United States Nuclear Regulatory Commission

Protecting People and the Environment

Technology Inclusive Content of Application Project Public Meeting

June 11, 2020

Telephone Bridgeline: 888-566-1533

Passcode: 2647310

Agenda

Time	Topic	Presenter
10 -10:10 am	Introduction	NRC
10:10 -10:40 am	More detailed discussion of the industry developed licensing modernization project (LMP)- based safety case	Southern
10:40 – 11:40 am	Industry developed draft annotated outline for an application following the TICAP approach	Southern
11:40 – 12:00 pm	Intention to pilot the LMP-based safety case and the annotated outline for three designs in the summer of 2020	Southern
12 pm - 1:30 pm	Extended Break to allow for industry and NRC caucus	All
1:30 – 2:30 pm	Continuation of Discussions from the morning session (if applicable) and Questions from Extended Break	All
2:45 – 3:00 pm	Concluding Remarks	All

Technology Inclusive Content of Application Project (TICAP)

TICAP – NRC Working Meeting
June 11, 2020

Southern Company

Outline of Today's Presentations

- General overview of TICAP Objectives and Principles
- Discussion of LMP-Based Safety Case
- Discussion of Final Safety Analysis Report (FSAR) Formulation Approach
- Planned TICAP Table-top efforts
- Next Steps
- Takeaways

Purpose of Presentation

- To present our approach for proposing an optimized formulation of the FSAR portion of the combined license (COL) application. The formulation will use an affirmative safety case basis for presenting **the type** of information that is asked for in the current COL application content from a light water reactor (LWR) design applicant.
- The conceptual outline presents information limited to the envelope established by the LMP methodology(NEI 18-04). It does not address requirements for normal operation nor all regulations which are applicable to a nuclear facility application, (i.e. financial qualifications of the applicant, material control and accountability, etc.) It also does not address requirements for information that can be found in other parts of the application outside the FSAR (security or emergency preparedness plans).

Background
LMP-Driven Application Content

- ***Project Objective:** Develop a document that can be submitted to NRC for endorsement that outlines the content of an application in a manner that is **technology inclusive**, is r**isk-informed**, and its scope is governed by LMP methodology.*
- The need for the proposal:
  - Current prescriptive content of application requirements are based on the large LWR safety case which could be substantially different than the non-LWR energy generating systems safety case
  - A compliance-based application content for a non-LWR is likely to be costly and unpredictable to develop, time consuming to review, and create inconsistencies between reviews of different applications.

Background
LMP-Driven Application Content (Cont.)

- Guiding Principles:
  - LMP-Based Safety Case focuses on direct radiological risk to the health and safety of the public
  - LMP-Based Safety Case, **anchored around design's Principal Design Criteria (PDCs)**, meets the underlying safety objectives of the current regulations
  - Content and level of detail are risk-informed (RI) graded fashion developed within LMP process) to meet NRC's objective of requiring information commensurate with the importance of the safety functions to be performed.
  - Content is organized in a logical safety-focused manner that is usable for the licensee and reviewable by the regulator
  - Guidance can be applied to any reactor using the NEI 18-04 methodology

Background
LMP-Driven Application Content (Cont.)

- Project's Expected Outcomes:
  - A standardized content structure that facilitates efficient
    - » preparation by an applicant,
    - » review by the regulator, and
    - » maintenance by the licensee.
  - A content formulation that , based on the complexity of a design's safety case, optimizes
    - » the scope (the functions, the structures, systems, and components (SSCs), and the programmatic requirements that need to be discussed) based on what is relevant to the design specific safety case.
    - » the type of information to be provided (e.g., licensing basis events (LBEs), Required Safety Functions (RSFs), safety-related (SR) SSCs, defense-in-depth (DiD), etc.),
    - » level of detail to be provided
      - based on the importance of the functions and SSCs to the safety case (risk-informed, performance-based (RIPB) details).
      - based on the relevance to the safety finding determination.

Technology Inclusive Content of Application Project (TICAP)

LMP-Based Safety Case Discussion

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Discussion Topics for the LMP-based Safety Case

- TICAP Definitions
- Use of LMP-Based Affirmative Safety Case
- What, When, How, and How Well (WWHHW) Labeling of LMP-Based Safety Case
- Summary

TICAP[11] Specific Definitions

- **Generic Safety Case Definition-** A collection of scientific, technical, administrative and managerial arguments and evidence in support of the safety objectives of a nuclear facility covering the suitability of the site and the design, construction, and operation of the facility, the assessment of radiation risks and assurance of the adequacy and quality of all the safety related work associated with the nuclear facility.

- **Affirmative Safety Case Definition** – an affirmative safety case presents the scientific, technical, administrative, and managerial information in support of the safety objectives that the design will provide reasonable assurance of adequate protection of public health and safety. The safety case does not provide arguments and evidence that justifies why certain requirements of the current regulations are not needed.

