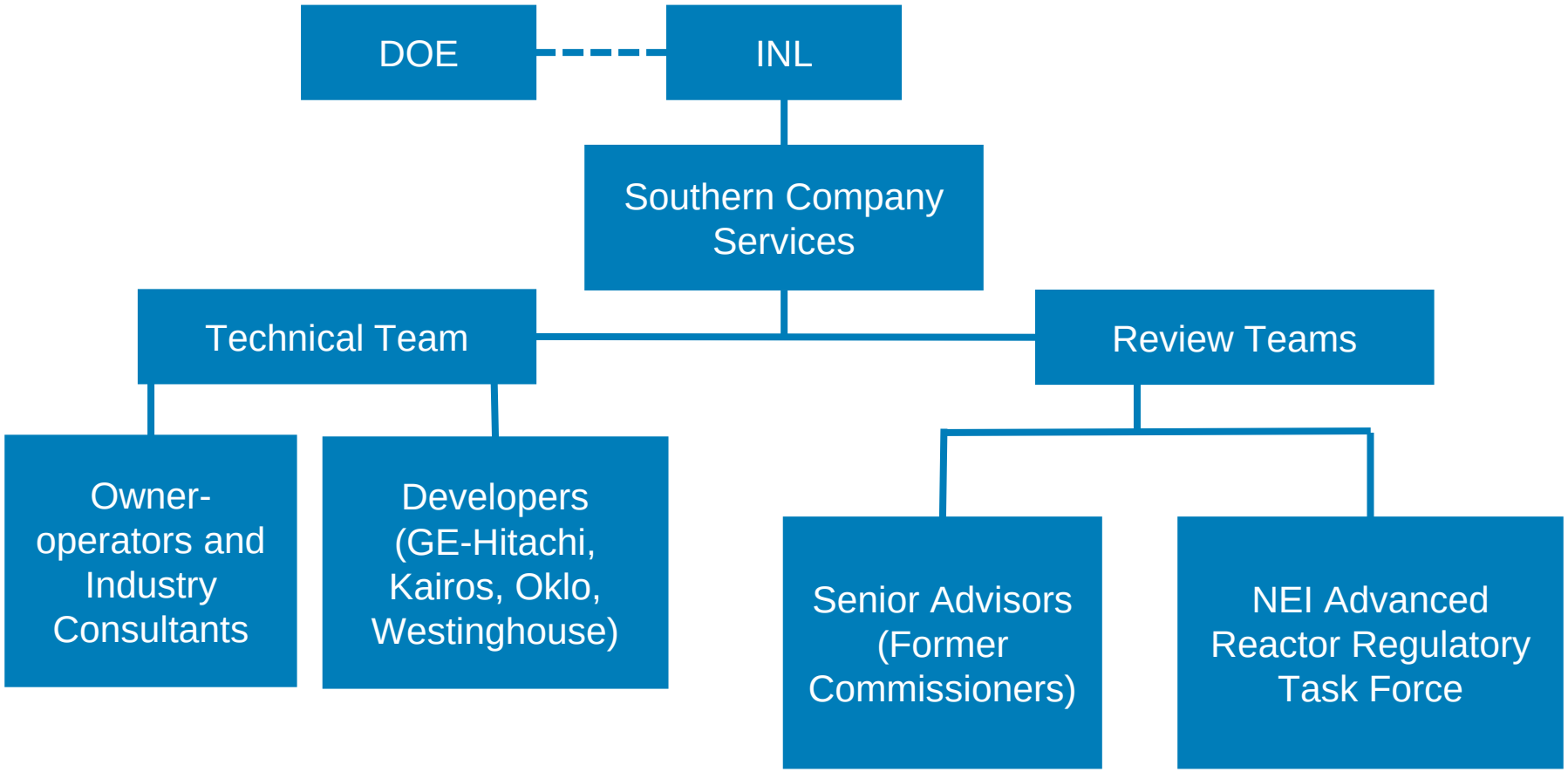
- Applicable to all non-light water reactor (LWR) designs
- Builds on foundation provided by LMP
- Focus on combined construction and operating license with no design certification or early site permit

Department of Energy-cost shared, Southern Company-led project

Development team consisting of owner-operators, advanced reactor developers and consultants

Ultimate product is an NRC-endorsable NEI guidance document

TICAP Organization



Key TICAP Products

Fundamental Safety Functions Definition (to NRC 11/2019)

Formulation of Technology Inclusive Content of Application (to NRC 10/2020)

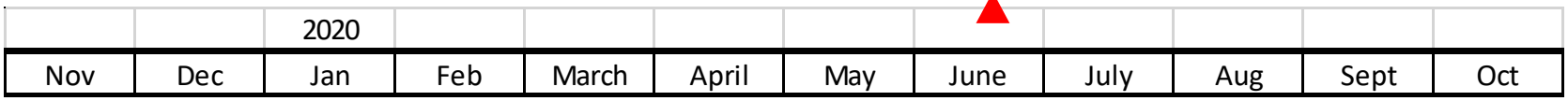
Regulation Mapping to FSFs (to NRC 5/2020)

NEI Guidance Document Annotated Outline (to NRC 10/2020)

LMP-Related Safety Case (To NRC 6/2020)

Tabletop Exercises

▲ Denotes approximate date provided to NRC for review



Key TICAP Products (cont.)

