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

Technology Inclusive Content of Application Project Workshop

May 19, 2021
Microsoft Teams Meeting
Bridgeline: 301-576-2978
Conference ID: 590 307 334#

U.S.NRC
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Agenda

Time	Topic*	Speaker
10:00 - 10:15 am	Opening Remarks	NRC/Southern
10:15 - 12:00 am	First Workshop Session. The topic# is based on the list of topics found in a document available in ADAMS at Accession No. ML21120A057 Topic #1 Construction Permit Guidance Topic #21 Safety Case Topic #5 Affirmative Safety Case	NRC/Southern
12:00 - 1:00 pm	Break	All
1:00 -2:45 pm	Second Workshop Session Topics Topic #6 Principal Design Criteria (PDC) Topic #13 PDC and eVinci Tabletop	NRC/Southern
2:45 - 3:30 pm	BREAK	All
3:30 - 5:15 pm	Third Workshop Session Topics Topic #11 External Events (Probabilistic vs. Deterministic) Topic #23 Probabilistic Risk Assessment Guidance	NRC/Southern
5:15 - 5:30 pm	Plans for Future Workshops	NRC/Southern
5:30 - 6:00 pm	Stakeholder Comments/Questions	All

***Note that the list of topics to be discussed during the allotted time slot is subject to change. Additional detail regarding the list of topics can be found at ADAMS Accession No. ML21120A057**

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TICAP Workshop

- The purpose of this workshop is to discuss with the nuclear industry issues related to the draft guidance document for Safety Analysis Report (SAR) content for an advanced reactor application based on the licensing modernization project
- Key documents associated with the workshop are referenced in the meeting notice and include:
  - Industry-developed draft TICAP guidance document (ADAMS Accession No. ML21106A013)
  - Potential Issues to be Discussed During TICAP Workshops (ADAMS Accession No. ML21120A057)
    - As updated by May 11, 2021, Meeting Summary Enclosure 2 (ADAMS Accession No. ML21132A295)
- Additional Background Available on NRC ARCAP/TICAP public webpage (see: https://www.nrc.gov/reactors/new-reactors/advanced/details.html#advRxContentAppProj)

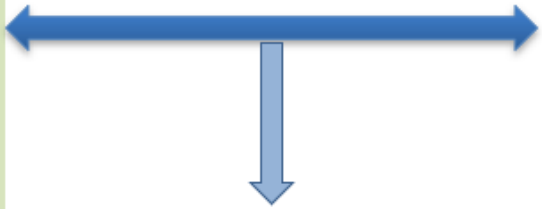
ARCAP and TICAP – **Nexus**

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

1. General Plant Information, Site Description, and Overview of the Safety Case
2. Generic Analyses
3. Licensing Basis Event (LBE) Analysis
4. Integrated Plant Analysis
5. Safety Functions, Design Criteria, and SSC Categorization
6. Safety Related SSC Criteria and Capabilities
7. Non-safety related with special treatment SSC Criteria and Capabilities
8. Plant Programs

Additional SAR Content –Outside the Scope of TICAP

9. Control of Routine Plant Radioactive Effluents, Plant Contamination, and Solid Waste
10. Control of Occupational Doses
11. Organization
12. Initial Startup Programs



Audit/inspection of Applicant Records

- Calculations
- Analyses
- P&IDs
- System Descriptions
- Design Drawings
- Design Specs
- Procurement Specs

Additional Portions of Application

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

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

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

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NRC Advanced Reactor Construction Permit Guidance White Papers

- May 14, 2021, NRC Staff Issued Draft White Papers Associated with the Development of a TICAP Regulatory Guide and ARCAP Roadmap Interim Staff Guidance (ADAMS Accession No. ML21134A164)
  - Appendix E of ARCAP Roadmap ISG white paper provides construction permit (CP) guidance outside of first 8 chapters of the safety analysis report (SAR)
  - Appendix A of TICAP regulatory guide white paper provides CP guidance for first 8 chapters of the SAR
  - Draft CP white paper guidance is preliminary and is based on an updated version of the CP guidance (advanced reactor portion) discussed during the February 25, 2021, ARCAP/TICAP public meeting (ADAMS Accession No. ML21043A339)

Discussion Slides

Technology Inclusive Content of Application Project (TICAP)

Workshop #2
May 19, 2021

Brandon Chisholm, Southern Company
Karl Fleming, KNF Consulting Services
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Southern Company

Overview

- The TICAP Team appreciates the preliminary comments from the Nuclear Regulatory Commission (NRC) and Idaho National Laboratory (INL)
- These slides are intended to support a dialog on initial NRC comments on the draft TICAP guidance document and do not represent final regulatory positions
- Workshop #2 Discussion Topics are addressed in the following order

1 21 5 6 13

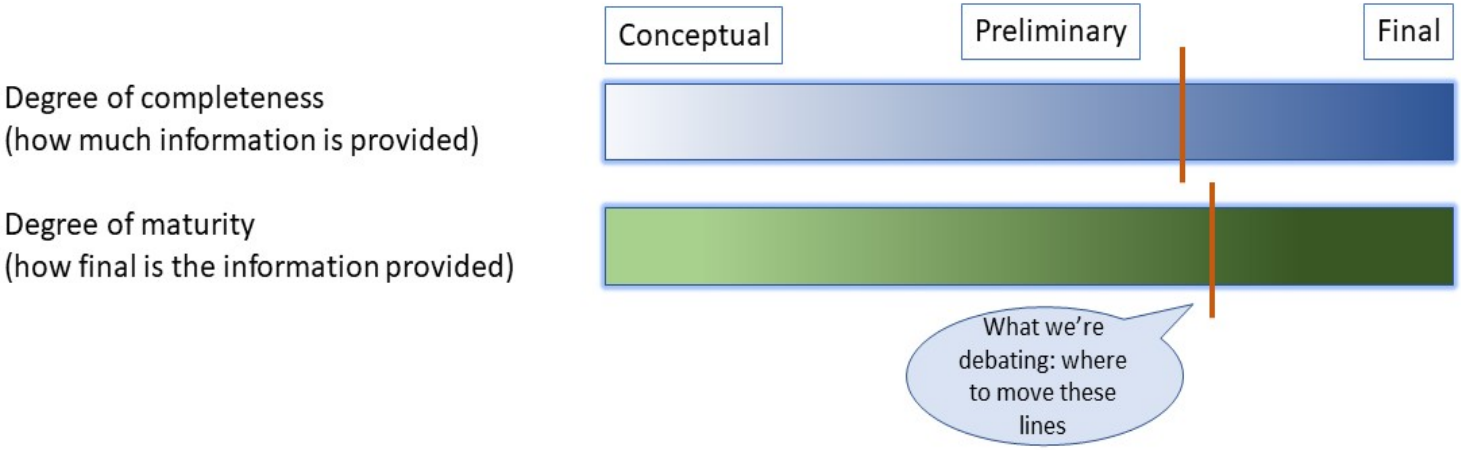
- The words in italics are the NRC topics and, in some cases, the associated NRC comments

