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

Technology Inclusive Content of Application Project, Advanced Reactor Content of Application Project, and Construction Permit Guidance Public Meeting

August 27, 2020
Telephone Bridgeline: 877-779-7419
Passcode: 9782874

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

Agenda

Time	Topic	Presenter
10: -10:10 am	Introduction	NRC
10:10 – 10:40 am	Updates on industry-led Technology Inclusive Content of Application Project (TICAP) efforts including status of fundamental safety function mapping, status of table top exercises	Southern
10:40 - 11:20 am	Discussion of the concept (including examples) of Principle Design Criteria, and Complementary Design Criteria	Southern
11:20 - 11:45 am	TICAP next steps	Southern
11:45 – 12:00 pm	Feedback on fundamental safety function mapping and other areas	NRC
12:00 - 12:30 pm	Stakeholder questions	All
12:30 - 1:30 pm	Break	All
1:30 -1: 50 pm	Updates on Construction Permit Guidance for light water small modular reactors	NRC
1:50 - 2:20 pm	Industry and other Stakeholder feedback	Industry, All
2:20 - 3:00 pm	Discussion of Advanced Reactor Content of Application Project Including Additional Thoughts on Use of Performance-Based Approach	NRC/Idaho National Lab
3:00 - 3:25pm	Industry and Other stakeholder feedback	All
3:25- 3:30 pm	Next Steps and Concluding Remarks	All

Technology Inclusive Content of Application Project (TICAP) Presentations

Steve Nesbit, LMNT Consulting
Brandon Chisholm, Southern Company

TICAP – Nuclear Regulatory Commission (NRC) Working Meeting
August 27, 2020

Southern Company

Outline of Today's TICAP Presentations

- Introduction and Overview (Steve)
- Content of Application Guidance (Steve)
- Tabletop Exercises (Brandon)
- Principal Design Criteria and Complementary Design Criteria (Brandon)

Please note that we will be discussing work in progress, not vetted and finalized results. We request your indulgence and welcome your feedback.

TICAP Overview

- ***Product:*** *Develop an endorsable Guidance Document that proposes an optional formulation of advanced reactor application content that*
  - *Benefits from the insights and knowledge gained through licensing and safely operating the current US-based nuclear fleet for over 40 years to ensure adequacy of proposed content requirements.*
  - *Is based on describing a technology-inclusive affirmative safety case that meets the underlying intent of the current requirements*
    - » *To optimize application content (add where additional content is needed and reduce where current content requirements are not commensurate with the contribution to risk)*
    - » *To provide the needed regulatory agility to accommodate review of spectrum of designs that are expected to submit licensing application,*
  - *Is risk-informed, performance-based to right size the required information in an application (based on the complexity of the safety case) to increase efficiency of generating and reviewing an application*
  - *Its scope is governed by the Licensing Modernization Project (LMP)-based safety case to facilitate a systematic, technically acceptable, and predictable process for developing a design's affirmative safety case*
  - *Provides similar information as is currently required from a light water reactor (LWR) applicant*

Background
LMP-Driven Application Content

- 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 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 details).
      - based on the relevance to the safety determination

Creating Clarity, Predictability, and Transparency

Affirmative Safety Case

LMP-Based Affirmative Safety Case Definition - A collection of scientific, technical, administrative and managerial 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) 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 SSC functions are reliably performed.

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 principal design criteria (PDC), on the basis that

- The LMP's approach to meeting the radiological risk performance objectives provides evidence that the underlying safety objectives of the regulations for providing "reasonable assurance of adequate protection . . . " are 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" *(introduction to 10 CFR 50 Appendix A)*

Technology Inclusive Content of Application Project (TICAP)

Content of Application Guidance

Steve Nesbit

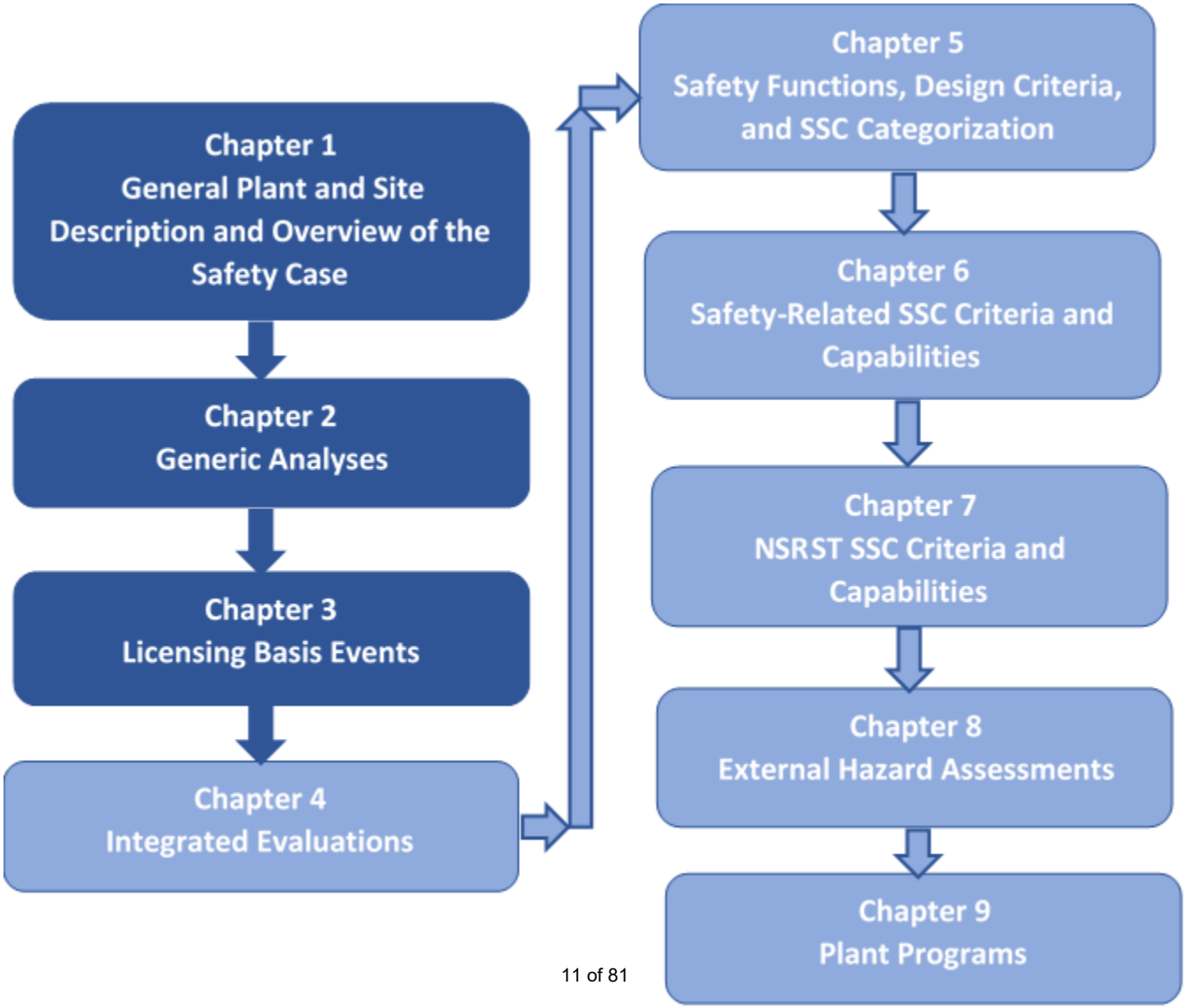
TICAP – NRC Working Meeting
August 27, 2020

Southern Company

NEI Guidance Document Annotated Outline

- NEI Guidance Document
  - Key product from TICAP
  - Guidance for structure, scope, and level of detail for portions of an advanced reactor safety analysis report (SAR) related to the affirmative safety case developed in accordance with NEI 18-04
  - To be submitted by the Nuclear Energy Institute to the NRC around September 2021
- Guidance organized around Safety Analysis Report (SAR) outline
  - Development of guidance ongoing

SAR Organization



Something I Noticed on the Way to the Forum

- Traditionally SARs include a large amount of information, much of which does not directly relate to public radiological safety
- Example: recent Lee Nuclear Station combined license SAR for two AP1000 reactors
  - Reference 205 is the website for the Thunder Road Marathon
    - » Mentioned in “2.1.3.3.2 Transient Population Between 10 and 50 Miles”
    - » Once a year event 50 miles from the proposed reactor site
  - Section 2.5.1 (Basic Geological Information) includes 97 pages of text and references, four tables, and 58 figures
  - Section 2.3 (Meteorology) has 89 figures

Things are the way they are because they got that way.
- Gerald Weinberg, American computer scientist

There May Be a Bit of a Problem

TICAP Philosophy - Focus on Affirmative Safety Case

What Are the Goals for the SAR?

