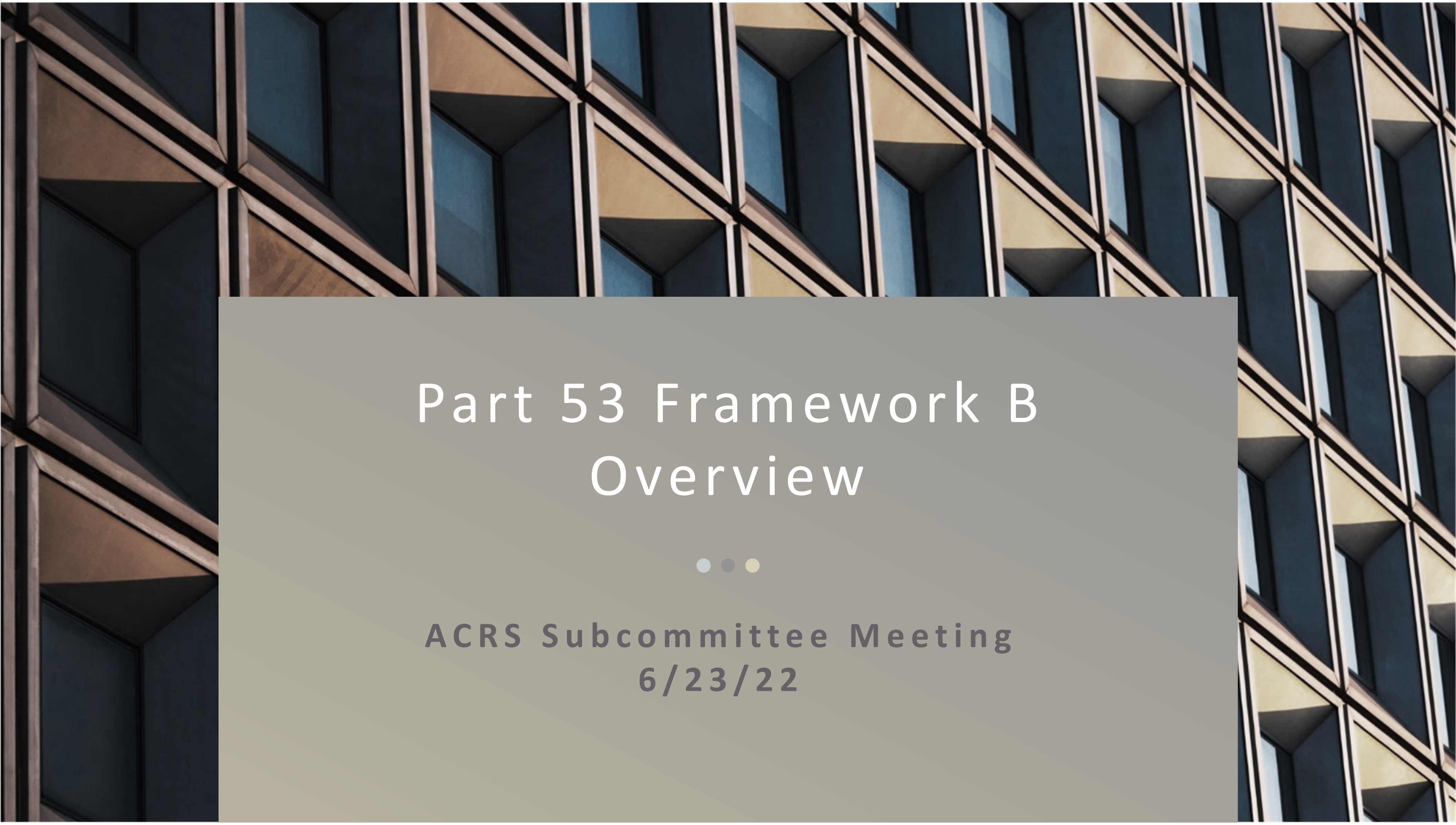
# Advisory Committee on Reactor Safeguards (ACRS) Regulatory Rulemaking, Policies and Practices: Part 53 Subcommittee

**10 CFR Part 53 "Licensing and Regulation of Advanced Nuclear Reactors"**

**June 23-24, 2022**



# Part 53 Framework B Overview

**ACRS Subcommittee Meeting**
**6/23/22**

# Agenda

- Overview of Part 53 Structure
- Comparison of Part 53 Frameworks
- Framework B Development Approach
- Framework B Subparts Overview
- Guidance Development
- Framework Merger
- Next Steps

# Background

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

# Part 53 Licensing Frameworks

Subpart A - General Provisions

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

**Framework A**

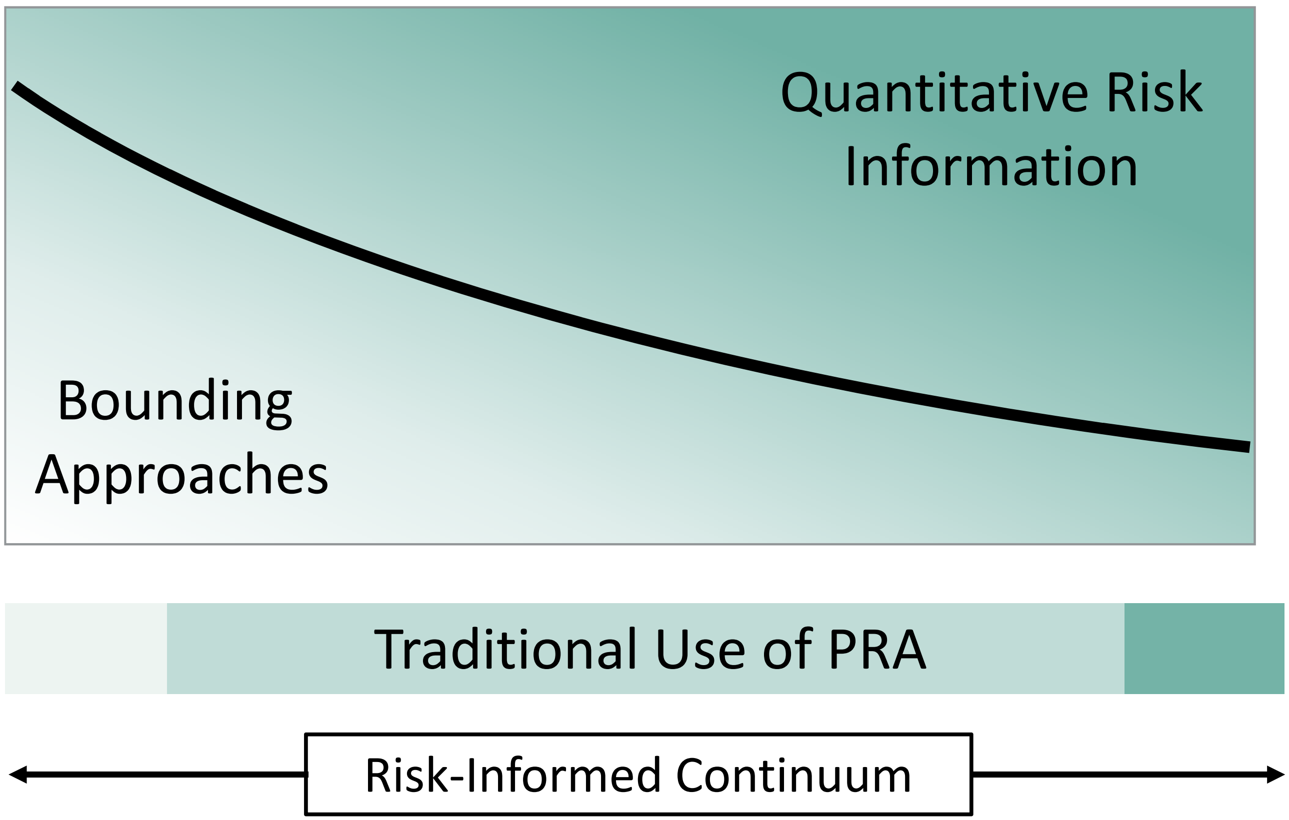
- PRA-led approach
- Functional design criteria

Subpart N - Definitions
Subpart O - Construction/Manufacturing
Subpart P - Operations
Subpart Q - Decommissioning
Subpart R - Application Requirements
Subpart S - License Maintenance
Subpart T - Reporting
Subpart U - Quality Assurance

**Framework B**

- Traditional use of risk insights
- Principal design criteria
- Includes an Alternative Evaluation for Risk Insights (AERI) approach

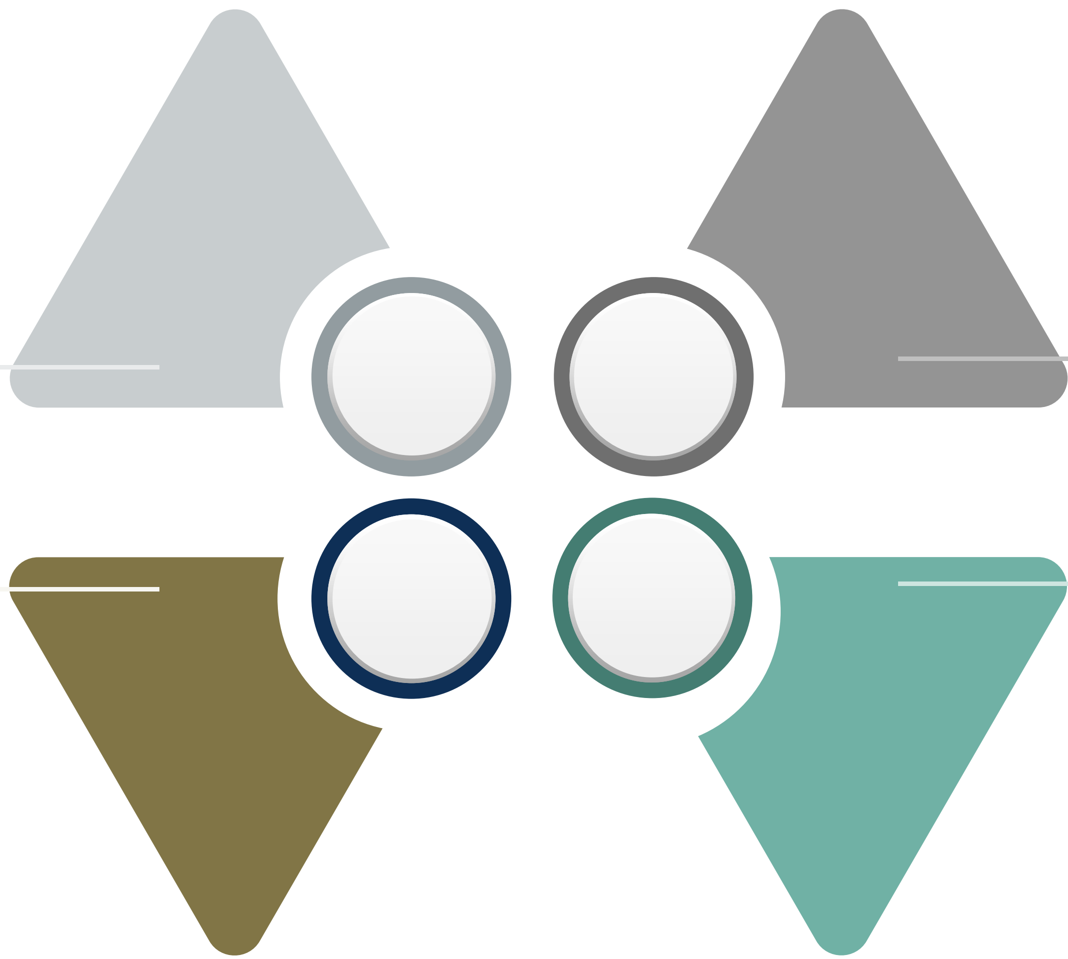
# Part 53 Licensing Frameworks



# Part 53 Subpart Comparison

| Subpart Title | Framework A Subpart | Framework B Subpart |
|---|---|---|
| **General Provisions** | Subpart A (Common) | |
| **Technology-Inclusive Safety Requirements** | Subpart B | - |
| **Design and Analysis Requirements** | Subpart C | |
| **Siting Requirements** | Subpart D | (Part 100) |
| **Definitions** | - | Subpart N |
| **Construction and Manufacturing Requirements** | Subpart E | Subpart O |
| **Requirements for Operation** | Subpart F | Subpart P |
| **Decommissioning Requirements** | Subpart G | Subpart Q |
| **Licenses, Certifications, and Approvals** | Subpart H | Subpart R |
| **Maintaining and Revising Licensing Basis Information** | Subpart I | Subpart S |
| **Reporting and Other Administrative Requirements** | Subpart J | Subpart T |
| **Quality Assurance Criteria** | Subpart K | Subpart U |