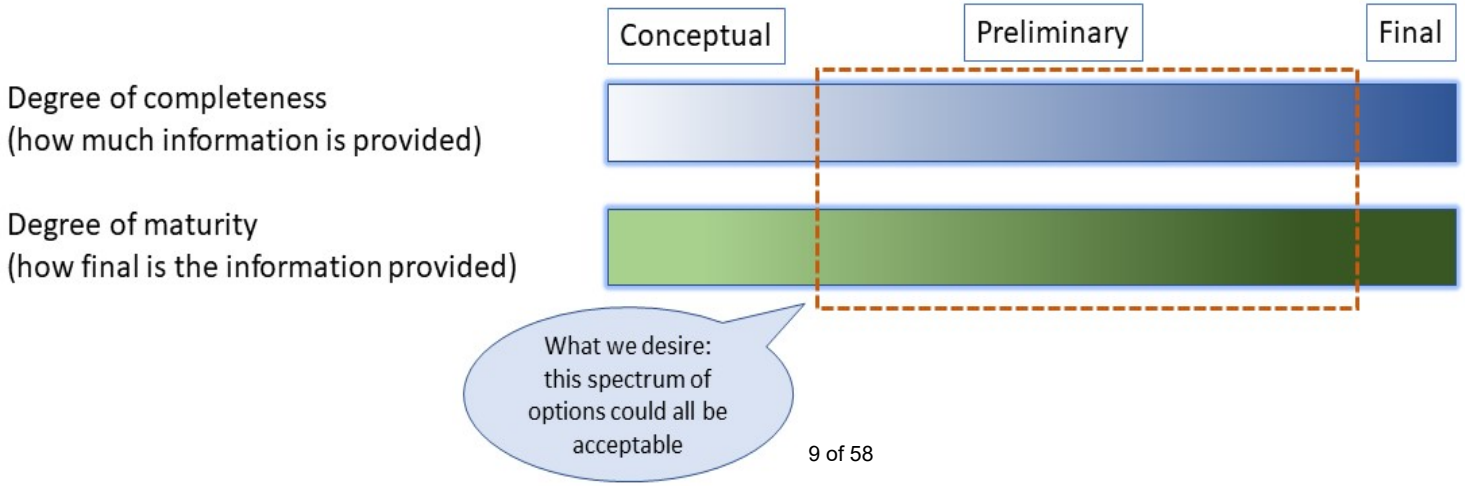
Topic 1 – Construction Permit

- *The construction permit (CP) guidance contained in the two-step Licensing section is not sufficiently detailed to ensure consistent implementation.*
- TICAP Discussion
  - TICAP CP guidance provides necessary and sufficient content guidance to support the regulatory decision in 10 CFR 50.35(a)
  - Additional language regarding level of detail in Introduction to RG 1.70
    - » The language provides some useful thoughts on level of detail in a CP application.
  - Potential CP applicants have technologies with a range of maturity and completeness levels

Topic 1 – Construction Permit (cont.)

Advanced Reactor Design Completeness and Maturity





Topic 1 – Construction Permit (cont.)

- CP guidance addresses “adjustments” to the COL guidance
- CP guidance sets the necessary and sufficient information content that would permit the staff to reach the required safety conclusions under 50.35(a)
- CP guidance in Section 2.1.1, “Overview of PRA” notes that at construction permit stage, neither the plant design nor the PRA is expected to have the level of maturity necessary to support the OL
  - » If applicant makes use of ASME/ANS RA-S-1.4-2021 a simple statement to that effect should be sufficient. That standard does provide the analyst significant flexibility in implementing the standard
  - » Applicant should describe ultimate intended approach for qualifying the PRA so that it is adequate with the flexibility allowed in the standard

Topic 1 – Construction Permit (cont.)

- PRA to address at least last five items in Section 2.1.1
  - » Identification of sources of radionuclides addressed and the sources of radionuclides that were “screened out” of the PRA models
  - » Discussion of multi-reactor scenarios that were addressed
  - » Identification of internal and external hazards that were considered
  - » Identification of plant operating states that were included and those that were screened out
  - » Identification of the software and analytical tools that were used to perform the event sequence modeling and quantification, determine the mechanistic source terms, and perform radiological consequence evaluations (with appropriate references to technical and/or topical reports provided as applicable)
- No PRA peer review should be required at the CP application stage
- These items begin to establish a lower-limit on design maturity for TICAP use
- Additional PRA issues addressed in Topic 23 discussion

Topic 1 – Construction Permit (cont.)

- Subsequent sections of the guidance reflect levels of detail consistent with technology maturity and the corresponding level of maturity of supporting analyses
  - » Emphasis on level of detail consistent with preliminary design
  - » Each CP applicant and technology developer will have a basis for determining when a design has reached a preliminary level of maturity and completeness
- Absent additional guidance, CP content and level of detail should be consistent with guidance for COL/OL
- Specific NRC comments on Chapters 3 and 4 seek clarification of "preliminary"
  - » "Preliminary" is used in the TICAP CP guidance in the same context as In 50.34(a): the design and supporting analyses are not finalized to the degree to support the FSAR required in 50.34(b), but methods to be used in finalizing information are clearly described

Topic 1 – Construction Permit (cont.)

- *Comment 1: For Sections 1.2, 1.3, 1.4, and 2.4 there is no CP guidance. For Section 2.3, simplified and/or qualitative analyses should be available to support reasonable assurance findings (examples are provided in Appendix C of NRC's Construction Permit White Paper found at ADAMS Accession No. ML21043A339)*
- TICAP Discussion
  - Where no specific guidance is provided for CP application, the COL language in the Section applies
  - CP guidance in Section 2.3 differs from COL guidance only to the degree that it reflects the preliminary nature of the design and information
    - » Analysis methods used in calculations of DBA sequences should be specified including key assumptions
    - » As with COL guidance, multiple sections may be used to describe multiple methods
    - » Level of detail sufficient to support 50.35(a)

Topic 1 – Construction Permit (cont.)