- Satisfy regulatory requirements
- Provide a basis for a licensing decision in a manner that is understandable to the applicant, the NRC, and other stakeholders
  - Present information at the appropriate level of detail
  - Focus on safety
- Capture the design basis of the facility in a manner that is straightforward to apply and maintain
- Not goals for the SAR
  - Highlight things considered important
  - Discuss features and programs that do not impact the safety case
  - Compile all data related to a parameter of interest

The Dilemma of Technology-inclusive Guidance

- Detailed guidance is appealing
  - Predictable
  - Standard of acceptability – whatever was done last time
- Technology-inclusive guidance
  - Wide variation in safety cases and number and type of
    - » Licensing basis events
    - » PRA Safety Functions
    - » Safety Related SSCs and Non-Safety-Related with Special Treatment SSCs
  - Past a certain point, detail in guidance is counterproductive
  - Focus should be on formulation of content
  - Tabletop exercises will play a key role in refining and validating guidance

TICAP and ARCAP – Drawing the Line

- TICAP – focused on the LMP Affirmative Safety Case
- ARCAP – more general guidance
- How big is the TICAP box?
  - Is every input to the affirmative safety case covered by TICAP?
    - » Example – Design Basis External Hazard Levels
  - What about chapters which include material fundamental to TICAP plus other stuff?
    - » Example – Chapter 1 (General Plant and Site Description and Overview of Safety Case)

Construction Permit (CP) Guidance

- TICAP baseline is 10 CFR Part 52 combined license
- Other licensing paths to be addressed
  - Design Certification
  - 10 CFR Part 50 CP followed by operating license (CP/OL)
- NRC CP decision recognizes the design is generally maturing
  - Major concepts and high level performance requirements are established
  - Detailed means for achieving the performance requirements may still be evolving
  - Finality of the safety case is not required
- TICAP plans to assume a CP/OL applicant which seeks minimal finality at the CP stage

Technology Inclusive Content of Application Project (TICAP)

Tabletop Exercises

Brandon Chisholm

TICAP – NRC Working Meeting
August 27, 2020

Southern Company

Overview of Tabletop Exercises

- Objectives
  - Exercise the TICAP guidance for content of application so that the guidance can be validated and, where necessary, improved
  - Provide examples of an affirmative safety case including the use of Principal Design Criteria (PDC) and Complementary Design Criteria (CDC)
  - Refine understanding of the broad set of inputs required to produce an affirmative safety case
  - Develop feedback for the TICAP team (e.g., information about how decisions were made and how analyses were verified) to assist in the refining of the Guidance Document
- Organization (includes socialization & NRC observation)
  - Initiation Phase – Define project structure and organization
  - Planning Phase – Define a set of goals for each exercise
  - Preparation Phase – Prepare necessary foundation to execute each tabletop exercise
  - Execution/Facilitation Phase – Execute each tabletop exercise and produce results
  - Wrap-up and Documentation Phase – Refine results for incorporation into TICAP Guidance Document and sharing

Tabletop Exercise Update and Path Forward

- Tabletop Charter Document complete
- Negotiations (e.g., scope and schedule) started with 5 vendors
- Tabletop reports (i.e., final deliverables) will be publicly available
- Vendors support NRC participation in tabletops as observers
  - Due to intellectual property, the working meetings will not be public

Vendor	Design	Tabletop Status
GE Hitachi	PRISM	Contract Negotiations + LMP Demonstration
Westinghouse	eVinci	Contract Negotiations + LMP Demonstration
Kairos	KP-FHR	Contract Negotiations + LMP Demonstration
X-energy	Xe-100	Contract Negotiations + LMP Demonstration
TerraPower	Molten Chloride Fast Reactor	Contract Negotiations

Technology Inclusive Content of Application Project (TICAP)

Principal Design Criteria (PDC) and Complementary Design Criteria (CDC)

Brandon Chisholm

TICAP – NRC Working Meeting
August 27, 2020

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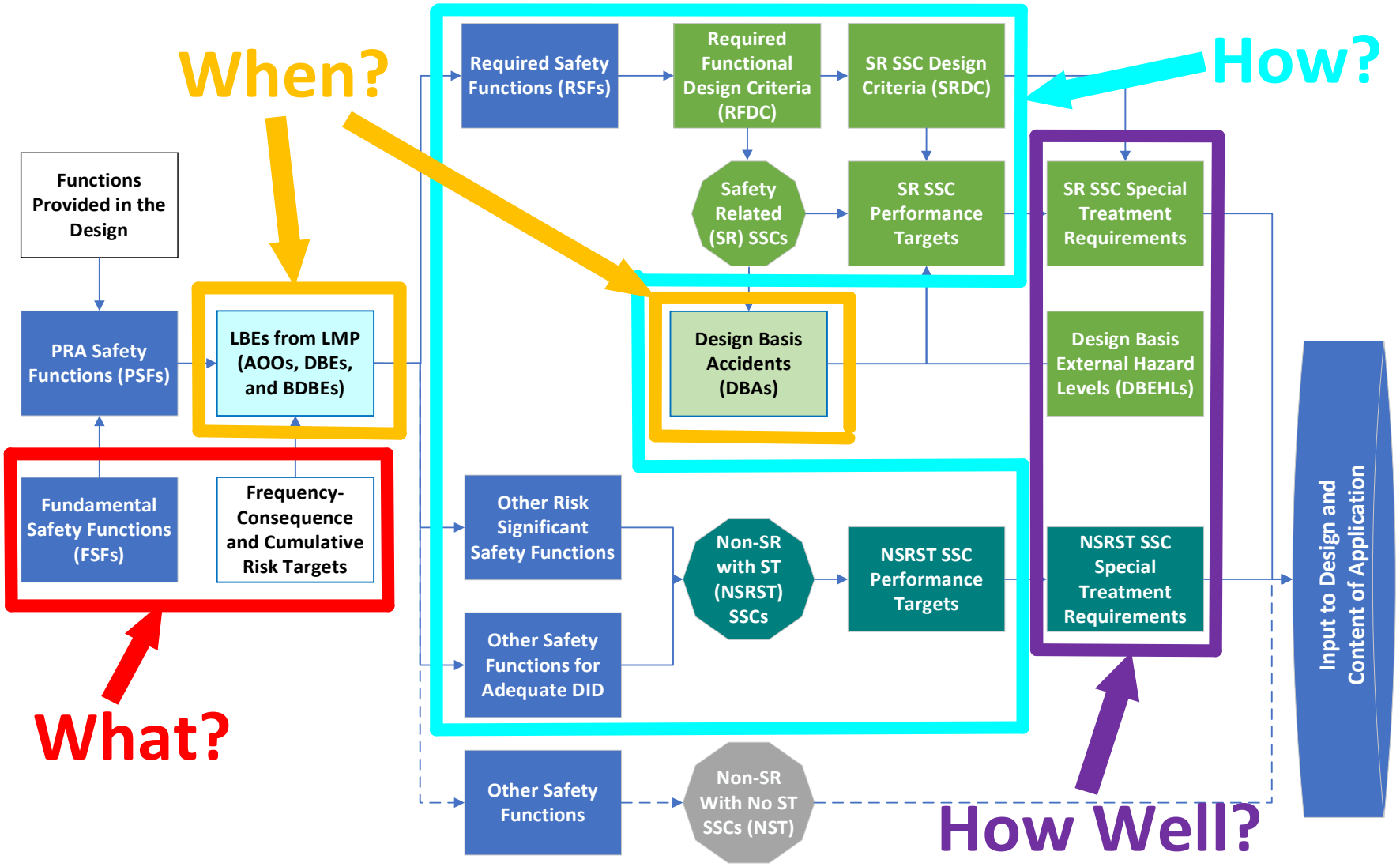
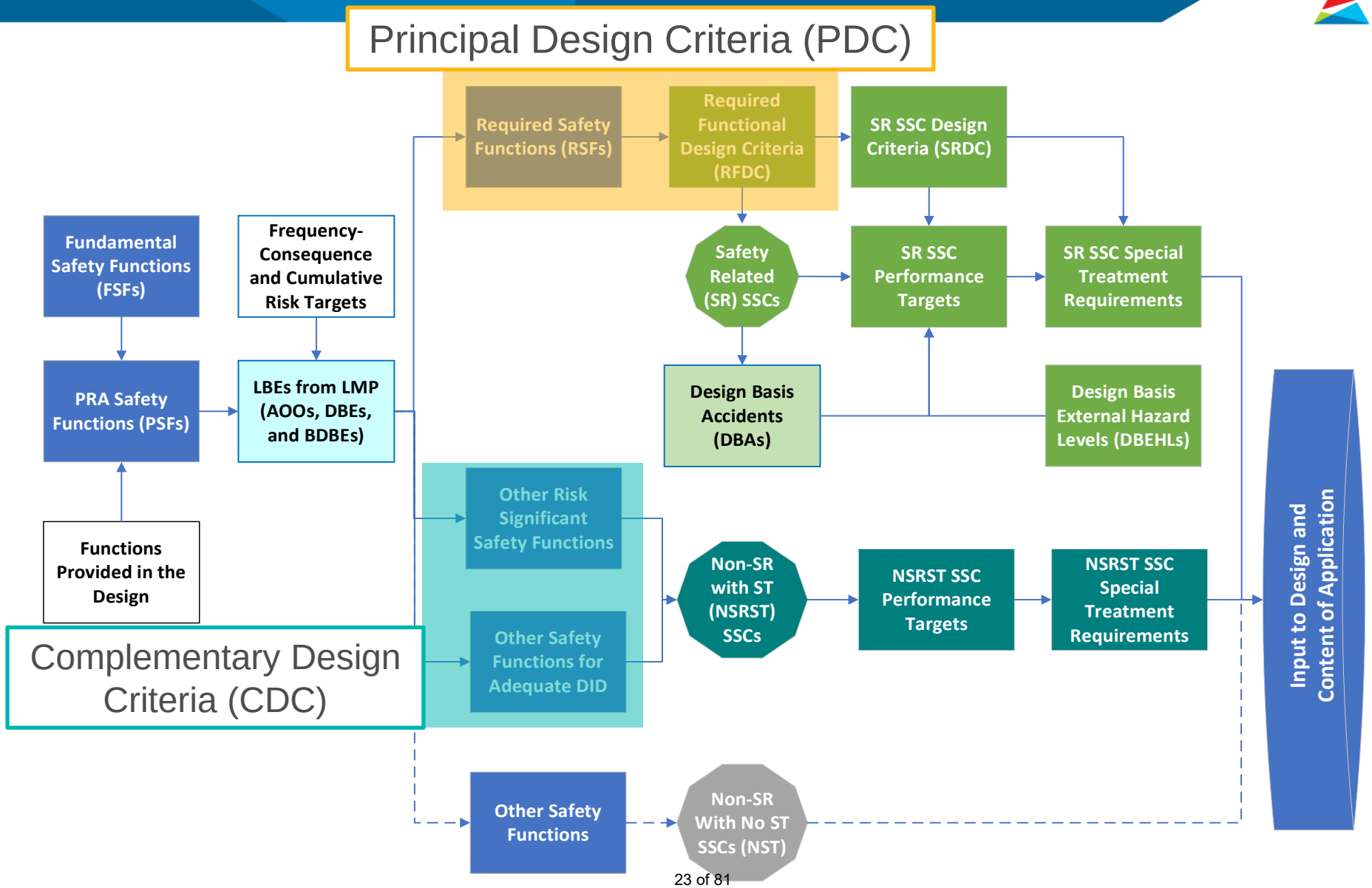
TICAP FSF Chart



