

Workshop #1

Choose Your Path - Understanding NRC Licensing Frameworks

Presented by the
Office of Advanced Reactors



WORKSHOP SERIES

LICENSE TO LAUNCH

MASTERING THE NRC FRAMEWORKS FOR ADVANCED REACTOR SAFETY

A practical workshop series for new and advanced reactor designers and companies navigating the NRC licensing process from concept to approval.



Agenda

1	Introduction and Welcome	CURRENT	12:30 PM
2	Parts 50 and 52 Frameworks		12:45 PM
3	Part 53 Framework		1:25 PM
4	Part 57 Framework (Proposed Rule)		2:05 PM
5	Break		2:45 PM
6	Recap and Tabletop Exercises		3:00 PM
7	Wrap Up		4:15 PM

Meeting Housekeeping



Tabletop Exercises

LMP for Part 53

Part 57 FOAK to NOAK

Framework Transitions

Share your
questions here



Pre-Application



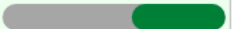
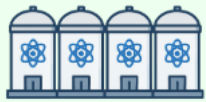
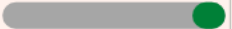
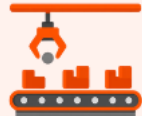
DANU-ISG-2022-01

**Review of Risk-Informed, Technology-Inclusive
Advanced Reactor Applications—Roadmap**

Interim Staff Guidance

March 2024

Advanced Reactor Licensing Frameworks

Pathway	Primary Use	How It Works	Design Maturity	When To Use It	Safety Approach	Environmental	All Deliver
 Part 50	First of a Kind and NPUFs	 2-Step	 Low → High (CP → OL)	 Early Design Maturity; Sequential Licensing	 Defense-in-Depth and Safety Margins		 Consistent Safety Expectations
 Part 52	Standardized Reactors	 Flexible Toolkit	 Moderate → High (Varies By Mechanism)	 Fleet Deployment; Standardized Design		 ER with EA/EIS or Applicant Prepared EA/EIS	 Licensing of Various Design Maturities and Business Models
 Part 53	Advanced Reactors of All Technologies	 Flexible Toolkit	 Any	 New Designs; Optimization & Scaling	 Fully Risk-Informed Performance Based		 Deployment at Scale and Speed
 Part 57 (Proposed)	Microreactors	 Simplified 1-Step	 High	 Factory-Built; Rapid Deployment	 Bounding Entry Criteria	 Categorical Exclusion Possible	 Risk-Informed, Safety-Focused Reviews

CP= Construction Permit OL=Operating License COL= Combined Operating License ESP=Early Site Permit SDA=Standard Design Approval ML=Manufacturing License
 EIS=Environmental Impact Statement DC=Design Certification ER=Environmental Report EA=Environmental Assessment



Agenda

1

Introductions and Welcome

2

Parts 50 and 52 Frameworks

CURRENT

3

Part 53 Framework

4

Part 57 Framework (Proposed Rule*)

5

Break

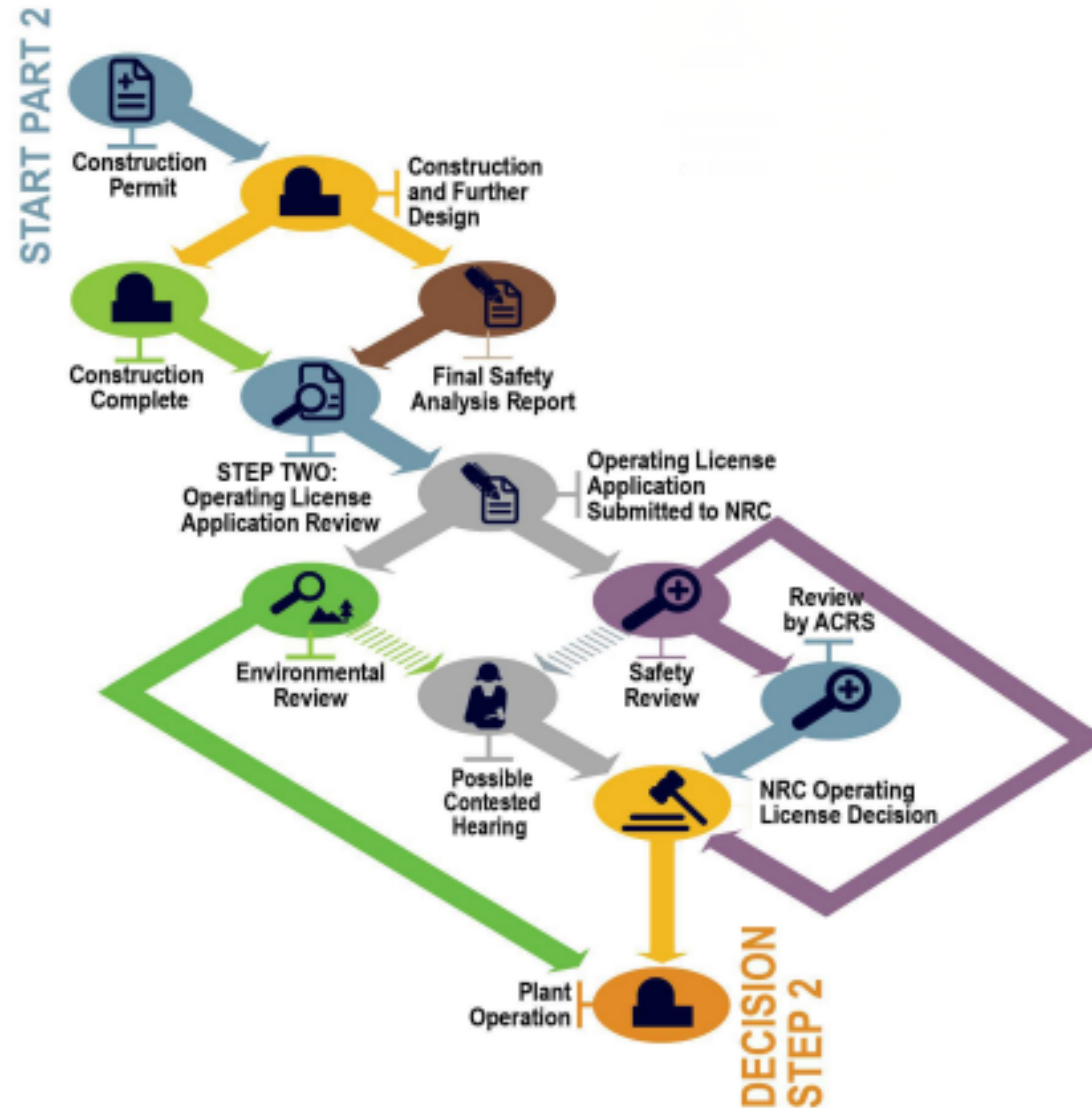
6

Recap and Tabletop Exercises

7

Wrap Up

Part 50 CP and OL Licensing Process



General

Part 50

Part 52

Part 53

Part 57

Classes of Licenses

COMMON TERMINOLOGY

Non-power and Utilization Facility (NPUF)	Commercial NPUF	Commercial Power
---	-----------------	------------------

LICENSE CLASS

CLASS 104			CLASS 103	
104(a) Medical therapy	104(c) Research reactor	104(c) Testing facility	103 Commercial NPUF	103 Power reactor
PURPOSE Medical therapy utilization facility- does not include isotope production	PURPOSE Research, education, training, or isotope production	PURPOSE Research, education, training, or isotope production	PURPOSE Commercial or industrial utilization activity, including commercial isotope production	PURPOSE Commercial production of electricity or useful heat
ACCIDENT / RISK Facility-specific safety analysis	ACCIDENT / RISK ≤ 1 rem TEDE and not a testing facility	ACCIDENT / RISK > 1 rem TEDE or NRC risk determination	ACCIDENT / RISK Same as research reactor or testing facility	ACCIDENT / RISK Power-reactor safety requirements apply
OPERATING COST THRESHOLD Does not apply	OPERATING COST THRESHOLD $\leq 75\%$ qualifying sales and $\leq 50\%$ energy sales	OPERATING COST THRESHOLD $\leq 75\%$ qualifying sales and $\leq 50\%$ energy sales	OPERATING COST THRESHOLD Commercial purpose establishes Class 103	OPERATING COST THRESHOLD Commercial purpose establishes Class 103
REGULATORY BASIS AEA §104 minimum regulation applies	REGULATORY BASIS AEA §104 minimum regulation applies	REGULATORY BASIS AEA §104 minimum regulation applies	REGULATORY BASIS AEA §104 minimum regulation does not apply	REGULATORY BASIS AEA §104 minimum regulation does not apply
REVIEW / HEARING No automatic ACRS review or mandatory licensing hearing	REVIEW / HEARING No automatic ACRS review or mandatory licensing hearing	REVIEW / HEARING ACRS review and mandatory licensing hearing	REVIEW / HEARING ACRS review and mandatory licensing hearing	REVIEW / HEARING ACRS review and mandatory licensing hearing
PART 100 SITING Does not apply unless the facility is a testing reactor	PART 100 SITING Does not apply as a research reactor	PART 100 SITING Applies under Part 100, Subpart A	PART 100 SITING Does not apply unless facility meets accident/risk criteria of a testing facility	PART 100 SITING Applies to stationary power reactors
KEY REFERENCES 10 CFR 50.2, 50.21(a), and 50.34	KEY REFERENCES 10 CFR 50.2, 50.21(c), 50.22(c), and 50.34	KEY REFERENCES 10 CFR 50.2, 50.21(c), 50.22, 50.34, 50.58, and Part 100, Subpart A	KEY REFERENCES 10 CFR 50.2, 50.22, 50.34, and 50.58	KEY REFERENCES 10 CFR 50.22, 50.34, 50.58, and Part 100, Subpart B

Class 104(b) is a limited legacy category for specified historic or demonstration facilities and is not shown as a current pathway.

Part 52 Licensing Process



General

Part 50

Part 52

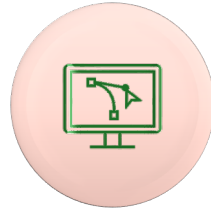
Part 53

Part 57

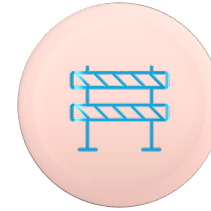
Part 52 Licensing Instruments



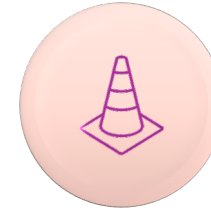
DESIGN
CERTIFICATIONS
(DC)



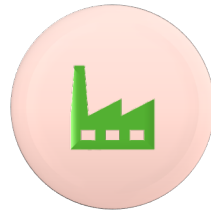
STANDARD
DESIGN
APPROVALS
(SDA)



LIMITED WORK
AUTHORIZATION
(LWA)



EARLY SITE
PERMIT (ESP)



MANUFACTURING
LICENSE (ML)



COMBINED
OPERATING
LICENSE (COL)

General

Part 50

Part 52

Part 53

Part 57

Design Certification/ Standard Design Approval

- 10 CFR Part 52, Subparts B and E - Addresses pre-approval of facility designs
- May be referenced by a COL or ML
- Design Certifications
 - Essentially complete design
 - Finality through rulemaking - added appendix to Part 52
- Standard Design Approval
 - May be entire or major portions of a design
 - Staff approval

General

Part 50

Part 52

Part 53

Part 57

Limited Work Authorizations

- An applicant may request a LWA for approval of a limited set of construction activities in accordance with 10 CFR 50.10(d)

General

Part 50

Part 52

Part 53

Part 57

Early Site Permits

- 10 CFR Part 52, Subpart A – Address site-related issues independent of a specific reactor design
 - § 52.27: Limited work authorization after issuance of early site permit.
- May be referenced by a CP or COL
- <https://www.nrc.gov/reactors/new-reactors/large-lwr/esp>

General

Part 50

Part 52

Part 53

Part 57

Manufacturing Licenses

- 10 CFR Part 52, Subpart F – Requirements and procedures for authorizing manufacture of nuclear power reactors to be installed at sites not identified in the license application.
- A nuclear power reactor manufactured under a manufacturing license may only be transported to and installed at a site for which either a construction permit or a combined license has been issued.
- A manufacturing license applicant may reference a standard design certification or a standard design approval in its application.