# Framework B Development Approach



**Incorporate Applicable Existing Part 53 Framework Innovations**

**Leverage Part 50 and 52 Rule Language**

**Consider Compatibility with International Standards**

**Develop Unique Rule Language**

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

# Subpart N – Definitions

- Definitions specific to Framework B
    - Anticipated operational occurrence (AOO)
    - Design bases
    - Reactor coolant pressure boundary
    - Safety-related structures, systems, and components (SSCs)

- Common definitions remain in Subpart A (§ 53.020)

## Subpart O – Construction and Manufacturing Requirements

- Parallel structure and content to Framework A Subpart E
- Variations largely limited to conforming changes needed to adapt Framework A provisions to Framework B

# Subpart P – Requirements for Operation

| | |
|---|---|
| § 53.4210 | Maintenance, repair, and inspection programs. |
| § 53.4213 | Technical specifications. |
| §§ 53.4220 - 53.4299 | General staffing, training, personnel qualifications, and human factors requirements. |
| § 53.4300 | Programs. |
| § 53.4310 | Programs: Radiation protection. |
| § 53.4320 | Programs: Emergency preparedness. |
| § 53.4330 | Programs: Security programs. |
| § 53.4340 | Programs: Quality assurance. |
| § 53.4350 | Programs: Fire protection. |
| § 53.4360 | Programs: Inservice inspection/inservice testing. |
| § 53.4380 | Programs: Environmental qualification of electric equipment |
| § 53.4390 | Programs: Procedures and guidelines. |
| § 53.4400 | Programs: Integrity assessment program. |
| § 53.4410 | Programs: Primary containment leakage rate testing program. |

# Subpart P – Requirements for Operation

- Maintenance, repair, and inspection programs generally aligned with § 50.65
- Programs
  - Security, Emergency Preparedness, Radiation Protection requirements aligned with Framework A
  - Environmental qualification of electrical equipment derived from § 50.49
  - Integrity Assessment Program translated from Framework A, with changes to reflect SSC classification scheme in Framework B
  - Requirements for procedures and guidelines translated from Framework A
  - Inservice inspection/inservice testing requirements acknowledge existing requirements for light water reactors (LWRs); non-LWRs must meet Framework A requirements
  - Containment leak rate requirements from Part 50 (§ 50.54(o))

# Subpart P – Requirements for Operation

**Technical Specifications**

- Requirements in § 53.4213 generally aligned with § 50.36
- Limiting Conditions for Operation (LCOs)
  - Modifications made to Criteria 1 and 3 to ensure technology-inclusiveness
    - Requirements for detection/indication of reactor coolant pressure boundary degradation maintained for water-cooled reactors
    - Functional containment requirements used to drive LCOs for other technologies
  - No changes to Criteria 2 and 4 from § 50.36(c)(2)(ii)
- No material changes to other requirements in § 53.4213 that were translated from § 50.36 (e.g., surveillance requirements, design features, administrative controls, decommissioning)

# Subpart P – Requirements for Operation

**Fire Protection**

- Combination of § 50.48, Appendix R, and NFPA 805 Chapter 3
  - All requirements are contained in "in-line" rule text
    - No appendices in Part 53
    - No cross-references back to Parts 50 or 52
- Provision for performance-based alternatives to detailed requirements with NRC approval
  - Similar to § 50.48(c)(2)(vii) and § 50.48(c)(4)
  - Must demonstrate achievement of safe and stable state, safety margin, defense-in-depth
- No fire PRA required, but may be useful in performance-based justifications

# Subpart P – Requirements for Operation

**Fire Protection**

- Technology neutral
  - Designers must define the "safe and stable state" for their design
  - Designers must determine the safe shutdown functions to achieve and maintain safe and stable state
- Written for new designs and implementations
  - Compromises needed to license plants that existed prior to the rule have been removed
    - No allowance for repairs to needed safe shutdown equipment
    - No allowance for operator actions to achieve safe and stable state
    - Some of this flexibility may be available through performance-based alternatives

# Subpart P – Requirements for Operation

**Staffing, Training, Personnel Qualifications, and Human Factors**

- Analysis by staff identified that essentially all Framework A, Subpart F provisions for staffing, human factors engineering (HFE), and the licensing of senior reactor operators (SROs) and reactor operators (ROs) were suitable for inclusion in Framework B, Subpart P
- Importantly, the technical requirements in the areas of Concept of Operations, Functional Requirements Analysis, and Function Allocation provide a means of providing the necessary human-systems design insights needed to facilitate the use of similar flexibilities under either Framework
- Subpart P adopts most requirements from Subpart F via cross-references or copying requirements with changes; structures of each are similar
- Features of Subpart P that are different than what was presented under the first iteration of Subpart F will be discussed here, as well as differences between the two subparts in their current versions

# Subpart P – Requirements for Operation

**Staffing, Training, Personnel Qualifications, and Human Factors (cont'd)**

- NEW: the staffing plan required in § 53.4226(f) must include a description of how "engineering expertise" will be available to support the on-shift operating personnel during all plant conditions
- Engineering expertise requirement:
  - Common to Subparts F and P
  - For all types of Part 53 plants, regardless of licensed operator category
  - To assist the on-shift crew with uncertainties - situations not covered by training or procedures
  - Must have qualifying degree/professional engineering license and familiarity with facility operation
  - Offers flexibility: could be met by someone filling a traditional shift technical advisor (STA) role or engineering expertise provided from offsite

# Subpart P – Requirements for Operation

**Staffing, Training, Personnel Qualifications, and Human Factors (cont'd)**

Several other differences exist between Subpart P provisions and those discussed in the first iteration of Subpart F; these include the changes summarized below that are now common within the current versions of Subparts F and P:

- Load Following
  - Allowance for load following expanded to include process heat use such as for desalination, hydrogen production, and district heating
- Change Control
  - Changes to approved programs permitted based on specific criteria
- Simulator HFE testbed requirements
  - Removed; to be covered via guidance instead (current status quo)

# Subpart P – Requirements for Operation

**Staffing, Training, Personnel Qualifications, and Human Factors (cont'd)**

- Primary difference between current versions of Subparts P and F stems from their differing provisions for operator licensing
- Subpart F provisions for alternatives to using licensed ROs and SROs are <u>not</u> currently included in Subpart P
- Staff continues to evaluate the suitability of including such staffing alternatives in Subpart P; this includes giving consideration to those plants applying the AERI process
- Provisions for alternatives to using licensed ROs and SROs have been extensively revised within the second iteration of Subpart F and will be discussed in detail during the 6/24 session
- Other changes to Subpart F that are consistent with requirements discussed for Subpart P today will be summarized during the 6/24 session

# Subpart Q – Decommissioning Requirements

- Parallel structure and content to Framework A Subpart G
- Variations largely limited to conforming changes needed to adapt Framework A provisions to Framework B

# Subpart R – Licenses, Certifications, and Approvals

| | |
|---|---|
| § 53.4700 | General Provisions. |
| § 53.4725 | Standards for review. |
| **§ 53.4730** | **General technical requirements.** |
| § 53.4731 | Risk-informed classification of structures, systems, and components. |
| § 53.4740 | Limited work authorizations. |
| § 53.4750 | Early site permits. |
| § 53.4800 | Standard design approvals |
| § 53.4830 | Standard design certifications. |
| § 53.4870 | Manufacturing licenses. |
| § 53.4900 | Construction permits. |
| § 53.4960 | Operating licenses. |
| § 53.5010 | Combined licenses. |

# Subpart R – Licenses, Certifications, and Approvals

- Subpart R developed to parallel Subpart H in Framework A
  - Covers all application types (e.g., Construction Permit (CP), Operating License (OL), Combined License (COL))
  - Process-related requirements (e.g., duration of a license) similar or the same between frameworks
  - Technical contents of application structures derived from Parts 50 and 52 and represent primary differentiator between Subparts H and R
  - Includes § 53.4731 that parallels § 50.69 regarding risk-informed SSC classification

# Subpart R – Licenses, Certifications, and Approvals

## *§ 53.4730: General Technical Requirements*

- Technical content of application requirements consolidated in § 53.4730
    - Reduces rule length
    - Minimizes the potential for requirements to diverge between application types

Application Type

§ 53.4730(a) Requirement

| | COL | OL | CP | ML | DC | SDA | ESP |
|---|---|---|---|---|---|---|---|
| (1) | X | X | X | X | X | X | X |
| (2) | X | X | X | X | X | X | X |
| (3) | X | X | | X | X | X | |
| … | | | | | | | |
| (37) | X | X | X | X | X | X | X |

# Subpart R – Licenses, Certifications, and Approvals
## *§ 53.4730: General Technical Requirements*

Many § 53.4730 requirements derived directly from COL technical contents of application in § 52.79

| | |
|---|---|
| (a)(7) | Combustible gas control. |
| (a)(12) | Post-accident radiation monitoring and protection. |
| (a)(19) | Organizational structure. |
| (a)(21) | Pre-operational testing and initial start-up. |
| (a)(22) | Normal operations and maintenance. |
| (a)(24) | Fitness-for-duty programs. |
| (a)(25) | Multi-unit sites. |
| (a)(26) | Technical qualifications. |
| (a)(33) | Minimization of contamination. |
| (a)(37) | Water-cooled reactor requirements. |

# Subpart R – Licenses, Certifications, and Approvals
## *§ 53.4730: General Technical Requirements*

Several § 53.4730 requirements modified from § 52.79 to ensure technology-inclusiveness

| | |
|---|---|
| (a)(1) | Site safety analysis. |
| (a)(2) | Facility description. |
| (a)(4) | Design bases and principal design criteria. |
| (a)(21) | Pre-operational testing and initial start-up. |
| (a)(35) | Aircraft impact assessment. |

# Subpart R – Licenses, Certifications, and Approvals
## *§ 53.4730: General Technical Requirements*

Several Subpart P programs referenced in § 53.4730

| | |
|---|---|
| (a)(6) | Fire protection. |
| (a)(8) | Environmental qualification of electric equipment important to safety. |
| (a)(9) | Role of personnel. |
| (a)(10) | Maintenance rule. |
| (a)(11) | Effluent control. |
| (a)(15) | Emergency plans. |
| (a)(23) | Technical specifications. |
| (a)(27) | Training program. |
| (a)(28) | Physical security program. |
| (a)(31) | Radiation protection. |

# Subpart R – Licenses, Certifications, and Approvals

## *§ 53.4730(a)(5): Accident Analyses and Initiating Events*

- Goal was to provide an equivalent level of safety by developing technology-inclusive analogs to applicable Part 50 and 52 requirements.

- Leveraged previously developed language from the “Part 5X” effort.
  - Part of the motivation was to provide an approach that better aligned with international regulatory paradigms, as appropriate and consistent with Commission policy.

- Preliminary Proposed rule language maintains top-level acceptance criteria from Part 50 and 52.

# Subpart R – Licenses, Certifications, and Approvals
# *§ 53.4730(a)(5): Accident Analyses and Initiating Events*

**(i) Analysis and Evaluation:** From § 52.79(a) with modifications to support technology-inclusiveness and Framework B event classifications.

**(ii) Design Basis Accidents (DBAs)**: Technology-inclusive requirements for DBA analyses and SSC classification drawing from §§ 50.34(a)(4) and 50.46.

**(iii) AOOs:** Consistent with existing requirements including Part 20 acceptance criteria

**(iv) Beyond Design Basis Events (BDBEs)**: Technology-inclusive requirements for relevant BDBEs and analysis requirements for other BDBEs, drawn from Anticipated Transients Without Scram (ATWS)/Station Black Out(SBO) rulemakings; similar to international defense-in-depth requirements.