PDC and CDC are answers to "How?"



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
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

PDC

PDC vs. CDC

Principal Design Criteria (PDC) – Define plant capabilities that:

- Support demonstration of the performance objectives for the FSFs
- Are credited to perform RSFs for Design Basis Accidents (DBAs)
- Are classified as Safety-Related (SR) with appropriate treatment requirements
- Establish the foundation for making the adequate protection determination

Complementary Design Criteria (CDC) – Define plant capabilities that:

- Provide additional means to perform required safety functions
- Are **not** credited to perform RSFs for DBAs
- Are classified as non-Safety-Related with special treatment requirements appropriate to the functions performed
- Support plant functions related to risk significance or DID as defined in NEI 18-04

Introduction to MHTGR Safety Case

The Modular High Temperature Gas-Cooled Reactor (MHTGR) safety case (Rev. 3, 1987) predates the LMP approach but can be used to demonstrate aspects of PDC and CDC

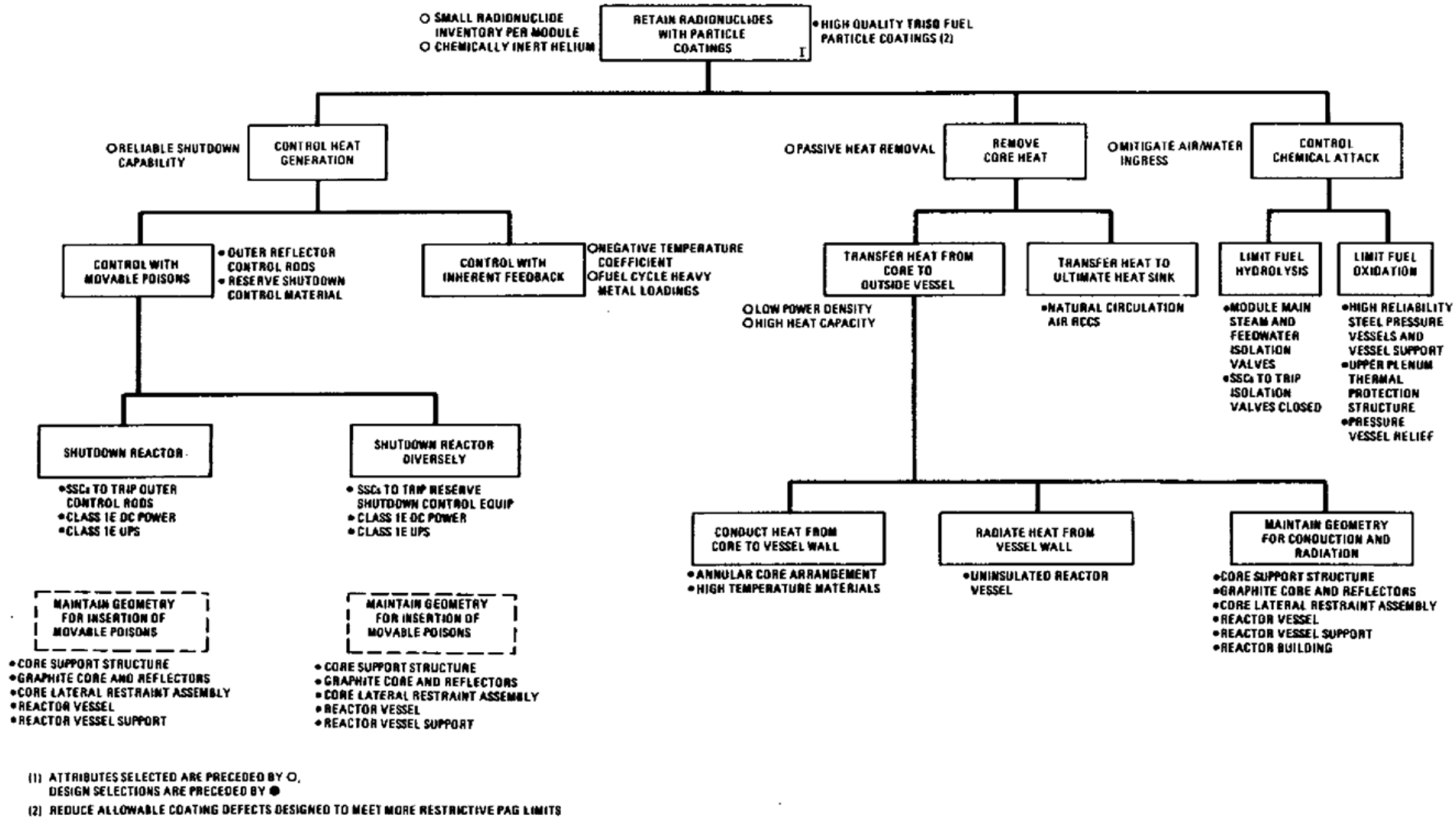
Tasks related to PDC identification and information flowdown

- Identification of RSFs
- Description of RFDC ***(i.e., PDC)***
- Selection of SR SSCs
- Identification of SR SSC Design Criteria (SRDC)

Tasks related to identification of CDC

- Identification of other PSFs (non-SR) that support SR SSC to perform RSFs ***(i.e., CDC)***
- Description of SSCs performing these other PSFs