Differences Between Licensing Paths (to NRC 1/2021)

NEI Guidance Document (draft to NRC 4/2021) (final to NRC 7/2021)

NRC Review

Tabletop Exercises

		2021									
Nov	Dec	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct

Desired Outcomes of Definition of FSFs Report

Alignment with the NRC

- on definitions of FSFs
  - categories
  - breadth of coverage
- that providing information to demonstrate FSFs are met by a design is sufficient for the Commission to conclude that there is reasonable assurance of adequate protection of public health and safety
- that an application which demonstrates the FSFs are assured by the design does not need to request exemptions for
  - regulations that do not apply to non-light water technologies, and
  - regulations for which the intent has been satisfied by alternative means

Definition of FSFs

- Functions that all technologies must be capable of performing in all plant states
- Not specific to transient or accident mitigation only
- Design-specific Required Safety Functions in LMP are derived from FSFs
- FSFs chosen:
  - Controlling Reactivity
  - Removing Heat from Reactor and Waste Stores
  - Limiting Releases of Radioactive Materials

Definition of FSFs (cont.)

- Generally aligns with other FSFs used by other regulators
- Technology inclusive
- Applicable to technology dependent set of postulated transients or accidents initiated by internal events and external hazards
- Considers initiating events resulting from unique site characteristics

Controlling Reactivity

- Proponents for “controlling heat generation” as an alternative FSF, per NEI 18-04
- Inherent, passive or active means available to:
  - Control the nuclear chain reaction consistent with intended plant operating conditions
  - Terminate the nuclear chain reaction when transient or accident conditions dictate that the facility must be shut down
  - Prevent inadvertent criticality in the reactor core, primary system, fuel handling system, or other areas where inadvertent criticality is an adverse condition that could result in unacceptable radiological consequences

Removing Heat from Reactor and Waste Stores

- Inherent, passive, or active means available to:
  - Remove heat generated from the nuclear chain reaction in the nuclear fuel, primary system, or fuel handling system during planned operating modes, or following postulated transients and accidents
  - Remove the decay or residual heat from the reactor or primary system when the nuclear chain reaction is terminated and the plant is shut down so that unplanned releases of radioactive materials from the plant do not occur
  - Remove the residual heat from radioactive material that is stored in the fuel handling or waste handling areas so that unplanned releases of radioactive materials from the plant do not occur

Limiting Releases of Radioactive Materials

- Uses inherent, passive or active means available to prevent or mitigate releases of radioactive materials from the plant
- Ultimate objective of protecting public health and safety
- Achieves established public exposure limits

Mapping FSFs to Regulations

- Activity underway to map underlying safety objectives of the regulations to one or more FSFs
- An accountability step in overall TICAP efforts which will demonstrate that these FSFs provide a comprehensive list of functions that must be reliably performed to meet the intent of the existing regulations

Summary

- FSFs for TICAP are:
  - Controlling Reactivity
  - Removing Heat from Reactor and Waste Stores
  - Limiting Releases of Radioactive Materials
- FSFs are technology inclusive and will be assessed using a technology-specific set of postulated transients and accidents.
- FSFs will be mapped to demonstrate that LMP-developed safety bases will provide as comprehensive an evaluation of initiating events and external hazards as provided by existing regulations
- Looking forward to NRC feedback

Canadian Licensing Approach

USNRC Stakeholders Meeting on Possible Process Improvements for Advanced Reactor Designs

Chantal Morin, Senior Project Officer
New Major Facilities Licensing Division
Canadian Nuclear Safety Commission

December 12, 2019
Rockville, Maryland

Outline

- Background
- Regulatory Framework and Licensing Approach
- License Application Guides
- Pre-Licensing Engagments
- Objectives of Design Requirements
- International Collaboration
- Conclusion

Canadian Nuclear Safety Commission

OUR MANDATE

REGULATE
the use of nuclear energy and materials to protect health, safety, and security and the environment

IMPLEMENT
Canada's international commitments on the peaceful use of nuclear energy

DISSEMINATE
objective scientific, technical and regulatory information to the public

OVER 70 YEARS OF REGULATORY EXPERIENCE

Section 26 of the Nuclear Safety and Control Act

26 Subject to the regulations, no person shall, except in accordance with a licence,

(a) possess, transfer, import, export, use or abandon a nuclear substance, prescribed equipment or prescribed information;

(b) mine, produce, refine, convert, enrich, process, reprocess, package, transport, manage, store or dispose of a nuclear substance;

(c) produce or service prescribed equipment;

(d) operate a dosimetry service for the purposes of this Act;

(e) **prepare a site for, construct, operate, modify, decommission or abandon a nuclear facility**; or

(f) construct, operate, decommission or abandon a nuclear-powered vehicle or bring a nuclear-powered vehicle into Canada.