General

Part 50

Part 52

Part 53

Part 57

You can also share
questions here:



Agenda

1 Introductions and Welcome

2 Parts 50 and 52 Frameworks

3 **Part 53 Framework**

CURRENT

4 Part 57 Framework (Proposed Rule)

5 Break

6 Recap and Tabletop Exercises

7 Wrap Up

Part 53 Licensing Framework

- General Comparison of Regulatory Frameworks
- Part 53 Hierarchy of Safety Requirements
- Overview of Part 53 Licensing Instruments
- Cross-Part Licensing

General

Part 50

Part 52

Part 53

Part 57

Comparing Part 53 to Parts 50 & 52

Feature	10 CFR Part 53 Risk-Informed, Technology-Inclusive Regulatory Framework	10 CFR Parts 50 & 52 Established Regulatory Framework (LWRs and Other Technologies)
Technology Scope	Technology-inclusive Applies across a wide range of reactor technologies (e.g., advanced, non-light-water, non-traditional).	Technology-focused May be used to license any technology, but it is primarily based on large light-water reactors (Part 50) and traditional designs with standardization (Part 52).
Risk Approach	Risk-informed and performance-based Uses PRA and other systematic risk evaluations to tailor requirements to the design and risk profile.	Confirmatory use of risk Risk analyses are used more in a confirmatory role that complements a deterministically established licensing basis.
Licensing Approach	Greater flexibility Additional features (e.g., factory fuel loading, performance-based requirements) to support a wide range of deployment models, sizes, and design characteristics.	Defined, established pathways Part 50 uses a construction permit/operating license process; Part 52 uses a combined license and standardization approach.
Regulatory Focus	Safety outcomes and performance objectives Less reliance on prescriptive, design-specific requirements; focuses on meeting safety goals and objectives.	Prescriptive requirements and detailed criteria Focuses on meeting established design, technical, and procedural requirements (with exemptions as needed).

General

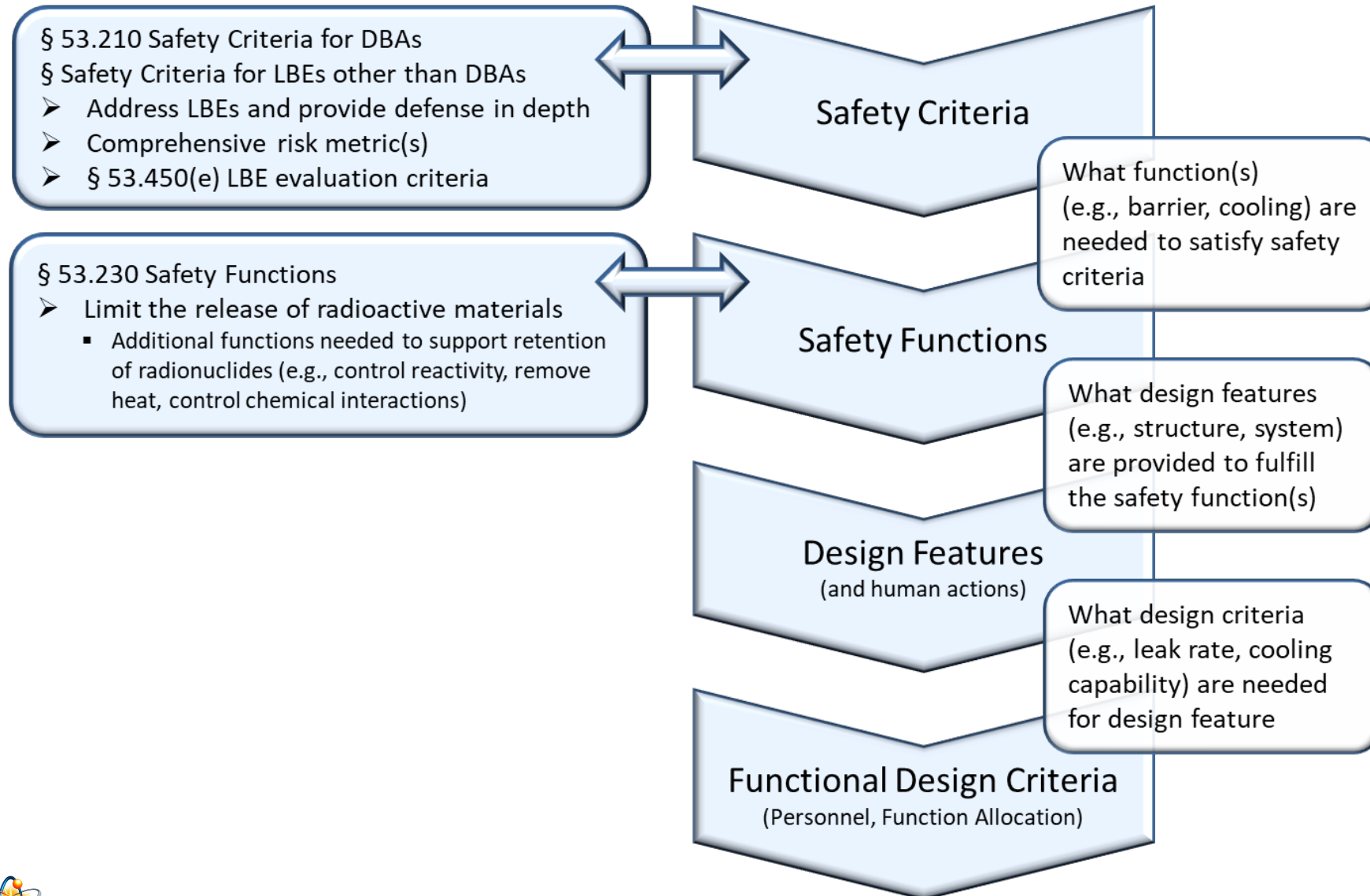
Part 50

Part 52

Part 53

Part 57

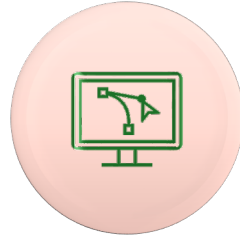
Part 53 Hierarchy of Safety Requirements



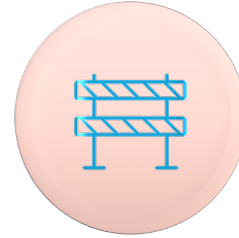
Part 53 Licensing Instruments



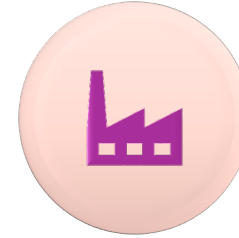
STANDARD DESIGN
APPROVALS (SDA)



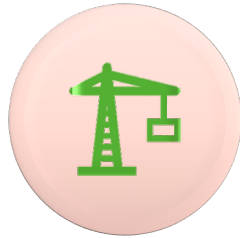
STANDARD DESIGN
CERTIFICATIONS
(DC)



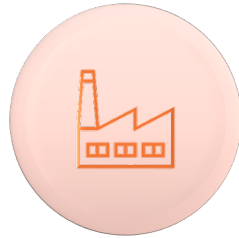
LIMITED WORK
AUTHORIZATION
(LWA)



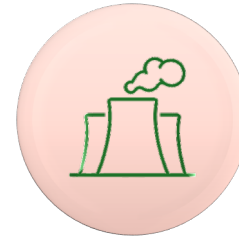
MANUFACTURING
LICENSE (ML)



CONSTRUCTION
PERMIT (CP)



OPERATING LICENSE
(OL)



COMBINED LICENSE
(COL)

General

Part 50

Part 52

Part 53

Part 57

Relationships of Part 53 Licensing Instruments (§53.1124)

- Part 53 SDA or DC applicants can reference a Part 53 OL or COL
 - Allows a first-of-a-kind (FOAK) designs to be licensed for operation prior to seeking generic approval or certification of the standard design for nth-of-a-kind licensing (NOAK)
- Allows export of reactors manufactured under a Part 53 ML in accordance with Part 110.
- Part 53 leaves open how a Part 53 CP referencing a Part 53 ML would be structured (e.g., addressing ML ITAAC in the CP)

General

Part 50

Part 52

Part 53

Part 57

Part 53 Licensing Instruments and Approaches

		Referenced Actions				
		Siting	Standardized Designs			Facility License
		ESP	SDA	DC	ML	OL & C-COL*
Facility License	COL	✓	✓	✓	✓	
	CP/OL	✓	✓	✓	✓	
Standard Design	SDA					✓
	DC		✓			✓
	ML		✓	✓		

An LWA may be submitted as part of an ESP, CP, or COL

* New relationship added under Part 53, operating license afforded finality similar to an SDA

- ESP

Early site permit
- SDA

Standard design approval
- DC

Standard design certification
- ML

Manufacturing license
- LWA

Limited work authorization
- CP

Construction permit
- OL

Operating license
- COL

Combined license
- C-COL

Custom COL



Part 53 Standard Design Approval

(§§ 53.1200 – 53.1221)

§ 53.1209(a) – expands discussion of major portion of a design to address Part 53 technical req's

§ 53.1221(a) – extends the same finality of an SDA referenced in an individual facility license application to include an SDA referenced in a standard DC

§ 53.1221(d) – information normally contained in engineering documents must be completed and available for audit before a CP, COL, OL, or ML referencing the SDA would be granted

General

Part 50

Part 52

Part 53

Part 57

Part 53 Standard Design Certification

(§§ 53.1230 – 53.1263)

§ 53.1239 – technical content of applications aligned with technical req's in Part 53

§ 53.1242(c) – DC applicant can reference licensing-basis information in a Part 53 OL or COL

- provides finality for that information in the DC application (not binding to public or Commission)

§ 53.1254 – consistent with current agency practice, a DC renewal does not need to be referred to the ACRS

Part 53 Limited Work Authorization

(§ 53.1130)

Part 53 requirements are equivalent Part 50 LWA requirements under § 50.10

General

Part 50

Part 52

Part 53

Part 57

Part 53 Early Site Permits

(§ 53.1140 – 53.1188)

§ 53.1173 – consistent with current agency practice, an ESP renewal does not need to be referred to the ACRS

General

Part 50

Part 52

Part 53

Part 57

Part 53 Manufacturing License

(§§ 53.1270 – 53.1291)

§ 53.1276 – general information for an ML application addresses potential variations in MLs under Part 53

§ 53.1279(a) and (b) – technical content of applications aligned with technical req's in Part 53

§ 53.1279(c) – application req's for deployment

§ 53.1279(d) – application req's for factory fueling

General

Part 50

Part 52

Part 53

Part 57

Part 53 Manufacturing License

(§§ 53.1270 – 53.1291)

§ 53.1282(a)(1) – ML application includes ITAAC within scope of the ML that a COL or CP referencing the ML must meet

§ 53.1282(a)(2) – portions of an ML within the scope of a referenced standard design certification must apply associated ITAAC from that standard design certification

§ 53.1282(b) – application includes an environmental report (ER)

- if referencing a DC, ER need not contain discussion of severe accident design alternatives for the manufactured reactor