**(v) Severe Accidents**: Derived from § 52.79(a)(38), with modifications to support technology-inclusiveness

**(vi) Chemical Hazards**: Derived from Framework A to address potential chemical hazards associated with licensed material

# Subpart R – Licenses, Certifications, and Approvals

## *§ 53.4730(a)(36): Functional Containment*

Requirements split to acknowledge differences between non-LWR and LWR approaches to containment

- For non-LWRs, § 53.4730(a)(36)(i) addresses:
  - Set of barriers used to meet requirements for AOOs, DBAs, and siting criteria (functional containment)
  - Safety classification (i.e., safety-related) and qualification of SSCs making up functional containment barriers
- For LWRs, § 53.4730(a)(36)(ii) addresses the need for a leak-tight primary containment that:
  - Meets the requirements of Part 50 Appendix J (also addressed in Subpart P)
  - Addresses any technically relevant requirements from LWR operating experience (containment isolation systems, penetrations, venting/purging)

# Subpart R – Licenses, Certifications, and Approvals

## *Assessing Risk in Framework B*

- Risk insights support or complement deterministic analyses, consistent with traditional approach
- Includes requirement to provide a description of the plant-specific PRA and its results translated to Framework B

**§ 52.79(a)(44) → § 53.4730(a)(34)(i)**

- Optional alternate risk evaluation for applicants that meet the criteria in § 53.4730(a)(34)(ii)
    - No PRA required
    - Implicitly demonstrates that quantitative health objectives (QHOs) are met, searches for severe accident vulnerabilities, and provides risk insights without a requirement for a PRA
    - Inherently addresses the mitigation of beyond-design-basis events requirements when AERI entry criteria are met
    - Cannot implement risk-informed applications if AERI approach is used
- Risk evaluations (PRA or AERI) must be maintained consistent with requirements in Subpart S (§ 53.6052, informed by § 50.71(h))

# Subpart S – Maintaining and Revising Licensing Basis Information

- Parallel structure and content to Framework A Subpart I

- Notable differentials
  - § 53.6010, *Application for amendment of license*
  - § 53.6040, *Updating licensing basis information and determining the need for NRC approval*
  - § 53.6045, *Updating final safety analysis reports*
  - § 53.6050, *Evaluating changes to facility as described in final safety analysis reports*
  - § 53.6052, *Maintenance of risk evaluations*

- Remaining variations largely limited to conforming changes to adapt Framework A provisions to Framework B

# Subpart T – Reporting and Other Administrative Requirements

- Parallel structure and content to Framework A Subpart J
- Notable differentials
  - § 53.6320(e) added to align with state-of-practice policy initiative on reporting requirement for fee purposes
  - § 53.6330, *Immediate notification requirements for operating commercial nuclear plants*, aligned with § 50.72
  - § 53.6340, *Licensee event report system*, aligned with § 50.73
- Remaining variations largely limited to conforming changes to adapt Framework A provisions to Framework B

# Subpart U – Quality Assurance

- Subpart U parallels structure and content of Framework A Subpart K
- Closely aligned with 10 CFR Part 50 Appendix B (18 criteria)
- Exception: § 53.6635, *Control of Purchased Material, Equipment and Services* (10 CFR Part 50 Appendix B Criterion VII)
    - “Commercial nuclear plant” used in lieu of “nuclear power plant”
    - Ensures consistency with terminology throughout Part 53

# Framework B Guidance Development

Many Framework A and B guidance development activities are linked

May involve updates or supplements to existing guidance covering existing regulatory frameworks

Guidance for technical content of application requirements now part of Advanced Reactor Content of Application Project effort

# Areas of Focus for Merger of Frameworks A and B

**Ensure consistency between parallel provisions**

**Evaluate other provisions for potential alignment**

- Siting
- Seismic Design Criteria
- Requirements for Operation

**Commonalities in Subpart A**

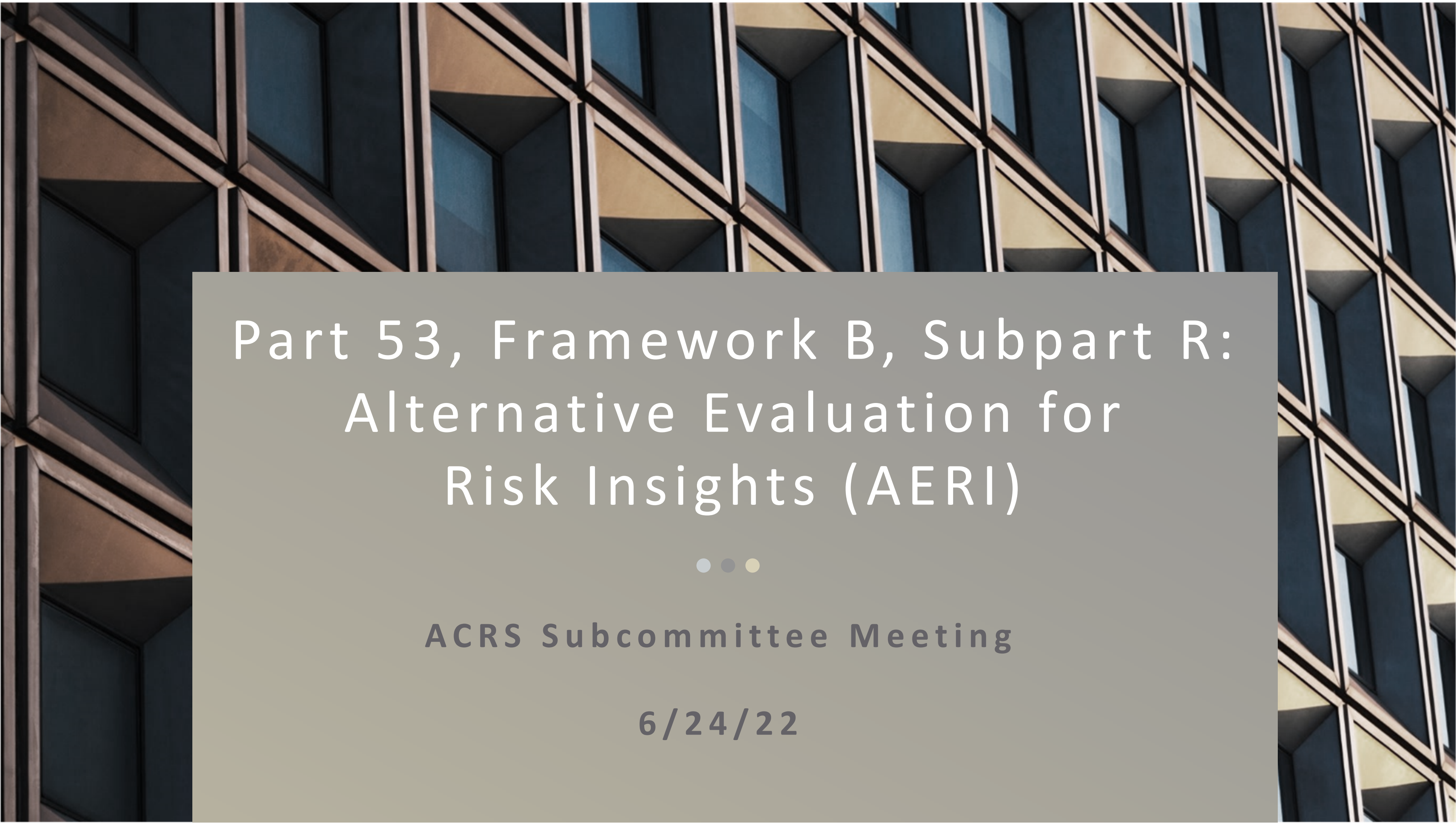
- Definitions
- General Provisions

**Continue consideration of stakeholder feedback**

# Next Steps

- Advisory Committee on Reactor Safeguards
  - Full Committee: July 6 - 9, 2022
- Advanced Reactor Public Stakeholder Meeting: June 30, 2022
- Commission Meeting: July 21, 2022

# Final Discussion and Questions



# Part 53, Framework B, Subpart R: Alternative Evaluation for Risk Insights (AERI)

**ACRS Subcommittee Meeting**

**6/24/22**

# Agenda

- Evolution of Graded PRA Tasking - Katie Wagner
- Proposed AERI Entry Condition - Marty Stutzke
- Technology-Inclusive Identification of Licensing Events for Commercial Nuclear Plants - Mihaela Biro
- AERI Framework - Alissa Neuhausen
- Next Steps - Katie Wagner

# Introductions

- **Marty Stutzke** – Technical Lead of the Graded PRA Working Group, Senior Technical Advisor for Probabilistic Risk Assessment, Division of Advanced Reactors and Non-power Production and Utilization Facilities (DANU), Office of Nuclear Reactor Regulation (NRR)
- **Mihaela Biro** – Principal Author of Pre-decisional Draft Regulatory Guide DG-1413, "Technology-Inclusive Identification of Licensing Events for Commercial Nuclear Plants," Senior Reliability and Risk Analyst, Division of Risk Assessment (DRA), NRR
- **Alissa Neuhausen** – Principal Author of Pre-decisional Draft Regulatory Guide DG-1414, "Alternative Evaluation for Risk Insights (AERI) Framework," Reliability and Risk Analyst, DRA, NRR
- **Katie Wagner** – Project Manager of the Graded PRA Working Group, Project Manager, DANU, NRR

# The Graded PRA Working Group Membership

Project Manager

- Katie Wagner, NRR/DANU

Technical Lead

- Marty Stutzke, NRR/DANU

Working Group Members

- Hosung Ahn, on rotation from NRR/Division of Engineering and External Hazard
- Mihaela Biro, NRR/DRA – Principal Author of PDG-1413
- Anne-Marie Grady, NRR/DRA
- Matt Humberstone, Office of Nuclear Regulatory Research (RES)/DRA
- Ian Jung, NRR/DANU
- Alissa Neuhausen, NRR/DRA – Principal Author of PDG-1414
- Hanh Phan, NRR/DANU
- Sunil Weerakkody, NRR/DRA
- Robert Budnitz, consultant

Management/Coordination

- Candace de Messieres, NRR/DANU
- Steve Lynch, NRR/DANU
- Nathan Sanfilippo*
- John Segala, NRR/DANU

*Former NRC employee

# Alternative Evaluation for Risk Insights (AERI)

- Evolved from the staff's "graded PRA" initiative starting in Spring 2021
  - Began with intent to grade the technical content of the PRA
  - Moved to grading the uses of the PRA in the design and licensing process
    - PRA in an enhanced/leading role
    - PRA in a supporting/confirmatory/traditional role
- Various names have been used to describe the concept:
  - Dose/consequence-based approach
  - Technology-inclusive, risk-informed maximum accident (TIRIMA) approach
  - Part 53-BE (bounding event)
  - AERI

# Uses of Probabilistic Risk Assessment

- The Policy Statement on the Regulation of Advanced Reactors (73 FR 60612; October 14, 2008) references three PRA-related policy statements:
  - Safety Goals for the Operation of Nuclear Power Plants (51 FR 28044; August 4, 1986, as corrected and republished at 51 FR 30028; August 21, 1986)
    - ⇨ Meet the QHOs
  - Severe Reactor Accidents Regarding Future Designs and Existing Plants (50 FR 32138; August 8, 1985)
    - ⇨ Search for severe accident vulnerabilities
  - Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities (60 FR 42622; August 16, 1995)
    - ⇨ Identify risk insights

- The AERI approach and two pre-decisional draft regulatory guides (PDGs) have been developed to:
  - Clarify for potential applicants the logic and the expectations of the NRC staff
  - Provide sufficient risk information to inform licensing decisions
  - Address related ACRS recommendations

# ACRS Recommendations

- October 7, 2019 - Letter concerning review of draft SECY paper, "Population – Related Siting Considerations for Advanced Reactors," ML19277H071:
  - Need to examine new designs with a clean sheet of paper.
  - Think carefully about the failures and combinations of failures that could occur.
  - Must remain vigilant and remember that nature provides surprises.
  - Creative thinking will be required to identify such unique situations, to thoroughly identify the scenarios that will be the basis of the safety analysis and the source of releases, and to evaluate the suitability of sites.
- October 20, 2020 - Letter concerning 10 CFR Part 53, ML20091L698:
  - Compensate for novel designs with uncertainties due to incompleteness in the knowledge base by performing systematic searches for hazards, initiating events, and accident scenarios with no preconceptions that could limit the creative process.
- May 5, 2021 - Letter concerning Part 53, ML21140A354:
  - Compensate for novel designs with uncertainties due to incompleteness in the knowledge base by performing systematic searches for hazards, initiating events, and accident scenarios with no preconceptions that could limit the creative process.
- October 26, 2021 - Letter concerning Regulatory Guide (RG) 1.247, ML21288A018:
  - Include guidance that the initial search for initiating events and scenarios should be done without preconceptions or using existing lists.

