United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentations for June 22, 2017 Public Meeting
Regulatory Improvements for Advanced Reactors

1) NRC Staff Slides

- Opening
- Policy Issues
- Feedback: Standard Design Approval/Major Portions
- Feedback: Licensing Basis Events

2) Nuclear Energy Institute/Licensing Modernization Project

- Licensing Basis Events
- Probabilistic Risk Assessment Approach
- Defense in Depth

3) Nuclear Infrastructure Council / High Bridge Energy Development

United States Nuclear Regulatory Commission

Protecting People and the Environment

Public Meeting on Possible Regulatory Process Improvements for Advanced Reactor Designs

June 22, 2017

Telephone Bridge
(888) 793-9929
Passcode: 3543986

Public Meeting

- Telephone Bridge

  (888) 793-9929

  Passcode: 3543986
- Opportunities for public comments and questions at designated times

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Outline

- Policy Issues (ML17144A383)
- Feedback on SDA/Major Portions (ML17128A507)
- Feedback on Licensing Basis Events (ML17145A573, ML17145A570, ML17145A574)
- Lunch
- Probabilistic Risk Assessment Approach (ML17158B543)
- Nuclear Infrastructure Council
- Planning for Upcoming Meetings/Interactions

Advanced Reactor Program

Policy Issues – Updated Table Ongoing / Active

Issue	Activity / Status
License for Prototype Reactors	Public - ML17025A353
Appropriate Source Term, Dose Calcs, and Siting	LMP, Guidance Doc
Offsite Emergency Planning Requirements	comments due 6/27
Use of PRA in Licensing Process	LMP, Guidance Doc
Implementation of Defense-in-Depth Philosophy	LMP, Guidance Doc
Licensing Basis Events	LMP, Guidance Doc
Security and Safeguards Requirements	NEI WP - ML17026A474
Functional Containment Performance Requirements	SECY paper - early 2018
Fuel Qualification	Resourced, awaiting reports
Materials Qualification	Standards forum – 9/26
Increased Enrichments	awaiting white paper(s)

Policy Issues – Updated Table
Open but not active

- **Open Issues for non-LWRs but no current activities**
  - Annual Fees
  - Manufacturing Licenses
  - Industrial Facilities Using Nuclear-Generated Process Heat
  - Key Component and System Design Issues
  - Fuel Cycle Facilities
  - Waste Issues
  - Transportation
  - Rulemaking for RIPB TI Framework (Part 53)

Policy Issues – Updated Table
No current plans

- **Issues with no current plans to undertake activities (resolved or need input from stakeholders)**
  - License Structure for Multi-Module Facilities
  - Operator Staffing for Small or Multi-Module Facilities
  - Operational Programs for Small or Multi-Module Facilities
  - Installation of Reactor Modules During Operation of Multi-Module Facilities
  - Decommissioning Funding Assurance
  - Aircraft Impact Assessments

- **Public Comments / Questions**

Staff Feedback
SDA – Major Portions

- Good discussion of Standard Design Approval and use of “major portions” of plant design to define scope of application
- Available option for developers with various factors to consider
  - Goals of applicant
  - Ability to establish interfacing systems/boundary conditions
  - Practical tradeoffs
- Staff plans to incorporate/reference white paper in next revision of regulatory roadmap document

Staff Feedback
SDA – Major Portions

- Phase 2/3 activities provide possible opportunity to expand and integrate guidance
  - More detailed discussion of boundary conditions
  - Integration with related activities (e.g., LMP)
  - Possible differences in SDA to support construction permit versus design certification
  - Update of guidance for format and content for construction permit application
  - Staff’s safety focused guidance – scope & depth of applications and related NRC reviews

- **Public Comments / Questions**

Staff Feedback
LBE – High Level Comments

- Re-characterize the frequency-consequence figure and describe it as not defining specific acceptance criteria for analyzing Licensing Basis Events (LBEs) but providing a tool to focus the attention of the designer and those reviewing the design and related operational programs to the most significant events and possible means to address those events.

Staff Feedback
LBE – High Level Comments

- The paper emphasizes its use for selecting Design Basis Accidents (DBAs) and safety related structures, systems, and components. It would be useful to understand how the Licensing Modernization Project (LMP) views the use of the LBEs in other parts of the regulations
- Table or framework discussion
- Staff prefers for consolidated guidance to be as generic as possible in terms of relationships between event categories and regulatory requirements. This can also be useful to explain LBE efforts in relation to ARDC.