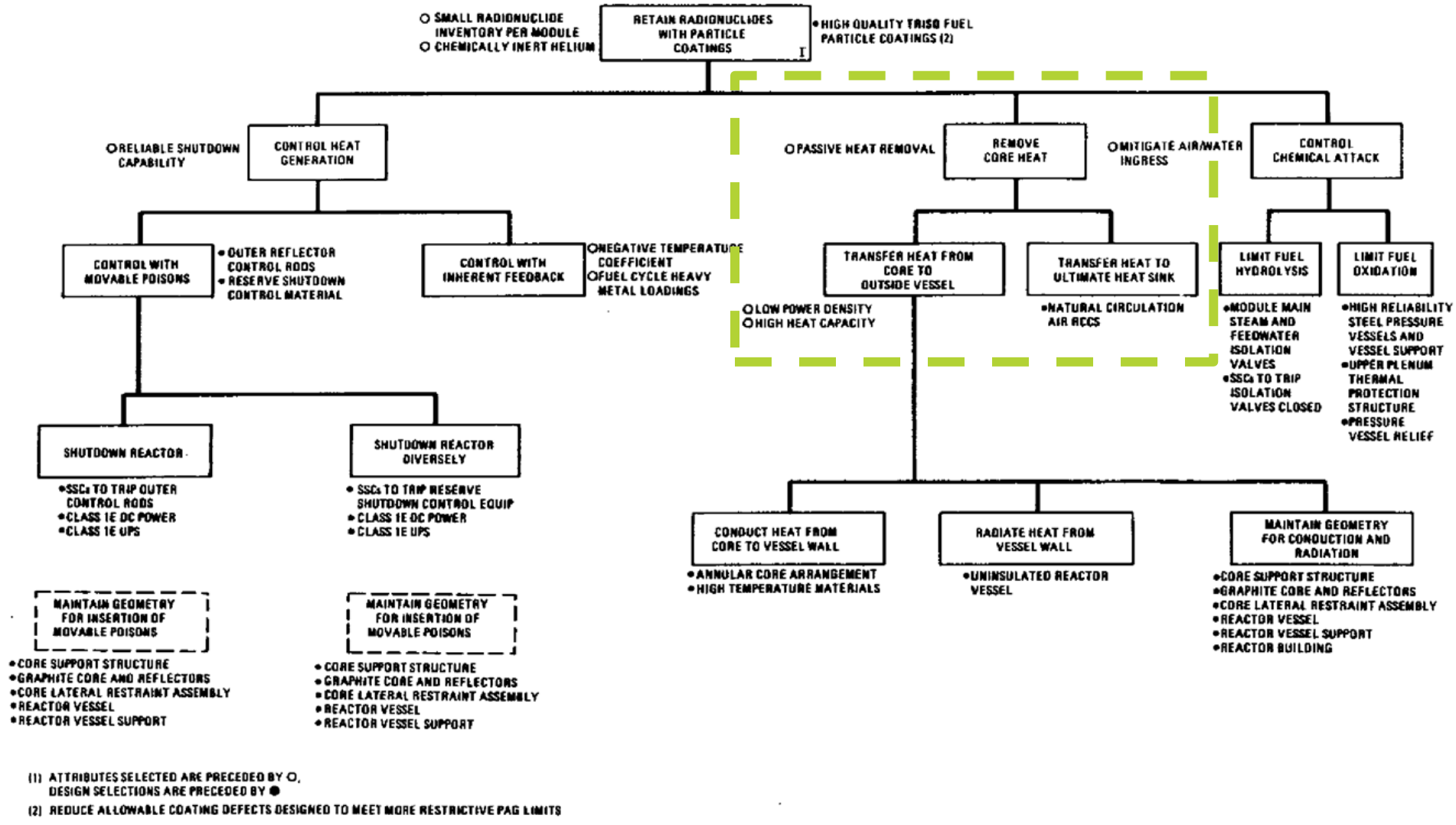
MHTGR RSFs and SR SSCs



(1) ATTRIBUTES SELECTED ARE PRECEDED BY O, DESIGN SELECTIONS ARE PRECEDED BY ●

(2) REDUCE ALLOWABLE COATING DEFECTS DESIGNED TO MEET MORE RESTRICTIVE PAG LIMITS

MHTGR RSFs and SR SSCs



MHTGR PDC Examples

Required Safety Function (RSF)	Required Safety Sub-Functions	Required Functional Design Criteria (RFDC)
Control Heat Removal	The reactor shall be designed, fabricated, and operated in such a manner that the inherent nuclear feedback characteristics will ensure that the reactor thermal power will not exceed acceptable values. Additionally, the reactivity control system(s) shall be designed, fabricated, and operated in such a manner that during insertion of reactivity, the reactor thermal power will not exceed acceptable values.	
	Transfer Heat to Ultimate Heat Sink	**A highly reliable, passive means of removing the heat generated in the reactor core and radiated from the vessel wall shall be provided. The system shall remove heat at a rate which limits core and vessel temperatures to acceptable levels during a loss of forced circulation.**
	Conduct Heat from Core to Vessel Wall	The reactor core shall be designed and configured in a manner that will ensure sufficient heat transfer by conduction, radiation, and convection to the reactor vessel wall to maintain fuel temperatures within acceptable limits following a loss of forced cooling. The materials which transfer the heat shall be chosen to withstand the elevated temperatures experienced during this passive mode of heat removal. This criterion shall be met with the primary coolant system both pressurized and depressurized.
	Radiate Heat from Vessel Wall	The vessel shall be designed in a manner that will ensure that sufficient heat is radiated to the surroundings to maintain fuel and vessel temperatures within acceptable limits. This criterion shall be met with the primary coolant system in both a pressurized and depressurized condition.
	Maintain Geometry for Conduction and Radiation	The design, fabrication, operation, and maintenance of the core support structure, graphite core and reflectors, core lateral restraint assembly, reactor vessel, reactor vessel support, and reactor building shall be in such a manner that their integrity is maintained during off-normal conditions so as to provide a geometry conducive to removal of heat from the reactor core to the ultimate heat sink and maintain fuel temperatures within acceptable limits.

Example of SR SSC Satisfying PDC

- **SR SSC:** Reactor Cavity Cooling System (RCCS)
  - Passive reactor cavity cooling system relying on air natural convection to the environment to provide passive core heat removal and protect the vessel and supports
- **SRDC for the RCCS**
  - The RCCS shall have the capability to remove sufficient decay heat from the reactor core to prevent overheating of the outer control rods, the reactor, vessel, and vessel internals.
  - The RCCS shall have the capability of removing sufficient decay heat from the reactor core to maintain peak fuel temperatures below 1600°C (2900°F).
  - The RCCS shall provide the required decay heat removal capability for the “duration of the HTS and SCS shutdown whether the vessel is pressurized (with full primary coolant inventory) or depressurized.”
  - Offsite radionuclide releases are to be limited as necessary to meet the numerical dose guidelines of the Top-Level Regulatory Criteria.
  - In the event of a loss of primary coolant pressure boundary integrity, the RCCS shall be capable of withstanding a 69 kPa (10 psi) differential pressure.

MHTGR Requirements Related to CDC

- The MHTGR did not use the NSRST class in SSC safety classification and also did not include an explicit evaluation of DID adequacy – hence the original safety case did not explicitly define any CDC.
- However, the MHTGR did include some requirements for non-safety related SSCs that could be viewed as a surrogate for example CDC.
- The Helium Purification System is not safety related, but is required to have a function to monitor radioactivity circulating in the primary system to confirm performance of the safety related fuel.
  - **CDC:** Monitor radioactivity circulating in the primary system to confirm performance of the Safety Related fuel (PSF associated with DID)
  - **NSRST SSC:** Helium Purification System

Introduction to PRISM Safety Case

PRISM LMP Demonstration: ADAMS Accession ML19036A584

Tasks related to identification of PDC

red = not included in PRISM LMP Demonstration Report

- Identification of RSFs
- Selection of SR SSCs
- Description of RFDC
- Identification of SR SSC design criteria (SRDC)

Tasks related to identification of CDC

- Analysis of other PSF risk significance
  - » No SSCs classified at NSRST based upon SSC Risk Significance
- Preliminary evaluation of DID
  - » As part of DID evaluation, SSCs identified as candidates for NSRST classification

PRISM Required Safety Functions

Based on four sensitivity cases, the following RSFs were proposed for the PRISM demonstration:

- Reactivity Control
- **Heat Removal**

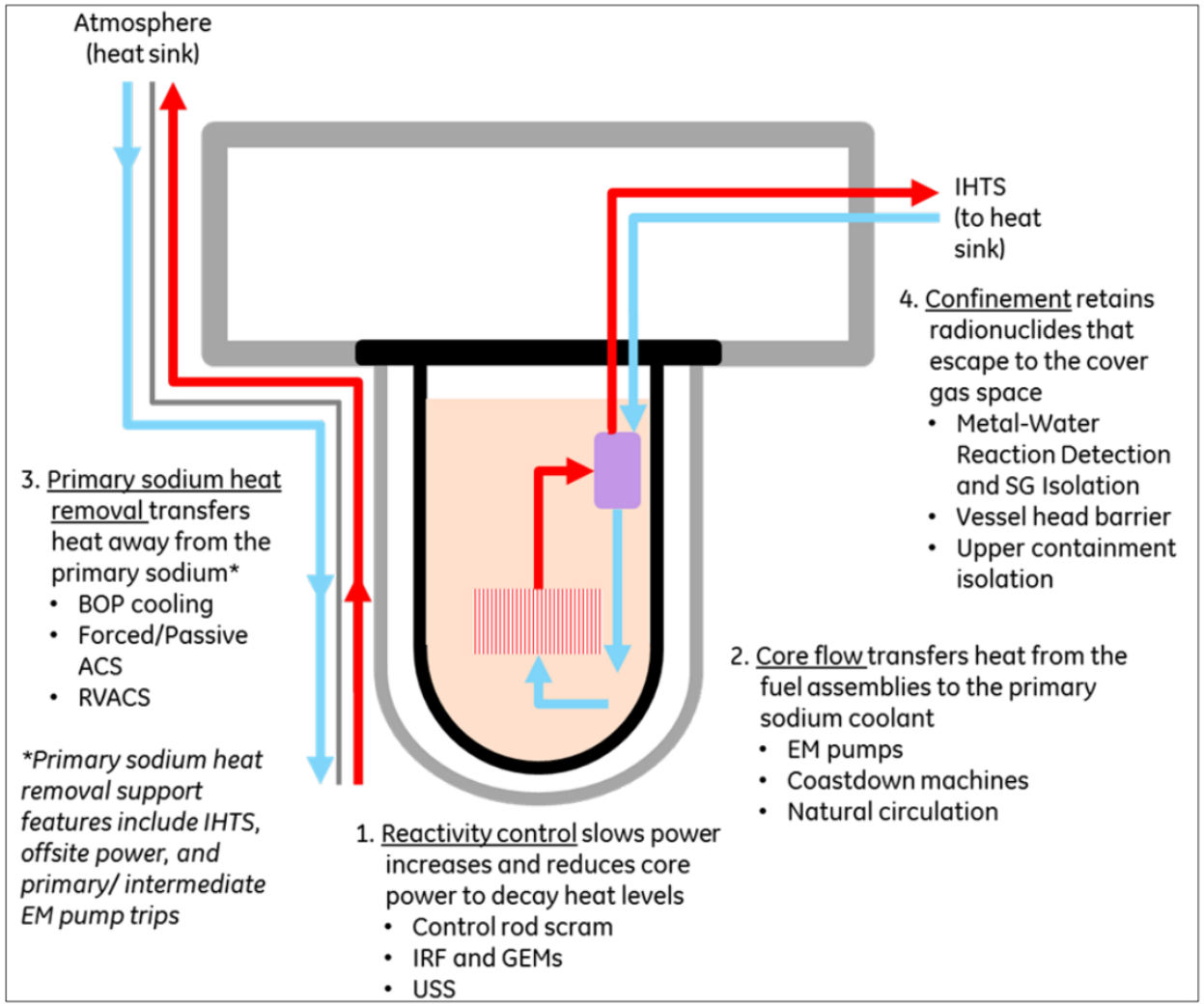


Figure 6. PRISM PRA Safety Functions

PRISM Required Sub-functions and SR SSCs

Five studies were carried out to identify the following required sub-functions:

RSF	Required Sub-functions
Heat Removal	RVACS passive cooling
	Tripping of Primary and Intermediate electromagnetic (EM) pumps
Reactivity Control	Inherent Reactivity Feedback
	Control Rod Insertion

Four SSC cases were sufficient to determined that the selected SR SSCs could be grouped into the following high-level categories:

- Digital I&C logic and load drivers (Reactor Protection System [RPS], Diverse Protection System [DPS], and Safety-Related Qualified Distributed Control and Information System [Q-DCIS])
- Control rods and drives and associated operator actions
- **EM pump supply breakers and associated operator actions**
- 120-VAC equipment
- 125-VDC equipment
- Reactor vessel and internals
- Reactor Vessel Auxiliary Cooling System (RVACS)
- Supporting structures

Example of PRISM PDC and Supporting Information

- **RSF:** Remove Core Heat
- **Sub-function:** EM pump trip ensures no pump heat is added to decay heat in the Primary Heat Transport System
- **RFDC:** When a reactor scram occurs, the primary EM pumps shall be tripped such that coolant and fuel temperatures remain within specified acceptable design limits
- **SR SSC:** EM Pump Supply Breakers
- **SRDC:** 3 of 4 Primary EM pump supply breakers are tripped open upon receiving a successful trip signal and the neutron flux below TBD%

Examples of PRISM CDC [1 of 2]

- Evaluation was conducted to understand how to minimize the frequency of SR SSC challenges to PRISM DID Layer 2 (i.e., control abnormal operation, detect failures, and prevent DBEs)
- *Reactor Vessel Auxiliary Cooling System (RVACS)* is only challenged after Intermediate Heat Transport System (IHTS) has failed to transport heat to the BOP or Alternate Cooling System (ACS) **or** when the BOP/ACS fail
- **PRA Safety Function (PSF):** Transfer heat to Steam Generator (SG) Alternate Cooling System (ACS)
- **NSRST SSCs:** SG shell (not including feed water supply and steam supply to turbine), cooling fan, and dampers
  - The SG ACS removes SG heat by successful opening the SG ACS inlet and outlet dampers and starting the cooling fan. Power is supplied to the ACS Fan.
  - Note: PRISM LMP analysis has not yet been completed to determine if power is needed on a loss of offsite power for this PSF

Example of PRISM CDC [2 of 2]

- **PRA Safety Function (PSF):** Transfer heat to SG ACS
- **Sub-function:** Prevent a sodium-water reaction following a SG tube rupture from resulting in over-pressure of the Intermediate Heat Transport System (IHTS)
- **NSRST SSC:** Sodium-Water Reaction Protection System (SWRPS)
  - The SWRPS detects a sodium-water interaction, actuates the integrated leak detection system, and actuates the steam isolation, feedwater isolation, water dump valves, steam relief valves and nitrogen purge valves.
    - » Note: Not all components listed will be needed for PSF success and would therefore not all will be classified as NSRST
    - » Note: Intermediate sodium loop pressure control is by passive means and not initiated by SWRPS

Additional Questions?

Light-Water Small Modular Reactor Construction Permit Review Guidance

August 27, 2020

Light-Water SMR
Construction Permit Guidance

During the July 31 ARCAP meeting, the staff received the following feedback:

- The staff's guidance options (Interim Staff Guidance (ISG), Draft Strategy, and Office Instruction) are viable options that need further industry consideration.
- Of the three options, the ISG would likely be the most efficient and provide regulatory stability and durability.
- Challenges to developing guidance recognized:
  - It may take 6-9 months to receive specific industry input needed in the guidance because of on-going activities for the DOE program.
  - The first CP applications could be submitted by the end of 2021/early 2022. Draft guidance with application content or critical areas for a CP application by Spring 2021 could support this schedule.
- Prospective applicants have been encouraged to contact the NRC regarding the application process and the applicant's schedule.

Light-Water SMR Construction Permit Guidance (continued)

- Specific public feedback:
  - Based on a review of Regulatory Guide (RG) 1.70 and the Standard Review Plan (SRP):
    - Clarity needed on Preliminary Safety Analysis Report (PSAR) content vs Final Safety Analysis Report (FSAR) content.
    - Alignment needed regarding what specific level of detail is required for "preliminary."
    - Alignment needed on the applicability of specific [*regulatory*] requirements [*and staff guidance*] identified in the SRP to advanced reactor design features.
  - A more efficient approach may be the following:
    - Developing a set of Regulatory Framework Documents as an integral part of the [applicant's] Regulatory Engagement Plan.
    - Using the Regulatory Engagement Plan to support early and often NRC preapplication engagement to gain alignment.
    - Obtaining feedback from NRC management in writing that the applicant and NRC can refer to during the review.