# The Original Approach to Identifying Licensing Events

To avoid the very real and very great danger of an accidental release of radioactivity from a reactor, our committee established a simple procedure: We asked the planner of each reactor to imagine the worst possible accident and to design safety apparatus guaranteeing that it could not happen. The committee reviewed each reactor plan, trying to imagine an accident even greater than that conceived by the planner. If we could think of a plausible mishap worse than any discussed by the planner, his analysis of the potential dangers was considered inadequate.

Edward Teller*
First chair of the Atomic Energy Commission (AEC)
Reactor Safeguards Committee (1947-1949)

*Teller, Edward with Allen Brown, *The Legacy of Hiroshima*, Double Day & Company, Garden City, NY, 1964.

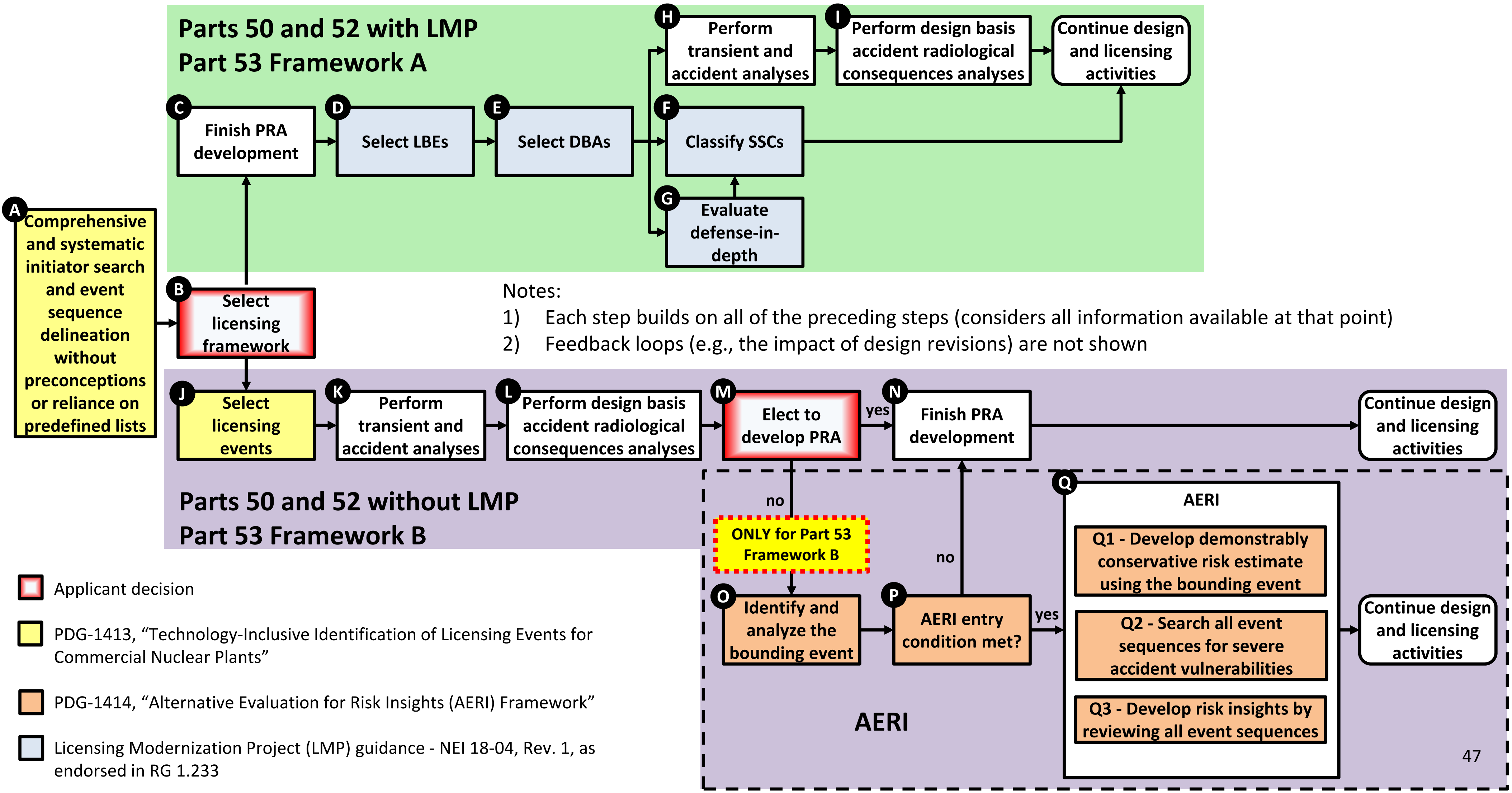
# Recognized Problems with the Original Approach to Identifying Licensing Events

It is inherently impossible to give an objective definition or specification for "credible accidents" and thus the attempt to identify these for a given reactor entails some sense of futility and frustration, and, further, it is never entirely assured that all potential accidents have been examined…It should be noted parenthetically, however, that this systematic search for credible accidents often contributes substantially to the safety of a facility…In the plants finally approved for operation, there are no really credible potential accidents against which safeguards have not been provided to such extent that the calculated consequences to the public would be unacceptable.

Clifford K. Beck, AEC, 1959*

*Beck, Clifford K., TID-7579, "Safety Factors to be Considered in Reactor Siting," Sixth International Congress and Exhibition of Electronics and Atomic Energy, Rome, Italy, 1959. Available at https://www.osti.gov/biblio/4200786-sixth-international-congress-exhibition-electronics-atomic-energy-rome-italy-june-papers.

# Licensing Frameworks – Risk Evaluation Perspective




Notes:

1) Each step builds on all of the preceding steps (considers all information available at that point)
2) Feedback loops (e.g., the impact of design revisions) are not shown

Applicant decision

PDG-1413, "Technology-Inclusive Identification of Licensing Events for Commercial Nuclear Plants"

PDG-1414, "Alternative Evaluation for Risk Insights (AERI) Framework"

Licensing Modernization Project (LMP) guidance - NEI 18-04, Rev. 1, as endorsed in RG 1.233

# Proposed AERI Entry Condition

**§ 53.4730(a)(34) *Description of risk evaluation*.**
A description of the risk evaluation developed for the commercial nuclear plant and its results. The risk evaluation must be based on:

(i) A PRA, or

(ii) An AERI, provided that the dose from a postulated bounding event to an individual located 100 meters (328 feet) away from the commercial nuclear plant does not exceed 1 rem total effective dose equivalent (TEDE) over the first four days following a release, an additional 2 rem TEDE in the first year, and 0.5 rem TEDE per year in the second and subsequent years.

- Provides plants with flexibility in establishing their exclusion area boundaries (EABs) if the bounding event's source term is small.
- The 100-meter criterion was back-calculated from a scoping consequence model:
  - 50-year dose at 100 meters = 27.5 rem TEDE
  - Conditional individual latent cancer fatality risk (CILCFR) = 2 x $10^{-6}$ per event
  - Meet the QHO without developing a PRA to credit accident frequency in the risk estimate
- The AERI entry condition is <u>not</u> a safety or siting criterion.

# Derivation of AERI Entry Condition (1 of 7)

1

Risk, $R$, is the sum of the products of frequency, $f_i$, and consequence, $c_i$, over the set of delineated event sequences.

$$R = \sum f_i c_i$$

2

Suppose we can identify a bounding event.

$$c_{max} = \max(c_1, c_2, \dots, c_n)$$

3

Then we can bound the risk.

$$R \leq \left(\sum f_i\right) c_{max}$$

4

$\sum f_i$ = sum of the initiating event frequencies
≈ 1/plant-year, based on large LWR history

This demonstrably conservative approach eliminates the need to estimate the individual event sequence frequencies by developing a PRA.

# Derivation of AERI Entry Condition (2 of 7)

5

- There are two QHOs:
  - Individual early fatality risk (IEFR) within 1 mile of the site
  - Individual latent cancer fatality risk (ILCFR) within 10 miles of the site
- The Safety Goal Policy Statement specifies the distances to be used.
- Justification for these values is provided in NUREG-0880, Rev. 1, pp. 30-31.

$$IEFR \leq 5 \times 10^{-7}/y$$
$$ILCFR \leq 2 \times 10^{-6}/y$$

6

Focus on ILCFR:

- Part 53, Framework B has been developed to provide the same level of safety as currently operating plants.
- The State-of-the-Art Reactor Consequence Analysis studies indicate that IEFR is essentially zero for large LWRs.

$c_{max}$ = conditional latent cancer fatality risk, $CILCFR$, of the bounding event

$$ILCFR \leq \frac{1}{year} \times CILCFR \leq 2 \times 10^{-6}/y$$

7

$E[N_{LC}]$ = expected number of latent cancer fatalities within 10 miles of the site over 50 years following occurrence of the bounding event

$N_T$ = total population within 10 miles of the site

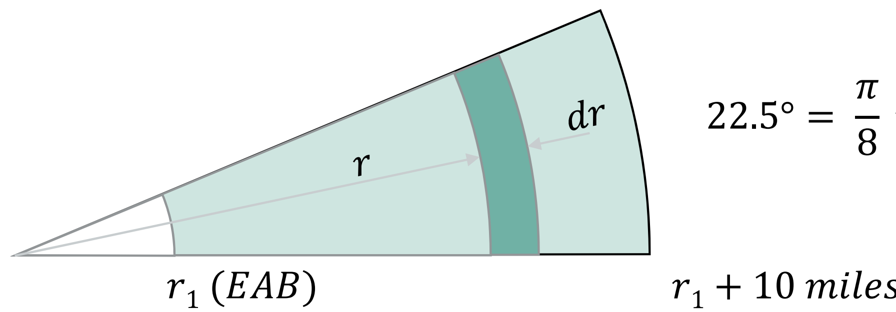
$$\text{CILCFR} = \frac{E[N_{LC}]}{N_T}$$

# Derivation of AERI Entry Condition (3 of 7)

**8**

Assume that the plume is confined to one of sixteen 22.5-degree sectors.

$E[N_{LC}]$ = expected number of latent cancer fatalities in the 10-mile, 22.5° sector over 50 years following occurrence of the bounding event




$$22.5° = \frac{\pi}{8}\ radians$$

**9**

Assume a uniform population density, $\rho$.

This assumption eliminates the need to consider the wind direction

# Derivation of AERI Entry Condition (4 of 7)

**10**

On a differential basis, the number of latent cancer fatalities is a random variable that is characterized by a binomial probability distribution:

$$dN_{LC} \sim Binomial[p_{LC}(r), dN(r)]$$

Accordingly, the expected (mean) value is:

$$E[dN_{LC}] = p_{LC}(r) \cdot dN(r)$$

$p_{LC}(r)$ = probability that an individual located at distance r dies within 50 years

$dN(r)$ = differential number of individuals in the 22.5° sector that are located between r and r + dr

**11**

Apply the linear no-threshold (LNT) model, which relates cumulative radiation exposure to latent cancer fatality risk.

$$p_{LC}(r) = \lambda \cdot D(r)$$

The Commission affirmed the NRC's use of the LNT model in SRM-SECY-19-0008, July 16, 2021.

$\lambda$ = risk coefficient (per rem)

≈ $6 \times 10^{-4}$ according to BEIR-VII*

$D(r)$ = 50-year dose at distance r (rem)

*National Research Council. 2006. Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2. Washington, DC: The National Academies Press.

# Derivation of AERI Entry Condition (5 of 7)

**12**

Assume a power-law dose vs. distance model:

$$D(r) = D_0 \left(\frac{r_0}{r}\right)^{1.5}$$

The subscript "0" refers to an arbitrary reference location and dose.

Consistent with NUREG-0396, "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants," November 1978.

**13**

$$E[N_{LC}] = \int_{r_1}^{r_1+10} p_{LC}(r) \cdot dN(r)$$

Integrate over the 10-mile area surrounding the site.

$$= \int_{r_1}^{r_1+10} \lambda D_0 \left(\frac{r_0}{r}\right)^{1.5} \cdot \rho \cdot \frac{1}{16} \cdot 2\pi r dr$$

Apply the uniform population density, LNT, and power-law dose vs. distance assumptions.

$$= \frac{\pi\rho\lambda D_0 r_0^{1.5}}{4}\left(\sqrt{r_1+10} - \sqrt{r_1}\right)$$

$E[N_{LC}]$ = expected number of latent cancer fatalities in the 10-mile, 22.5° sector over 50 years following occurrence of the bounding event

# Derivation of AERI Entry Condition (6 of 7)

**14**

The total population in the 10-mile area is:

$$N_T = \rho \cdot \pi[(r_1 + 10)^2 - r_1^2]$$
$$= 20\rho\pi(r_1 + 5)$$

Apply the uniform population density assumption.