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Staff Feedback
Licensing Basis Events (LBEs)

Framework

<table>
<tr><th></th><th colspan="4">Analysis Attributes/Documentation</th><th colspan="5">How Analysis Supports Selected Regulatory Areas</th></tr>
<tr><th></th><th>Approach</th><th>Acceptance Criteria</th><th>Analysis QA Standard</th><th>Lic Basis Document</th><th>SSC Safety Class</th><th>Tech Spec</th><th>Procedures</th><th>Used for Siting (<25 rem)</th><th>Environ Reviews (SAMDA)</th></tr>
<tr><td>AOOs</td><td rowspan="5">Risk Assess (PRA)</td><td>SAFDL, SARRDL, Part 20</td><td rowspan="5">PRA Reg Guide (1.200*), 50.69, Realistic mean values</td><td rowspan="5">Chapters 15/19</td><td rowspan="5">Non-Safety systems with enhanced regulatory treatment (e.g. NSRST, RTNSS, 50.69, D-RAP, etc.)</td><td rowspan="4">50.36 criteria 1,2,3, or 4</td><td>Normal, Alarm, AOPs</td><td>No</td><td rowspan="2">No</td></tr>
<tr><td>DBEs</td><td>FPB (eg, SAFDL, SARRDL), F-C (PAG option)</td><td>EOP</td><td rowspan="4">Yes</td></tr>
<tr><td>BDBEs</td><td rowspan="2">Safety Goal (PAG option)</td><td rowspan="2">Guidelines (eg.,SAMGs, FSGs)</td><td rowspan="3">Yes</td></tr>
<tr><td>Functional Containment Basis</td></tr>
<tr><td>EP-basis</td><td>PAGs</td><td>No</td><td>EP</td></tr>
<tr><td>DBAs</td><td>Deterministic</td><td>FPB, 50.34</td><td>Appendix B</td><td>Chapter 15</td><td>Safety Related</td><td>Yes</td><td>EOP</td><td>No</td><td>No</td></tr>
<tr><td>External Events</td><td>Probabilistic Hazards Analysis

Role of “design basis external events (DBEE)”?</td><td>Facility protection requirements</td><td>PRA Reg Guide (1.200*), Realistic mean values</td><td>Chapters 2/3/19</td><td>Safety related for DBEEs?</td><td>Via equipment qualification Or 50.36 criteria 1,2,3, or 4</td><td>OPs, AdmPs, EDMGs</td><td>Yes</td><td>Yes</td></tr>
</table>

Advanced Reactor Program

Staff Feedback
LBE – High Level Comments

- The staff questions the value of the following acceptance criteria included in the paper:
  - The total frequency of exceeding a site boundary dose of 100 mrem shall not exceed 1/plant-year (the integrated frequency-weighted dose for all LBEs) to correlate to the annual exposure limits in 10 CFR 20.
  - The total frequency of a hypothetical site boundary dose for the duration of an event exceeding 750 rem shall not exceed 10^{-6}/plant-year. Meeting this criterion is related to the NRC Safety Goal Policy Statement on limiting the frequency of a large release.

Staff Feedback
LBE – High Level Comments

- Discussions of external events within the paper should be expanded and include discussion of how the events and related protection features are addressed within the broader LBE categories and safety classification of structures, systems, and components. For example, is it expected that in addition to being included in the PRA events, there will remain a set of traditional design-basis external events to define equipment seismic qualification specifications, minimum flood protections, and capacities for withstanding wind and missile loads?

Staff Feedback
LBE – High Level Comments

- Although mechanistic methods for modeling of source terms and release pathways is mentioned within the paper, the topic does not appear to be among the planned LMP white papers. Does the LMP plan to address the topic of mechanistic source term for subsequent inclusion in the consolidated guidance document?

- Additional discussion is needed regarding the frequency cutoff for the BDBE Region.