- *Comment 2: Chapter 3 – Use of term "preliminary assessments." What does that mean? Should reference bounding assumptions and conservative modeling to account for the uncertainty in final design details. Should reference discussion of the major SSCs of the facility that are intended to mitigate the radiological consequences of a design basis accident (DBA).*
- TICAP Discussion
  - CP guidance is to provide clear description of methodology used in determining initial set of LBEs – clearly describe role of PRA
  - Use of "bounding assumptions and conservative modeling" is not consistent with LMP approach
  - Discussion of SSCs starts with Section 1.1.4 such that discussion of FSFs can be put into context with overall plant design and SSCs. Also points to location of more detailed SSC-specific information provided elsewhere in Chapters 6 or 7

Topic 1 – Construction Permit (cont.)

- *Comment 3: For Chapter 4, the staff would like to understand better the use of term "preliminary description of the integrated plant performance."*
- TICAP Discussion
  - Section 4.1 CP content to address three cumulative plant performance metrics in NEI 18-04, Section 3.2.2, Task 7b for risk to the public from radiation
    - » PRA methodology to be used in dose and risk estimates
    - » If design not sufficiently complete to support full-scope PRA, performance-based approach may be used in support of 50.35(a) findings
    - » CP application should clearly describe methods used in analyses

Topic 1 – Construction Permit (cont.)

- *Comment 4: For Chapter 6, guidance for first of a kind (FOAK) structures, systems and components (SSCs) does not appear to be sufficiently detailed to ensure consistent implementation*
- TICAP Discussion
  - Chapter 6 notes FOAK components should be identified, as should plans for component performance validation and acceptance criteria
  - Topic 7 addressed testing and qualification plans for FOAK safety-related SSCs for CP applications, and points to 50.43(e) testing
    - » TICAP believes NEI 18-04 methodology does not encompass the 50.43(e) regulation but results of the testing would likely appear in the technical justifications supporting the safety case
    - » TICAP committed to take another look at whether and, if so, how the 50.43(e) testing should be addressed by TICAP

Topic 1 – Construction Permit (cont.)

- *Comment 5: The CP guidance should consider including a description of the research and development (R&D) plans supporting the design.*
- TICAP Discussion
  - CP guidance in Section 2.3 (p. 28) specifically notes applicant should describe areas that require R&D to confirm assumptions and methodologies
    - » The intent is that the necessary R&D activities, whether on-going or planned, with be described at a level of detail to identify objective and scope of the research and include specific details of the research to be conducted, to the degree practical
    - » The language in Section 2.3 will be expanded to provide more detail on expectations for R&D plans

Topic 1 – Construction Permit (cont.)

- *Comment 6: The minimum level of detail to support a CP application should be considered for discussion. The CP white paper provides thoughts regarding minimum level of detail.*
- TICAP Discussion
  - As noted, the level of detail warrants further discussion
  - The NEI letter of April 2 should provide a basis for that discussion

Topic 1 – Construction Permit (cont.)

- *Comment 7: The non-light water reactor probabilistic risk assessment (NLWR PRA) standard contains numerous supporting requirements to document the assumptions made in lieu of detailed design information. Will these assumptions be identified in the preliminary safety analysis report (PSAR) or will they be provided in the detailed PRA information (which is only available to the staff via onsite audit)? This comment is related to issue #8 below.*
- TICAP Discussion
  - The PRA information, including applicable assumptions made in lieu of detailed design information, will be available for audit
  - TICAP will revise language in Section 2.1.1 to clarify this point

Topic 1 – Construction Permit (Backup Slide)

10 CFR 50.35(a)

When an applicant has not supplied initially all of the technical information required to complete the application and support the issuance of a construction permit which approves all proposed design features, the Commission may issue a construction permit if the Commission finds that (1) the applicant has describe the proposed design of the facility, including, but not limited to the principal architectural and engineering criteria for the design, and has identified the major features or components incorporated therein for the protection of the health and safety of the public; (2) such further technical or design information as may be required to complete the safety analysis and which can reasonably be left for later consideration, will be supplied in the final safety analysis report; (3) safety features or components, if any, which require research and development have been described by the applicant and the applicant has identified, and there will be conducted, a research and development program reasonably designed to resolve any safety questions associated with such features or components; and that **(4) on the basis of the foregoing, there is reasonable assurance that, (i) such safety questions will be satisfactorily resolved at or before the latest date stated in the application for completion of construction of the proposed facility, and (ii) taking into consideration the site criteria contained in part 100 of this chapter, the proposed facility can be constructed and operated at the proposed location without undue risk to the health and safety of the public.**

Topic 1 – Construction Permit (Backup Slide)

Introduction to Regulatory Guide 1.70 – Level of Detail

If certain information identified in the Standard Format is not yet available at the time of submission of a PSAR because the design has not progressed sufficiently at the time of writing, the PSAR should provide the criteria and bases being used to develop the required information, the concepts and alternatives under consideration, and the schedule for completion of the design and submission of the missing information. In general, the PSAR should describe the preliminary design of the plant in sufficient detail to enable a definitive evaluation by the staff as to whether the plant can be constructed and operated without undue risk to the health and safety of the public.

Topic 21 – Term “safety case”

- *The term “safety case” is not currently used in NRC licensing processes.*
- *Need alignment on what a safety case is and, equally important, what it is not.*
- TICAP Discussion
  - TICAP proposes a definition for safety case derived from those established by the International Atomic Energy Agency (IAEA) and respected national regulatory bodies.
  - TICAP concurs that elements of an application and the NRC’s decision-making are outside the scope of the technology-inclusive, risk-informed, performance-based process, including but not limited to physical security, cyber security, IAEA safeguards, etc.

Topic 21 – Term “safety case” (cont.)