Light-Water SMR
Construction Permit Guidance (continued)

The staff is considering developing the ISG to clarify the following:

- Regulatory requirements and findings for issuing a CP.
- Information needed and level of detail in an application to review and issue the CP.
- Specific topics; e.g., siting.

The staff is interested in hearing feedback on:

- The draft ISG details above.
- Additional topics to consider.

Light-Water SMR
Construction Permit Guidance (continued)

Next Steps:

- The staff plans to present additional initial considerations for the ISG during the monthly ARCAP meetings and is interested in hearing feedback on the considerations.
- The staff would like more information to better understand the guidance needs of prospective applicants.
- The staff encourages early engagement to better prepare and plan for a CP review.

Construction Permit Application Guidance

Marc Nichol
Senior Director New Reactors

August 27, 2020

NUCLEAR ENERGY INSTITUTE

Interest in Part 50 Construction Permits

- Part 50 Construction Permit: 13 of 20 (2 did not respond)*

	By EOY 2021	2022-2025	2026 and later
Number	2	7	4
Technologies	Non-LWR	LWR SMR & non-LWR	Non-LWR
Licensing basis	LMP variations, and non-LMP	LMP, and variations	LMP, variations, and non-LMP

- Benefits of Part 50
  - Earlier start to licensing
  - Flexibility for changes during construction

*Member survey results may not include all industry application interest; results here do not show Part 52 interest

Goals for Guidance

- Minimum scope/level of detail needed for NRC to approve CP
- Cross-cutting generic issues to clarify acceptable level of details
- Interim Staff Guidance (likely 15 to 30 pages)
- Uses for guidance
  - Develop applications
  - Predictable acceptance review
  - Scope of audits and RAIs

Topics for Guidance (preliminary)

- Commitments
- Analyses
- Design/SSC descriptions
- Programs
- Role of PRA
- Quality assurance
- Relationship with Topical Reports
- Relationship to operating license application
- Finality
- Non-applicability or exemption to requirements
- Part 50 lessons learned rulemaking topics

Path Forward

- NEI paper – target December 2020
- NRC ISG – target Spring 2021
- Applications – potentially before end of year 2021

QUESTIONS?

By Third Way, GENSLER

U.S. Nuclear Industry Council Comments regarding Construction Permit at NRC Public Meeting

Cyril Draffin
Senior Fellow, Advanced Nuclear
U.S. Nuclear Industry Council

27 August 2020 -

Construction Permit: NRC considered prior input

- USNIC appreciates NRC considering Stakeholder comments made at 31 July 2020 meeting regarding Light-Water SMR Construction Permit:
  - Interim Staff Guidance (ISG) would likely be the most efficient and provide regulatory stability and durability
  - First CP applications could be submitted within the next year. Draft guidance with application content or critical areas for a CP application by Spring 2021 could support this schedule.
  - Developing a set of Regulatory Framework Documents as an integral part of the applicant's Regulatory Engagement Plan, and using the Regulatory Engagement Plan to support early and NRC preapplication engagement to gain alignment.
  - Obtaining feedback from NRC management in writing that the applicant and NRC can refer to during the application review.

Construction Permit: Interim Staff Guidance

- Regulatory requirements and findings for issuing a CP
- Information needed and level of detail in an application to allow timely review and issuance of CP

Construction Permit – Considerations

- Construction Permit (CP) guidance that appropriately considers elements of LMP/TICAP/ARCAP for vendors who may use LMP
- NRC has noted that non-LWR applicants not using TICAP should engage NRC early regarding safety classification and Defense in Depth; Part 50 and Part 52 both viable regulatory pathways
- NRC needs to ensure that Structures, Systems, and Components (SSCs) are selected appropriately; consultation with NRC staff on classification approach is advised
- Construction Permit guidance should consider stakeholder input, be timely, and have stability and predictability
- NRC should not sweep non-safety issues into applications

Construction Permit: Timing & Planning Considerations

- DOE selection of demo winners may influence and accelerate siting and construction permit application timing
- Need NRC guidance as soon as possible before applications:
  - draft NRC guidance on critical areas by end of 2020
  - draft guidance by spring 2021
- NRC should prepare Interim Staff Guidance that includes both LWR SMRs and non-LWRs
- NRC should indicate when and what kind of input they would like from industry on ISG

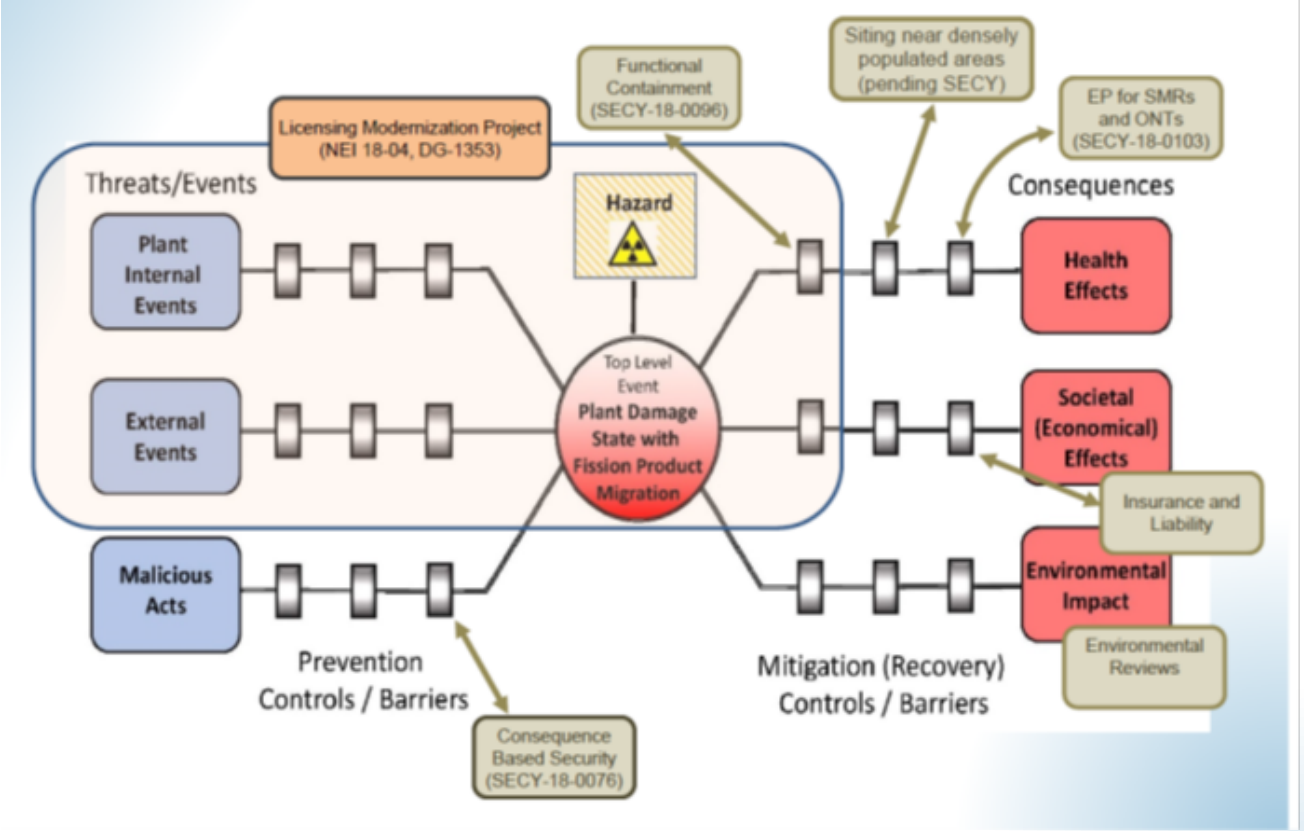
Proposal for Advanced Reactor Content of Application Project (ARCAP) Guidance Document

Background

- ARCAP Proposed Guidance document would provide a roadmap for developing an application
- Roadmap would leverage existing guidance or guidance that is under development
- Examples include:
  - Technology Inclusive Content of Application Project (TICAP) developing portions of the application associated with the Licensing Modernization Project (LMP)
  - Emergency planning and security rulemaking will provide insights to this portion of the application
- Never the intention of the ARCAP guidance document to attempt to replicate the Standard Review Plan for Light Water Reactors (NUREG-0800)

Background

- Figure provides an overview of some of the more important efforts underway to develop advanced reactor guidance
- TICAP will use the LMP (upper left of figure) to develop portions of the application



Proposal for ARCAP Guidance Document

- High level ARCAP proposal found in document referenced in meeting notice (ADAMS Accession No. ML20231A563)
  - Proposed guidance includes table providing roadmap
    - Table based on Idaho National Laboratory (INL) developed annotated structure for final safety analysis report (FSAR) portion of the application
      - INL developed outline discussed in previous ARCAP meetings and can be found at ADAMS Accession No. ML20107J565
    - Recognized that the TICAP FSAR proposed structure is different than INL-developed structure
      - Table will be updated based on final version of TICAP structure

Proposal for ARCAP Guidance Document

- High level ARCAP proposal found in document referenced in meeting notice (ADAMS Accession No. ML20231A563) (continued)
  - First 14 items in table associated with FSAR, the rest of the items in the table associated with other portions of the application
  - Table color coded to note where proposed guidance would :
    - point to guidance that is being developed as part of another advanced reactor activity (e.g., TICAP)
    - Note where new ARCAP guidance is being developed
    - Note where a combination of new ARCAP guidance is being developed and provide pointers to guidance that is being developed as part of another advanced reactor activity (e.g., TICAP, rulemaking etc.)