TICAP Specific Definitions

- **LMP-Based Affirmative Safety Case Definition-** A collection of scientific, technical, administrative and managerial evidence which document the basis that **the performance objectives** of the technology inclusive **fundamental safety functions** (FSFs) are met by a design during design specific **AOOs, DBEs, DBAs, and BDBEs by**
  - Identifying **design specific safety functions** that are adequately performed by **design specific SSCs AND**.
  - Establishing **design specific features (programmatic (e.g., inspections) or physical (e.g., redundancy))** to provide reasonable assurance that credited SSCs are reliably performed.
- Compared with the current content of application, an application content based on the LMP-Based Affirmative Safety Case
  - Will include information on new functions, SSCs, and programs when are needed (e.g., functions/SSC/program to prevent coolant catching fire)
  - Will not provide evidence where certain functions, SSCs, and programmatic requirements for the LWRs are not applicable or needed (e.g., Human Factors program)

Foundation of the TICAP Affirmative Safety Case Description

- The underlying intent of the current Application Content (within TICAP scope) is met by providing the LMP-Based Safety Case, anchored around PDCs, on the basis that
  - » The LMP's approach to meet the radiological risk performance objectives provide evidence that the underlying safety objectives of the regulations for providing "reasonable assurance of adequate protection . . . " is met.
  - » "The principal design criteria establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components important to safety; that is, **structures, systems, and components that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public"**
- To facilitate PDC-anchored articulation of the LMP-Based Safety Case, the constituents of the LMP process are labeled as follows:
  - » **What** are the performance objectives for the FSFs,
  - » **When** do the FSF's performance objectives need to be demonstrated,
  - » **How** plant capabilities (functional and structural) demonstrate that the fundamental safety functions are met.
  - » **How Well** do these capacities need to be performed to provide reasonable assurance

Defining WWHHW - What

- At the highest level, the Atomic Energy Act (AEA) establishes standard as “no undue risk”

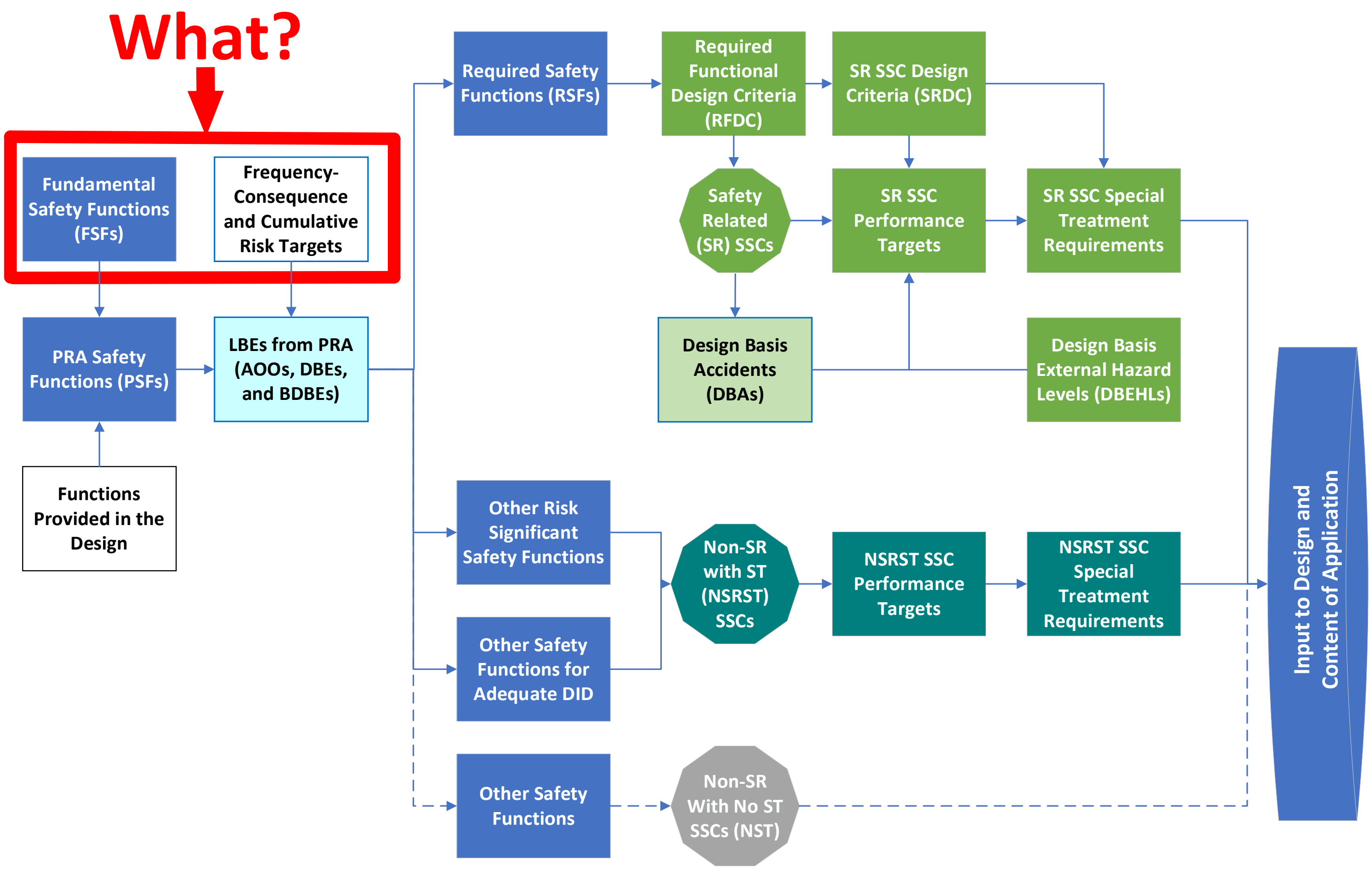
- LMP implements the “no undue risk” standard, within its scope, by using the RDLT (regulatory dose limit targets) as the performance objectives for the FSFs.

- In TICAP, the performance objectives of the FSFs, to demonstrate that the “no undue risk” standard, within its scope, is met, is labeled as “WHAT”.