**15**

$$CILCFR = \frac{\lambda D_0 r_0^{1.5}}{80} \cdot \frac{\left(\sqrt{r_1 + 10} - \sqrt{r_1}\right)}{r_1 + 5}$$

Scoping consequence model.

Note: $CILCFR$ decreases as $r_1$ increases.

**16**

$$CILCFR \leq \frac{\lambda D_0 r_0^{1.5}\sqrt{10}}{400} \leq QHO$$

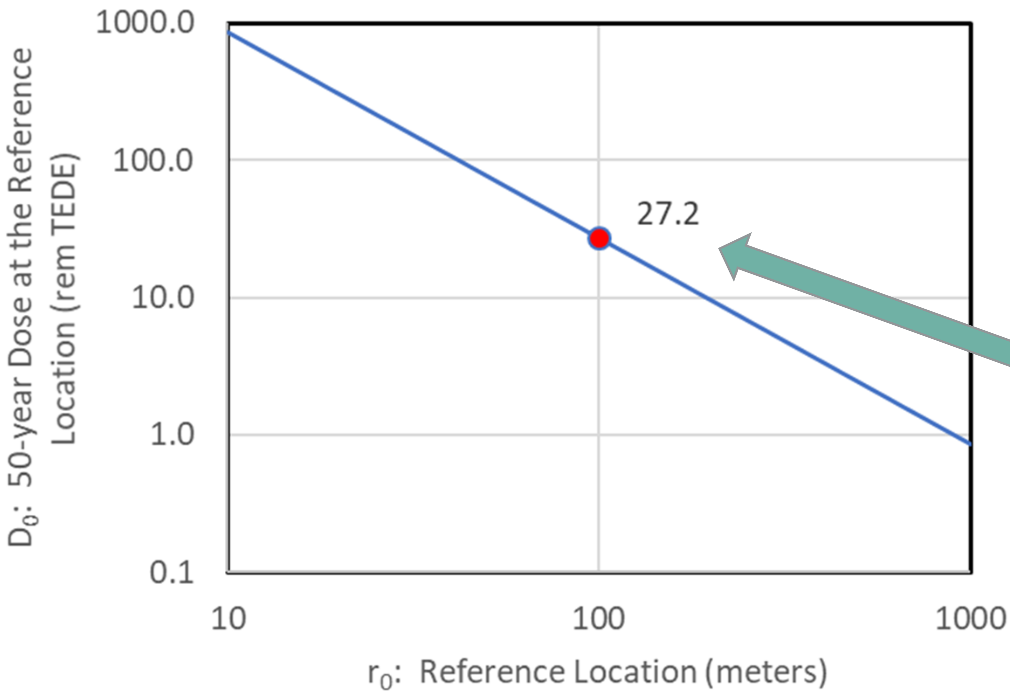
Upper bound of the scoping consequence model

$$D_0 r_0^{1.5} \leq \frac{400 \cdot QHO}{\sqrt{10}\lambda} \approx 0.422$$

Criterion for the reference point

# Derivation of AERI Entry Condition (7 of 7)

17




| Dose (rem TEDE) | Condition |
|---|---|
| 1 | First 96 hours |
| 2 | Additional dose during the 1st year |
| 0.5 x 49 = 24.5 | Additional dose during the second and subsequent years |
| 27.5 | TOTAL |

**Note: The reference location is not necessarily the same as the EAB**

# Technology-Inclusive Identification of Licensing Events for Commercial Nuclear Plants (PDG-1413)

- Formatted like a regulatory guide; currently a pre-decisional draft regulatory guide
- Section A: Applies to LWRs and non-LWRs licensed under Parts 50, 52, and 53 (Frameworks A and B)
- Section B (Discussion):
  - Identifies licensing events for each licensing framework
  - Provides historical perspectives (early licensing, development of the standard review plan (SRP))
  - Addresses ACRS recommendations to "start with a blank sheet of paper" (10/7/2019, 10/21/2020, 5/30/2021, and 10/26/2021)
- Section C (Staff Guidance) provides an integrated approach for:
  - Conducting a systematic and comprehensive search for initiating events
  - Delineating a systematic and comprehensive sets of event sequences
  - Grouping the lists of initiating events and event sequences into licensing events
- Appendix A (Comprehensive Search for Initiating Events):
  - Reviews techniques for searching for initiating events and points the user to helpful references
  - Does not endorse or recommend any specific technique

# Licensing Event Refers to the Designated Event Categories in 10 CFR Parts 50, 52, and 53

| Licensing Basis | Designated Licensing Event Categories |
|---|---|
| 10 CFR Parts 50 and 52<br>**Mix of initiating events and event sequences** | Based on a search of the regulations and associated regulatory guidance:<br>• Design basis events (DBEs) (§ 50.49):<br>o AOOs<br>o DBAs<br>o External events<br>o Natural phenomena<br>• Non-DBA (§ 50.2, alternate ac source)<br>• BDBEs<br>• ATWS<br>• SBO |
| LMP as presented in NEI 18-04, Rev. 1 and endorsed in RG 1.233<br>**Event sequences**<br>**PRA used to identify licensing events** | Licensing events are collectively referred to as licensing basis events (LBEs), which include the following categories:<br>• AOOs<br>• DBEs<br>• BDBEs<br>• DBAs |
| 10 CFR Part 53, Framework A<br>**Event sequences**<br>**PRA used to identify licensing events** | Licensing events are collectively referred to as LBEs, which include the following categories:<br>• AOOs<br>• Unlikely event sequences<br>• Very unlikely event sequences<br>• DBAs |
| 10 CFR Part 53, Framework B<br>**Mix of initiating events and partial event sequences** | • AOOs<br>• DBEs<br>• DBAs<br>• BDBEs |

# Implications of Applicant Decisions on Licensing Event Identification

| Applicant Decisions | | | Implications | | |
|---|---|---|---|---|---|
| Licensing Basis | **Use of Risk Insights** | **Reactor Design** | **Exemptions Required** | **Risk Evaluation** | **Licensing Event Identification**[a] |
| 10 CFR Parts 50 or 52 | traditional | LWR | no | PRA | PDG-1413 |
| | | non-LWR | yes | PRA | PDG-1413 |
| | enhanced | LWR or non-LWR | yes | PRA | RG 1.233 |
| Preliminary proposed 10 CFR Part 53 Framework A | enhanced[b] | LWR or non-LWR | no | PRA | RG 1.233 |
| Preliminary proposed 10 CFR Part 53 Framework B | traditional[b] | LWR or non-LWR | no | PRA or AERI[c] | PDG-1413 |

[a]LWRs must compare the plant design to the SRP regardless of how the licensing events are identified.
[b]Dictated by the choice of licensing framework.
[c]Voluntary risk-informed applications require development of a PRA.

# Staff Perspective

The use of a "blank sheet of paper" approach helps to avoid pitfalls such as, but not limited to:

- The unwitting or unquestioning carryover of assumptions about plant design or behavior,
- The tendency to focus on which predefined events apply (or do not apply) rather than which events are missing from the list,
- The use of predefined lists that are dated and do not reflect contemporary commercial nuclear plant design or operating experience.

The identification of licensing events, conducted objectively and without preconceptions or over-reliance on predefined lists, helps to ensure that the final list of licensing events is comprehensive and, hence, that the plant design is appropriately analyzed and demonstrated to be safe based on the comprehensive set of licensing events.

# Techniques for Identifying Initiating Events

- The staff has reviewed many sources for identifying initiating events:
  - NRC NUREGs
  - NRC and Canadian Nuclear Safety Commission, "Joint Report on Terrestrial Energy's Methodology for Developing a Postulated Initiating Events List for the Integral Molten Salt Reactor"
  - IAEA-TECDOC-719 and IAEA SSG-3
  - International Electrotechnical Commission, International Standard IEC 31010
  - American Society of Mechanical Engineers and American Nuclear Society PRA standards
  - Center for Chemical Process Safety, American Institute of Chemical Engineers
  - Electric Power Research Institute technical reports
  - Open literature internet search
- PDG-1413 does not endorse any specific standard or reference
- PDG-1413 provides a guide to useful references; it is not intended to be a textbook

# Examples of Techniques for Identifying Initiating Events

## Inductive Techniques

- Double Failure Matrix
- **Failure Mode and Effects Analysis***
- Failure Mode Effects and Criticality Analysis
- Fault Hazard Analysis
- Functional Hazard Analysis
- **Hazard and Operability Analysis***
- **Preliminary Hazard Analysis***

## Deductive Techniques

- Cause Consequence Analysis
- Common Cause Failure Analysis
- **Fault Tree Analysis***
- Markov Analysis
- **Master Logic Diagram***
- Operating and Support Hazard Analysis
- System Hazard Analysis

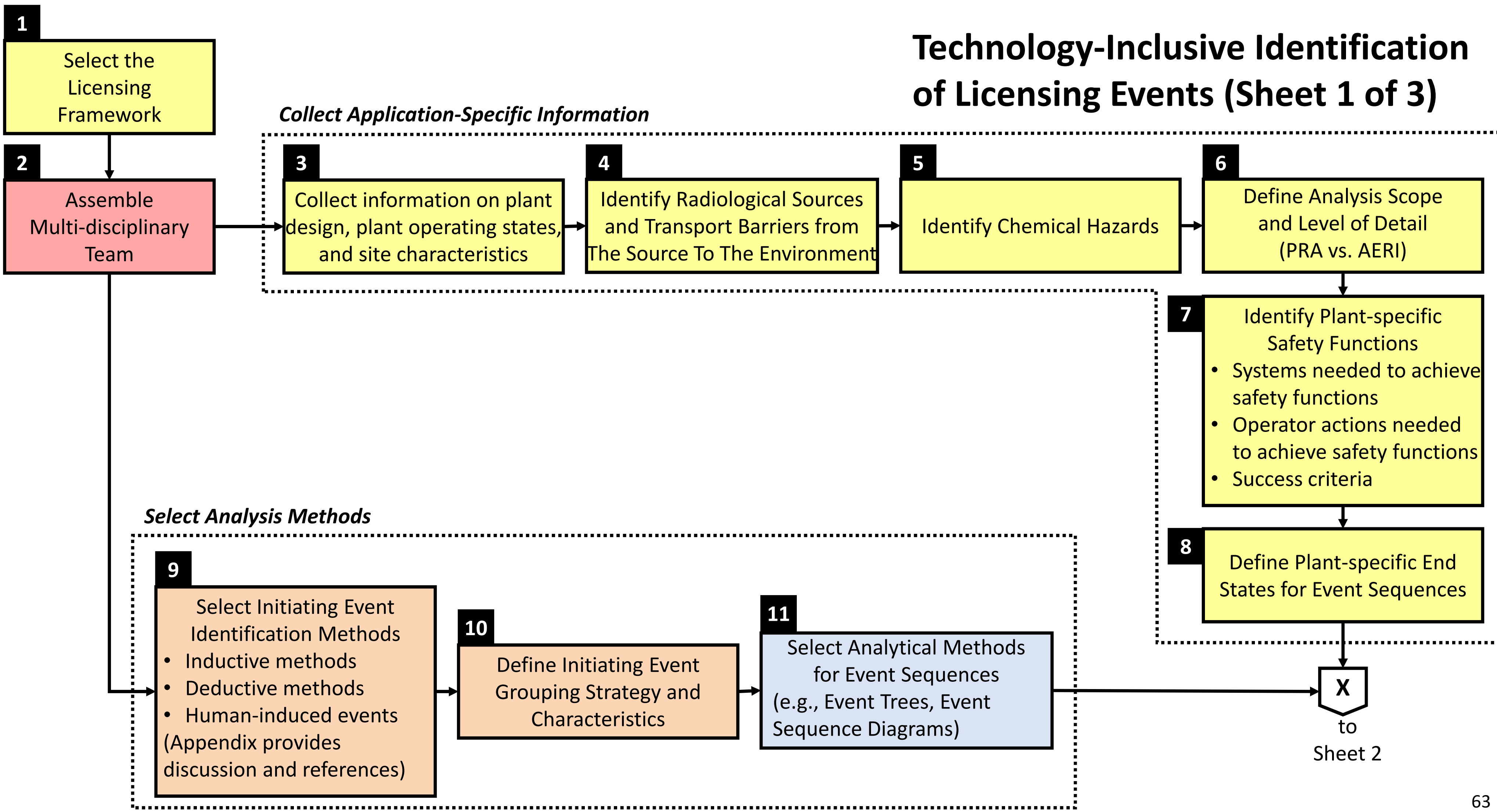
* Most common and well-developed techniques

PDG-1413 recommends the use of an inductive and a deductive technique when searching for initiating events to ensure the list of initiating events is comprehensive.