Part 53 Manufacturing License

(§§ 53.1270 – 53.1291)

§ 53.1288 – no constraint on granting a departure that may reduce standardization where special circumstances outweigh any decrease in safety

§ 53.1295(a)(3) – excludes limitation on starting manufacturing less than 3 years before expiration of ML

General

Part 50

Part 52

Part 53

Part 57

Part 53 Construction Permit

(§§ 53.1300 – 53.1348)

§ 53.1306 – Part 70 standard for financial qualification

§ 53.1309 – technical content of applications aligned with technical req's in Part 53

- Includes several categories of detailed information while allowing that information may be preliminary

Other req's are equivalent to related Part 52 req's, but adapted for a CP application

Part 53 Operating License

(§§ 53.1360 – 53.1405)

§ 53.1366 – Part 70 standard for financial qualification

§ 53.1369 – technical content of applications equivalent to Parts 50 and 52, but aligned with technical req's in Part 53

§ 53.1372(b) – include description of availability controls to support § 53.710(b), but are not in FSAR

§ 53.1375(a) – only general provisions for license renewal req's; detailed req's/approach to be determined

General

Part 50

Part 52

Part 53

Part 57

Part 53 Combined License

(§§ 53.1410 – 53.1461)

§ 53.1413 – Part 70 standard for financial qualification

§ 53.1416 – technical content of applications equivalent to Parts 50 and 52, but aligned with technical req's in Part 53

- As for a DC, information normally included in engineering documents must be completed and available for audit for a safety determination

§ 53.1422 – only general provisions for license renewal req's; detailed req's/approach to be determined

§ 53.1452 – provisions related to installation of fueled manufactured reactors, as referenced by a COL

Cross Part Licensing (Transferability)

- Information from previous approvals under 10 CFR Parts 50 and 52 and other sources can be leveraged to support applications under 10 CFR Part 53 which can improve review efficiency
- Regulatory constructs under 10 CFR Part 53 are fundamentally different than for 10 CFR Parts 50 and 52
- Some licensing products may be more easily referenced (i.e., transferable) from one framework to another due to similarities—e.g., ESP:
 - Requirements and fundamental constructs of an ESP under Part 53 are largely the same as an ESP under Part 52
 - Technical differences of a Part 52 ESP may need to be addressed with supplemental information in a Part 53 application
 - Early engagement with NRC is encouraged regarding administrative and procedural differences of referencing a Part 52 ESP under Part 53

General

Part 50

Part 52

Part 53

Part 57

You can also share
questions here:



Agenda

1 Introductions and Welcome

2 Parts 50 and 52 Frameworks

3 Part 53 Framework

4 **Part 57 Framework (Proposed Rule)**

CURRENT

5 Break

6 Recap and Tabletop Exercises

7 Wrap Up

Proposed Part 57 - Overview

- Background
- General Structure
- Eligibility Requirements
- Licensing Overview – Joint CP and OL for:
 - Single Reactor
 - Multiple Reactors at a Single Plant
 - Deployment in Large Designated Areas

General

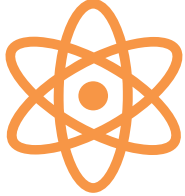
Part 50

Part 52

Part 53

Part 57

Proposed Part 57 - Background



Laws

- ~Atomic Energy Act of 1954, as amended, section 103
- ~Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy (ADVANCE) Act
- ~ Nuclear Energy Innovation and Modernization (NEIMA) Act



Executive Order 14300

- ~ Sec. 5(e) Establish a process for high-volume licensing of microreactors and modular reactors, including by allowing for standardized applications and approvals and by considering to what extent such reactors or components thereof should be regulated through general licenses.



Commission Policy Statement and Staff Requirements Memoranda

- ~ SRM-SECY-98-144, "White Paper on Risk-Informed and Performance-Based Regulations" (ML003753601)
- ~ Commission's Policy Statement on the Regulation of Advanced Reactors (73 FR 60612, October 14, 2008)
- ~ SRM-SECY-24-0008, "Micro-Reactor Licensing and Deployment Considerations: Fuel Loading and Operational Testing at a Factory" (ML25168A133)
- ~ SRM-SECY-25-0052, "Nth-of-a-Kind Microreactor Licensing and Deployment Considerations" (ML25317A650)

General

Part 50

Part 52

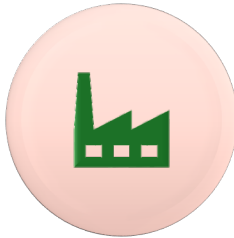
Part 53

Part 57

Proposed Part 57 Licensing Instruments



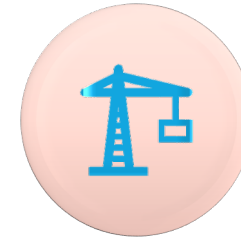
CONSTRUCTION PERMIT (CP) /
OPERATING LICENSE (OL)



MANUFACTURING
LICENSE (ML)



STANDARD DESIGN
APPROVALS (SDA)



GENERAL LICENSE (GL)

General

Part 50

Part 52

Part 53

Part 57

Proposed Part 57 - Structure

General

Part 50

Part 52

Part 53

Part 57

Focused Part 50 technical requirements and Parts 50, 52, & 53 licensing and approval frameworks

- Subpart A – General Provisions
- Subpart B – Eligibility
- Subpart C – Construction Permits and Operating Licenses
- Subpart D – Manufacturing Licenses
- Subpart E – Standard Design Approvals
- Subpart F – Reporting of Defects and Noncompliance
- Subpart G – Irradiated Fuel Storage, Decommissioning, and License Termination Requirements
- Subpart H – Maintaining and Revising Licensing-Basis Information
- Subpart I – Transportation Package Design Certification
- Subpart J – Physical Security Requirements
- Subpart K – Categorical Exclusion
- Subpart L – Inspections
- Subpart M – Material Control and Accounting
- Subpart N – [Reserved]
- Subpart O – Enforcement
- Subpart P – Operator Licensing and Human Factors
- Subpart Q – Reporting and Other Administrative Requirements
- Part 26, Subpart P – Fitness For Duty

Proposed Part 57 - Eligibility

Proposed Part 57 Subpart B Eligibility Criteria

Accident Consequence Criterion

- ≤ 1 rem TEDE in the unrestricted area for the duration of a maximum hypothetical accident or maximum credible accident.

Fuel Mass Limit

- ≤ 10 metric tons of heavy metal per reactor.

Design Criteria Attributes

- Reactivity control
- Heat removal
- Fission product retention
- Shielding
- Radioactive effluent control
- Security-by-design

General

Part 50

Part 52

Part 53

Part 57

Proposed Part 57 - Licensing

Proposed Part 57 would provide applicants with several licensing options to fit their deployment models:

- A joint application for a CP and associated OL(s) for deployment of nuclear reactors and nuclear plants.
- An ML for approval and manufacture of nuclear reactors of standardized designs.
- A standard design approval (SDA) for approval of entire reactor designs or major portions thereof.
- Applicants would be able to combine requests for these types of licenses and approvals with requests for licenses, approvals, and certifications under other regulations (e.g., 10 CFR Parts 70, 71, and 72) in a single application to holistically address their deployment strategies.