- Inputs to “What”:
  - Regulatory dose limits and the quantitative health objective (as shown by the frequency consequence targets and as provided in NEI 18-04))

- Outputs from “What”:
  - Demonstration that reasonable assurance of adequate protection is provided by the selected design

FSF Chart - What



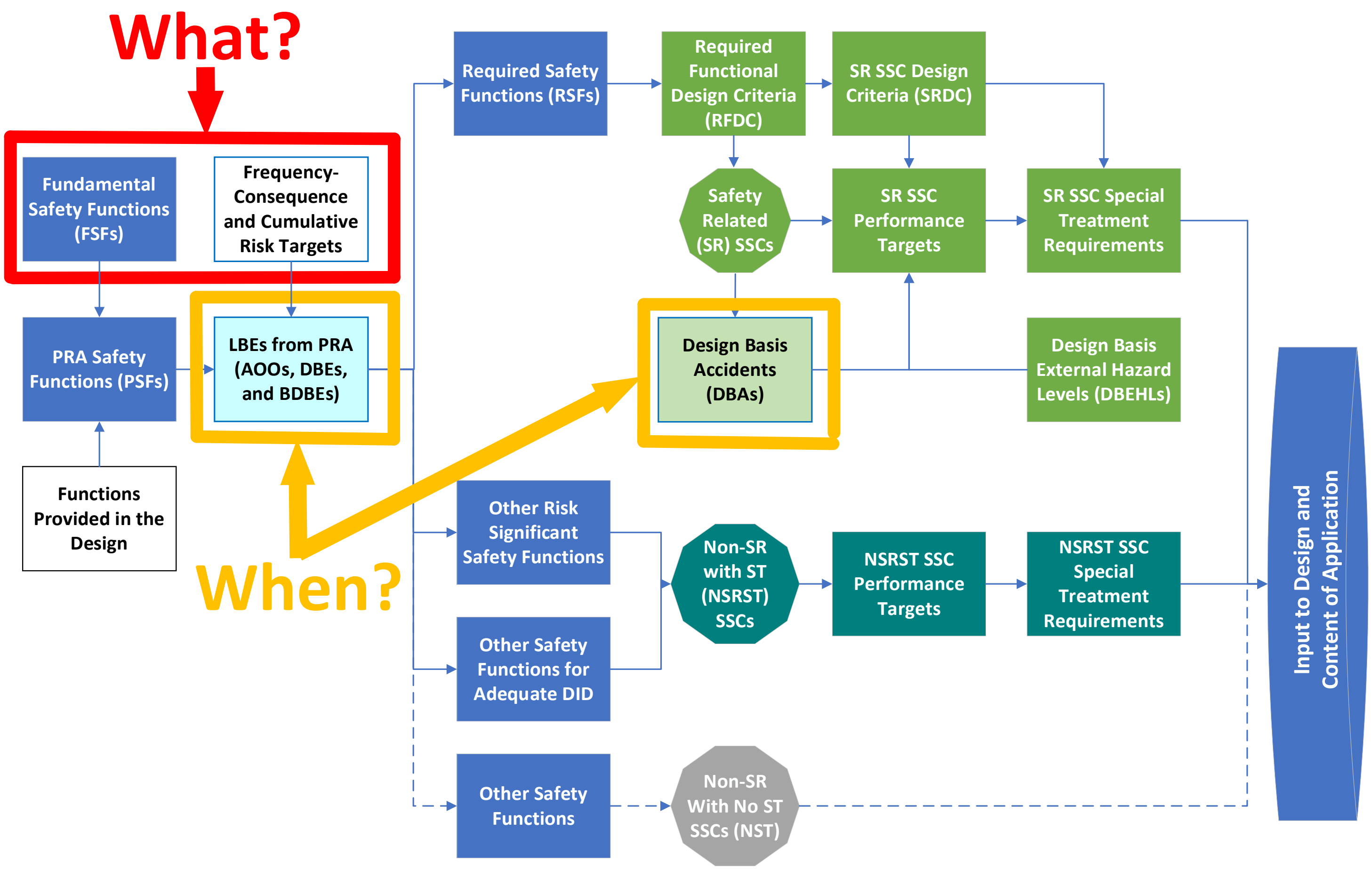
Defining WWHHW - When

- "When" is the label assigned to the category of information that is obtained from the design-specific LBEs.

- Inputs to "When"
  - Design-specific PRA model, including consequence analysis,
  - NEI 18-04 methodology for developing design specific AOOs, DBEs, and BDBEs
  - NEI 18-04 methodology for defining design-specific DBAs.

- Outputs defined as "When"
  - Identification of design-specific AOOs, DBEs (including DBAs), and BDBEs that are used to contextualize when different LMP-defined safety functions must be performed.

FSF[17] Chart - When



Defining WWHHW - How

- This label is assigned to the **capabilities** (LMP-defined functions and SSCs) that are credited to show performance-objective of the FSFS are met.
- The necessary capabilities **include** SSCs that can be used to form a design's principal design criteria through specification of the LMP-Defined "Required Safety Functions".
- Inputs to "How":
  - Design-specific event sequences classified as AOOs, DBEs, DBAs and BDBEs;
  - Analytical tools and resources for deterministic design and analyses.
  - NEI 18-04 process for classification of functions and SSCs
- Output:
  - Classification of design-specific functions and SSCs;