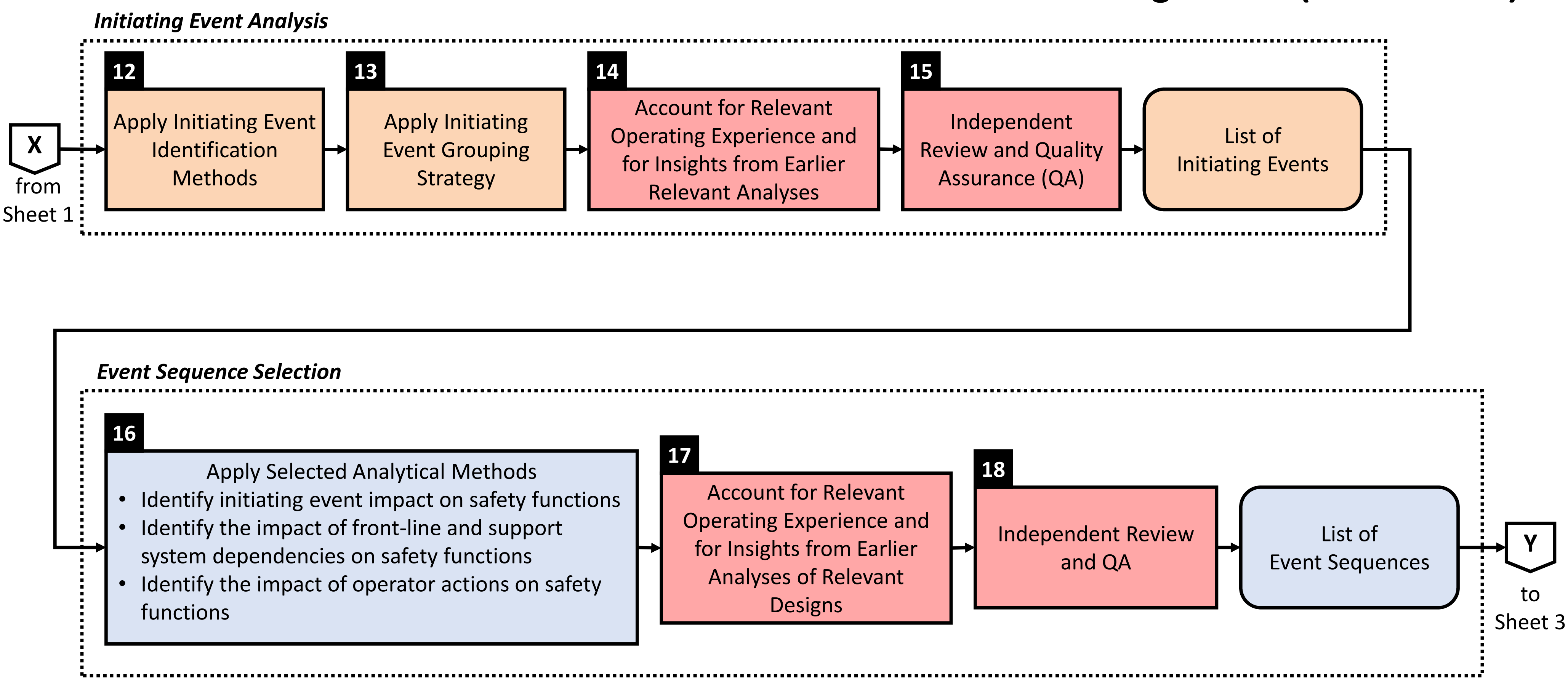
# Overarching Principles

- Identify application-specific factors (licensing framework, plant-specific design features, and site characteristics).
- Conduct a systematic and comprehensive search for initiating events.
- Use a systematic process to delineate a comprehensive set of event sequences.
- Group initiating events and event sequences into designated licensing event categories according to the selected licensing framework.
- Provide assurance that the set of licensing events is sufficient.

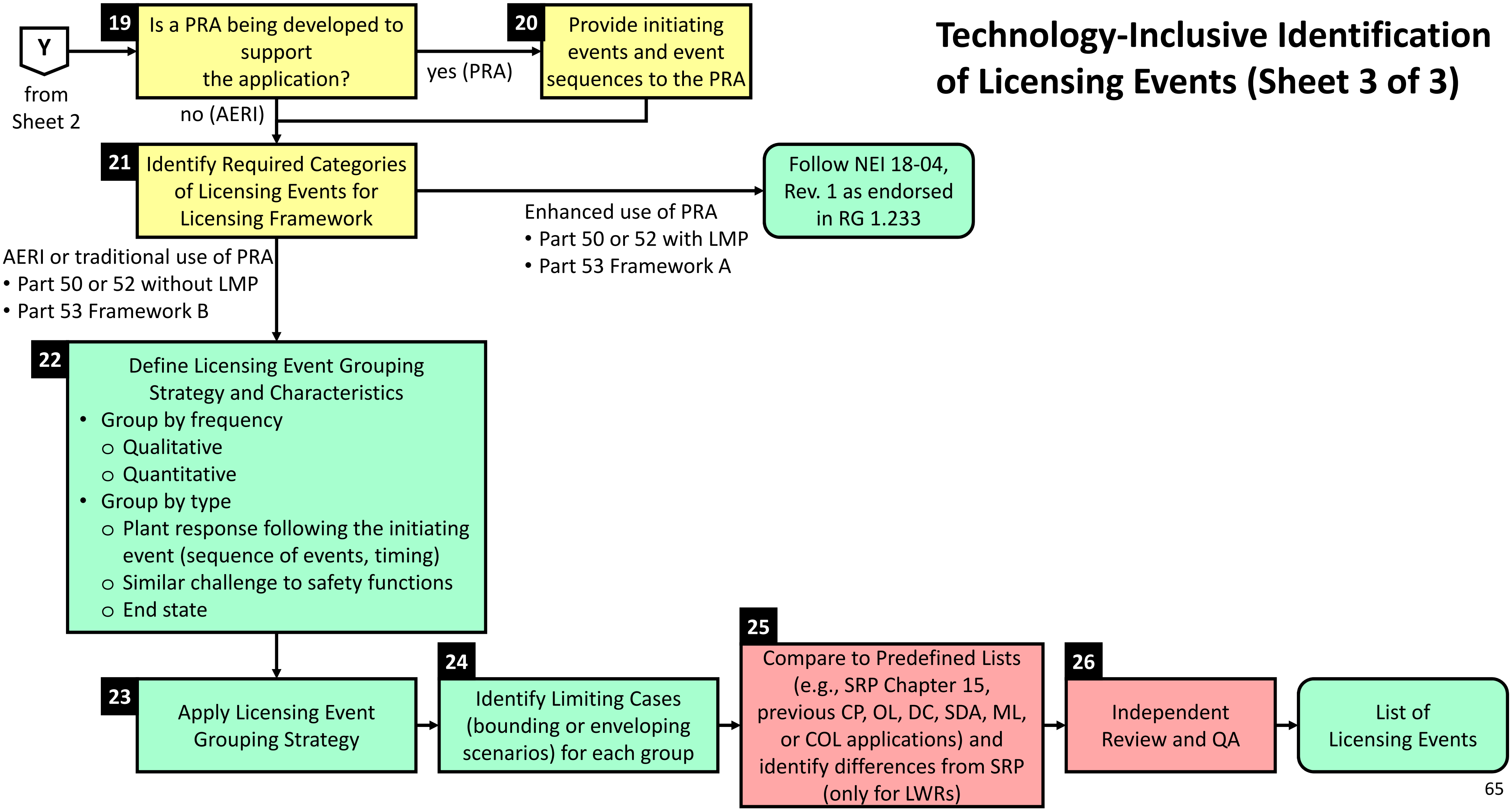
# Technology-Inclusive Identification of Licensing Events (Sheet 1 of 3)



# Technology-Inclusive Identification of Licensing Events (Sheet 2 of 3)



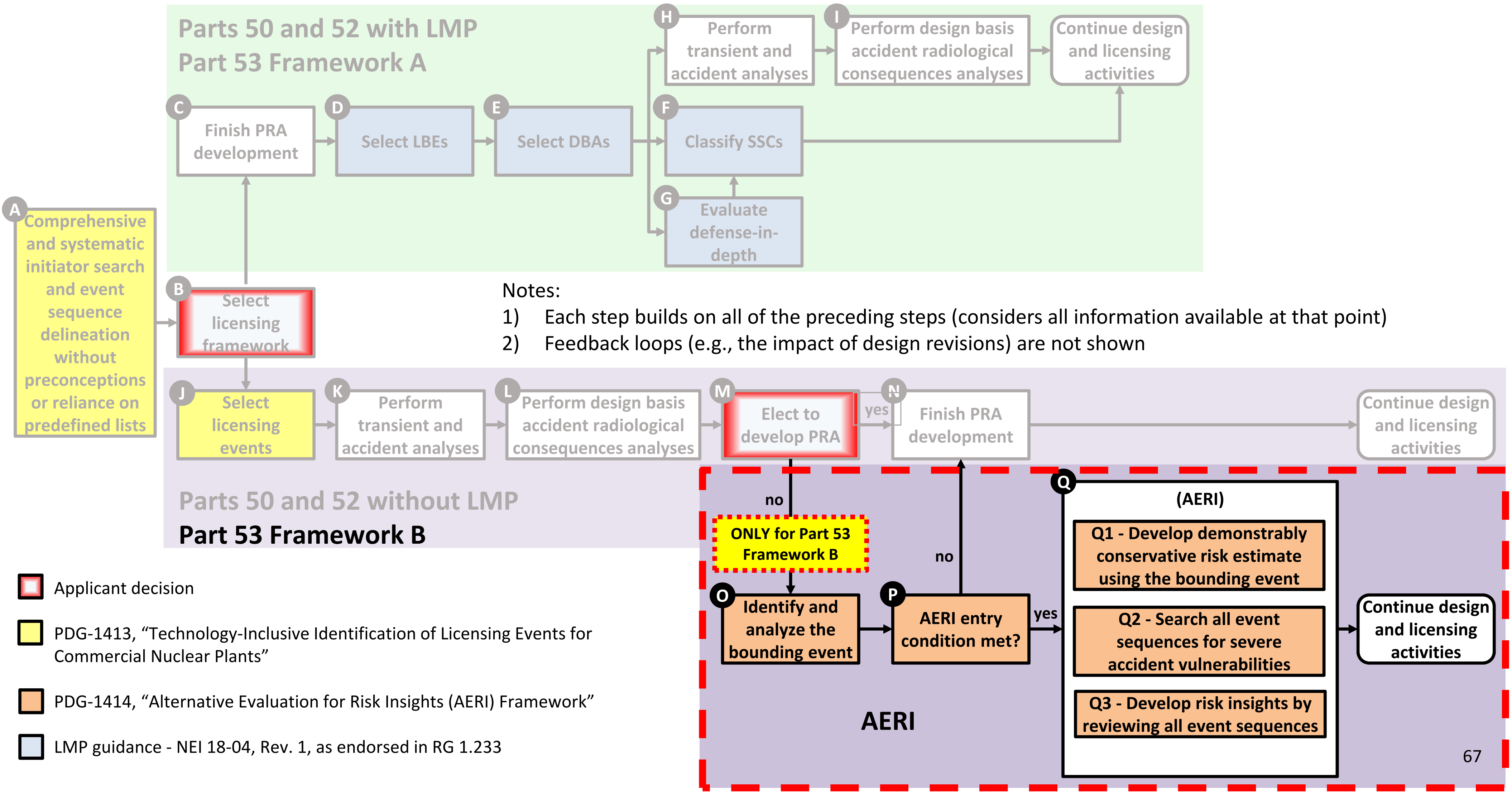
# Technology-Inclusive Identification of Licensing Events (Sheet 3 of 3)