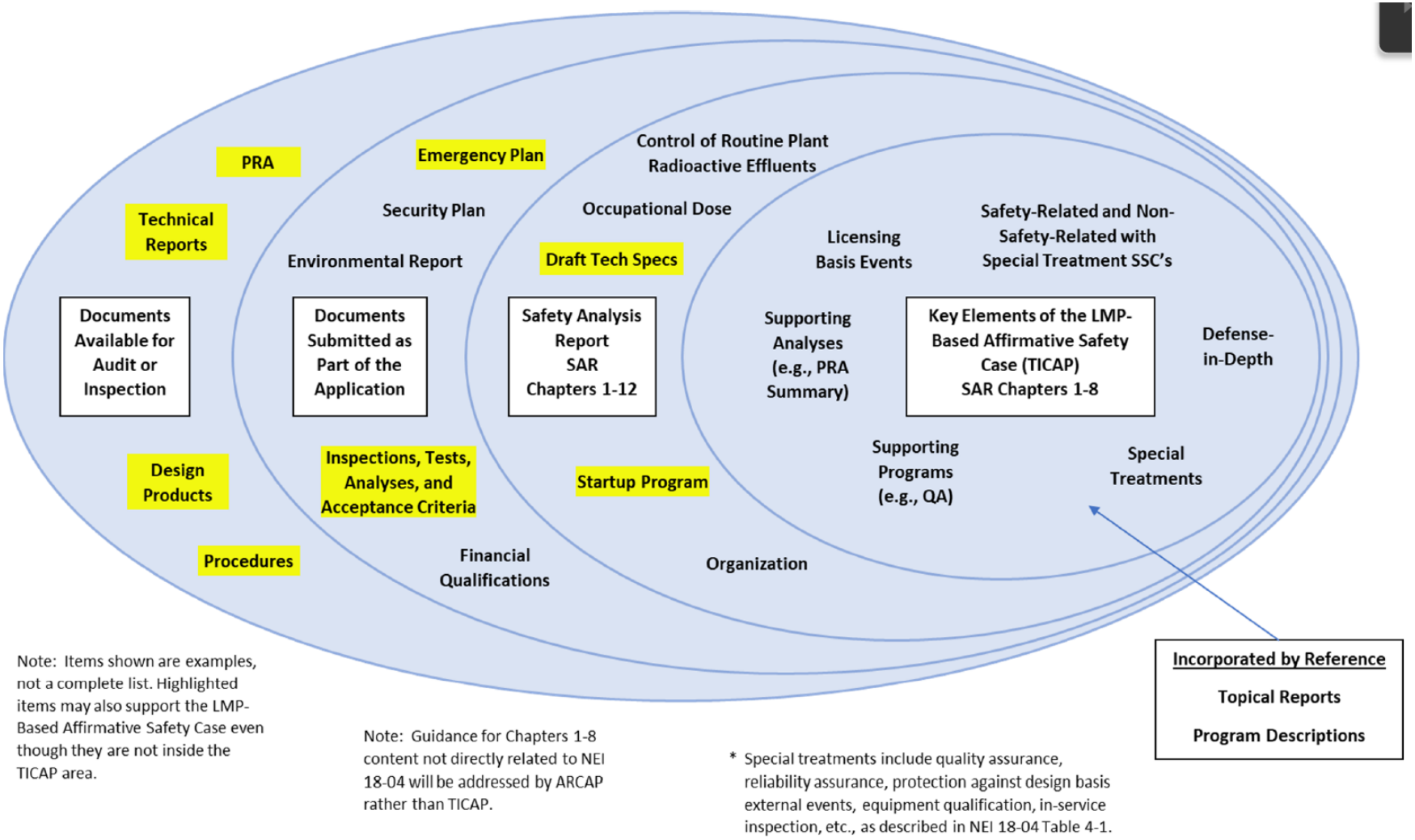
- IAEA: “a collection of scientific, technical, administrative and managerial arguments and evidence in support of the safety of a disposal facility covering the suitability of the site and the design, construction, and operation of the facility, the assessment of radiation risks and assurance of the adequacy and quality of all the safety related work associated with the disposal facility.”
- UK Office of Nuclear Regulation: “The nuclear safety case is a term used to encompass the totality of the documentation developed by a designer, licensee or dutyholder to demonstrate high standards of nuclear (including radiological) safety and radioactive waste management.”

Topic 21 – Term “safety case” (cont.)

TICAP definition: “An affirmative safety case is a collection of technical and programmatic evidence which documents the basis that the performance objectives of the technology-inclusive Fundamental Safety Functions (FSFs) are met by a design during design specific Anticipated Operational Occurrences (AOOs), Design Basis Events (DBEs), Beyond Design Basis Events (BDBEs), and Design Basis Accidents (DBAs). This is accomplished by the following:

- Identifying design-specific safety functions that are adequately performed by design-specific SSCs;
- Establishing design-specific features (programmatic, e.g., inspections, or physical, e.g., diversity) to provide reasonable assurance that credited SSC functions are reliably performed and to demonstrate the adequacy of defense-in-depth.”

Topic 21 – Term "safety case" (cont.)



Note: Items shown are examples, not a complete list. Highlighted items may also support the LMP-Based Affirmative Safety Case even though they are not inside the TICAP area.

Note: Guidance for Chapters 1-8 content not directly related to NEI 18-04 will be addressed by ARCAP rather than TICAP.

* Special treatments include quality assurance, reliability assurance, protection against design basis external events, equipment qualification, in-service inspection, etc., as described in NEI 18-04 Table 4-1.

Figure 1. Relationship of TICAP to an Advanced Reactor License Application

Topic 5 – Performance-based Approach

- *The document describes a move away from compliance-based applications to a more performance-based approach. It's not clear from these statements whether applicants will be expected to describe how they comply with the regulations that are associated with the performance-based scope and outcomes of the affirmative safety case approach.*
- TICAP Discussion
  - TICAP agrees that the focus of TICAP is on the portions of 10 CFR 52.79 related to the identification and analysis of licensing basis events; categorization and requirements for structures, systems, and components; and demonstration of defense-in-depth
  - The TICAP-related portions of the Safety Analysis Report are not intended to address the entirety of the regulations applicable to an advanced reactor, either within Part 52 itself or within the broader range of NRC regulations

Topic 5 – Performance-based Approach (cont.)

- Early in the project TICAP developed white papers related to Fundamental Safety Functions (FSFs)
  - » Technology-independent FSFs were defined
    - Retaining Radioactive Materials
    - Controlling Reactivity
    - Removing Heat from the Reactor and Waste Stores
  - » Design requirements in 10 CFR Parts 50 and 52 were mapped to one or more FSFs
- Conclusion – an advanced reactor design satisfying the FSFs should meet the intent of the Part 50 and Part 52 design requirements
  - » The Licensing Modernization Project (LMP) provides a technology-independent methodology for demonstrating that FSFs are met
  - » An advanced reactor with an acceptable LMP-based affirmative safety case may be deemed to meet the intent of the Part 50 and Part 52 requirements

Topic 5 – Performance-based Approach (cont.)

- NRC Staff Draft White Paper "Analysis of Applicability of NRC Regulations for Non-Light Water Reactors" (September 2020)
  - » "The NRC staff anticipates that non-LWRs applicants will request exemptions from some of the NRC's regulations. "
- The LMP-based affirmative safety case provides evidence that a plant poses no undue risk to the public from its licensing basis events and has adequate defense-in-depth
  - » The LMP-based affirmative safety case using a PRA that is compliant with the non-light water reactor PRA Standard has already addressed a wide range of hazards covered by NRC regulations
  - » Therefore, the plant meets the intent of the regulations – reasonable assurance of adequate protection of public health and safety – for those NRC regulations addressing hazards covered by the LMP-based affirmative safety case developed in accordance with NEI 18-04

Topic 5 – Performance-based Approach (cont.)