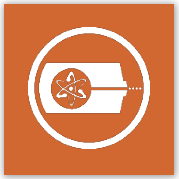
REGULATION IS ASSOCIATED WITH THE CONDUCT OF ACTIVITIES

Scope of CNSC regulation – activities associated with:

Uranium mines and mills

Uranium fuel fabrication and processing

Nuclear power plants



Nuclear substance processing

Industrial and medical applications

Nuclear research and educational activities

Transportation of nuclear substances

Nuclear security and safeguards

Import and export controls

Waste management facilities

OVER THE FULL LIFECYCLE OF THESE FACILITIES / ACTIVITIES

REGULATORY FRAMEWORK AND LICENSING APPROACH

Five Stages in the Lifecycle of a Nuclear Facility

Site preparation
=
Licence to prepare site

Construction
=
Licence to construct

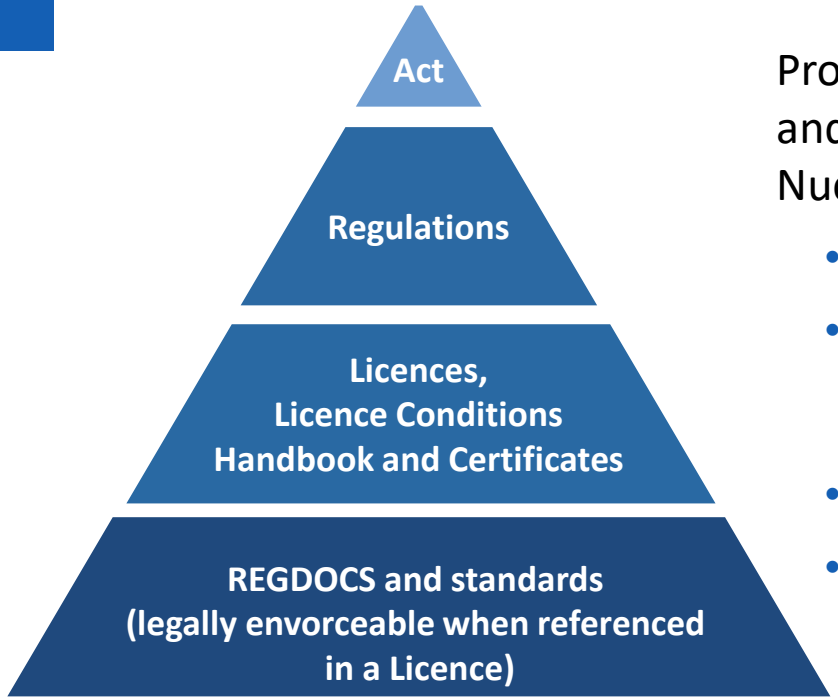
Operation
=
Licence to operate

Decommissioning
=
Licence to decommission

Release from CNSC regulatory control
=
Licence to abandon

COMBINED LICENCES ARE POSSIBLE

Regulatory Framework



Provides detail and clarification of the licensing and other regulatory requirements of the Canadian Nuclear Safety Commission with respect to

- The *Nuclear Safety and Control Act*
- Regulations made under the Act
  - General Nuclear Safety and Control Regulations
  - Class 1 Nuclear Facilities Regulations, etc.
- Licence conditions
- Regulatory Documents (REGDOCs)

Regulations, REGDOCs and Industry Standards

- Regulations provide further legislative authority under the NSCA
- Regulatory documents (REGDOCs) explain how to meet the requirements in the Act and Regulations
- The applicant propose the standards (proven practices) to be applied in the safety case
- Industry or international standards may be referenced in CNSC regulatory documents and licences

Safety Case & the Licensing Basis

Safety and Control Areas (SCAs)
Management System
Human Performance Management
Operating Performance
Safety Analysis
Physical Design
Fitness for Service
Radiation Protection
Conventional Health and Safety
Environmental Protection
Emergency Management and Fire Protection
Waste Management
Security
Safeguards and Non-Proliferation
Packaging and Transport
Other
Informing the public
Siting and EA

- SCAs are technical areas subject to CNSC assessment, review, verification and used to report on regulatory requirements and performance across all regulated facilities and activities
- Regulatory framework documents exist for each **Safety and Control Area** (SCA)
- Licence Application Guides articulate scope and depth considerations for each SCA
- The combination of all constitutes the safety case and licensing basis for the conduct of the licensed activity