# Alternative Evaluation for Risk Insights (AERI) Framework (PDG-1414)

- Formatted like a regulatory guide; currently a pre-decisional draft regulatory guide
- Section A (Introduction): Only applies to LWRs and non-LWRs licensed under Part 53 Framework B
- Sections B (Discussion) & C (Staff Guidance): Components of the AERI approach:
  - Identification and characterization of the bounding event
    - Definition of a bounding event
    - Multiple events may need to be considered as bounding events
  - Determination of a consequence estimate for the bounding event to confirm that the reactor design meets the AERI entry condition
  - Determination of a demonstrably conservative risk estimate for the bounding event to demonstrate that the QHOs are met
    - Assumed frequency of 1/yr consistent with frequency of all event sequences for LWRs
    - Applicant may use a lower frequency with justification
  - Search for severe accident vulnerabilities for the entire set of licensing events
    - Definitions of severe accident and severe accident vulnerability
  - Identification of risk insights for the entire set of licensing events
  - Assessment of defense-in-depth adequacy for the entire set of licensing events

# Licensing Frameworks – Risk Evaluation Perspective

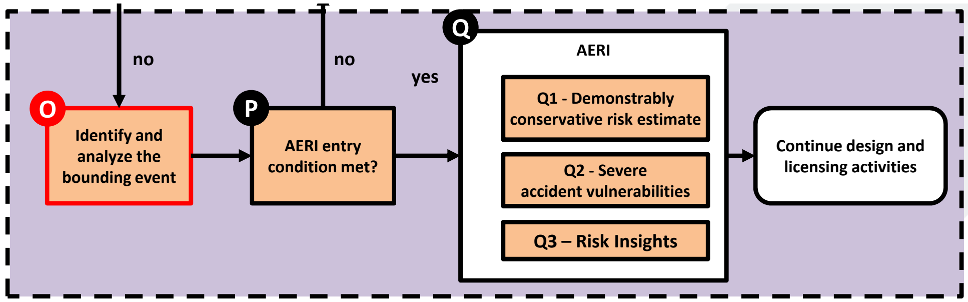



Notes:

1) Each step builds on all of the preceding steps (considers all information available at that point)
2) Feedback loops (e.g., the impact of design revisions) are not shown

- Applicant decision
- PDG-1413, "Technology-Inclusive Identification of Licensing Events for Commercial Nuclear Plants"
- PDG-1414, "Alternative Evaluation for Risk Insights (AERI) Framework"
- LMP guidance - NEI 18-04, Rev. 1, as endorsed in RG 1.233

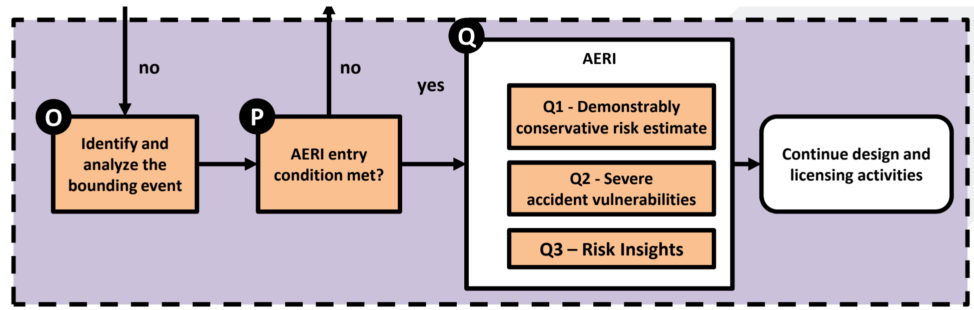
# Identification and Characterization of the Bounding Event(s)




- The analysis of the bounding event should be capable of estimating the doses and consequences used in the demonstrably conservative risk estimate that result from evaluating <u>the limiting initiating event for the design, considering credit only for inherent safety features</u>.

- The process should:
    - use the full set of licensing events
    - consider both core and non-core radiological sources associated with the reactor unit or multiple units
- The bounding event:
    - should be defined by parameters that include source term, meteorology, atmospheric transport, protective actions, dosimetry, health effects, economic factors, and consequence quantification
    - may combine features of several individual licensing events
- Multiple bounding events should be considered when, for example, a design has more than one event with approximately similar annual likelihoods of occurrence and with similar overall radiological impacts, but with different radiological characteristics of the analyzed release (isotopic composition, chemistry, timing)

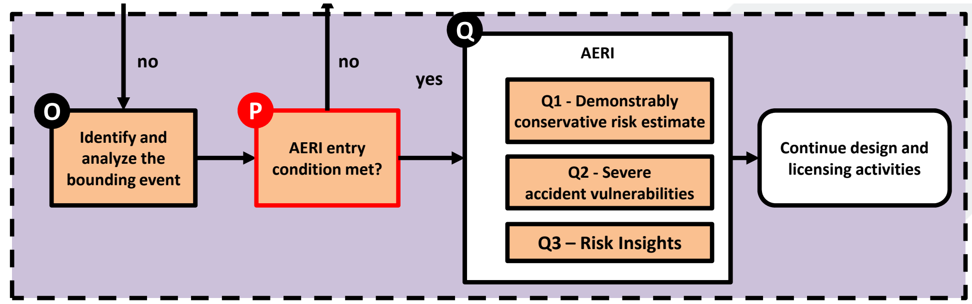
# The bounding event(s) is used to both:




- Confirm that the AERI entry condition is met
  - 10 CFR 53.4730(a)(34)(ii)
  - Uses dose estimate based on the bounding event(s)
    - Risks of acute and long-term radiation exposures

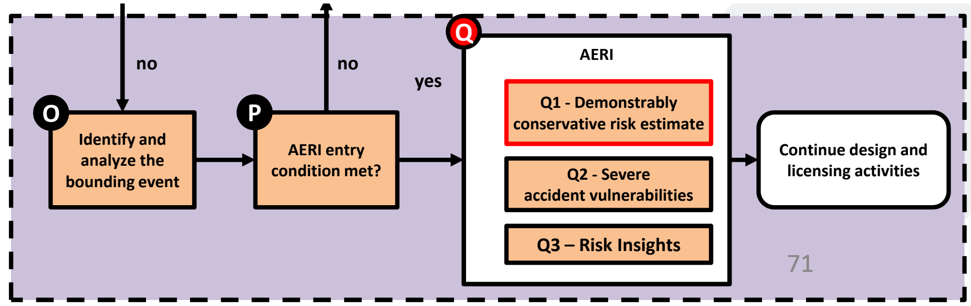
- Conduct the AERI
  - Develop a demonstrably conservative risk estimate
    - Uses a consequence estimate based on the bounding event(s) for risks of prompt and latent cancer fatalities)
  - Search for severe accident vulnerabilities (all licensing events)
  - Identification of risk insights (all licensing events)
  - Assessment of defense-in-depth

# Confirmation that the AERI Entry Condition is Met



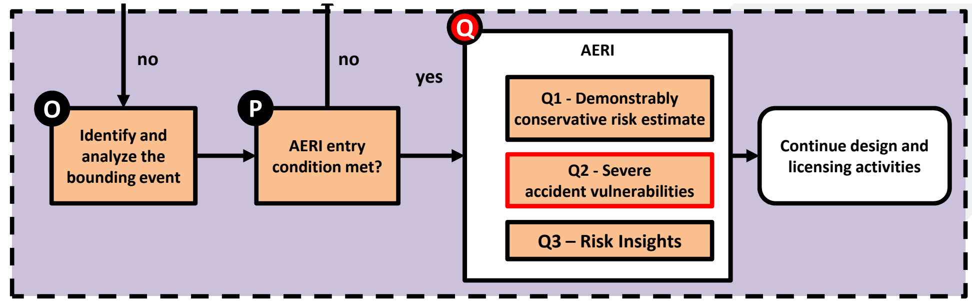

- When electing to use the AERI approach, it may not be known at first whether the entry condition is met
- Confirmation is based on a realistic dose estimate and realistic description of uncertainties (preferred)
- Conservatisms are identified and addressed
- For multiple bounding events, the entry condition should be met for each bounding event

# Development of a Demonstrably Conservative Risk Estimate



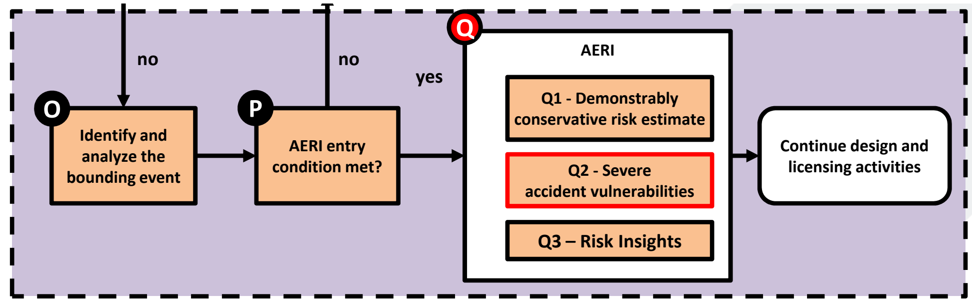

- Demonstration that a reactor design meets the QHOs
- Risks of prompt radiation-caused fatalities and latent cancer fatalities to offsite populations
- No realistic estimate of annual frequency expected
- Assumed frequency of 1/yr, represents the sum of event sequence frequencies and equal to the sum of initiating event frequencies; based on LWR statistics
- Applicant may use a different frequency with justification and NRC staff will review on a case-by-case basis

# Search for Severe Accident Vulnerabilities



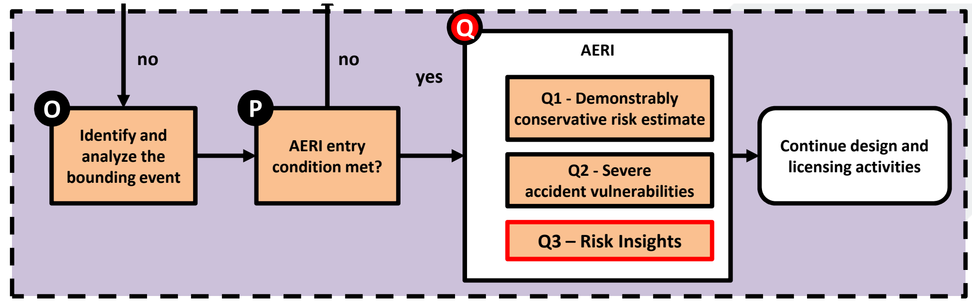

- Encompass entire set of licensing events and any additional severe accidents
- Severe accident vulnerabilities should be eliminated through modifications to the design, operations, or maintenance
- Justification may be provided for why a severe accident vulnerability is acceptable for the design

# Definition of Severe Accidents and Severe Accident Vulnerabilities




- Severe accidents defined in 10 CFR 53.4730(a)(5)(v)(B) are those events that progress beyond the DBAs, in which substantial damage is done to the reactor core whether or not there are serious offsite consequences
- In PDG-1414, severe accident vulnerabilities are those aspects of a facility design that represent an overreliance on a single design feature, whether for accident prevention or mitigation, and that could lead to a severe accident after accounting for SSC reliability, human actions, and defense-in-depth

# Identification of Risk Insights




- Based on entire set of licensing events
- Qualitative descriptions should be provided
- Quantitative descriptions should be provided when available
- Risk insights should provide an understanding of the hierarchy of event sequences ranked by frequency
- Risk insights identified using AERI may be used to support other licensing decisions

# Assessment of Defense-in-Depth

- Encompasses entire set of licensing events
- Regulatory guidance position is adapted from RG 1.174
- NEI 18-04 may also provide guidance for the AERI framework related to assessing defense-in-depth (adapted from IAEA SSR 2/1)
- Assessment of defense-in-depth complements the search for severe accident vulnerabilities and search for risk insights

# Path Forward

PDG-1413 & PDG-1414

- Make revisions in response to ACRS and stakeholder feedback
- Monitor changes to preliminary proposed rule text