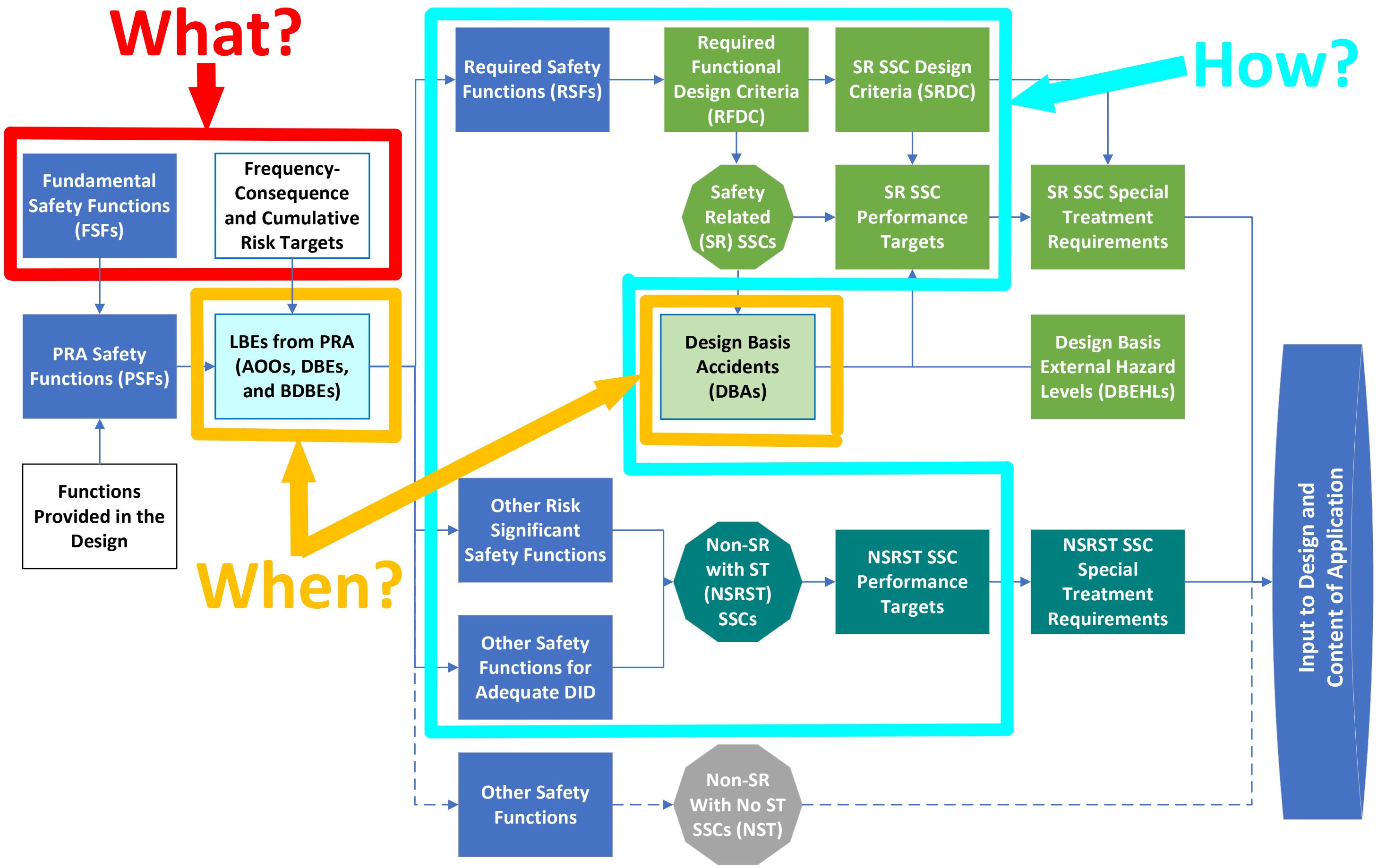
  In TICAP we plan to introduce the concept of

  » "Required Safety Functions" = Principal Design Criteria = Safety-Related SSCs = Adequate Protection

  » "Complimentary Design Criteria (CDC)*" = The design specific SSCs, classified as Non-Safety Related with Special Treatment (NRST) in the LMP process, to provide **additional margins** for adequate protection finding.

* This new term is suggested to convey the message that information on the SSCs classified as NRST will also be provided.