Safety and Control Areas and Regulatory Framework

Functional Area	Safety and Control Area	CNSC's Regulatory Framework
Management	Management system	• **REGDOC-2.1.1,** Management System • **REGDOC-2.1.2** Safety Culture
	Human performance management	• **REGDOC-2.2.2,** Personnel Training, version 2 • **REGDOC-2.2.3,** Personnel Certification, Volume III: Certification of Persons Working at Nuclear Power Plants • **REGDOC-2.2.4:** Fitness for Duty: Managing Worker Fatigue • **REGDOC-2.2.4:** Fitness for Duty: Volume II: Managing Alcohol and Drug Use
	Operating performance	• **REGDOC 1.1.1,** Licence to Prepare Site and Site Evaluation for New Reactor Facilities (in particular section 4) • **REGDOC-1.1.2,** Licence Application Guide: Licence to Construct a Nuclear Power Plant • **REGDOC 2.3.1,** Conduct of Licensed Activities: Construction and Commissioning Programs • **REGDOC-1.1.3:** Licence Application Guide: Licence to operate a Nuclear Power Plant • **REGDOC-2.3.2:** Accident Management
Facility and equipment	Safety analysis	• **CNSC REGDOC-2.4.1,** Deterministic Safety Analysis • **CNSC REGDOC-2.4.2,** Probabilistic Safety Assessment (PSA) for Nuclear Power Plants • **REGDOC-2.4.3,** Nuclear Criticality Safety
	Physical design	• **REGDOC-2.5.1,** General Design Considerations: Human Factors • **REGDOC-2.5.2,** Design of Reactor Facilities: Nuclear Power Plants
	Fitness for service	• **REGDOC-2.6.1,** Reliability Programs for Nuclear Power Plants • **REGDOC-2.6.2,** Maintenance Programs for Nuclear Power Plants • **REGDOC 2.6.3,** Aging Management

Safety and Control Areas and Regulatory Framework

Core control processes	**Radiation protection**	• **G-91**, Ascertaining and Recording Radiation Doses to Individuals • **G-129**, Keeping Radiation Exposures and Doses "As Low as Reasonably Achievable (ALARA)" *__Important to note__ is that **REGDOC-2.7.1,** Radiation Protection, and **REGDOC-2.7.2**, Dosimetry, Volume I: Ascertaining Occupational Dose, are currently under development by the CNSC. Once published, these REGDOCs will supersede the documents listed above.
	Conventional health and safety	• **REGDOC-2.8.1,** Conventional Health and Safety
	Environmental protection	• **REGDOC-2.9.1**, Environmental Protection: Environmental Principles, Assessments, and Protection Measures, Version 1.1
	Emergency management and fire protection	• **REGDOC-2.10.1** Nuclear Emergency Preparedness and Response, Version 2
	Waste management	• **REGDOC-2.11,** Framework for Radioactive Waste Management and Decommissioning in Canada • **CNSC, REGDOC 2.11.1,** Waste Management, Volume I: Management of Radioactive Waste, Ottawa, Canada, [DRAFT] • **REGDOC-2.11.2**, Decommissioning [DRAFT]
	Security	• **REGDOC-2.12.1,** High-Security Facilities, Volume I: Nuclear Response Force. Document contains prescribed information. • **REGDOC-2.12.1,** High-Security Facilities, Volume II: Criteria for Nuclear Security Systems and Devices. • **REGDOC-2.12.2,** Site Access Security Clearance
	Safeguards and non-proliferation	• **REGDOC-2.13.1,** Safeguards and Nuclear Material Accountancy • **REGDOC-2.13.2,** Import and Export, Version 2

Basis for a Licensing Decision

Section 24(4) of the *Nuclear Safety and Control Act* (NSCA)

No licence may be issued, renewed, amended or replaced unless, in the opinion of the Commission, **the applicant**:

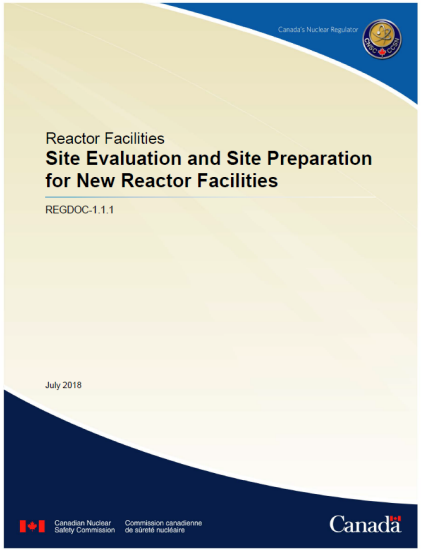
(a) is qualified to carry on the activity that the licence will authorize the licensee to carry on; and

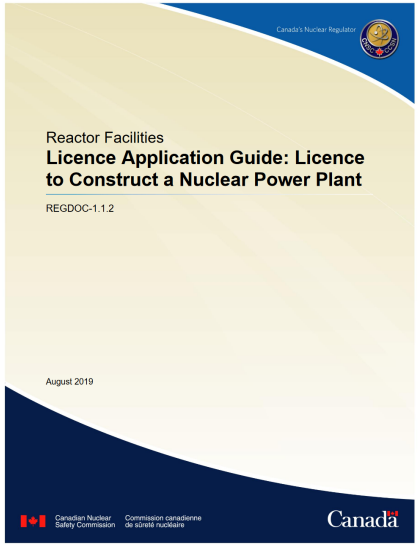
(b) will, in carrying on that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed

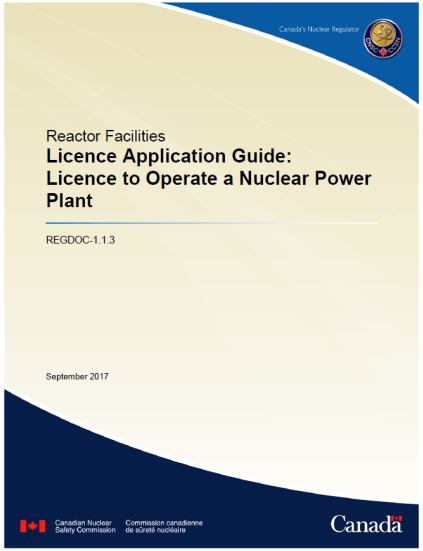
THE REACTOR DESIGN IS ONLY PART OF THE CONVERSATION CONCERNING SAFE CONDUCT OF LICENSED ACTIVITIES

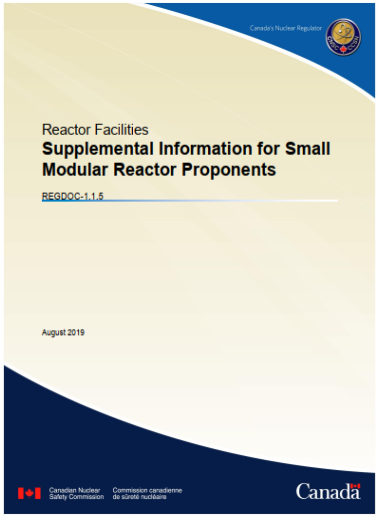
LICENCE APPLICATION GUIDES

Licence Application Guides (LAGs)









New Supplemental Guidance

PROVIDES EXPECTATIONS ON CONTENT OF APPLICATIONS

Licence to Construct (REGDOC 1.1.2)

Application guide has a strong emphasis on:

- Responsibility of applicant for all activities pertaining to design, procurement, manufacturing construction, commissioning
- Appropriate knowledge, skills & abilities for all persons involved design, procurement, manufacturing construction & commissioning activities
- Systematic control of procurement and manufacturing and of services purchased by the applicant, the applicant's contractors, and their suppliers and sub-suppliers
- High degree of design completion

Approach is designed to:

- Facilitate commissioning prior to fuel load
- Facilitate fuel-in commissioning upon receipt of Operating Licence
- Prepare for Operational Readiness (Operators' certification, etc.)

Licence to Operate (REGDOC 1.1.3)

Application guide has a strong emphasis on:

- Final safety analysis and design information
- Final policies, programs and supporting procedures to ensure safe operation of the facility covering areas such as:
  - Operation and maintenance of the nuclear facility
  - Control of the release of nuclear substances and hazardous materials into the environment
  - Readiness of emergency preparedness measures, including assistance to deal with an abnormal off-site release
  - Facility security
  - appropriate number of qualified staff are in-place for facility operation
  - Readiness of the Operating Organisation and supporting programs

Supplemental Guidance for SMR Proponents (REGDOC 1.1.5)

- Provide guidance on the use of existing LAGs for SMRs and Advanced Reactor Technologies based on the Safety and Control Areas
- Provide guidance on the application of the graded approach and use of alternative approaches for development of the Licensing Basis
- Describe the two pre-licensing engagement processes by which a vendor or an applicant can engage with CNSC prior to licencing:
  - Vendor Design Review
  - Process for establishing an appropriate application assessment strategy

PERSPECTIVES ON PRE-LICENSING ENGAGEMENT PROCESSES FOR NEW TECHNOLOGY CONCEPTS

Pre-licensing Engagement and Licensing Process Relationship

Environmental Assessment

Optional
Pre-licensing Engagement
No regulatory decision making

Determining appropriate application assessment strategy

Prepare application and submissions

Licensing Process
Publicly transparent regulatory decision making

Site preparation
- Under licence to prepare site
- Licenceapplication guide (REGDOC-1.1.1)

Construction
- Under licence to construct
- Licence application guide (RD/GD-369 – under revision)

Operation
- Under licence to operate
- Licence application guide (REGDOC-1.1.3)

Decommissioning
Under licence to decommission

Vendor design review

Vendor leverages VDR results in discussions with potential applicant

- Reactor vendor(s)
- REGDOC-3.5.4, *Pre-licensing Review of a Vendor's Reactor Design*

REGDOC-1.1.5, *Supplemental Information for Small Modular Reactor Proponents*

Pre-Licensing Engagement Triggers

Pre-licensing engagement is productive when considering:

- New organizational models for conducting a project
- New types of activities being proposed with little or no past experience
  - In a demonstration facility, what are the demonstration activities that will be performed?
- New ways to conduct activities (e.g. construction approaches)
- New technological approaches that require extensive interpretation of requirements

Vendor Design Review: A tool for reactor vendors

An **optional** process to determine whether the vendor is ready for potential deployment in Canada.