Proposal for ARCAP Guidance Document

Preliminary ARCAP Roadmap

Legend: - ARCAP points to guidance that is being developed as part of another advanced reactor activity (e.g., TICAP)

- New ARCAP guidance being developed

- Combination of new ARCAP guidance and pointers to guidance that is being developed as part of another advanced reactor activity (e.g., TICAP, rulemaking etc.)

Item #	Description	ARCAP Disposition	Comment
1	FSAR Chapter 1 - General Information	Combination of TICAP and ARCAP-developed guidance	INL developed annotated outline suggests that major portions of chapter 1 would come from TICAP and would layout the safety case for the design
2	FSAR Chapter 2 – Site Information	Combination of TICAP and ARCAP – developed guidance	Portions of this chapter expected to come from TICAP (see TICAP chapter 8, "External Hazards Assessment," from proposed outline found in July 30, 2020 meeting handouts available at: https://www.nrc.gov/docs/ML2021/ML20210M083.pdf). In addition, ARCAP will consider Commission guidance associated with SECY-20-0045, "Population Related Siting Considerations for Advanced Reactors," as part of the Chapter 2 guidance development.
3	FSAR Chapter 3 – License Basis Event Analysis	ARCAP points to TICAP	
4	FSAR Chapter 4 – Integrated Plant Analysis	ARCAP points to TICAP	
5	FSAR Chapter 5 – Description and Classification of SSCs	ARCAP points to TICAP	
6	FSAR Chapter 6 – Design Basis Accident Analysis	ARCAP points to TICAP	
7	FSAR Chapter 7 – Defense in Depth	ARCAP points to TICAP	

Proposal for ARCAP Guidance Document

Item #	Description	ARCAP Disposition	Comment
8	FSAR Chapter 8 – Control of Routine Plant Radioactive Effluents and Solid Waste	ARCAP – developed guidance	ARCAP team developed draft guidance that discusses a performance based approach. The draft guidance has been well received by stakeholders in public meetings. Team is furthering refining the approach
9	FSAR Chapter 9 – Control of Occupational Dose	ARCAP – developed guidance	ARCAP team to develop draft guidance based on FSAR chapter 8
10	FSAR Chapter 10 – Human Factors Analysis	ARCAP points to TICAP	
11	FSAR Chapter 11 – Physical Security	ARCAP to point to physical security rulemaking guidance and other existing physical security guidance	See physical security plan below
12	FSAR Chapter 12 – Overview of PRA	ARCAP points to TICAP	
13	FSAR Chapter 13 – Administrative Control Programs	ARCAP points to TICAP	
14	FSAR Chapter 14 – Initial Startup Programs	Combination of TICAP and ARCAP-developed guidance	Unclear at this point how much TICAP guidance will be provided in this area
15	Technical Specification	Combination of TICAP and ARCAP-developed guidance	TICAP will have a major impact on technical specifications. NRC and INL have identified the need for TICAP to consider tech spec development as part of TICAP. Unclear at this point how much TICAP guidance will be provided in this area
16	Technical Requirements Manual	Combination of TICAP and ARCAP-developed guidance	Existing guidance in this area needs to be adjusted to reflect LMP terminology
17	Quality Assurance Plan (design)	Combination of TICAP and possibly ARCAP-developed guidance	TICAP outcomes expected to heavily influence quality assurance plan for the design. Appendix B expected to apply to safety-related SSCs. Unclear at this point how TICAP will address QA for Non-safety related special treatment SSCs
18	Fire Protection Program (design)	Combination of TICAP and possibly ARCAP-developed guidance	Results of TICAP developed affirmative safety case expected to influence fire protection program

Proposal for ARCAP Guidance Document

Item #	Description	ARCAP Disposition	Comment
19	PRA	Mostly TICAP. ARCAP will point to Non-LWR PRA review standard that is under development	See FSAR Chapter 12 and Non-LWR PRA review standard that is under development
20	Quality Assurance Plan (Construction and Operations)	Combination of TICAP and possibly ARCAP-developed guidance	Similar to item 17 above
21	Emergency Plan	ARCAP point to EP rulemaking	EP rulemaking expected to develop guidance in this area
22	Physical Security Plan	ARCAP point to physical security rulemaking	Physical security rulemaking expected to develop guidance in this area
23	SNM physical protection plan	ARCAP point to existing guidance	
24	SNM material control and accounting plan	ARCAP will point to guidance that is expected to be developed	MC&A is an issue that has identified as needing to have guidance developed for some of the non-lwrs. A pebble-bed MC&A application standard and review standard has been developed by ORNL. MC&A for liquid fueled molten salt reactors will be a particular challenge
25	Fire Protection Program (Operational)	Combination of TICAP and possibly ARCAP-developed guidance	See item 18 above
26	Radiation Protection Program	ARCAP – developed guidance	Relates to FSAR chapter 8 above
27	Offsite Dose Calculation Manual	ARCAP – developed guidance	Relates to FSAR chapter 8 above
28	Inservice Inspection/Inservice testing (ISI/IST)	Combination of TICAP and ARCAP guidance	TICAP outcomes expected to heavily influence ISI/IST. In addition ASME Section XI Section 2 guidance identified as needing to be developed
29	Environmental Report and Site Redress Plan	ARCAP pointer	Point to environmental guidance that is being developed
30	Financial Qualification and Insurance and Liability	ARCAP pointer	SECY paper under development to address issues
31	Cyber Security Plan	Combination of TICAP and ARCAP guidance	Unclear at this point how much TICAP guidance will be provided in this area

ARCAP Chapters Under Consideration for a Performance-Based (PB) Approach

(i.e., Approach 3)

Background

- In the July 31, 2020 ARCAP meeting, NRC provided additional details on a potential PB approach (Approach 3) for ARCAP Chapter 8, “Control of Routine Plant Radioactive Effluents and Solid Waste”. At the same meeting, industry suggested siting, EP and security as candidates for a PB approach.

- At the present time, the following ARCAP chapters are under consideration for a more PB approach:
  - Chapter 2, “Site Information”
  - Chapter 8, Section 8.3, “Solid Waste”
  - Chapter 9, “Control of Occupational Dose”

- Since there are rulemaking activities underway for EP and security that may incorporate PB approaches, work on these topics will be dependent upon the outcome of the rulemakings.

ARCAP Chapter 2, Site Information

- 10 CFR 100, Subpart B, requires that site characteristics be determined in order to establish (1) the external hazards (man-made and natural) the plant must be designed for, (2) the hydrological radionuclide transport properties, (3) if the site poses a significant impediment to EP and (4) that the individual and societal risk of potential accidents is low.

- Much of the above information is contained in Chapter 2 of the SAR, with the result that the chapter becomes very large. For example, the SARs contain information on historical records of the site (such as floods, temperatures, seismic events, etc.) as well as the results of recent site characterization work (e.g. meteorology, core samples).

- It is recognized that TICAP Chapter 1 will address siting, however, until TICAP Chapter 1 is provided, we've considered work on ARCAP Chapter 2 to identify areas where the amount of information that is required to be in the SAR might be reduced.

ARCAP Chapter 2 – Changes Being Considered

- What is being considered is using the guidelines in NEI 98-03 “Guidelines for Updating FSARs” (endorsed by RG 1.181), developed to identify areas where information can be removed from FSARs, as the starting point for determining if it was needed in the first place. Examples include:
  - Historical information (floods, storms, etc.)
  - Information not expected to change with time (geological data, seismic data, etc.)
  - Redundant information
  - Excessive detail
- The intent is to limit the amount of material in SAR Chapter 2 to that which is necessary for establishing safety significant design parameters and performing the safety analysis, along with its supporting bases.
- If necessary, any additional supporting information (e. g. historical records, geological data) could be documented in a separate report available for audit.
- Note: Site population density considerations are dependent on Commission action on SECY-20-045, “Population-Related Siting Considerations for Advanced Reactors” and are not included in the ARCAP Chapter 2 work at this time.