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Morning Wrap Up

- Public Comments / Questions
- Lunch
- Afternoon Session
  - LMP PRA Approach
  - Nuclear Infrastructure Council
  - Planning – Activities & Future Meetings

Utility-Led Initiative for Licensing Modernization of Technical Requirements for Licensing of Non-Light Water Reactors

NRC Review of LBE and PRA White Papers

Karl Fleming, LMP Team

June 22, 2017 • USNRC, Rockville MD

Discussion Topics

- LMP Response to NRC Comments on LBE white paper
- NRC feedback on PRA Approach WP

NRC LBE Paper Comment Summary

- High Level Comments
  - LMP appreciates the constructive comments
  - LMP providing written responses to comments
- Proposed LBE Table
  - LMP agrees table useful way to summarize approach
  - LMP version Table requires development of future white papers
- LBE Paper Markup
  - Proposed edits consistent with high level comments
  - LMP agrees with and will incorporate most proposed edits
  - Several edits require further discussion
  - LMP plans to issue revised paper addressing comments

High Level Comments

- Revise characterization of F-C chart to avoid suggestion of "acceptable risk"
- Address additional LBEs such as design basis external events and siting event
- Proposed LBE table with tie-in to other aspects of framework
- Suggestion to remove Part 20 and LRF cumulative risk metrics; drop LRF anchor point on F-C chart
- Suggestion of an option to F-C curve based on barrier integrity
- Question whether mechanistic source term paper is planned
- Additional discussion on the frequency cut-off on the BDBE region

F-C Curve Characterization

- Agreement on key points in the comment
  - F-C chart is not intended to be “risk acceptance criteria”
  - Provides useful way to demonstrated enhanced safety margins
  - Focuses on most (risk) significant events
  - F-C curve is not TLRC but rather derived from TLRC
- F-C chart primary purpose is to evaluate the risk significance of LBEs and to use as a tool in selecting and evaluating individual LBEs