General

Part 50

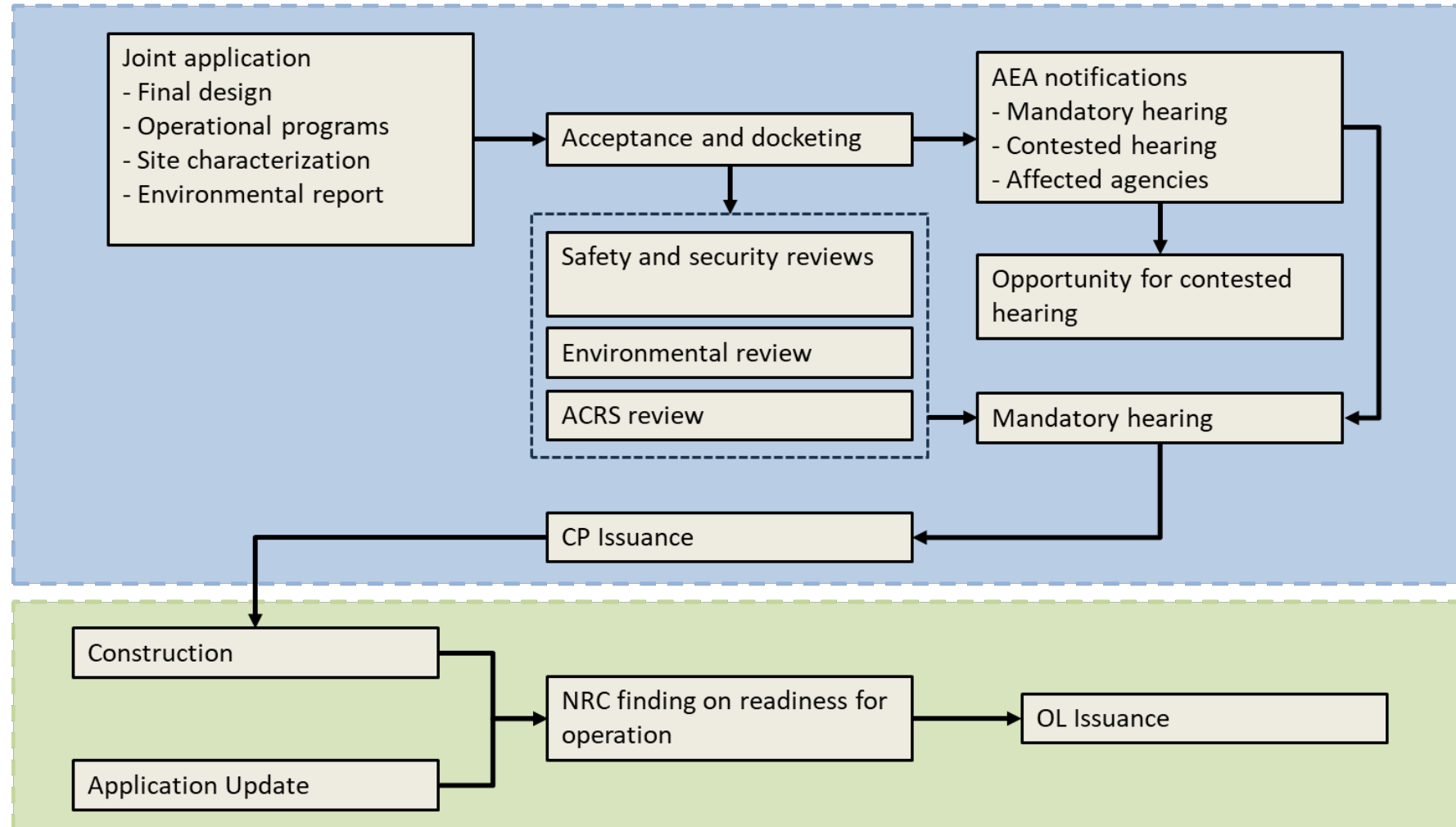
Part 52

Part 53

Part 57

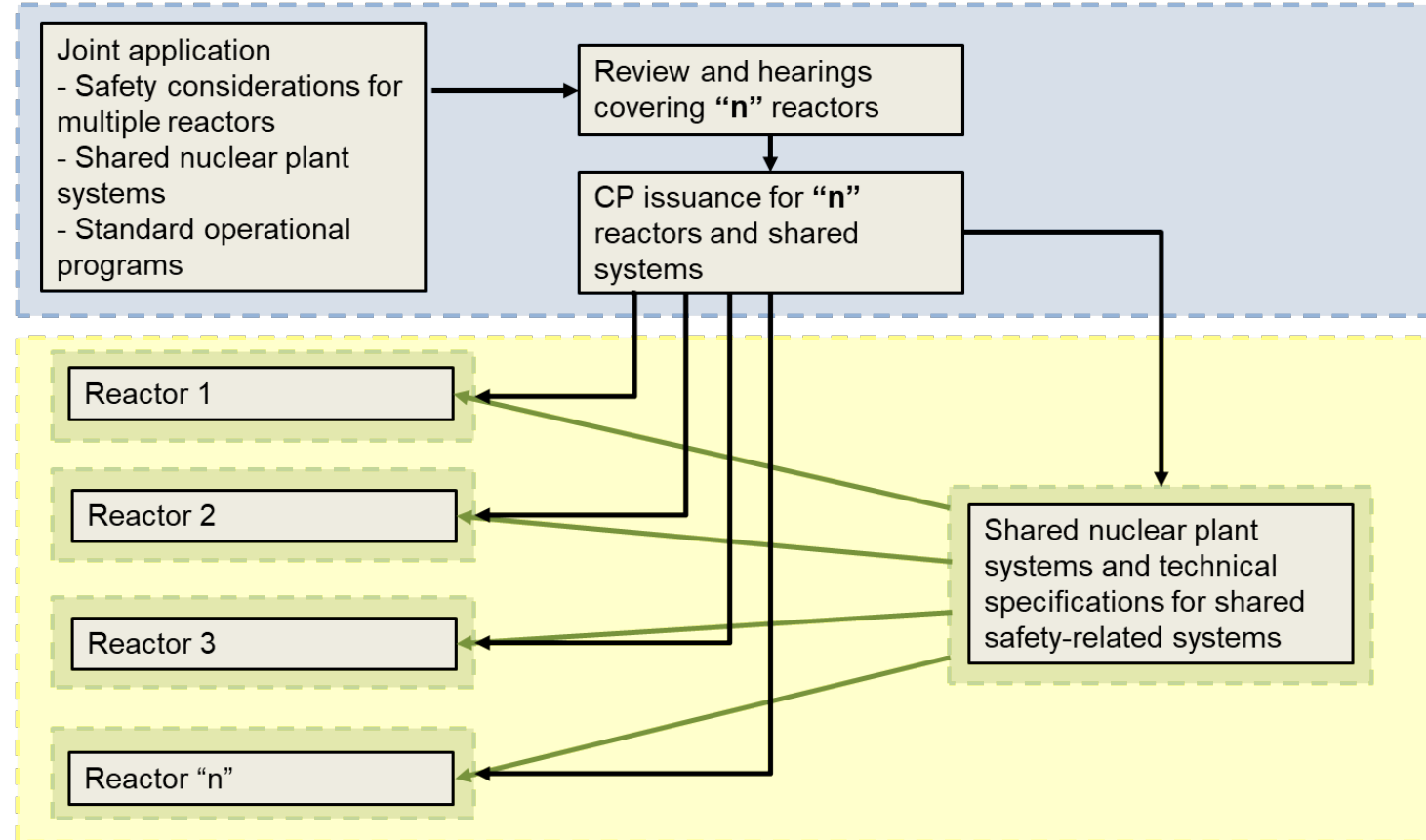
Proposed Part 57 - Licensing

Licensing Flowchart for a Joint Application for a CP and OL for a Single Reactor



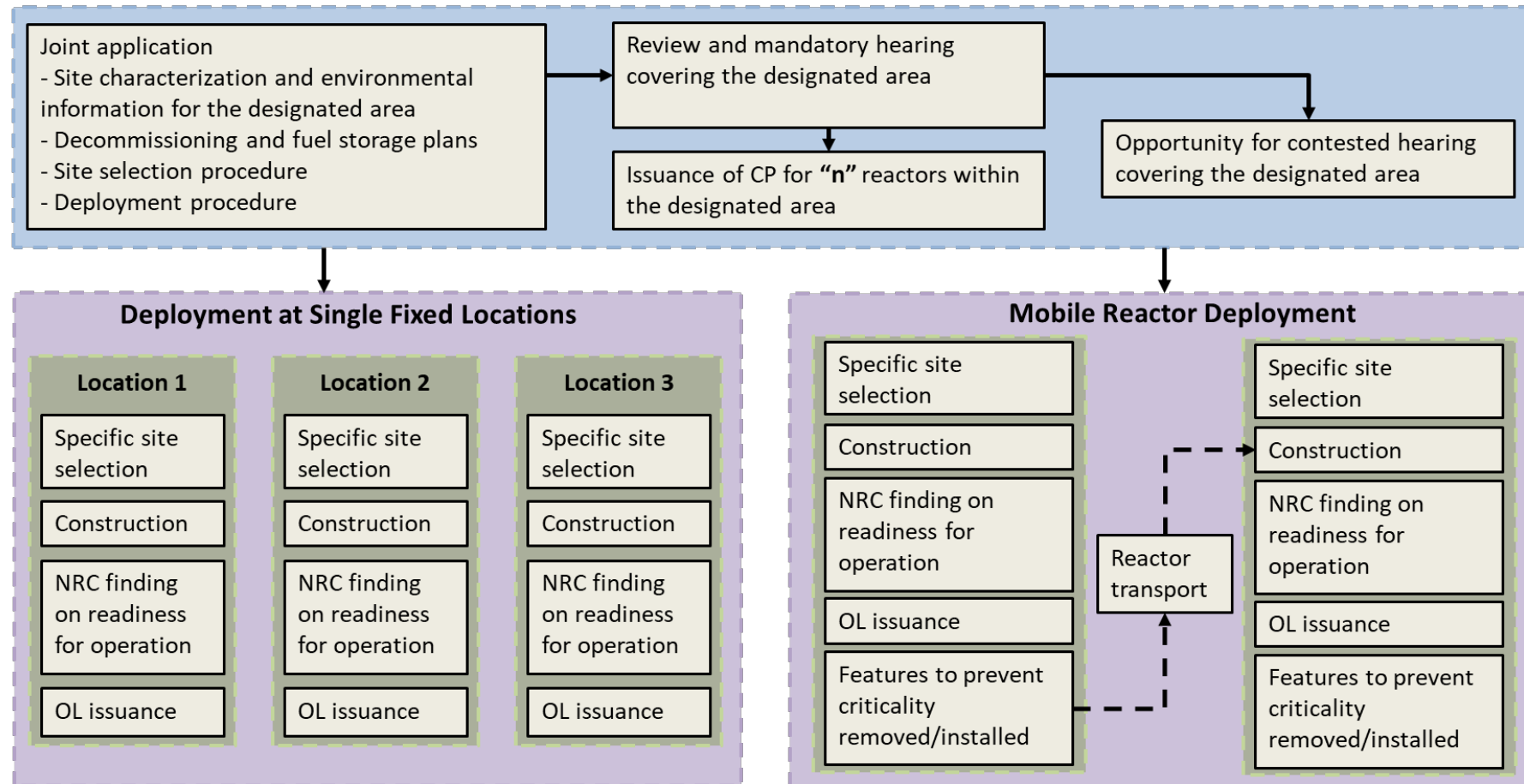
Proposed Part 57 - Licensing

Licensing Flowchart for a Joint Application for a CP and Associated OLs for Multiple Reactors at a Single Nuclear Plant



Proposed Part 57 - Licensing

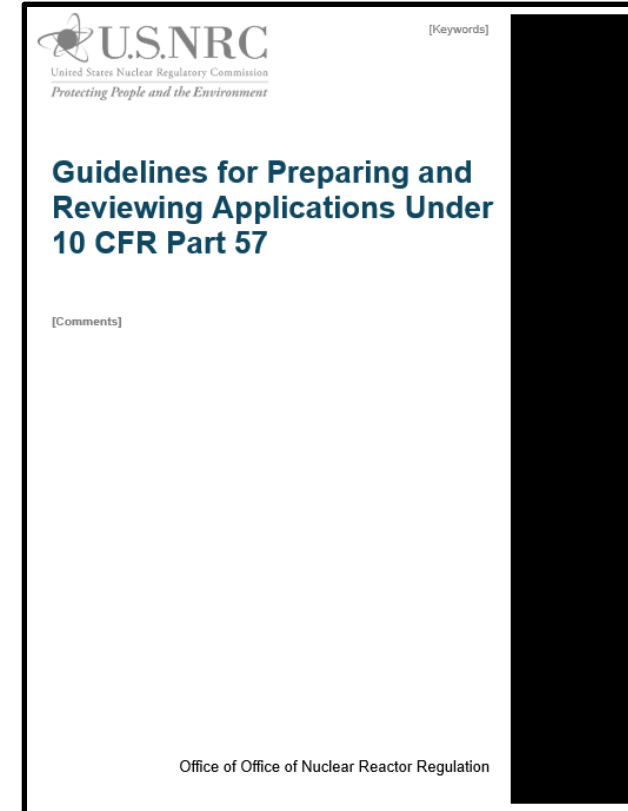
Licensing Flowchart for a Joint Application for a CP and Associated OLs for Reactors to be Deployed in a Large Designated Area



Proposed Part 57 – Draft Guidance

Draft NUREG-2271, “Guidelines for Preparing and Reviewing Applications Under 10 CFR Part 57”

- Patterned from existing licensing practices (e.g., non-power production and utilization facilities) and guidance (NUREG-1537).
- Combines applicant and staff guidance into one document for developing and reviewing submittals under Part 57.
- Provides a flexible, graded hazard analysis approach consistent with DOE authorization methodologies.



General

Part 50

Part 52

Part 53

Part 57

You can also share
questions here:



A group of white paper cutouts of human figures holding hands in a line, set against a green background. The figures are arranged in a line, with some in the foreground and others in the background, creating a sense of depth. The word "BREAK" is overlaid on the bottom left of the image.

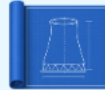
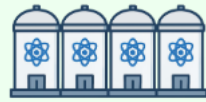
BREAK

Agenda

- 1 Introductions and Welcome
- 2 Parts 50 and 52 Frameworks
- 3 Part 53 Framework
- 4 Part 57 Framework (Proposed Rule)
- 5 Break
- 6 Recap and Tabletop Exercises**
- 7 Wrap Up

CURRENT

Advanced Reactor Licensing Frameworks

Pathway	Primary Use	How It Works	Design Maturity	When To Use It	Safety Approach	Environmental	All Deliver
 Part 50	First of a Kind and NPUFs	 2-Step	 Low → High (CP → OL)	 Early Design Maturity; Sequential Licensing	 Defense-in-Depth and Safety Margins	 ER with EA/EIS or Applicant Prepared EA/EIS	 Consistent Safety Expectations
 Part 52	Standardized Reactors	 Flexible Toolkit	 Moderate → High (Varies By Mechanism)	 Fleet Deployment; Standardized Design			 Licensing of Various Design Maturities and Business Models
 Part 53	Advanced Reactors of All Technologies	 Flexible Toolkit	 Any	 New Designs; Optimization & Scaling	 Fully Risk-Informed Performance Based	 Deployment at Scale and Speed	 Deployment at Scale and Speed
 Part 57 (Proposed)	Microreactors	 Simplified 1-Step	 High	 Factory-Built; Rapid Deployment	 Bounding Entry Criteria		

CP= Construction Permit
OL=Operating License

COL= Combined Operating License
EIS=Environmental Impact Statement

ESP=Early Site Permit
DC=Design Certification

SDA=Standard Design Approval
ER=Environmental Report

ML=Manufacturing License
EA=Environmental Assessment

CP= Construction Permit OL=Operating License ESP=Early Site Permit SDA=Standard Design Approval ML=Manufacturing License
 COL= Combined Operating License EIS=Environmental Impact Statement DC=Design Certification ER=Environmental Report EA=Environmental Assessment

Advanced Reactor Licensing Instruments

Pathway	Siting	Design	Manufacturing	Limited Construction	Full Construction and Operation
Part 50				GL LWA	CP → OL
Part 52	ESP	SDA DC	ML	LWA	COL
Part 53	ESP	SDA DC	ML	GL LWA	CP → OL COL
Part 57 (Proposed)		SDA	ML	GL	CP/OL

ESP=Early Site Permit
DC=Design Certification

SDA=Standard Design Approval
ML=Manufacturing License

GL = General License for Construction
LWA = Limited Work Authorization

CP= Construction Permit
OL=Operating License

COL= Combined
Operating License

Exercise #1

Leveraging the LMP Methodology for a Part 53 Application

Comparing Selected Aspects of 10 CFR Part 53 and the Key Processes of the LMP Methodology

Purpose: Stimulate thought about how the LMP methodology relates and might apply to requirements under 10 CFR Part 53

Process: Highlight some commonalities between 10 CFR Part 53 and related aspects of the three key processes of the LMP methodology

Comparison Topics:

- licensing basis event (LBE) selection/identification
- safety classification of SSCs and associated special treatments
- defense-in-depth evaluation

NOTE: 10 CFR Part 53 adopts many of the fundamental principles and concepts of the LMP methodology; however, the rule remains flexible in that it does not prescribe or require the processes for how to establish a licensing-basis under the rule.