- NRC regulations (50.34, 52.79) require the SAR provide analyses, program descriptions, etc., intended to address a number of issues that are derived from the light water reactor experience base
- To the extent that those issues are covered by a non-LWR LMP application, that fact provides a justification for an exemption request
  - » "Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule" [10 CFR 50.12(a)(2)(ii)]

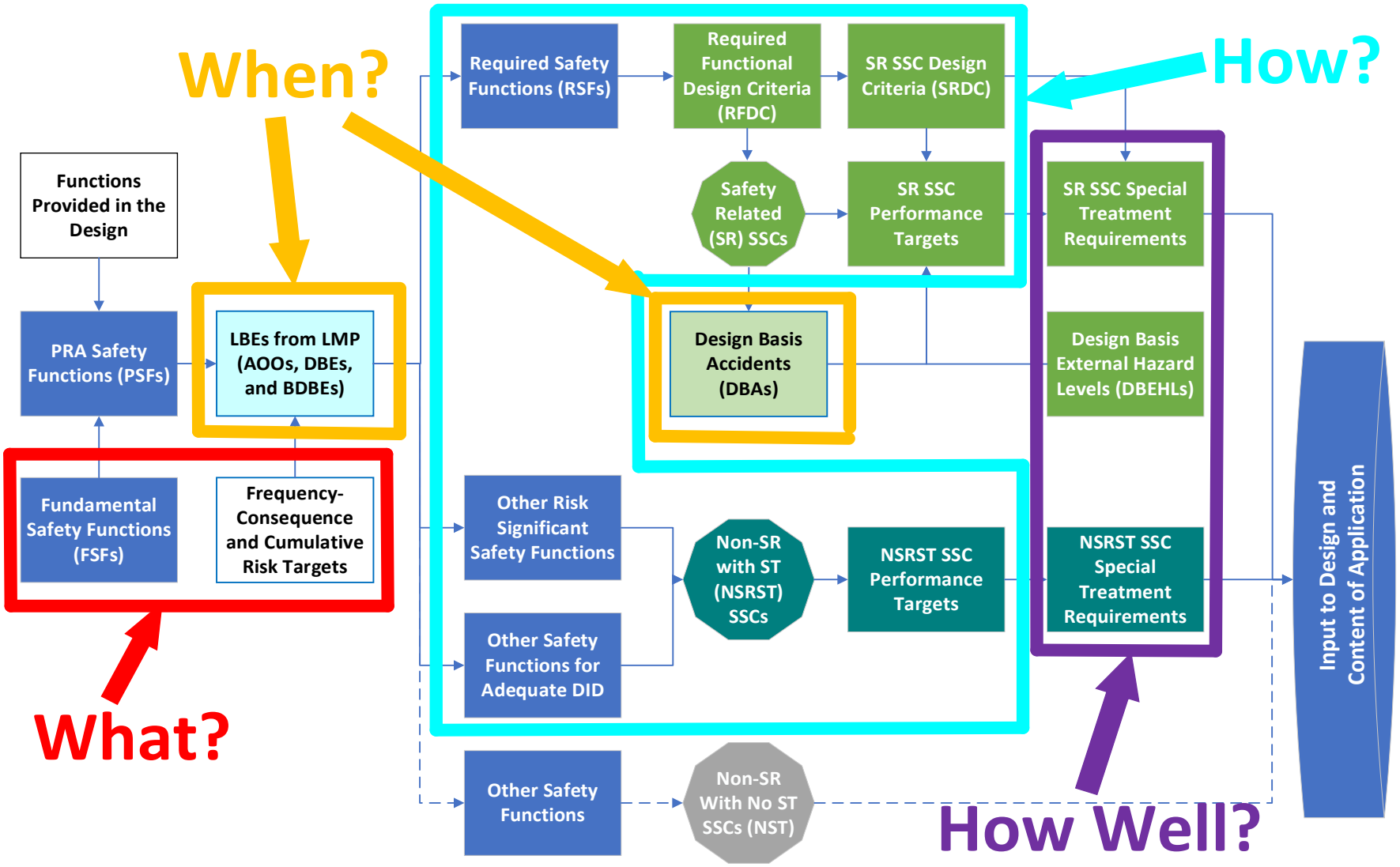
Topic 6 – Principal Design Criteria

- *The guidance for inclusion of principal design criteria (PDC) may be incomplete, since only "LMP outcomes" are addressed, and other topics from Part 50 App. A (like Monitoring Fuel & Waste Storage) are not clearly included for consideration*
- *Comment 6: The TICAP methodologies are trying to adapt the PDC concept to the affirmative safety case approach and equate the PDC to those associated with RSFs. In that approach, considering non-reactor sources could have associated RSFs and PDCs if high-consequence events might be associated with such inventories. Other issues associated with the LWR GDC or ARDC may be addressed by other parts of an application.*