A proven and standardized process to evaluate, in principle, whether there are fundamental barriers to licensing the vendor's reactor design in Canada.

The process should not be triggered unless the vendor's conceptual design is essentially complete and the basic engineering program has begun (design requirements being established).

Outcomes of the process helps the vendor have discussions with potential future licensees interested in their technology.

A PRE-LICENSING VDR IS NOT A LICENSING DISCUSSION – IT IS A TECHNICAL CONVERSATION BETWEEN THE CNSC AND THE VENDOR

Licensee is accountable and responsible for the safe conduct of the activities being licensed

Reactor Vendor + its supply chain

- A vendor is part of the licensee's procurement process.
- They supply services and products which applicants generally expect to be adaptable to any project

Applicant specifies user requirements + must have capability to assess and accept what supply chain provides

Vendor reconciles site specific design configuration to meet the applicant's user needs

Applicant / Licensee

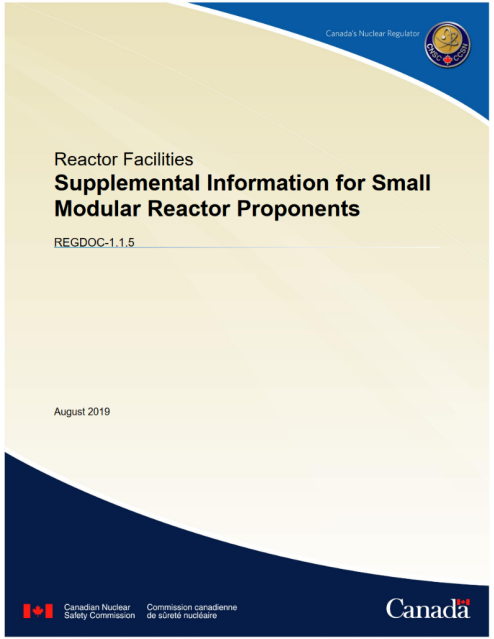
- Licensing involves an applicant for a licence who is proposing to build and operate a vendor's design.
- Expected to be intelligent customer
- Usually an owner/ operator of a plant

CNSC executes licensing and compliance for new build project

OPTIONAL: CNSC can provide non-binding feedback (Vendor Design Review)

How well is vendor understanding and meeting Canadian expectations in their design activities and outputs?

Licence Application Assessment Strategy



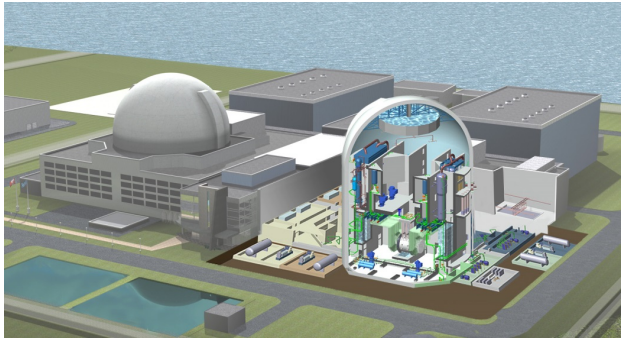
Enables potential applicants to understand:

- The licensing process and their obligations as a future licensee
- The regulatory framework tools available to support the licensing process and how they are used in the establishment of a licensing basis
- Licensing process considerations as a result of specific activities being considered for an application

NO REGULATORY DECISION MAKING BY THE COMMISSION

DESIGN REQUIREMENTS OF REACTOR FACILITIES

Design of Reactor Facilities



REGDOC-2.5.2 Design of Reactor Facilities

- Sets out design requirements and guidance for new water-cooled NPPs
- Aligned with international practice (IAEA SSR-2/1)
- Includes safety goals and objectives as well as high-level safety concepts
- Includes safety management of the design process
- Both general and specific structures, systems and components (SSC) design requirements
- Allows alternative approaches (Section 11)
- Includes Appendix A on containment structural acceptance criteria

Requirements for use of "Proven Engineering Practices"

REGDOC 2.5.2: *Design of Reactor Facilities: Nuclear Power Plants*

Section 5.4: *Proven Engineering Practices*

*"When a **new SSC design, feature or engineering practice is introduced, adequate safety shall be demonstrated** by a combination of supporting research and development programs and by examination of relevant experience from similar applications.*

An adequate qualification program shall be established to verify that the new design meets all applicable safety requirements.

New designs shall be tested before being brought into service and shall be monitored while in service so as to verify that the expected behaviour is achieved."