Referring to the “LMP Methodology” means...

NEI 18-04, Revision 1, “Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development” ([ML19241A472](#)), as endorsed in...

RG 1.233, Revision 0, “Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors” ([ML20091L698](#))

NEI 18-04, Rev. 1, is also complemented by guidance in—

NEI 21-07, Revision 1, “Technology Inclusive Guidance for Non-Light Water Reactors” ([ML22060A190](#)) as endorsed in...

RG 1.253, Revision 0, “Guidance for a Technology-Inclusive Content-Of-Application Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals For Non-Light-Water Reactors” ([ML23269A222](#))

Holistic, Integrated Safety Analysis

- **Statement:** The foundations of 10 CFR Part 53 are built on principles and concepts of the LMP methodology.
- **Discussion Prompt:** How might an LMP-based application under 10 CFR Part 53 look different than for an LMP-based application under 10 CFR Part 50?

Licensing Basis Event Definitions – LBEs other than DBAs

- Part 53 allows applicants to propose numerical frequency ranges for LBE categories
- The LMP methodology defines numerical frequency ranges for LBE categories

10 CFR Part 53	LMP Methodology
<i>anticipated event sequence (AES)</i> —means event sequences expected to occur one or more times during the life of a commercial nuclear plant.	<i>anticipated operational occurrence (AOO)</i> —Anticipated event sequences expected to occur one or more times during the life of a nuclear power plant, which may include one or more reactor modules. Event sequences with mean frequencies of 1×10^{-2} /plant-year and greater are classified as AOOs.
<i>unlikely event sequences (UES)</i> —means event sequences that are not expected to occur in the life of a commercial nuclear plant and are less likely than anticipated event sequences, but are infrequent rather than rare.	<i>design-basis event (DBE)</i> —Infrequent event sequences that are not expected to occur in the life of a nuclear power plant, which may include one or more reactor modules, but are less likely than AOOs. Event sequences with mean frequencies of 1×10^{-4} /plant-year to 1×10^{-2} /plant-year are classified as DBEs.
<i>very unlikely event sequences (VUES)</i> —means event sequences that are not expected to occur in the life of a commercial nuclear plant, are less likely than an unlikely event sequence, and are rare.	<i>beyond design-basis event (BDBE)</i> —Rare event sequences that are not expected to occur in the life of a nuclear power plant, which may include one or more reactor modules, but are less likely than a DBE. Event sequences with frequencies of 5×10^{-7} /plant-year to 1×10^{-4} /plant-year are classified as BDBEs.
AESs, UESs, and VUESs and AOOs, DBEs, and BDBEs take into account the expected response of all structures, systems, and components (SSCs) within the plant, regardless of safety classification.	

Licensing Basis Event Definitions – DBAs

10 CFR Part 53	LMP Methodology
<i>design-basis accidents (DBAs)</i>—means postulated event sequences that are used to set functional design criteria and performance objectives for the design of SR SSCs through deterministic analyses. Design-basis accidents are a type of licensing-basis event and are based on the capabilities and reliabilities of SR SSCs needed to mitigate and prevent event sequences, respectively.	<i>design-basis accidents (DBAs)</i>—Postulated accidents that are used to set design criteria and performance objectives for the design of Safety-Related SSCs. DBAs are derived from DBEs based on the capabilities and reliabilities of Safety-Related SSCs needed to mitigate and prevent accidents, respectively. <u>DBAs are derived from the DBEs by prescriptively assuming that only SR SSCs classified are available to mitigate postulated accident consequences to within the 10 CFR 50.34 dose limits.</u>

- DBAs in the LMP methodology serve the same function as DBAs under Part 53
- Under Part 53, the applicant decides how to select DBAs
- The LMP methodology provides one way to select DBAs

Licensing Basis Events

10 CFR Part 53	LMP Methodology
<i>design-basis accidents (DBAs)</i>	<i>design-basis accidents</i>
<i>anticipated event sequence (AES)</i>	<i>anticipated operational occurrence (AOO)</i>
<i>unlikely event sequences (UES)</i>	<i>design-basis event (DBE)</i>
<i>very unlikely event sequences (VUES)</i>	<i>beyond design-basis event (BDBE)</i>
Related Elements	
§ 53.240(a)—LBEs must be identified for each commercial nuclear plant and analyzed under § 53.450 to demonstrate that the safety requirements in this subpart have been satisfied. b) The identified LBEs, ranging from anticipated event sequences to very unlikely event sequences, must collectively address appropriate risk-informed combinations of malfunctions of plant SSCs, human errors, facility hazards, and the effects of external hazards. c) The analysis of LBEs must— ... (2) Confirm the adequacy of design features and programmatic controls needed to satisfy the safety criteria defined in §§ 53.210 and 53.220,	NEI 18-04, Rev. 1: Section 3.2.2, <i>LBE Selection Process</i> Task 4 – <i>Identify/Revise List of AOOs, DBEs, and BDBEs</i> Section 3.3, <i>Role of PRA in LBE Selection</i> Section 3.3.1, <i>Use of PRA in LBE Selection Process</i>
§ 53.450(b) <i>Specific uses of the analyses</i>. The PRA, other SREs, or a combination thereof, together with other generally accepted approaches for systematically evaluating engineered systems must be used to— (1) Inform the selection of LBEs described in § 53.240	NEI 18-04, Rev. 1: Section 3.2.2 Task 3 <i>PRA Development/Update</i>

Licensing Basis Events – DBAs (1 of 2)

10 CFR Part 53	LMP Methodology
<i>design-basis accidents (DBAs)</i>	<i>design-basis accidents</i>
<i>anticipated event sequence (AES)</i>	<i>anticipated operational occurrence (AOO)</i>
<i>unlikely event sequences (UES)</i>	<i>design-basis event (DBE)</i>
<i>very unlikely event sequences (VUES)</i>	<i>beyond design-basis event (BDBE)</i>
Related Elements	
§ 53.210, <i>Safety criteria for design-basis accidents</i>— Design features and programmatic controls must be provided for each commercial nuclear plant such that identification and analyses of DBAs in accordance with § 53.240 demonstrate the following: a) An individual located at any point on the boundary of the exclusion area for any 2-hour period following the onset of the postulated fission product release would not receive a radiation dose in excess of 25 rem (250 millisieverts) total effective dose equivalent (TEDE); and b) An individual located at any point on the outer boundary of the low-population zone who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a radiation dose in excess of 25 rem (250 millisieverts) TEDE.	NEI 18-04, Rev. 1: Section 3.2.2, <i>LBE Selection Process</i> • Task 1 – <i>Propose initial List of LBEs</i> • Task 2 – <i>Design Development and Analysis</i> • Task 5a – <i>Identify Required Safety Functions</i>, refers to the same 25-rem dose criteria • Task 5b – <i>Select/Revise Safety-Related SSCs</i> • Task 7 – <i>Perform LBE Evaluations</i>
§ 53.240(c) The analysis of LBEs must— 1) include analysis of one or more DBAs under § 53.450(f)	NEI 18-04, Rev. 1: Section 3.2.2, <i>LBE Selection Process</i> • Task 4 – <i>Identify/Revise List of AOOs, DBEs, and BDBEs</i> • Task 6 – <i>Select DBAs including Design-Basis External Hazard Levels</i>

Licensing Basis Events – DBAs (2 of 2)

10 CFR Part 53	LMP Methodology
<i>design-basis accidents (DBAs)</i>	<i>design-basis accidents</i>
<i>anticipated event sequence (AES)</i>	<i>anticipated operational occurrence (AOO)</i>
<i>unlikely event sequences (UES)</i>	<i>design-basis event (DBE)</i>
<i>very unlikely event sequences (VUES)</i>	<i>beyond design-basis event (BDBE)</i>
Related Elements	
§ 53.450(f), <i>Analysis of DBAs</i>. 1) The analysis of LBEs required by § 53.240 must include analysis of DBAs that address possible challenges to the safety functions identified under § 53.230. The events selected as DBAs must be those that, if not terminated, have the potential for exceeding the safety criteria in § 53.210. 2) The DBAs selected must be analyzed using deterministic methods that address event sequences from initiation to a safe stable end state and assume only the SR SSCs identified under § 53.460 and human actions addressed by the requirements of subpart F of this part are available to perform the safety functions identified in accordance with § 53.230. 3) The analysis must conservatively demonstrate compliance with the safety criteria in § 53.210.	NEI 18-04, Rev. 1: Section 3.2.2, <i>LBE Selection Process</i>, • Task 7 – <i>Perform LBE Evaluations</i> • Task 7a – <i>Evaluate LBEs Against F-C Target</i> • Task 7d – <i>Perform Deterministic Safety Analyses Against 10 CFR 50.34</i>, the 95th percentile upper bound consequence for each DBA is used to meet the 10 CFR 50.34 dose criteria.