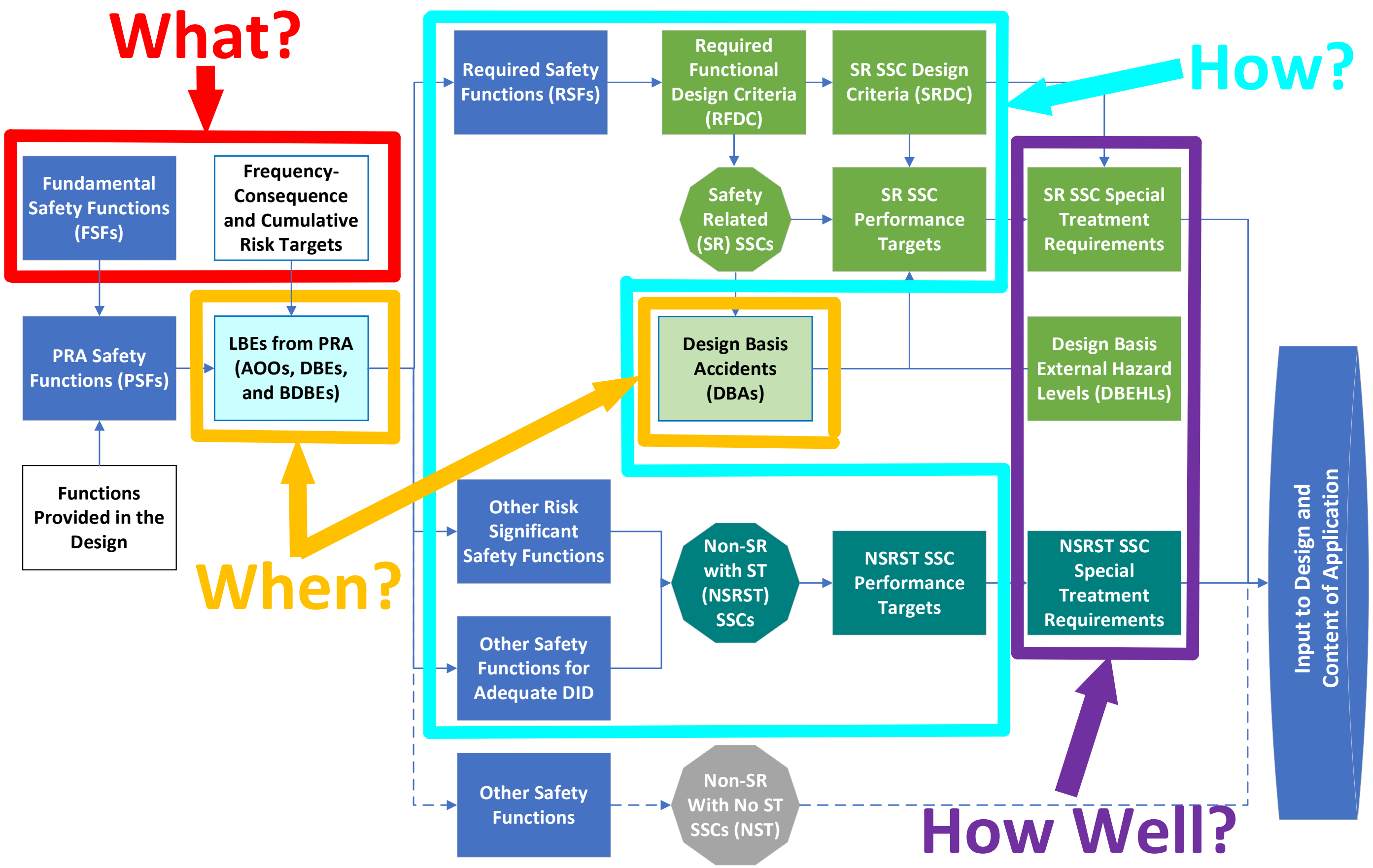
FSF Chart - When



Defining WWHHW – How Well

- This label is applied to the features (programs and configurations) that are credited in a design to provide reasonable assurance that the functions and SSCs labeled as "How" will perform the design specific credited functions.
- NEI 18-04 provides the methodology and guidance to identify and apply appropriate special treatments to SR and NSRST SSC.
- Inputs to "How Well":
  - NEI 18-04 methodology for methodology and guidance to identify and apply appropriate special treatments to SR and NSRST SSC;
  - Performance Targets for both SR and NRST.
- Outputs defined as "How Well":
  - Assignment of appropriate special treatments to SR and NSRST SSC such as environmental qualification, inspection and testing, technical specifications for monitoring and maintenance, treatment of uncertainties.;
  - Identification and assignment of site-specific (or bounding) Design Basis External Hazard Levels (DBEHL) for use in analysis of SR and NSRST SSC performance.
  - Design specific physical features needed to address redundancy and diversity concerns
  - Industry Standards (e.g., Quality Assurance, ASME Section III, XI, IEEE, etc.)

FSF Chart – How Well



Summary of the LMP-Based Safety Case Presentation

- LMP-Based Safety Case- An affirmative safety case where reasonable assurance of adequate protection of the **public** health and safety, from the **radiological risk** point of view, is demonstrated by illustrating that the **performance objectives** of the **FSFs** are met
  - during design specific **LBEs** by crediting certain design specific **LMP-defined functions** that are adequately performed by the **LMP-classified SSCs** where reasonable assurance of such SSCs are established through **design specific features (programmatic (e.g., inspections) or physical (e.g., redundancy))**.

Technology Inclusive Content of Application Project (TICAP)

Potential FSAR LMP-Based Content of Application

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Discussion Topics for Content Formulation Discussion

- Outcomes Reminder
- Caveats and Limitations
- Application Universe (TICAP vs ARCAP)
- Conceptual Formulation

Outcome Reminder

- Project’s Expected Outcomes:
  - A standardized content structure that facilitates efficient
    - » preparation by an applicant,
    - » review by the regulator, and
    - » maintenance by the licensee.
  - A content formulation that, based on the complexity of a design’s safety case, optimizes
    - » the scope (the functions, the structures, systems, and components (SSCs), and the programmatic requirements that need to be discussed) based on what is relevant to the design specific safety case.
    - » the type of information to be provided (e.g., licensing basis events (LBEs), Required Safety Functions (RSFs), safety-related (SR) SSCs, defense-in-depth (DiD), etc.),
    - » level of detail to be provided
      - based on the importance of the functions and SSCs to the safety case (risk-informed, performance-based (RIPB) details).
      - based on the relevance to the safety finding determination.