BURDEN OF DEMONSTRATION IS ON THE LICENSEE

Design General Objectives and Safety Concepts (REGDOC 2-5-2)

4.1 General Nuclear Safety Objectives

4.1.1 Radiation protection objective
4.1.2 Technical safety objectives
4.1.3 Environmental protection objective

4.2 Application of the technical safety objectives

4.2.1 Dose acceptance criteria
4.2.2 Safety goals
4.2.3 Safety analyses
4.2.4 Accident mitigation and management

4.3 Safety Concepts

4.3.1 Defence in depth
4.3.2 Physical barriers
4.3.3 Operational limits and conditions
4.3.4 Interface of safety with security and safeguards

INTERNATIONAL COLLABORATION

Leveraging International Experience

- Working with IAEA and NEA on sharing best practices
- Bilaterals with other countries
- MOC with USNRC to increase regulatory effectiveness through collaboration
  - Exchange of lessons learned and leveraging reviews and research and development data to support regulatory reviews
  - Compare regulatory practices, including areas of alignment, areas of potential convergence, and differences in criteria and practices to improve effectiveness
  - Share research, training, and development activities to allow more cost effective in regulatory readiness

CONCLUSION

CONCLUSIONS

- Licensing approach is flexible with high level objectives to be met
- Licensees can suggest alternative approaches to meet requirements
- Vendor Design Review is a pre-licensing engagement activity and not part of the licensing process
- CNSC is collaborating internationally to improve effectiveness

THANK YOU!

Connect With Us

Join the conversation

nuclearsafety.gc.ca

Advanced Nuclear Reactors Justify Modernized Emergency Preparedness Requirements

U.S. Nuclear Industry Council, ClearPath, and Third Way

November 19, 2019

Findings

A viable future U.S. advanced nuclear industry needs Emergency Planning Zones (EPZs) based on the specific safety characteristics of a reactor design. EPZs for advanced reactors should be appropriately based on the new generation of advanced reactor technologies. For example, advanced reactors should be regulated like industrial facilities that have similar levels of risk. The Tennessee Valley Authority (TVA) correctly recognized the contradiction between the existing Nuclear Regulatory Commission (NRC) EPZ regulations and the improved risk profiles of advanced reactors. TVA proposed an approach in their recent Early Site Permit (ESP) Application that is informed by enhanced design features and safety margins of light-water cooled small modular reactors (SMRs). This proposal establishes an important precedent for future advanced reactor emergency planning activities.

The U.S. Nuclear Industry Council (USNIC), ClearPath, and Third Way strongly support the NRC approval of the TVA plume exposure pathway EPZ sizing methodology for both the Clinch River ESP and for future advanced non-light water cooled advanced reactors. This methodology was initially presented in the TVA Clinch River ESP Application, which was reviewed and approved by the NRC staff. The TVA approach can result in an EPZ at the site boundary or at two miles, depending on the specific safety and design characteristics of the reactor selected within the envelope of the ESP.

Background

Historically, as a part of the licensing of a new nuclear reactor, the NRC has defined an EPZ surrounding the plant. The exact size and configuration of the EPZ can vary from plant to plant due to local emergency response needs and capabilities, the population surrounding the site, the topographic characteristics, access routes in the specific area, and the jurisdictional boundaries of the region. However, the regulation stipulates a plume exposure pathway EPZ of “about 10 miles” in a radius around the plant.

In the U.S., each commercial nuclear power reactor has both onsite and offsite emergency plans to assure that adequate protective measures can be taken to protect the public in the event of a radiological emergency. Federal oversight of emergency preparedness for nuclear power plants is shared by the NRC and Federal Emergency Management Agency (FEMA). The NRC has statutory responsibility for the radiological health and safety of the public by overseeing onsite preparedness and the overall authority for both onsite and offsite emergency preparedness.

Before a plant is licensed to operate, the NRC must have "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency." The NRC's decision of reasonable assurance is based on licensees meeting NRC regulations and guidance which demonstrate compliance with appropriate safety requirements. In addition, licensees and area response organizations must demonstrate that they can effectively implement emergency plans and procedures during periodic evaluated exercises. As part of the Reactor Oversight Process, the NRC reviews licensees' emergency planning procedures and training. These reviews include regular drills and exercises that assist licensees in identifying areas for improvement, such as in the interface of security operations and emergency preparedness. Each plant operator is required to exercise its emergency plan with offsite authorities at least once every two years to ensure state and local officials remain proficient in implementing their emergency plans. Those biennial exercises are inspected by the NRC and evaluated by FEMA. Licensees also self-test their emergency plans regularly by conducting drills.[i]

Discussion

The licensing of reactors depends on their facilities meeting NRC's regulations for construction and operation. However, many regulations including those for EPZs, were developed and implemented based on the currently licensed fleet of large light water reactors (LWRs) which have characteristics that differ from advanced reactors (including light-water SMRs)[1]. Regulations should be appropriately tailored to meet the potential safety risk of the facility, and should recognize the significant value that passive and inherent safety systems can provide. An approach that requires advanced reactors to meet standards and practices consistent with their safety characteristics and risk, such as a reduced EPZ, should apply for all advanced reactors, consistent with the approach set forth in TVA's Clinch River ESP Application, and independent of location. The NRC is in the process of a rulemaking that would allow multiple advanced nuclear reactors (including SMRs and non-LWRs) to use a similar methodology to determine appropriate EPZs. Such an approach would provide the same level of public health and safety as is provided by the current operating fleet of large LWRs.