Licensing Basis Events – LBEs other than DBAs (1 of 2)

10 CFR Part 53	LMP Methodology
<i>design-basis accidents (DBAs)</i>	<i>design-basis accidents</i>
<i>anticipated event sequence (AES)</i>	<i>anticipated operational occurrence (AOO)</i>
<i>unlikely event sequences (UES)</i>	<i>design-basis event (DBE)</i>
<i>very unlikely event sequences (VUES)</i>	<i>beyond design-basis event (BDBE)</i>
Related Elements	
§ 53.220, <i>Safety criteria for LBEs other than DBAs</i>— Design features and programmatic controls must be provided for each commercial nuclear plant such that identification and analysis of LBEs other than DBAs in accordance with § 53.240 demonstrate the following: a) Plant SSCs, personnel, and programs provide the necessary capabilities and maintain the necessary reliability to address LBEs other than DBAs in accordance with §§ 53.240 and 53.450(e), and provide measures for defense in depth in accordance with § 53.250; and b) The analysis of risks to public health and safety resulting from LBEs other than DBAs under § 53.450(e) includes comprehensive risk metrics that satisfy associated risk performance objectives that are acceptable to the NRC and provide an appropriate level of safety.	NEI 18-04, Rev. 1: Section 3.2.2, <i>LBE Selection Process</i> • Task 7 – <i>Perform LBE Evaluations</i> Section 3.3.5, <i>Selection of Risk Metrics for PRA Model Development</i>
§ 53.240(b) – The identified LBEs, ranging from anticipated event sequences to very unlikely event sequences, must collectively address appropriate risk-informed combinations of malfunctions of plant SSCs, human errors, facility hazards, and the effects of external hazards.	NEI 18-04, Rev. 1: Section 3.2.2, <i>LBE Selection Process</i> • Task 4 – <i>Identify/Revise List of AOOs, DBEs, and BDBEs</i>

Licensing Basis Events – LBEs other than DBAs (2 of 2)

10 CFR Part 53	LMP Methodology
<i>design-basis accidents (DBAs)</i>	<i>design-basis accidents</i>
<i>anticipated event sequence (AES)</i>	<i>anticipated operational occurrence (AOO)</i>
<i>unlikely event sequences (UES)</i>	<i>design-basis event (DBE)</i>
<i>very unlikely event sequences (VUES)</i>	<i>beyond design-basis event (BDBE)</i>
Related Elements	
§ 53.450(e), <i>Analysis of LBEs other than DBAs.</i>— 1) ...LBEs [other than DBAs] must be identified using insights from a PRA, other SREs, or a combination thereof with other generally accepted approaches for systematically evaluating engineered systems to identify and analyze equipment failures and human errors. 2) The analysis...must include definitions of evaluation criteria for each event or specific categories of LBEs to determine the acceptability of the plant response to the challenges posed by internal and external hazards to provide an appropriate level of safety. 3) The analyses...must address event sequences from initiation to a defined end state and be used in combination with other engineering analyses to demonstrate that the functional design criteria required by § 53.420 provide sufficient barriers to the unplanned release of radionuclides to satisfy the evaluation criteria defined for each LBE other than DBAs, to satisfy the safety criteria specified in accordance with § 53.220 and provide defense in depth as required by § 53.250. 4) The methodology used to identify, categorize, and analyze LBEs must include a means to identify event sequences deemed significant for controlling the risks posed to public health and safety.	NEI 18-04, Rev. 1: Section 3.2.2, <i>LBE Selection Process</i> • Task 3 – <i>PRA Development/Update</i> • Task 7 – <i>Perform LBE Evaluations</i> Section 3.3, <i>Role of PRA in LBE Selection</i> Section 3.3.1, <i>Use of PRA in LBE Selection Process</i> Section 3.3.5, <i>Risk Significance Evaluations</i>

Safety Classification of SSCs & Special Treatments (1 of 7)

10 CFR Part 53	LMP Methodology
<i>Safety-related (SR)</i>	<i>Safety-related (SR)</i>
<i>Non-safety-related but safety-significant (NSRSS)</i>	<i>Non-safety-related no special treatments (NSRST)</i>
<i>Non-safety-significant (NSS)</i>	<i>No special treatments (NST)</i>
Related Elements	
§ 53.240(c) The analysis of LBEs must— ... 3) Establish related functional requirements for plant SSCs, personnel and programs.	<u>NEI 18-04, Rev. 1:</u> Section 4, <i>Safety Classification and Performance Criteria for SSCs</i> • Various tasks including 1, 3, and 7
§ 53.450(b)(2) – [A PRA, other SREs, or combination...must be used to] inform the classification of SSCs according to their safety significance in accordance with § 53.460 and to identify the environmental conditions under which the SSCs and operating staff must perform their safety functions.	<u>NEI 18-04, Rev. 1:</u> Section 4, <i>Safety Classification and Performance Criteria for SSCs</i> • Various tasks including 4 and 5
§ 53.460(a) – Structures, systems, and components must be classified according to their safety significance. The SSC categories must include “Safety-Related,” “Non-Safety-Related but Safety-Significant,” and “Non- Safety-Significant,” as defined in subpart A of this part.	<u>NEI 18-04, Rev. 1:</u> Section 4, <i>Safety Classification and Performance Criteria for SSCs</i>

- A Part 53 applicant proposes the process for SSC safety classification and establishing special treatments
- The LMP methodology provides a process for safety classification of SSC functions and establishment of associated special treatments

Safety Classification of SSCs & Special Treatments (2 of 7)

10 CFR Part 53	LMP Methodology
<i>Safety-related (SR)</i>	<i>Safety-related (SR)</i>
<i>Non-safety-related but safety-significant (NSRSS)</i>	<i>Non-safety-related no special treatments (NSRST)</i>
<i>Non-safety-significant (NSS)</i>	<i>No special treatments (NST)</i>
Related Elements	
§ 53.410, <i>Functional design criteria for DBAs.</i> a) Functional design criteria must be defined for each SR design feature in terms of its role in demonstrating compliance with § 53.210 b) Special treatments for SR SSCs must consider human actions and programmatic controls...to achieve and maintain the reliability and capability of SSCs relied upon to satisfy the defined functional design criteria and § 53.210, and to maintain consistency with the analyses required under § 53.450(f)	<u>NEI 18-04, Rev. 1:</u> Section 4, <i>Safety Classification and Performance Criteria for SSCs</i> • Task 6 – <i>SSC Reliability and Capability Targets</i> • Task 7 – <i>Determine SSC Specific Design Criteria and Special Treatment Requirements</i> Section 4.4, <i>Development of SSC Design and Performance Requirements</i>
§ 53.440(b)—The design features classified as SR must, wherever applicable, be designed using generally accepted consensus codes and standards that have been endorsed or otherwise found acceptable by the NRC.	<u>NEI 21-07, Rev. 1:</u> Section 5.3, <i>Principal Design Criteria</i>, addresses the Principal Design Criteria-Required Functional Design Criteria (PDC-RFDC), which are similar to functional design criteria defined for SR design features under § 53.410.

Safety Classification of SSCs & Special Treatments (3 of 7)

10 CFR Part 53	LMP Methodology
<i>Safety-related (SR)</i>	<i>Safety-related (SR)</i>
<i>Non-safety-related but safety-significant (NSRSS)</i>	<i>Non-safety-related no special treatments (NSRST)</i>
<i>Non-safety-significant (NSS)</i>	<i>No special treatments (NST)</i>
Related Elements	
§ 53.415, <i>Protection against external hazards</i>—Safety-related SSCs must be protected against or must be designed to withstand the effects of natural phenomena (e.g., earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches) and constructed hazards (e.g., dams, transportation routes, military and industrial facilities) considering an event severity up to the design-basis external hazard levels as determined under § 53.510 without losing the capability to perform the safety functions identified under § 53.230. Specific requirements for earthquake engineering are included in § 53.480. § 53.510(a)—<i>General external hazard requirements</i>. The design-basis external hazard level for the relevant external hazards for a site must be identified and characterized based on site-specific assessments of natural and constructed hazards with the potential to adversely affect plant functions. The external hazard frequencies and magnitudes determined from the site-specific assessments must take into account uncertainties and variabilities in data, models, and methods relied on to characterize the external hazards.	<u>NEI 18-04, Rev. 1:</u> Section 3.2.2, <i>LBE Selection Process</i> Task 6 – <i>Select Deterministic DBAs and Design Basis External Hazard Levels</i> <u>NEI 21-07, Rev. 1:</u> Section 6.1.1, <i>Design Basis Hazard Levels</i>, provides a discussion of design-basis hazard levels (DBHLs), which is synonymous with the concept of design-basis external hazard levels (DBEHLs) in NEI 18-04, Rev. 1.

Safety Classification of SSCs & Special Treatments (4 of 7)

10 CFR Part 53	LMP Methodology
<i>Safety-related (SR)</i>	<i>Safety-related (SR)</i>
<i>Non-safety-related but safety-significant (NSRSS)</i>	<i>Non-safety-related no special treatments (NSRST)</i>
<i>Non-safety-significant (NSS)</i>	<i>No special treatments (NST)</i>
Related Elements	
§ 53.420, <i>Functional design criteria for LBEs other than DBAs.</i> a) Functional design criteria must be defined for each design feature classified as SR or non-safety-related but safety-significant (NSRSS) in terms of its role in demonstrating compliance with— (1) The safety criteria in § 53.220; and (2) The evaluation criteria in § 53.450(e). b) The identification of special treatments associated with the design of SR and NSRSS SSCs must consider human actions and programmatic controls identified and implemented in accordance with this and other subparts to achieve and maintain the reliability and capability of SSCs relied upon to satisfy— (1) The safety criteria in § 53.220; and (2) The evaluation criteria in § 53.450(e).	<u>NEI 18-04, Rev. 1:</u> Section 4, <i>Safety Classification and Performance Criteria for SSCs</i> • Task 6 – <i>SSC Reliability and Capability Targets</i> • Task 7 – <i>Determine SSC Specific Design Criteria and Special Treatment Requirements</i> Section 4.4, <i>Development of SSC Design and Performance Requirements</i> <u>NEI 21-07, Rev. 1:</u> Section 5.3, <i>Principal Design Criteria</i>, addresses the Principal Design Criteria-Complementary Design Criteria (PDC-CDC), which are similar to functional design criteria defined for SR or NSRSS design features under § 53.420.

Safety Classification of SSCs & Special Treatments (5 of 7)

10 CFR Part 53	LMP Methodology
<i>Safety-related (SR)</i>	<i>Safety-related (SR)</i>
<i>Non-safety-related but safety-significant (NSRSS)</i>	<i>Non-safety-related no special treatments (NSRST)</i>
<i>Non-safety-significant (NSS)</i>	<i>No special treatments (NST)</i>
Related Elements	
§ 53.440(c)—The materials used for each SR and NSRSS SSC must be qualified for their service conditions over the design life of the SSC as appropriate to satisfy the special treatments established for the SSC under § 53.460. § 53.440(d)—Possible degradation mechanisms related to aging, fatigue, chemical interactions, operating temperatures, effects of irradiation, and other environmental factors that may affect the performance of SR and NSRSS SSCs must be evaluated and used to inform the design and the development of integrity assessment programs under § 53.870. § 53.450(b)(6) – [A PRA, other SREs, or combination...must be used to] inform the establishment and updating of appropriate measures for plant operations, including availability controls, to ensure that the configurations and special treatments for SR SSCs and NSRSS SSCs provide the capabilities, availability, and reliability consistent with satisfying the safety criteria under § 53.220 and the analyses of LBEs other than DBAs under § 53.450(e).	<u>NEI 18-04, Rev. 1:</u> Section 4, <i>Safety Classification and Performance Criteria for SSCs</i> • Task 6 – <i>SSC Reliability and Capability Targets</i> • Task 7 – <i>Determine SSC Specific Design Criteria and Special Treatment Requirements</i>

Safety Classification of SSCs & Special Treatments (6 of 7)

10 CFR Part 53	LMP Methodology
<i>Safety-related (SR)</i>	<i>Safety-related (SR)</i>
<i>Non-safety-related but safety-significant (NSRSS)</i>	<i>Non-safety-related no special treatments (NSRST)</i>
<i>Non-safety-significant (NSS)</i>	<i>No special treatments (NST)</i>
Related Elements	
§ 53.460(b) For SR and NSRSS SSCs, the conditions under which they must perform their safety function in § 53.230 must be identified. Special treatments must be established in accordance with this and other subparts to provide confidence that the SSCs will perform under the service conditions and with reliability consistent with the analysis performed under § 53.450 to demonstrate meeting the safety criteria in §§ 53.210 and 53.220. 1) The special treatments for SR SSCs must include meeting the applicable quality assurance requirements from appendix B of part 50 of this chapter. 2) The special treatments for NSRSS SSCs and special treatments for SR SSCs beyond those required under paragraph (b)(1) of this section may include meeting selected quality assurance requirements from appendix B of part 50 of this chapter when such treatment is needed to address performance requirements, equipment reliability, or uncertainties.	<u>NEI 18-04, Rev. 1:</u> Section 4, <i>Safety Classification and Performance Criteria for SSCs</i> • Task 6 – <i>SSC Reliability and Capability Targets</i> • Task 7 – <i>Determine SSC Specific Design Criteria and Special Treatment Requirements</i>