ARCAP Section 8.3 and Chapter 9 - Overview

- Continue to develop performance-based guidance for additional non-TICAP safety analysis report chapters
  - Section 8.3, Solid Waste
  - Chapter 9, Control of Occupational Dose
- Related to the two performance-based content areas above, address continued applicability of NEI developed FSAR content templates:
  - NEI 07-10A, *Generic FSAR Template Guidance for Process Control Program (PCP)*
  - NEI 07-08A, *Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures are as Low as is Reasonably Achievable (ALARA)*

ARCAP Section 8.3, Solid Waste

- Develop using same approach as Sections 8.1 and 8.2
- Reference applicable requirements for performance-based criteria, such as:
  - 10 CFR 20.1301(a) regarding the allowable annual dose and allowable hourly dose to members of the public from routine operation
  - 10 CFR 20.1301(e) regarding compliance with EPA's generally applicable environmental radiation standards in 40 CFR part 190
  - 10 CFR Part 61 as it relates to requirements for classifying, processing, and disposing of dry solid and wet wastes
  - 10 CFR 20.2006 and Appendix G to 10 CFR Part 20, as they relate to the requirements for transferring and manifesting radioactive materials shipments to authorized facilities (e.g., disposal sites, waste processors)
  - 10 CFR 20.2007, as it relates to compliance with other applicable Federal, State, and local regulations governing any other toxic or hazardous properties of radioactive wastes, such as mixed wastes
  - 10 CFR Part 71 and 49 CFR Parts 171–180, as they relate to the use of approved containers and packaging methods for the shipment of radioactive materials
  - 49 CFR 173.443, as it relates to methods and procedures used to monitor for the presence of removable contamination on shipping containers, and 49 CFR 173.441, as it relates to methods and procedures used to monitor external radiation levels for shipping containers and vehicles

ARCAP Section 8.3, Solid Waste (cont.)

- Develop Acceptance Criteria - System Design, such as:
  - Provide a high-level description of the solid waste management system (SWMS)
  - Describe expected sources of waste
  - Describe equipment design capacities for expected waste volumes and radioactivity inventories of Class A, B and C waste
  - Describe design provisions to control and collect any solid waste spillage from equipment malfunction or puncture of waste containers

ARCAP Section 8.3, Solid Waste (cont.)

- Develop Acceptance Criteria - Operational Controls, such as:
  - Provide a description of operational controls for waste processing and surveillance requirements which assure that:
    - Allowable doses to members of the public remain within required levels
    - The final waste product meets the requirements of applicable Federal, State and disposal site waste form requirements for burial at a 10 CFR 61 licensed Low-Level Waste (LLW) disposal site
  - As an option, applicant may refer to NEI 07-10A, *Generic FSAR Template Guidance for Process Control Program (PCP)*
    - If an applicant chooses to reference this template to address the above acceptance criteria no need to replicate text in the FSAR; may need to update/revise template to reflect operation of specific non-LWR

ARCAP Chapter 9, Control of Occupational Dose

- Develop using same approach as Chapter 8
- Address applicability to:
  - Part 50 operating license and construction permit applications
  - Part 52 design certification and combined license applications
  - Non-LWRs and small modular LWRs
- Reference applicable requirements for performance-based criteria, such as:
  - 10 CFR 19.12, as it relates to keeping workers informed who receive occupational radiation exposure (ORE)
  - 10 CFR 20, Subpart C, *Occupational Dose Limits* (20.1201 – 20.1208)
  - 10 CFR 20.1101 and the definition of ALARA in 10 CFR 20.1003, as they relate to those measures that ensure that radiation exposures resulting from licensed activities are below specified limits and ALARA

ARCAP Chapter 9, Control of Occupational Dose (cont.)

- Develop Acceptance Criteria – System Design, such as:
  - Describe important equipment and facility design features used to ensure that occupational radiation exposures are ALARA such as, shielding, ventilation, area radiation and airborne radioactivity monitoring instrumentation and dose assessment
  - Describe the design features provided to control access to radiologically restricted areas (including potentially very high radiation areas) and describe each very high radiation area and indicate physical access controls and radiation monitor locations for each of these areas
  - Describe those features that reduce the need for maintenance and other operations in radiation fields, reduce radiation sources in areas where operations may be performed, allow quick entry and easy access, provide remote operation capability, or reduce the time spent working in radiation fields, as well as any other features that reduce radiation exposure of personnel
  - Describe methods for reducing the production, distribution, and retention of activation products through design, material selection, water chemistry, decontamination procedures, and so forth

ARCAP Chapter 9, Control of Occupational Dose (cont.)

- Develop Acceptance Criteria – Operational Controls, such as:
  - Provide commitments to develop comprehensive worker protection programs, organizational structure, training and monitoring to ensure 10 CFR 19 and 10 CFR 20 requirements are met. Include commitments to any relevant regulatory guides, NEI templates, or standards
  - As an option, applicant may refer to NEI 07-08A, *Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures are as Low as is Reasonably Achievable (ALARA)*
    - If an applicant chooses to reference this template to address the above acceptance criteria no need to replicate text in the FSAR; may need to update/revise template to reflect operation of specific non-LWR
  - These criteria for operational controls could also be addressed in the Radiation Protection Program with a reference in the FSAR

U.S. Nuclear Industry Council Comments regarding ARCAP at NRC Public Meeting

Cyril Draffin
Senior Fellow, Advanced Nuclear
U.S. Nuclear Industry Council

27 August 2020

ARCAP has better direction

- USNIC appreciates NRC considering industry ARCAP comments:
  - NRC providing acceptance criteria, eliminating unnecessary material, adding flexibility for application depending on design and technology, making ARCAP technology-inclusive, and indicating how to consider exemptions
  - NRC not requiring duplication of information--applicant can reference other documents
  - Because there will be more reliance on industry actions then application details, important to consider what NRC oversight & inspection is needed so monitoring does not become too arduous,

ARCAP NRC input to NEI on 17 August 2020

- NRC seems to be taking appropriate steps based in industry feedback from the 31 July 2020 meeting:
  - Limited set of new guidance will be developed as part of ARCAP. ARCAP new guidance will be technology inclusive, to the maximum extent possible, so a light water or non-light water reactor applicant can use the guidance if they desire.
  - ARCAP was never intended to be a comprehensive replacement or reiteration for all regulatory guidance for large light water reactors (e.g., NUREG-0800, other regulatory guidance)
  - Developed a roadmap document describing that ARCAP will provide high-level guidance that will provide pointers to advanced reactor guidance that is under development (e.g., TICAP, security and emergency planning rulemaking) and provide additional guidance (including in appendices) for areas that are not being addressed under an advanced reactor activity.
  - Table provided listing of portions of the application and how the ARCAP would address the guidance seems reasonable.

Re-iteration of input on ARCAP

- Process should be clear, risk informed and consistent with NRC safety goals
- Reduce unnecessary burden, particularly where there is no nexus to safety--focus on areas for elimination in a risk-informed review is appropriate
- Prompt elevation and expedited resolution of policy issues is needed
- Commissioners need to be fully engaged, recognizing a license application is being reviewed by the NRC and multiple license applications will be forthcoming in 2021-22
- If NRC will not have separate guidance on microreactors make sure approach considers their characteristics
- Outcome must be transformative
- ARCAP needs to provide a clear benefit to near and long term applicants

Relation of ARCAP to Part 53

- ARCAP should not be the default basis for Part 53-- but ARCAP could provide elements that could be used in Part 53
  - ARCAP is a bridge not a destination
  - In near term could focus on key issues in ARCAP (perhaps with ISG), and that work could used in Part 53
  - Making Part 53 more applicable to a wider variety of technologies will benefit staff and industry
  - Must have clear high level requirements, fewer exemptions, and less iteration on existing rules

Other input

- Be technology-inclusive
- Streamline near term application reviews to define appropriate scope and level of detail
- For ARCAP, NRC staff could indicate what they will do for siting (ARCAP Chapter 2) and physical security (e.g. role of security rulemaking)
- NRC need to define how and why requested information is used to make a regulatory decision
- USNIC looks forward to ongoing constructive engagement with Commission and Staff to develop regulatory review tools for advanced reactor deployment

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Future Meetings

2020 Tentative Schedule for Technology Inclusive Content of Application Project Public Meetings
September 24
October 22
November 19