A Standardized Application Content Structure

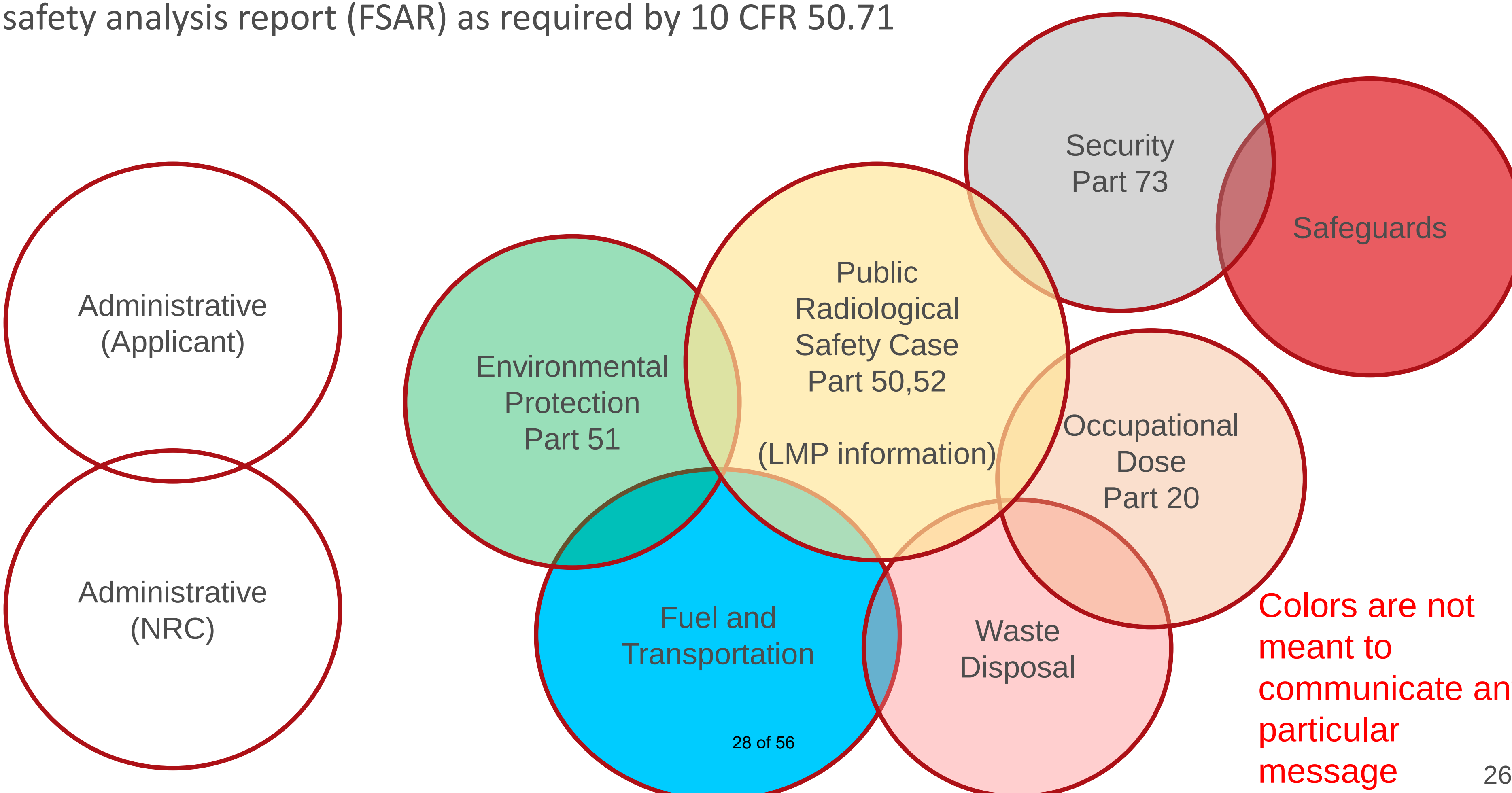
- A potential Application Content structure will be discussed today with the following caveats:
  - Starting point for conversation with the stakeholders
  - Once mature enough will be used as part of the tabletop exercises and refined.
  - Will be finalized based on additional socialization with the industry and the NRC.
  - Application content formulation will be subject of the next meeting with the NRC.

Potential Formulation of FSAR LMP-Based content

- Limitations:
  - Information within TICAP scope presents information developed within the envelope established by the LMP methodology(NEI 18-04).
  - It does not address requirements for normal operation nor all regulations which are applicable to a nuclear facility application (see figure)

Universe of Application Content and TICAP Scope

The current licensing basis (CLB) includes the NRC regulations contained in 10 CFR parts 2, 19, 20, 21, 26, 30, 40, **50,** 51**, 52**, 54, 55, 70, 72, 73, **100** and appendices thereto; orders; license conditions; exemptions; and technical specifications. It also includes the plant-specific design-basis information defined in 10 CFR 50.2 as documented in the most recent final safety analysis report (FSAR) as required by 10 CFR 50.71



Colors are not meant to communicate any particular message

Conceptual Formulation of FSAR LMP content

Chapter 1 – General plant description and Overview of LMP-Based Safety Case

Chapter 2 – LBE and DBA Development

Chapter 3 - Radiological Consequence Assessments

Chapter 4 - Required Safety Functions and Principal Design Criteria

Chapter 5 – Safety-related SSCs

Chapter 6 – Special treatment requirements for safety related SSCs

Chapter 7 – Non-safety-related SSCs

Chapter 8 – Special Treatment Requirements for non - Safety-related SSCs

Chapter 9 – Hazards development

Chapter 10 – PRA development

Chapter 11 Defense in Depth evaluation (?)

Conceptual FSAR Contents of Application- Chapter 1

Chapter 1 – General Plant Description and Overview of the Safety Case

-Overview of technology (size of the reactor and intent of the design – power production/industrial application, etc.)