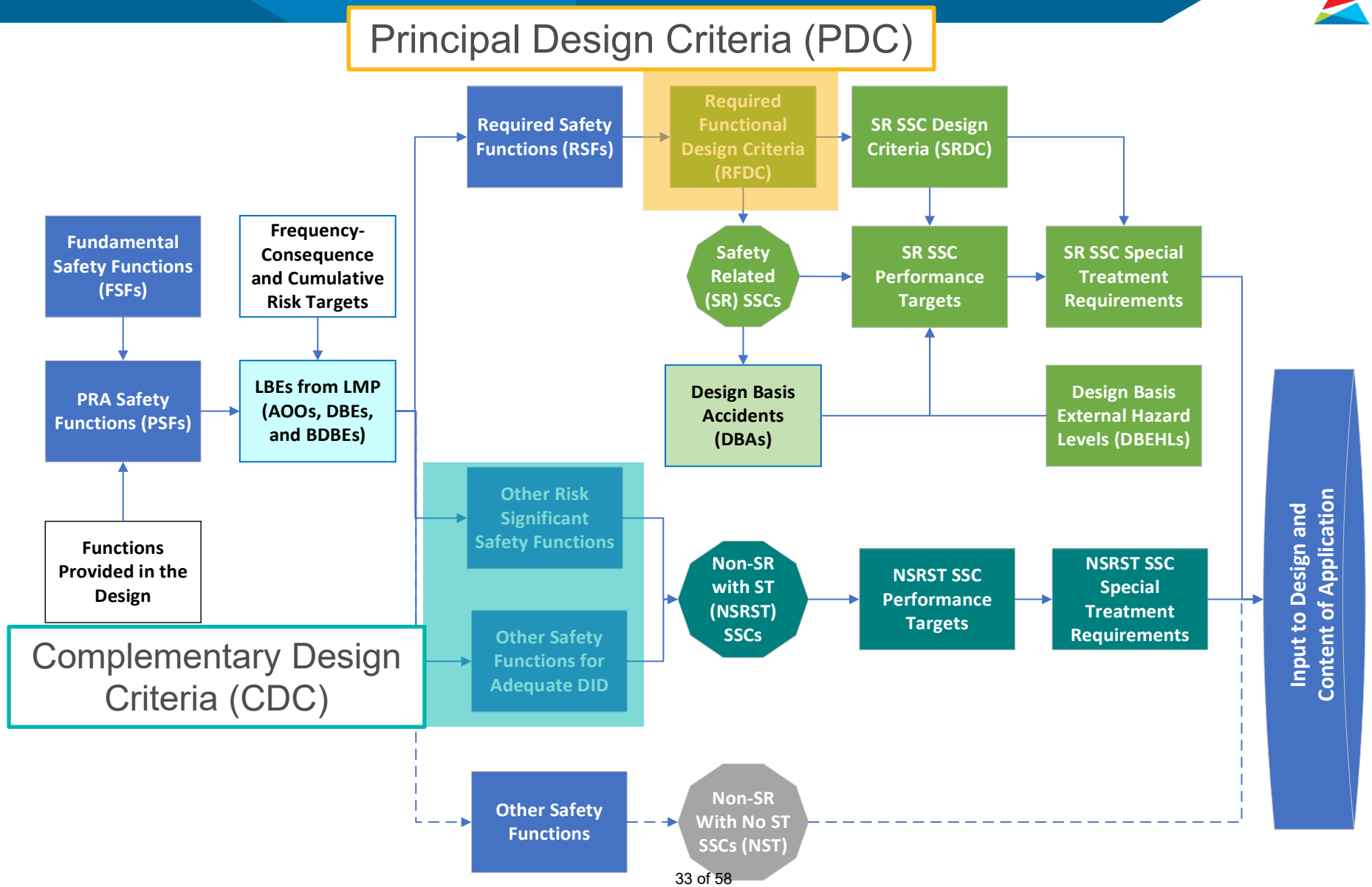
Topic 6 – Principal Design Criteria (cont.)

- TICAP Discussion
  - The TICAP vision for PDC was preliminarily briefed during the 8/27/2020 public meeting on TICAP; however, the tabletop exercises were used to more clearly refine the TICAP definition of PDC within the LMP approach
    - » The next two slides provide the TICAP context for PDC
  - Based on an affirmative safety case using the LMP approach, PDC answer the question “How do plant capabilities (functional and structural) demonstrate that the Fundamental Safety Functions are met?”
  - The question of “How well do these capabilities need to be performed to provide reasonable assurance of adequate protection to the public?” are addressed by LMP although “how well” items are not identified as PDC by the TICAP guidance
  - NRC Comment 6 (for Topic 6) correctly reflects that these “other issues associated with the LWR GDC or ARDC may be addressed by other parts of an application”

Topic 6 – Principal Design Criteria (cont.)



Topic 6 - Principal Design Criteria (cont.)



Topic 6 – Principal Design Criteria (cont.)

- Based on the definition of PDC within an LMP-based affirmative safety case, the TICAP team considers the guidance for inclusion of PDC to be complete
- The use of the LMP approach establishes a comprehensive set of requirements for meeting the performance objectives of the Fundamental Safety Functions through the systematic development of RSFs, RFDC, SRDC, and additional PSFs and design margins

Topic 6 – Principal Design Criteria (cont.)

- *Comment 1: This statement is not correct "For plants that use the NEI 18-04 methodology, the PDC that flows from the LMP methodology and are needed to support the LMP-based safety case are based on the RSFs and the Required Functional Design Criteria (RFDC)." RFDCs are used to "supplement or modify" ARDCs in developing PDCs. RG 1.232 should be referenced since there are other PDCs that are not tied to RFDCs (e.g., ARDCs 1 through 4).*
- *Comment 5: From NEI 18-04 4.1 Task 7: "RFDCs are defined to capture design- specific criteria that may be used to supplement or modify the applicable General Design Criteria or Advanced Reactor Design Criteria in the formulation of Principal Design Criteria."*

Topic 6 – Principal Design Criteria (cont.)

- TICAP Discussion
  - Because NEI 18-04 focused on the development of an LMP-based affirmative safety case and not the development of SAR content, the concept of PDC was not fully explored as part of the LMP initiative (including the LMP tabletop exercises)
  - Using the affirmative safety case concept, the SAR should only focus on the PDC that support the LMP-based affirmative safety case of a design (rather than justifying why a given GDC or ARDC is **not** applicable to a design)
  - According to Section 3.2.3 of NEI 18-04 (emphasis added): The ***early stages of design development*** are guided by deterministic decisions that outline the desired safety characteristics for a given design. ***NRC Regulatory Guide 1.232, "Developing Principal Design Criteria for Non-Light Water Reactors," should be used as one input by designers to initially establish principal design criteria*** for a facility based on the specifics of its unique design

Topic 6 – Principal Design Criteria (cont.)

- From RG 1.232 (emphasis added): “The non-LWR design criteria developed by the NRC staff and included in Appendices A to C of this regulatory guide are intended to provide stakeholders with insight into the staff’s views on how the GDC could be interpreted to address non-LWR design features; however, ***these are not considered to be final or binding regarding what may eventually be required from a non-LWR applicant***.”
- The TICAP team disagrees with Comment 1. The GDC/ARDC can be used as a tool to develop RFDC/PDC for a plant, but there is no obligation on the part of an applicant to comprehensively identify the GDC/ARDC that are not relevant to the LMP-based affirmative safety case

Topic 6 – Principal Design Criteria (cont.)

- The selected examples of ARDC in Comment 1 (i.e., ARDC 1-4) pertain to other elements of an LMP-based safety case that are selected by the designer to answer "How well do these capacities need to be performed to provide reasonable assurance of adequate protection to the public?"
- The eVinci & MCRE TICAP tabletop exercises explored how these generic design criteria might fit within the TICAP affirmative safety case
  - » The following slides provide detailed commentary on ARDC 1

ARDC	Title	TICAP disposition
1	Quality standards and records	Plant Programs (Chapter 8)
2	Design bases for protection against natural phenomena	Safety Related Design Criteria (Chapter 6)
3	Fire protection	Plant Programs (Chapter 8)
4	Environmental and dynamic effects design bases	Design criteria; could be SRDC (Chapter 6)

Topic 6 – Principal Design Criteria (cont.)

ARDC 1 (same as GDC 1). Emphasis added by TICAP team.