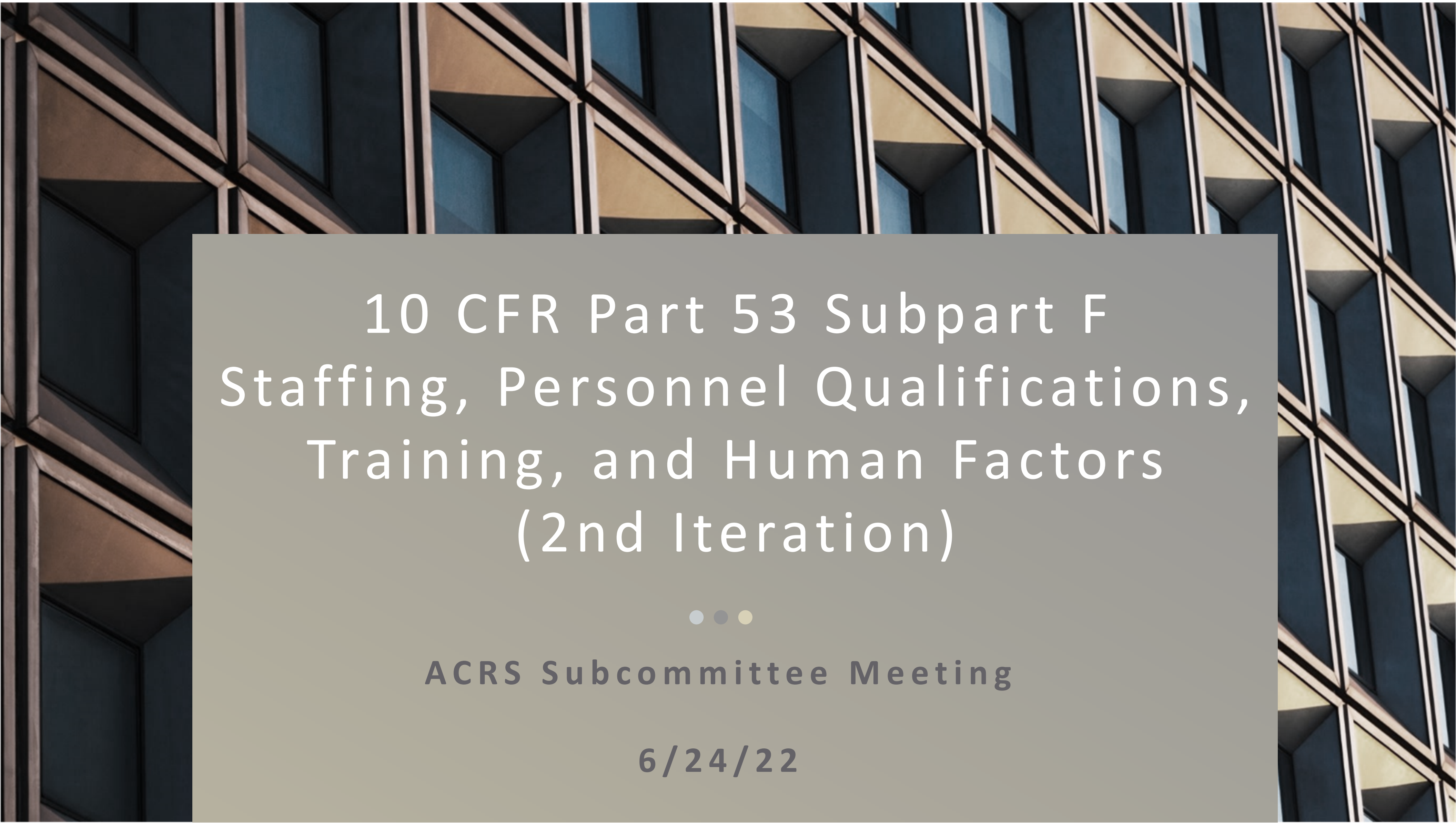
PDG-1414

- Develop guidance for AERI maintenance and upgrades

# Upcoming Meetings

- Periodic Advanced Reactor Stakeholder Public Meeting:
  June 30, 2022
- Advisory Committee on Reactor Safeguards Full Committee Meeting:
  July 6, 2022
- Commission Meeting - Update on 10 CFR Part 53 Licensing and Regulation of Advanced Nuclear Reactors:
  July 21, 2022

# Discussion



# 10 CFR Part 53 Subpart F Staffing, Personnel Qualifications, Training, and Human Factors (2nd Iteration)

**ACRS Subcommittee Meeting**

**6/24/22**

# Agenda

- Overview of Key Changes to Subpart F under the 2nd Iteration
  - Addition of Engineering Expertise Requirement
  - Expansion of Load Following Allowances
  - Removal of Simulator HFE Testbed Requirement
  - Replacement of Certified Operator Framework
- Generally Licensed Reactor Operators
- Questions

# Overview of Primary Staff Contributors (NRR & RES)

- Theresa Buchanan, Senior Reactor Engineer (Examiner)
- Dr. David Desaulniers, Senior Technical Advisor for Human Factors and Human Performance Evaluation
- Dr. Brian Green, Senior Human Factors Engineer -Team Lead
- Dr. Niav Hughes Green, Human Factors Psychologist
- Dr. Stephanie Morrow, Human Factors Psychologist
- Lauren Nist, Branch Chief, Operator Licensing and Human Factors Branch
- Maurin Scheetz, Reactor Engineer (Examiner)
- Jesse Seymour, Reactor Operations Engineer (Human Factors)

# Key Changes to Subpart F under the 2nd Iteration

- 2nd iteration of Subpart F retains majority of requirements developed for the 1st iteration
- Some requirements have been relocated to more appropriate spots (e.g., grouping technical requirements)
- Most changes made for the second iteration of Subpart F were mirrored in the contents of Subpart P; for that reason, most significant differences from the first iteration of Subpart F were discussed in detail during the Framework B presentation
- A summary of those major changes will be provided here

# Overview of Key Changes (continued)

- Addition of engineering expertise requirement
  - Staffing plan requirements of § 53.730(f) modified to include providing engineering expertise to operators
- Expansion of load following allowances
  - §§ 53.725(b) and 53.740(e) - (f) requirements modified to expand load following to include process heat usage
- Removal of simulator HFE testbed requirement
- Specific change management for approved programs
- Certified operator provisions completely replaced with an all new generally licensed reactor operator framework

# Generally Licensed Reactor Operators (GLROs)

Under 2nd iteration of subpart F operator licenses now consist of general licenses and specific licenses.

- A specific license is issued to a named person and is effective upon approval by the Commission of an application filed pursuant to the regulations in this part and issuance of licensing documents to the applicant. Specific licenses are issued to ROs and SROs.
- A general license is effective without the filing of an application with the Commission or the issuance of licensing documents to a particular person. The general licensing of GLROs is addressed by the requirements of §§ 53.800 through 53.830.

## Generally Licensed Reactor Operators (continued)

- What types of facilities would have GLROs?
  - No operator action is needed to mitigate plant events and achieve acceptable accident performance
  - Defense-in-depth independent of operator action
  - Operators not significant factor in safety outcomes
- What role would GLROs fulfil?
  - Administrative functions historically done by an SRO; keeps facility in analyzed state within licensing basis
  - Conduct manual reactivity manipulations if needed
  - Supervise core alterations and refueling operations

# Generally Licensed Reactor Operators (continued)

- Only a single operator license level exists within the GLRO framework (analogous to the SRO level)
- Plants meeting the criteria for using GLROs would have to use GLROs in lieu of ROs and SROs for staffing
- Like ROs and SROs, the GLRO training program must also be derived from a systems approach to training (SAT)
- Prescriptive staffing and capabilities for GLROs:
  - Continuous monitoring with continuity of responsibility
  - Monitor plant parameters, evaluate emergency conditions, initiate reactor shutdown, dispatch/direct ops & maintenance personnel, and implement emergency plan

# Generally Licensed Reactor Operators (continued)

- § 53.800 defines new class of plants using the design criteria previously developed for "certified operator" use
  - Establishing new class done to conform with Atomic Energy Act
- § 53.805 establishes the responsibilities of facility licensees that use GLROs:
  - Maintain GLROs qualifications for responsibilities
  - Only GLROs may manipulate facility controls
  - Develop/implement/maintain Commission approved programs for GLRO training, exams, & proficiency
  - Ensure GLROs meet Part 26 & 73 requirements
  - Report names of all GLROs to the NRC annually
- § 53.810 is the general license; it is granted provided that qualifications are established and maintained subject to restrictions. GLROs are subject to enforcement action.

# Generally Licensed Reactor Operators (continued)

- § 53.815 covers GLRO training, retraining, and proficiency provisions.
  - Training programs must be derived from SAT
    - Includes performing reactivity manipulations
  - Initial examination on knowledge and abilities
  - Continuing training and requalification exams
  - Requirements for use of simulation facilities
  - Records must be available for NRC inspection
  - Must establish a GLRO proficiency program
  - No specific medical requirements for GLROs
- § 53.830 covers expiration of the license for GLROs

# Specific Licensing (RO/SRO) versus General Licensing (GLRO)

Comparison of key aspects of the SRO/RO and GLRO frameworks:

| Framework Aspect | RO / SRO | GLRO |
|---|---|---|
| Licensed operators with responsibility for administrative requirements | Yes | Yes |
| Licensed operators with role in event mitigation | Yes | No |
| NRC has legal authority to suspend or revoke license for violations | Yes | Yes |
| NRC approval of training & exam programs required? | Yes | Yes |
| NRC approval needed for exams, medical, simulator, renewals, terminations, and waivers? | Yes | No |
| Flexibility for requalification training & exam periodicity? | No | Yes |

# Summary of how ACRS letter concerns were addressed

1. STA Elimination – addressed via the new engineering expertise requirement
2. Use of non-licensed, certified operators – entirely replaced by a new licensed operator framework (GLRO)
3. Limited scope simulators – to be addressed via guidance and usage of existing standards
4. Training program reviews – new SAT program review guidance under development
5. Staffing plan provisions for first-of-a-kind builds, senior license holders, and organizational interfaces – to be addressed via guidance

# Discussion

# Final Discussion and Questions

# Additional Information

- Additional information on the 10 CFR Part 53 rulemaking is available at https://www.nrc.gov/reactors/new-reactors/advanced/rulemaking-and-guidance/part-53.html
- For information on how to submit comments go to https://www.regulations.gov and search for Docket ID NRC-2019-0062
- For further information, contact Robert Beall, Office of Nuclear Material Safety and Safeguards, telephone: 301-415-3874; email: Robert.Beall@nrc.gov

# Acronyms

| | |
|---|---|
| ACRS | Advisory Committee on Reactor Safeguards |
| AEC | Atomic Energy Commission |
| AERI | Alternative evaluation for risk insights |
| AOO | Anticipated operational occurrence |
| ATWS | Anticipated transient without scram |
| BDBE | Beyond design basis event |
| BE | Bounding event |
| CFR | Code of Federal Regulations |
| CILCFR | Conditional individual latent cancer fatality risk |
| COL | Combined license |
| CP | Construction permit |
| DANU | Division of Advanced Reactors and Non-Power Production and Utilization Facilities |
| EAB | Exclusion area boundary |
| DBA | Design basis accident |
| DBE | Design basis event |
| DC | Design certification |
| DG | Draft regulatory guide |
| DRA | Division of Risk Assessment |
| ESP | Early site permit |
| FR | *Federal Register* |
| GLRO | Generally licensed reactor operator |
| HFE | Human factors engineering |
| IAEA | International Atomic Energy Agency |
| IEFR | Individual early fatality risk |
| ILCFR | Individual latent cancer fatality risk |
| LBE | Licensing basis event |

# Acronyms

| | |
|---|---|
| LCO | Limiting condition for operation |
| LMP | Licensing Modernization Project |
| LNT | Linear no-threshold |
| LWR | Light water reactor |
| ML | Manufacturing license |
| NEI | Nuclear Energy Institute |
| NFPA | National Fire Protection Association |
| NRC | U.S. Nuclear Regulatory Commission |
| NRR | Office of Nuclear Reactor Regulation |
| NUREG | U.S. Nuclear Regulatory Commission technical report designation |
| OL | Operating license |
| PDG | Pre-decisional draft regulatory guide |
| PRA | Probabilistic risk assessment |
| QA | Quality assurance |
| RO | Reactor operator |
| QHO | Quantitative health objective |
| RES | Office of Nuclear Regulatory Research |
| RG | Regulatory guide |
| SAT | Systems approach to training |
| SBO | Station black out |
| SDA | Standard design approval |
| SRO | Senior reactor operator |
| SRP | Standard review plan |
| SSCs | Structures, systems, and components |
| STA | Shift technical advisor |
| TEDE | Total effective dose equivalent |
| TIRIMA | Technology-inclusive, risk-informed maximum accident |