- General description of the plant systems and roles that they play in normal and off normal conditions, including refueling

- Summary of safety case findings using FSF as meeting adequate protection

    - Summary of Fundamental Safety Functions

    - summary of LBE

    - summary of radiological consequence assessment

    - summary of how design demonstrates providing FSFs

    - evaluation of defense in depth capabilities

- General description of references to Reg Guides used

- General site characteristics

Conceptual FSAR Contents of Application- Chapter 2

Chapter 2 – Licensing Basis Events

- description of risk-informed methodology used to select licensing basis
- AOO selection results
- DBE selection results
- DBA selection results
- BDBE selection results

Conceptual FSAR Contents of Application- Chapter 3

Chapter 3 – Analytical assessment of Radiological Consequences for Design Basis Accidents

- description of analytical methods used
- description of analysis assumptions used
- supporting basis for analysis assumptions that are unique applications
- description of acceptance criteria for each evaluated design basis accidents
- description of results versus established regulatory criteria

Conceptual FSAR Contents of Application – Chapter 4

Chapter 4 – Required Safety Functions and Principal Design Criteria

- 4.1 Required Safety Functions
- 4.2 Principal Design Criteria (specific to facility capabilities)
- 4.2 SSC Classification

Conceptual FSAR Contents of Application – Chapter 5

Chapter 5 – Safety Related Structures, Systems, and Components

- 5.1 Safety-Related Structures
  - description of structure functional requirements – what is it that this structure is included in design to do for both normal operation and off normal conditions
  - description of materials of construction
  - schematic of building structures with location of important components and with important boundaries shown
  - structural analysis
- 5.2 Safety-Related Systems
  - description of system functional requirements – what is it that this system is included in the design to do for both normal operation and off normal conditions
  - description of materials of construction
  - schematic of building structures with location of important components and with important boundaries shown
- 5.3 Safety-Related Components (not discussed as part of systems or structures)
  - description of system functional requirements – what is it that this system is included in the design to do for both normal operation and off normal conditions
  - description of materials of construction
  - schematic of building structures with location of important components and with important boundaries shown

Conceptual FSAR Contents of Application- Chapter 6

Chapter 6 – Special Treatment Requirements for Safety Related Structures, Systems, and Components

6.1 Safety-Related Structures ---- description of technical programs that programmatically support the reliability and integrity of safety related system functions. What things are needed to provide reasonable assurance the required functions will be performed when called upon.

- description of construction and qualification codes to be used and important design parameters

- description of Inservice Inspection and testing requirements

- discussion of quality standards used for procurement and fabrication

6.2 Safety-Related Systems ---- description of technical programs that programmatically support the reliability and integrity of safety related system functions. What things are needed to provider reasonable assurance the required functions will be performed when called upon.

- same as 6.1 above

6.3 Safety Related Components (things like reactor vessel, fuel, unique passive components not included in System or structure discussions)

- same as 6.1 above

Conceptual FSAR Contents of Application- Chapter 7

Chapter 7 – Non-Safety-Related with Special Treatments Structures, Systems, and Components Design Bases

-7.1 Non-safety-Related Structures with **Risk Significance** (if any)

- description of system functional requirements – what is it that this system included in the design to do for both normal operation and off normal conditions

- description of materials of construction

-7.2 Non-safety-related Structures with **defense-in-depth importance**, (if any)

(same as 7.1 above)

-7.3 Non-safety-related systems with **risk significance**

(same as 7.1 above)

-7.4 Non- safety related systems with **defense-in-depth importance**, if any

(same as 7.1 above)

Conceptual FSAR Contents of Application- Chapter 7

Chapter 7 – Non-Safety-related Structures, Systems, and Components Design Bases (continued)

- 7.7 non-safety related components with **risk significance** (not discussed as part of structure or systems discussion

  (same as 7.1 above)

- 7.8 non safety related components **with defense in depth** importance

  (same as 7.1 above)

Conceptual FSAR Contents of Application- Chapter 8

8.0 Special Treatment for non safety related SSCs

-8.1 non safety related Structures with risk significance-- description of technical programs that programmatically support the reliability and integrity of non safety related structure functions.

- description of construction and qualification codes to be used and important design parameters
- schematic of building structures with location of important components with important boundaries shown
- description of Inservice Inspection and testing requirements
- discussion of quality standards used for procurement and fabrication
- specification of structure performance targets

-8.2 Non-safety-Related Systems with risk significance

- (same as 8.1 above for information)

-8.3 Non-safety-related Systems with defense-in-depth importance

- (same as 8.1 above for information)

-

Conceptual FSAR Contents of Application- Chapter 8

8.0 Special Treatment for non safety related SSCs (continued)

-8.4 Non-safety-related systems with defense in depth importance

-8.5 non- safety related components with risk significance

-(same as 8.1 above for information)

- 8.6 non safety related components with defense in depth importance

- (same as 8.1 above for information)

Conceptual FSAR Contents of Application-Chapter 9

Chapter 9 – External and Internal Hazards Assessments

9.1 – External Hazard identification

- 9.1.1 Weather induced events
  - maximum precipitation
  - snow
  - flooding
  - tsunami
  - storm surges
  - nearby industrial, transportation or military facilities
- 9.1.2 Wind induced events
  - tornado winds and missiles
  - hurricane winds and missiles
- 9.1.3 natural phenomena
  - seismic – geotechnical engineering
  - meteorology – (X/Q dispersion)
  - other(?)