Structures, systems, and components important to safety shall be *designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed*. Where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency and shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function. *A quality assurance program shall be established and implemented in order to provide adequate assurance that these structures, systems, and components will satisfactorily perform their safety functions*. Appropriate records of the design, fabrication, erection, and testing of structures, systems, and components important to safety shall be maintained by or under the control of the nuclear power unit licensee throughout the life of the unit.

Topic 6 – Principal Design Criteria (cont.)

- According to NEI 18-04, QA requirements should be RIPB rather than compliance-based (see Table 4-1)

Special Treatment Category	Applicability[1] SR SSC	NSRST SSC	NST SSC	Available Guidance[4]
10 CFR 50 Appendix B Quality Assurance Program	√			QA requirements consistent with 10 CFR 50 Appendix B should be risk-informed and performance-based and not compliance-based; guidance in SRP 17.5 Quality Assurance for safety-related SSCs, 10 CFR 50.69, SRP 1.201
User provided Quality Assurance (QA) Program for non-safety SSCs		√		QA requirements consistent with SRP 17.4 (Reliability Assurance Program) for non-safety-related, safety significant SSCs should be risk-informed and performance-based and not compliance based; guidance in SRP 17.5 Quality Assurance for non-safety-related SSCs, 10 CFR 50.69, SRP 1.201

- QA requirements are analyzed as part of the evaluation of programmatic DID attributes (see Section 5.8 of NEI 18-04)
- As such, although QA requirements are not identified as PDC within an LMP-based safety case, they are part of the safety case and according to the TICAP guidance will be covered in the SAR as appropriate

Topic 6 – Principal Design Criteria (cont.)

- *Comment 2: Section 5.3 seems to imply that PDCs are only for DBEs and DBAs. What design criteria are applied to address BDBEs?*
- TICAP Discussion
  - According to the TICAP guidance, the PDC correspond to the design-specific RFDC, which "may be regarded as a decomposition of the RSFs into sub-functions that are necessary and sufficient to support the RSFs"
  - According to Section 4.1 of NEI 18-04 (Task 3), the RSFs are "the safety functions that are necessary to meet the F-C Target for all the DBEs and the high-consequence BDBEs"
  - If other PRA safety functions are identified by the applicant to be necessary for adequate DID, the applicant could choose to identify these as Complementary Design Criteria (CDC), which are covered in Section 5.6 of the TICAP guidance

Topic 6 – Principal Design Criteria (cont.)

- *Comment 4: Section 5.6: "Thus, the PSAR content for Chapter 5 should include functional decomposition of FSFs to RSFs, a preliminary set of RFDC/PDC with performance-based criteria"*

- TICAP Discussion
  - The TICAP team requests additional clarification on this comment in order to respond appropriately

Topic 13 – PDC & eVinci tabletop exercise

- *Based on internal discussion with the staff – believe a discussion of principal design criteria guidance embedded in draft industry document is appropriate in accordance with eVinci TICAP tabletop exercise comments*
- *Comment 1: Note that the guidance more accurately reflects the NEI 18-04 PDC development than was performed by eVinci.*
- TICAP Discussion
  - Both the eVinci and MCRE tabletop exercises were used by the TICAP team to refine the guidance on how PDC should be presented in an affirmative LMP-based safety case
  - The draft guidance provided to the staff was modified based on lessons learned during the eVinci tabletop exercise

Topic 13 – PDC & eVinci tabletop exercise (cont.)

- This comment from the staff does not fully reflect the objectives of the tabletop exercises
  - » A variety of considerations, including safety case & design maturity and design-specific details, affected the exploration of PDC in both the eVinci and MCRE tabletop exercises
  - » Other aspects of the LMP-based safety case that correspond to the TICAP guidance (e.g., Special Treatments and CDC) were explicitly outside of the scope of the eVinci tabletop exercise
- Given the current maturity of the eVinci design and safety case, assumptions were made either in the PRA or in the use of the PRA to explore the development of PDC include:
  - » LBEs identified in the utilized PRA include internal events only
  - » The utilized PRA was only focused on the operation phase
  - » The utilized PRA reflects the release of radionuclides directly from the fuel only
  - » The utilized PRA does not yet explicitly model failure of TRISO fuel beyond manufacturing failures
  - » Parametric uncertainties have not yet been considered in the utilized PRA

Topic 13 – PDC & eVinci tabletop exercise (cont.)

- Furthermore, the eVinci design analyzed was a micro-reactor with a relatively small inventory of radionuclides and a relatively simple safety case relying upon inherent and intrinsic features to ensure safety
  - » Accordingly, the LMP-based safety case for the eVinci design is relatively simple – hence using an affirmative safety case results in fewer RSFs and RFDC/PDC than might be expected for larger and/or more complicated designs

Principal Design Criteria (Backup Slide)
Allocating Design Criteria to SR SSCs

Safety Case Element	Definition	Reference
Radionuclide (Rn) Source	Starting point for defining the scope of the PRA which includes all Rn sources with the potential for producing a risk significant event sequence	ASME/ANS RA-S-1.4-2020 (Non-LWR PRA Standard)
Fundamental Safety Function (FSF) Performance Objective	Performance objectives related to the safety functions that are common to all reactor technologies and designs (including control heat generation, control heat removal, and confinement of radioactive material)	NEI 18-04 IAEA-TECDOC-1570
PRA Safety Function (PSF)	Reactor design-specific SSC functions modeled in a PRA that serve to prevent and/or mitigate a release of radioactive material from a specified source or to protect one or more barriers to release	ASME/ANS RA-S-1.4-2020 (Non-LWR PRA Standard)
Required Safety Function (RSF)	A PSF that is required to be fulfilled to maintain the consequence of one or more DBEs or the frequency of one or more high-consequence BDBEs inside the F-C Target	NEI 18-04
Required Functional Design Criteria (RFDC)	Reactor design-specific sub-functions and functional criteria that are necessary and sufficient to meet the RSFs	NEI 18-04 PDC
Safety-Related Design Criteria (SRDC)	Design criteria for SR SSCs (in performing their RSFs) that are necessary and sufficient to fulfill the RFDCs for those SSCs selected to perform the RSFs	NEI 18-04

Topic 11 – External Events

- *NEI 18-04 (Section 3.2.2 – Task 6) states that, where possible, external events are to be analyzed in the PRA but, in some cases, may be selected and treated deterministically. There is no discussion in the TICAP guidance document about how to select and treat external events selected using a deterministic approach. Accordingly, the VTR report did not address this topic.*
- TICAP Discussion
  - The methodology for the selection and evaluation of LBEs involving external events and for protecting the safety-related (SR) structures, systems, and components (SSCs) against the Design Basis External Hazard Levels (DBEHLs) is discussed in NEI 18-04 and was not repeated in TICAP guidance
  - Requirements to address external hazards in the Non-LWR PRA standard will lead to Licensing Basis Events (LBEs) initiated by external hazards

Topic 11 – External Events (cont.)