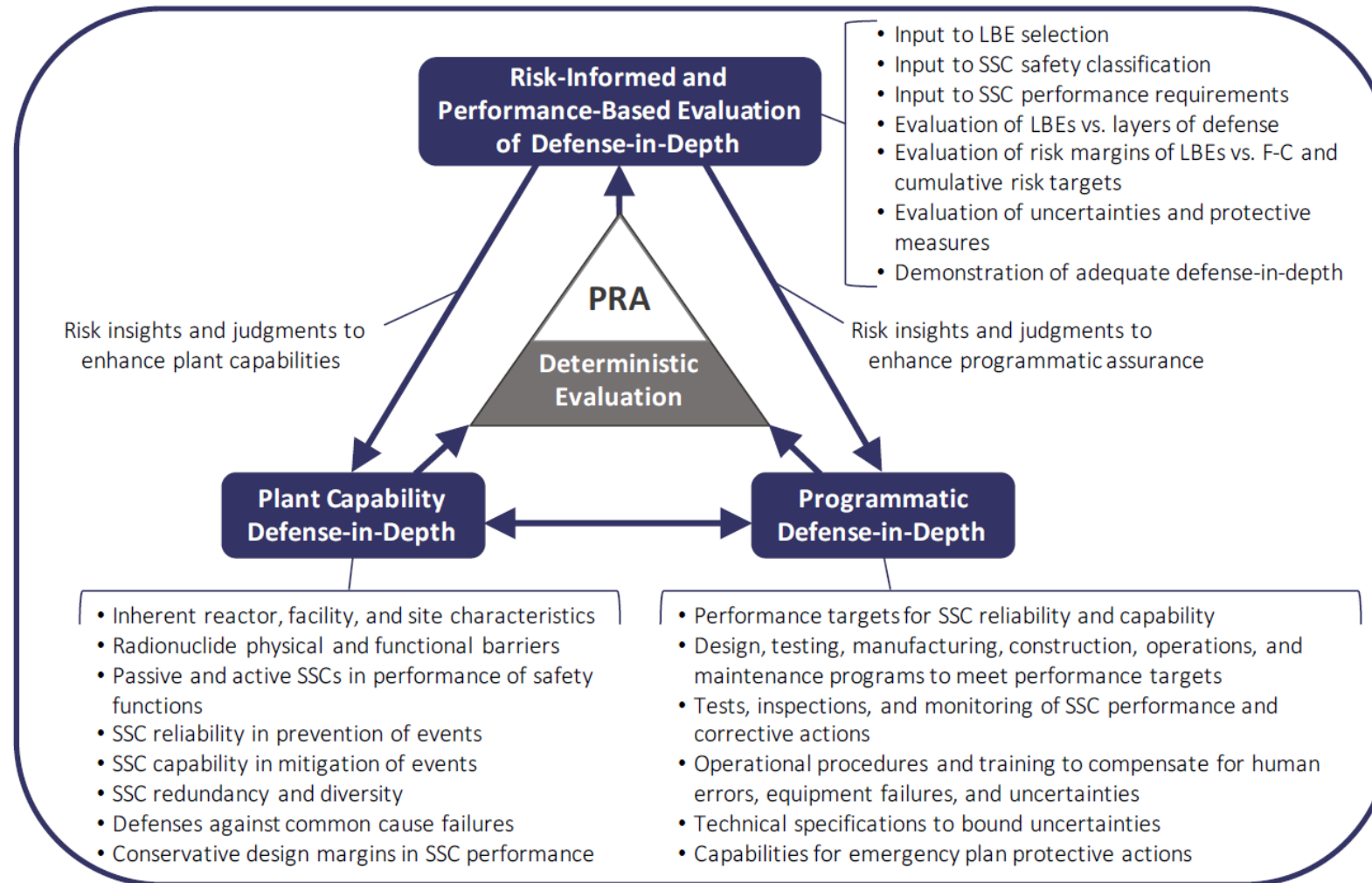
Safety Classification of SSCs & Special Treatments (7 of 7)

10 CFR Part 53	LMP Methodology
<i>Safety-related (SR)</i>	<i>Safety-related (SR)</i>
<i>Non-safety-related but safety-significant (NSRSS)</i>	<i>Non-safety-related no special treatments (NSRST)</i>
<i>Non-safety-significant (NSS)</i>	<i>No special treatments (NST)</i>
Related Elements	
§ 53.460(c) The identification of special treatments for SR and NSRSS SSCs must account for human actions needed to prevent or mitigate LBEs, the need to perform such actions reliably under the postulated environmental conditions, and the role of programs established in accordance with subpart F of this part to provide confidence that those actions will be performed as assumed in the analysis performed in accordance with § 53.450 to demonstrate meeting the applicable criteria in §§ 53.210, 53.220, and 53.450(e).	NEI 18-04, Rev. 1: Section 4, <i>Safety Classification and Performance Criteria for SSCs</i> - Task 6 – <i>SSC Reliability and Capability Targets</i> - Task 7 – <i>Determine SSC Specific Design Criteria and Special Treatment Requirements</i>

Defense in Depth

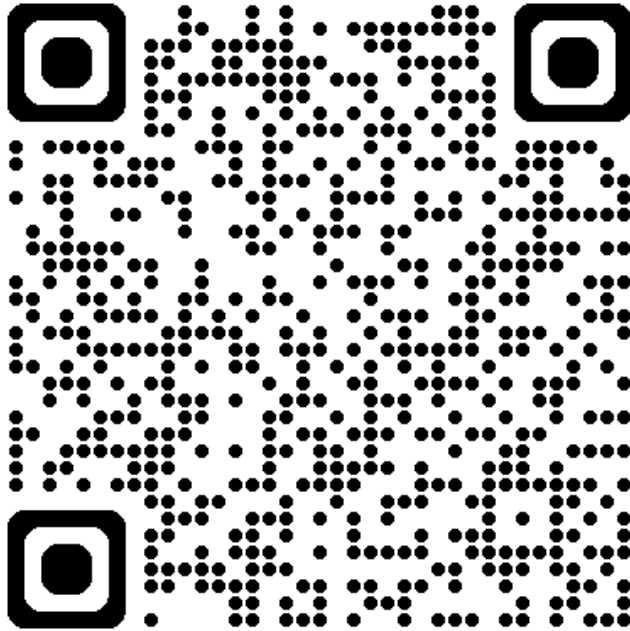
10 CFR Part 53	LMP Methodology
§ 53.250(a)—Measures must be taken for each commercial nuclear plant to ensure appropriate defense in depth is provided to compensate for uncertainties in the analysis of the safety criteria such that there is reasonable assurance that the safety criteria in this subpart are met over the life of the plant.	NEI 18-04, Rev. 1: Section 3.2.2, <i>LBE Selection Process</i> • Task 7 – <i>Perform LBE Evaluations</i>
§ 53.250(b)—The uncertainties that must be addressed under paragraph (a) of this section include those related to the state of knowledge and modeling capabilities, the ability of barriers to limit the release of radioactive materials from the facility during LBEs other than DBAs, the reliability and performance of plant SSCs and personnel, and the effectiveness of programmatic controls.	Section 4, <i>Safety Classification and Performance Criteria for SSCs</i> • Task 2 – <i>Identify and Evaluate SSC Capabilities and Programs to Support Defense-in-Depth</i> • Task 3 – <i>Determine the Required and Safety-Significant Functions</i>
§ 53.250(c)—The safety analysis may not exclusively rely upon a single engineered design feature, human action, or programmatic control, no matter how robust, to address the range of LBEs other than DBAs.	Section 5, <i>Evaluation of Defense-in-Depth Adequacy</i> • <i>Plant Capability Defense-in-Depth</i> • <i>Programmatic Defense-in-Depth</i> • <i>Risk-Informed Evaluation of Defense-in-Depth</i>
§ 53.450(b)(3) – [A PRA, other SREs, or combination...must be used to] evaluate the adequacy of defense-in-depth measures required in accordance with § 53.250.	Section 5.3, <i>Integrated Framework for Incorporation and Evaluation of DID</i> Table 5-2, <i>Guidelines for Establishing the Adequacy of Overall Plant Capability Defense-in-Depth</i>

Defense in Depth



NEI 18-04, Revision 1, Figure 5-2: Framework for Establishing DID Adequacy

Choose Your Path – QUIZ TIME



Exercise #2

Topics and considerations for scaling your site from FOAK to NOAK under Part 57

- Graded Siting & Environmental Review
 - Framework offers simpler siting guidelines for microreactors.
- Multi-Module & Cumulative Risk Assessments (MHA/MCA)
 - Addresses safety and risk evaluations for multi-module microreactor facilities, where shared systems or common-cause events could impact several units at once.
- Factory Building & Mass Deployment
 - Enabling mass factory manufacturing and rapid deployment of reactors.
- Staffing, Security & Emergency Plans
 - Right-sized security, smaller emergency zones, and fewer operators.

Siting & Environmental Review

- **Statement:** Framework offers simpler siting guidelines for microreactors, especially on previously used land.
- **Discussion Prompt:** How can applicants use these flexible siting rules to speed up environmental reviews compared to traditional nuclear plants?

Multi-Module & Cumulative Risk Assessments (MHA/MCA)

- **Statement:** The framework addresses safety and risk evaluations for multi-module microreactor facilities, where shared systems or common-cause events could impact several units at once.
- **Discussion Prompt:** How could applicants assess multi-module risk and interactions under Part 57 to evaluate cumulative hazards?

Factory Building & Mass Deployment

- **Statement:** A key goal of Part 57 and NUREG-2271 is enabling mass factory manufacturing and rapid deployment of reactors.
- **Discussion Prompt:** What challenges arise when moving a reactor design from initial testing to factory assembly lines and multi-site installations?

Staffing, Security & Emergency Plans

- **Statement:** Microreactors have smaller radiation inventories and passive safety systems, opening the door for right-sized security, smaller emergency zones, and fewer operators.
- **Discussion Prompt:** What information would support reduced traditional operational programs?

Part 57 Guidance, Chapter 12, Accident Analysis

Single-Unit Configuration with Radial Simplification

- Site boundary is typically defined by a simple radial distance from the reactor center or the most conservative release point.
- Licensee has total authority over all activities.