Conceptual FSAR Contents of Application-Chapter 9

Chapter 9 – Internal and External Hazards Assessments (continued)

9.2 – Internal Hazard identification

- 9.2.1 Fires
- 9.2.2 Chemicals
- 9.2.3 Flooding
- 9.2.4 Dynamic effects

Conceptual FSAR Contents of Application- Chapter 10

Chapter 10 – Probabilistic Risk Assessment

10.1- Scope of PRA

10.2 - description of methodology used to develop the PRA

- standards used

10.3 – Peer Review Finding

Conceptual FSAR Contents of Application- Chapter 11

Chapter 11 – Defense in Depth Assessment Summary

- Plant capabilities available
- Programmatic evaluation supporting DID
- Integrated Evaluation

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Tabletop Exercises

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Tabletop Exercises

- Scope of tabletop exercises-
- Planned start date- August
- Potential interactions with the NRC as observers
- Public release of results
- The following developers have expressed
  - GE - Prism Design- Solid fuel in a pool of coolant
  - WEC – A micro reactor design – Solid fuel, heat pipe cooled
  - Kairos – fluoride salt-cooled solid TRISO pebble-based fuel

Technology Inclusive Content of Application Project (TICAP)

Next Steps

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Next Steps

- Alignment on the FSFs definitions
- Mapping of current regulations to FSFs and mapping of GDCs to WWHHW labels
- Suggested outline for the final NEI document
- An LMP-based safety case
- Formulation of Application Content
- Tabletop Exercises Results
- Annotated Outlien of the FSAR

NEI Guidance Document

NEI Content of Application Formulation Guidance Document

Technology Inclusive Content of Application Project (TICAP)

Takeaways

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Takeaways

- LMP-Based Safety Case- An affirmative safety case where reasonable assurance of adequate protection of the **public** health and safety, from the **radiological risk** point of view, is demonstrated by illustrating that the **performance objectives** of the **FSFs** are met
  - during design specific **LBEs** by crediting certain design specific **LMP-defined functions** that are adequately performed by the **LMP-classified SSCs** where reasonable assurance of such SSCs are established through **design specific features (programmatic (e.g., inspections) or physical (e.g., redundancy))**.

Takeaways

- LMP-Based Safety Case constituents can be organized into the following categories:
  - » **What** are the performance objectives for the FSFs,
  - » **When** do the FSF's performance objectives need to be demonstrated,
  - » **How** plant capabilities (functional and structural) demonstrate that the fundamental safety functions are met.
  - » **How Well** do these capacities need to be performed to provide reasonable assurance

Takeaways (Continued)

- FSAR Formulation Approach- Proposal will be anchored by a LMP-safety-case-based approach for developing PDCs and Complimentary Design Criteria (CDC) because:
  - 10 CFR 52.47(a)(3)(i) require that an application for a combined license include the PDC for a proposed facility (similar requirements exist for other licensing paths).
  - 10 CFR Part 50, Appendix A, contains the GDC that establish the minimum requirements for the PDC for water-cooled nuclear power plants.
  - For LWRs, GDCs provide minimum requirements for PDC, which establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components (SSCs) that, as stated in Appendix A, SSCs “that provide reasonable assurance that the nuclear power plant can be operated without undue risk to the health and safety of the public.”

Takeaways (Continued)

– "The GDC serve as the fundamental criteria for the NRC staff **when reviewing** the SSCs that make up a nuclear power plant design particularly when assessing the performance of **their intended safety functions** in design basis events **postulated to occur during normal operations, anticipated operational occurrences (AOOs), and postulated accidents"**

– LMP-safety-case-based (LMP-SCB) PDCs and CDCs meet the underlying intent of the GDCs for the LWRs because [Will be demonstrated in the mapping report]

» At a high level, the current **radiological risk to the public related Regulations**, can be mapped into the same FSFs that the LMP-Safety-Case are mapped to.

» The GDC-based PDCs for LWRs, which reflect **radiological risk to the public related Regulations,** include the "How" and "How Well" of meeting the FSFs but for different "When".

Takeaways – (continued)

- Project's Expected Outcomes:
  - A standardized content structure that facilitates efficient
    - » preparation by an applicant,
    - » review by the regulator, and
    - » maintenance by the licensee.
  - A content formulation that, based on the complexity of a design's safety case, optimizes
    - » the scope (the functions, the structures, systems, and components (SSCs), and the programmatic requirements that need to be discussed) based on what is relevant to the design specific safety case.
    - » the type of information to be provided (e.g., licensing basis events (LBEs), Required Safety Functions (RSFs), safety-related (SR) SSCs, defense-in-depth (DiD), etc.),
  - PDCs will only include SSCs that are credited to perform the RSFs
  - PDCs and CDCs will be limited to those SSCs that are credited to perform the functions (Only "Hows" will be included)
    - » level of detail to be provided
      - based on the importance of the functions and SSCs to the safety case (risk-informed, performance-based (RIPB) details).
      - based on the relevance to the safety finding determination.

Additional Questions

- Additional Questions or comments

Acronyms

AEA – Atomic Energy Act

ASME – American Society of Mechanical Engineers

AOO – Anticipated Operational Occurrences

BDBE – Beyond Design Basis Events

CDC – Complimentary Design Criteria

DBA – Design Basis Accidents

DBE – Design Basis Events

DBEHL – Design Basis External Hazard Levels

DID – Defense-in- Depth

FSF – Fundamental Safety Function

GDC – General Design Criteria

NEI – Nuclear Energy Institute

NSRST – Non-safety Related Special Treatment

LBE – Licensing Basis Events

LMP – Licensing Modernization Project

LMP-SCB – Licensing Modernization Project Safety Case Based

PDC – Principal Design Criteria

PRA – Probabilistic Risk Assessment

RSF – Required Safety Functions

SSC – Structures, Systems, and Components

Break