- The PRA evaluation of external hazards cannot be performed until the design features to protect the plant against the hazards are developed
- NEI 18-04 assumes that DBEHLs will be determined BEFORE the PRA evaluation of external hazards is performed.
  - The selection of DBEHLs (which may be deterministically-based) does not preclude the need to address external hazards in the PRA
  - When the PRA standard requirements are applied all internal and external plant hazards will either be (i) included in the PRA or (ii) subject to screening criteria which ensures that screened out hazards would not, if included, produce any risk significant event sequences or event sequence families*
- TICAP will consider adding more guidance to clarify the deterministic selection of DBEHLs

* Events referred to as LBEs in NEI 18-04 are referred to in the PRA standard as event sequence families

Topic 11 – External Events (cont.)

- *Comment 1: There is Note on Page 51 that reads " Note: The development of the DBEHLs is addressed by ARCAP and summarized in SAR Chapter 2.*
- *Comment 2: Section 6.1.1 states that the design only needs to protect against external hazards with a frequency greater than 1 E-4/yr. Does this exclude BDBE external hazards from consideration?*
- TICAP Discussion
  - This statement refers to the selection of DBEHLs and is not the complete LMP story on external hazards
  - After the DBEHLs are selected and the design features to protect the SR SSCs from the DBEHLs are defined, the external hazards are incorporated into the PRA
    - » External hazards are evaluated over the full range of the probabilistic hazard analysis
    - » Address levels more severe and less severe than the DBEHLs

Topic 11 – External Events (cont.)

- Hence BDBEs associated with external hazards are not categorically excluded
- This will produce LBEs in the DBE region with successful operation of the SR SSCs as well as LBEs in the BDBE region which are evaluated against the F-C target
- All these external hazard LBEs will be subject to the LBE and SSC risk significance criteria and DID evaluation and will inform requirements for both SR and NSRST SSCs

Topic 11 – External Events (cont.)

- *Comment 3: Section 2.2 includes external events in the PRA. How are deterministically selected external events addressed in the PRA?*
- TICAP Discussion
  - The external events and internal plant hazards covered in the PRA standard will be addressed in the PRA
    - » Cover all hazards in NRC guidance
  - For Design Certification applications, the external hazards will be addressed for a set of site characteristics that bound those for the range of sites covered in the DC application
    - » The PRA standard permits screening hazards other than seismic and internal events

Topic 11 – External Events (cont.)

- *Comment 4: Additionally, incorporation of external hazards into the LBE determination process lacks basis and detail in 18-04 and the TICAP document.*
- TICAP Discussion
  - Additional guidance will be considered in the revised TICAP report
  - Additional guidance is also available in the Non-LWR PRA standard
    - »The anticipated NRC regulatory guide endorsing the Non-LWR PRA standard may provide further guidance
  - The LMP Lessons Learned, Best Practices, and Frequently Asked Questions Report also provides relevant guidance (see https://doi.org/10.2172/1700534)

Topic 11 – External Events (cont.)

- *Comment 5: Proposed 10 CFR 53.510(a) sets the design basis external hazard levels (DBHELs) at 1E-5/plant-year. RG 1.208 (seismic) establishes the site-specific ground motion response spectrum (GMRS) such that the frequency of significant inelastic deformation (FOSID) is 1E-5/y. RG 1.76 (tornados) and RG 1.221 (hurricanes) set DBHELs at 1E-7/y.*
- TICAP Discussion
  - When the option to define the DBEHLs probabilistically is used, the SR SSCs will be protected against a consistent frequency basis for the hazards
    - » The derivation of the DBEHLs must be documented and reviewed
  - When the option to use existing regulatory guides to establish the DBEHLs is used, the SR SSCs will be protected against different frequency bases for different hazards
    - » The basis for the levels is already established in NRC regulatory guides and presumably will be accepted without review

Topic 23 – PRA Guidance

- *The NRC staff finds that additional information and clarity on PRA is needed in the TICAP guidance.*
- *Comment 1: In Section 2.1.1, the overview of PRA needs additional clarity regarding peer review, the use of "technically adequate PRA', the level of details, and so on. In addition, PRA for construction permit applications needs discussion with the NRC staff since there is ongoing discussions on the subject as part of the NRC staff's ongoing development of guidance on construction permit.*
- TICAP Discussion
  - "Technically adequate PRA" means a PRA that meets the requirements in the PRA non-LWR PRA standard
    - » Requirements include a peer review

Topic 23 – PRA Guidance (cont.)

- A PRA for CP applications are expected to be limited in scope, likely
  - » Limited to internal events and at power plant operating states
  - » Lacking treatment of non-reactor sources of radionuclides
  - » Limited with respect to the treatment of external hazards
- Full treatment of external hazards in a PRA, operating states, and non-reactor sources typically requires plant walkdowns and design information not available at the CP application stage

Topic 23 – PRA Guidance (cont.)

- *Comment 2: In Section 2.1.2, the summary of key PRA results should include other information such as key assumptions, the results and insights from importance, sensitivity, and uncertainty analyses, and so on.*
  - Given the extensive set of requirements covered in the PRA standard the documentation of key assumptions, uncertainties, and sensitivities would be too voluminous to include in SAR
  - Most important results and risk insights from the PRA will be covered in the Chapters 3-8 SAR documentation
    - » Chapter 3 – LBEs
    - » Chapter 4 – Overall plant risk performance summary and DID evaluation
    - » Chapter 5 – SSC safety classification (risk significance)
    - » Chapters 6 & 7 – Design criteria and performance requirements
    - » Chapter 8 – Plant Programs
  - TICAP needs to understand the utility of putting additional information in the SAR rather than internal PRA or design input documentation

Topic 23 – PRA Guidance (cont.)

- *Comment 3: Although other Chapters (i.e., Chapter 3 and 4) include some of the PRA results or insights (such as risk-significant SSCs, human actions, etc.), it may be useful to have these key results under Section 2.1.2 to have the comprehensive PRA results in one place. Alternatively, a set of pointers (not at the Chapter level) at the individual topic areas may be included in Section 2.1.2.*
- TICAP Discussion
  - It is not clear how the information could be gathered in Section 2.1.2 without either repeating information in Chapters 3,4,5,6,7, and 8 or removing key information from those chapters
  - The current guidance calls for the applicant to provide pointers in Section 2.1.2

Next Steps – Future Milestones

TICAP Near-Term Milestones
May 26, 2021 (Workshop #3)
Early June 2021 (NRC staff comments on draft guidance document provided to industry)
Late July 2021 (Industry revised guidance provided to the NRC)