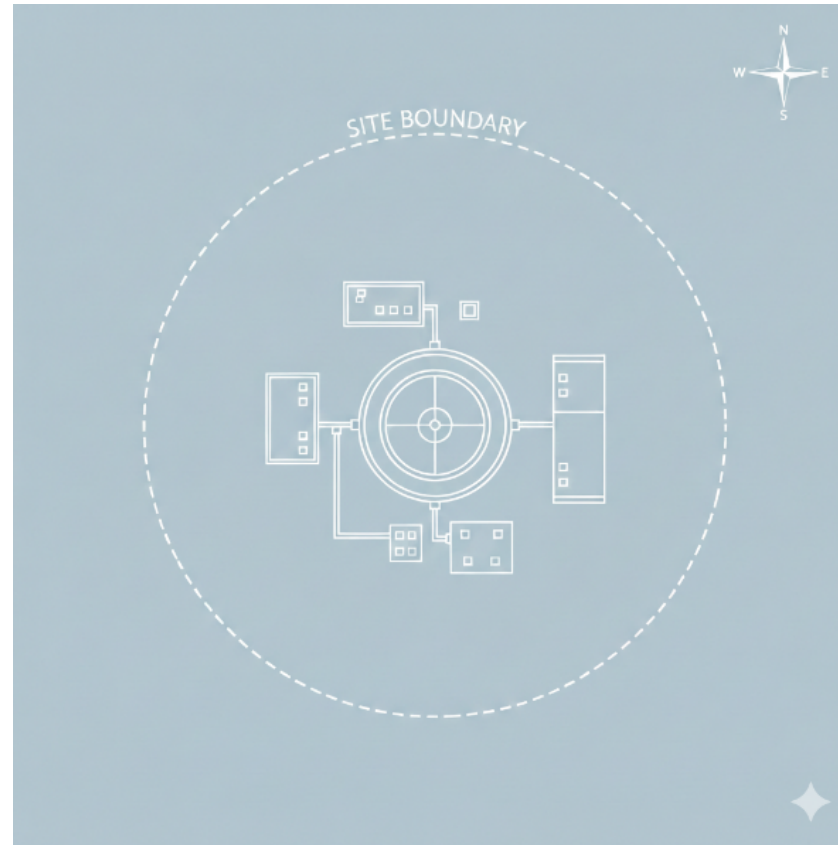


Figure 12-4 Schematic Representation of Single-Unit Configuration Relative to Site Boundary (Draft NUREG-2271)

Part 57 Guidance, Chapter 12, Accident Analysis

Large Area with Multiple Reactors and Independent SSCs

- Reactors may be treated as independent radiological sources.
- Each reactor may have its own individual site boundary; however, these boundaries may be nested within a larger, licensee-controlled perimeter.
- **Spatial Separation:** Units are sited far enough apart that the site boundary of “Unit A” does not overlap with the site boundary of “Unit B.”
- **Operational Control:** While the reactors are physically separate, the licensee may manage the entire perimeter to simplify security and emergency planning.

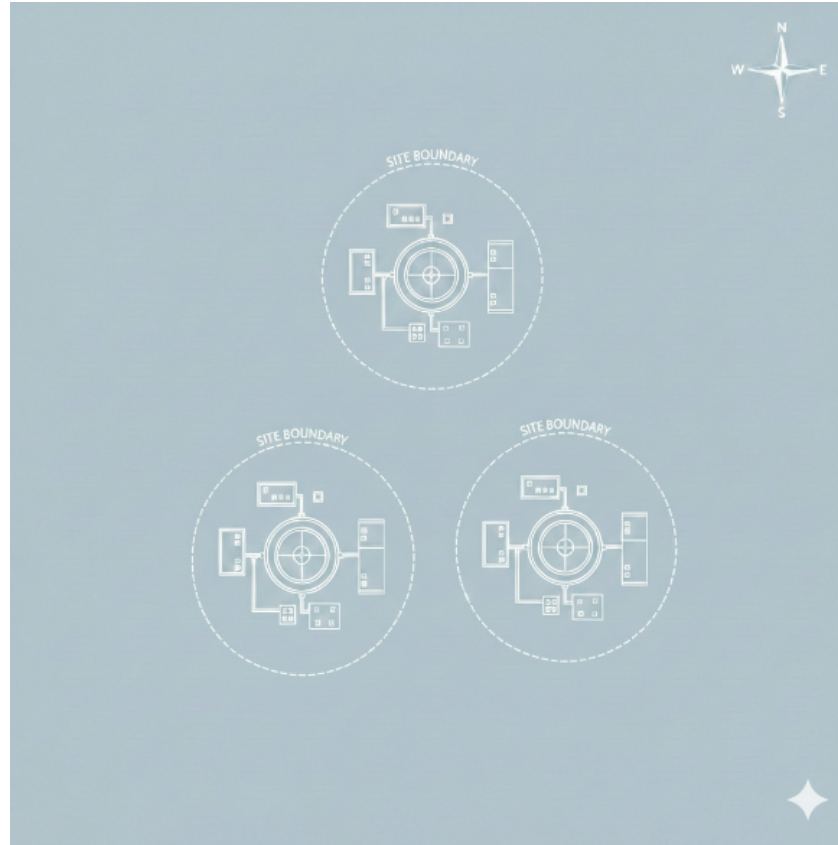


Figure 12-5 Schematic Representation of a Large Area Configuration with Independent SSCs Relative to Site Boundaries (Draft NUREG-2271)

Part 57 Guidance, Chapter 12, Accident Analysis

Multi-Unit Nuclear Plant with Shared SSCs Meeting 1-rem Site Boundary

- Reactors share safety-related SSCs-such as a common control room, shared emergency power, or a collective ultimate heat sink-the site boundary analysis becomes more rigorous.
- **Bounding Source Term:** Because a failure in a shared system could potentially impact multiple reactors simultaneously, the applicant must establish a bounding MHC/MCA source term. This would involve calculating the credible DBA release from all affected units (see subsection 12.4.11) to ensure the site boundary.
- **Integrated Boundary:** In this scenario, the site boundary is typically not a series of individual circles, but a single, contiguous perimeter encompassing all nuclear reactor units and their shared infrastructure.

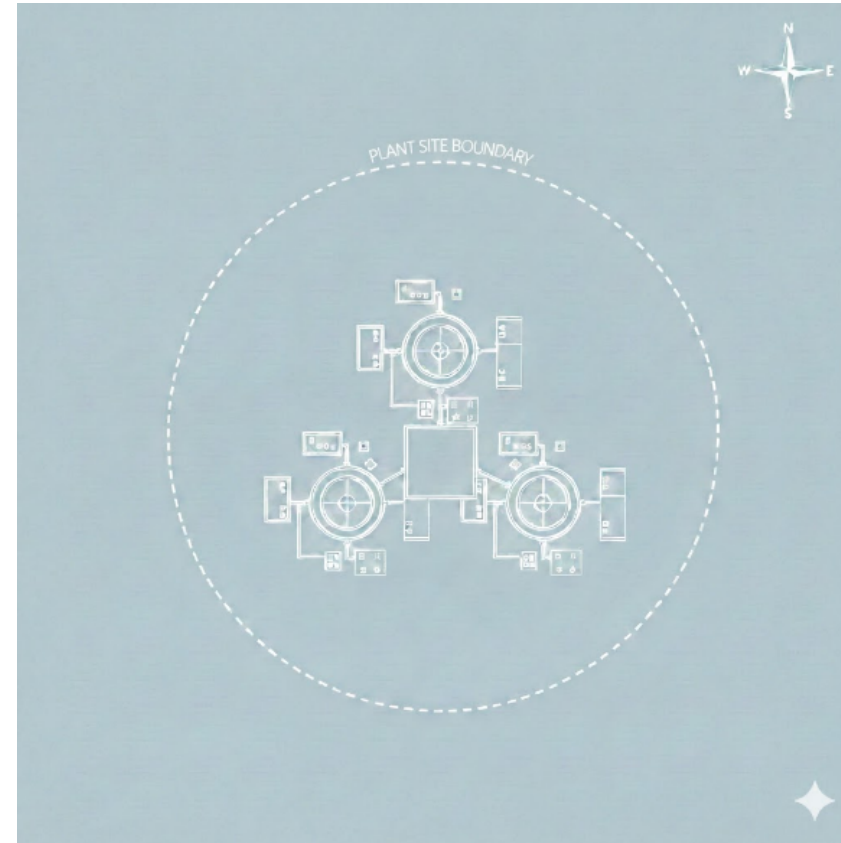


Figure 12-6 Schematic Representation of Multi-Unit Site with Shared SSCs Relative to Site Boundary (Draft NUREG-2271)

Part 57 Guidance, Chapter 12, Accident Analysis

Multi-Unit Nuclear Plant Meeting 1-rem Site Boundary

- Assess the bounding credible DBA for each reactor that can impact all reactors regardless of safety-related SSCs being shared or not. The likely credible DBA that impacts all reactors may be a seismic event.
- Develop a nuclear **plant-based MHA/MCA source term** that bounds the nuclear plant credible DBA impacting all reactors at the nuclear plant.
- Treat the MHA/MCA release as a point release near or at the geometric center of the nuclear plant.

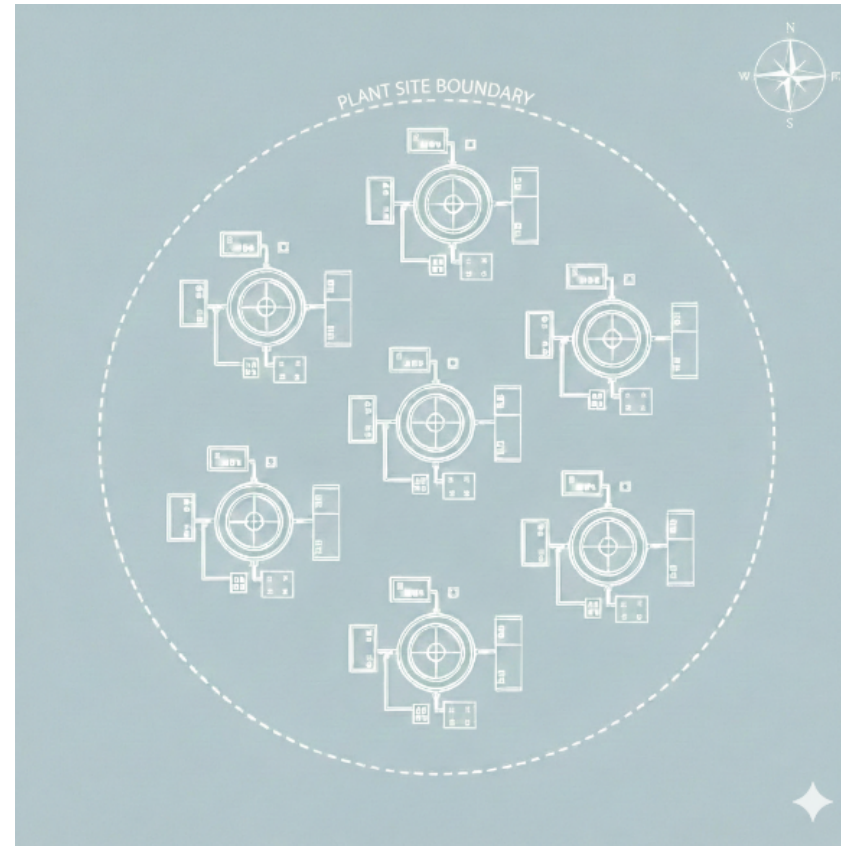


Figure 12-6 Schematic Representation of Multi-Unit Site with Shared SSCs Relative to Site Boundary (Draft NUREG-2271)

Exercise #3

Considerations for FOAK to NOAK Framework Transitions

- Framework Transition & "Generic Finality" (FOAK to NOAK)
- Use of issue finality or early site permit

Early Site Permits (ESPs) & Multi-Site Deployment Interfaces

- **Statement:** While standard 10 CFR Part 52 Early Site Permits resolve certain site safety and environmental issues for specific locations, Part 57 introduces streamlined regional/multi-site deployment pathways and general construction authorizations.
- **Discussion Prompt:** How can developers leverage existing or broad-envelope ESPs alongside Part 57's multi-site licensing options to accelerate NOAK deployment across varying geographic regions?

Framework Transition & "Generic Finality" (FOAK to NOAK)

- **Statement:** FOAK microreactor designs licensed under Parts 50, 52, or 53 establish baseline design and operational and information, but NOAK deployment models under Part 57 rely heavily on "generic finality" and standardized approvals to achieve high-volume manufacturing.
- **Discussion Prompt:** What operational information and safety evidence could an applicant gather during FOAK to successfully transfer approved design elements into Part 57's generic finality framework?



Next Workshop
Leveraging DOE Authorizations
Wednesday, October 28, 2026