If the NRC determines that the appropriate EPZ should be located at the reactor's site boundary, no formal off-site response plans would be required because the likelihood of accidents that have a significant public health and safety impact outside of the facility are extremely low. Any such hypothetical accident would have a risk commensurate with many other industrial hazards such that they would be covered by "all hazard plans" that are routinely developed and used by local and regional responders to respond to events such as natural disasters, industrial accidents, and transportation

[1] Small modular reactors (SMRs) are generally considered to be 300 MWe or less. "Advanced reactors" typically refers to non-LWRs, i.e., using different fuel, coolant, and/or moderator types. Many non-LWRs currently under development are also SMRs. In the context of EPZ sizing, SMRs and non-LWRs share similar attributes of smaller source terms, increased accident progression times, and passive/inherent safety features.

accidents. Importantly, licensees of advanced nuclear facilities would still be required to have appropriate onsite response plans.[ii]

TVA's Clinch River Proposal Leads the Way

Right-sizing regulations for future advanced reactor designs (including light-water SMRs), which utilize passive and inherent safety features, is essential to affordably facilitating the next generation of nuclear technologies while maintaining the safety of people living and working near advanced reactors. Approval of the TVA ESP will be the first formal regulatory action to recognize that future advanced reactor designs should have regulations that both credit their improved safety characteristics and are representative of a facility's overall reduced risk. The TVA ESP Application uses a plume exposure pathway EPZ methodology that is a risk-informed, dose-based, and consequence-oriented approach that is appropriate for such a technology.[iii]

The TVA ESP Application requested: (a) approval for plume exposure pathway EPZ sizing methodology, (b) exemptions for a site boundary EPZ or a 2-mile EPZ, and (c) approval for two major features emergency plans. The TVA ESP Application does not establish the final plume exposure pathway EPZ size for the Clinch River site. The final EPZ size for the Clinch River site would be determined in a future application based on a specific reactor's safety and design characteristics. Ultimately, the NRC staff supported the plume exposure pathway EPZ sizing methodology to be used in a future combined license or construction permit application.

The approach TVA used has broader applicability than just for a reactor built at the Clinch River site. The TVA ESP Application described the characteristics of a nuclear plant using a composite of reactor and engineering parameters based on four U.S. light water SMR designs. Other advanced reactor designs, including non-LWRs, may fit into the same set of parameters if they have the appropriate accident source terms, risks, and other similar safety characteristics. Thus, other advanced reactors also may be able to use this risk-informed methodology and justify having either a site boundary EPZ or a less than 10-mile EPZ.

The NRC issued a Final Environmental Impact Statement for the TVA ESP Application in April 2019,[iv] and the Final Safety Evaluation Report in June 2019[v]. The NRC staff has recommended, based upon the environmental and safety reviews, issuing an ESP for the Clinch River Nuclear site in Oak Ridge, TN.

The NRC held a mandatory public hearing on August 14, 2019. Based on a statement made at the August 14, 2019 NRC public hearing, the NRC Commissioners intend to decide on an appropriate methodology for determining EPZs in general after receiving any post-hearing input. FEMA submitted a post-hearing letter detailing their concerns with the scalable emergency planning approach on August 24, 2019. The NRC staff responded point by point to the FEMA post-hearing letter on September 5, 2019 substantiating that the basis for the NRC analysis, based in part on Environmental Protection Agency (EPA) policies, was appropriate for regulating future SMRs and non-LWRs.

In order to enable viable future U.S. advanced nuclear technologies, the NRC should approve the use of EPZs that are based on the specific safety characteristics of a reactor design. The TVA plume exposure

pathway methodology that is supported by the NRC staff is an appropriate methodology for the NRC to use not only for the Clinch River site, but also to apply to future advanced reactor designs.

About ClearPath
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Our agenda is ambitious, aspirational, and actionable. It is built on the bedrock belief that for political movements to succeed in our political system, they must relentlessly re-imagine their policies, strategies, and coalitions.

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Contact Information:
Nicholas McMurray
Nuclear Program Director
ClearPath
Phone: 216.407.2387
Email: mcmurray@clearpath.org

Cyril Draffin
Senior Fellow, Advanced Nuclear
United States Nuclear Industry Council
Phone: 301.233.4643
Email: Cyril.Draffin@usnic.org

Ryan Fitzpatrick
Director of the Clean Energy Program
Third Way
Phone: 202.384.1734
Email: rfitzpatrick@thirdway.org

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