Possible Revision to F-C Chart

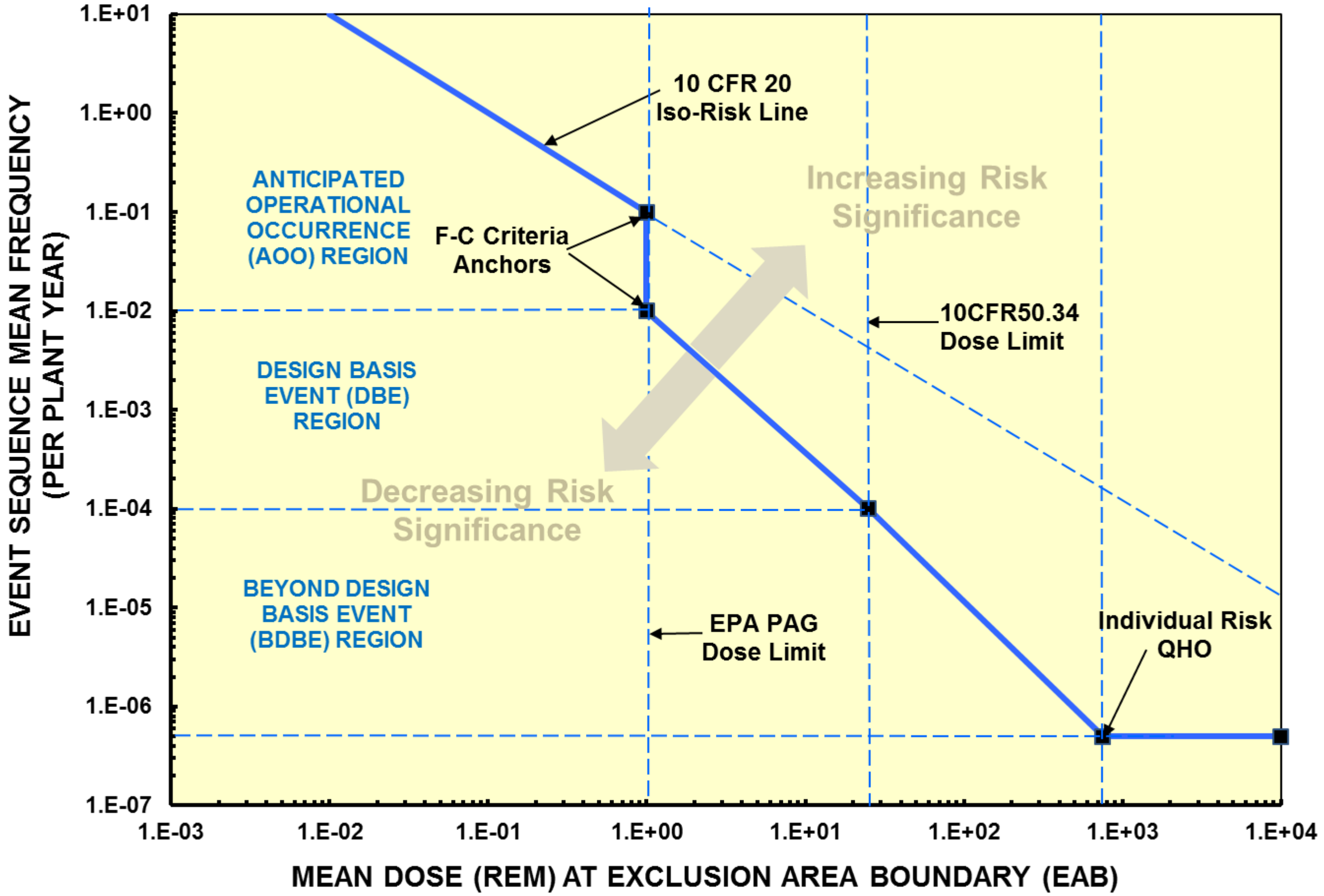


Table Linking LBEs to Regulatory Framework

- Agree that table like this is useful in summarizing key elements of framework
- Completion of an LMP equivalent of the table requires the completion of additional white papers on SSC classification, DID, and contents of license application chapters
- External events are intended to be included in AOOs, DBEs, and BDBEs; need to show visibility of design basis external events

Alternative Approach Based on Barriers

- LMP framework will include performance requirements for all SSCs including barriers as part of SSC paper
- LMP does not plan to develop an alternative LBE selection process based on barriers
- LMP is committed to the LBE selection attributes

LBE Selection Attributes of this project

- Systematic and reproducible process
- Sufficiently complete set of LBEs
- Timely input to design decisions
- Risk-informed and performance-based
- Reactor technology inclusive process
  - Capable of identifying reactor specific safety issues
  - Applicability to wide range of non-LWR concepts
  - Uniform level of safety across deigns
- Consistent with applicable regulatory requirements

Cumulative Risk Metrics

- LMP agrees to remove the LRF metric as it is somewhat redundant to prompt fatality QHO and agreement on LRF dose may be difficult
- LMP sees advantages to retaining the 10 CFR 20 metric
  - Consistent with the need for a broader definition of risk and risk significance that includes AOOs as well as DBEs, and BDBEs
  - F-C chart only useful to evaluate individual LBEs; this metric addresses the cumulative risks where AOOs are expected to dominate
  - Facilitates performance-based metric for initiating event prevention- first level in IAEA defense-in-depth framework

External Events

- Agree that more discussion is needed in LBE paper on external events
- LMP plans to retain the concept of design basis external events such as SSE, OBE and design basis wind and flooding hazards
- Approach emphasizes use of probabilistic hazards analysis where feasible
- SSC requirements to protect against external events (e.g. SC-I and II) to be addressed in SSC white paper

Mechanistic Source Terms

- LMP framework proposes mechanistic source terms (MST) for evaluating consequences of all LBEs including DBAs
- MSTs for LWR DBA acceptable per SECY 16-0012 and SRP Chapter 15
- NGNP MST WP focused on issues specific to mHTGRs
- ASME/ANS-S-1.4-2013 includes technology inclusive requirements for MST to support PRA (derived from ANS Level 2 PRA standard)
- No current plan to produce an LMP white paper on MST

Frequency Cut-off for BDBE

- Cut-off intended to be applied to upper bound (95%tile) BDBE frequencies
- Frequencies below $5x10^{-7}$/yr are sufficiently low to assure meeting the prompt fatality QHO independent of consequences
- Frequencies and QHOs interpreted on a per plant-year basis and address multi-module events
- Ready for additional discussions as requested

WRITTEN RESPONSES TO HIGH LEVEL COMMENTS AND REVISED LBE WHITE PAPER WILL BE PROVIDED

QUESTIONS?

PRA WHITE PAPER

PRA White Paper Objectives

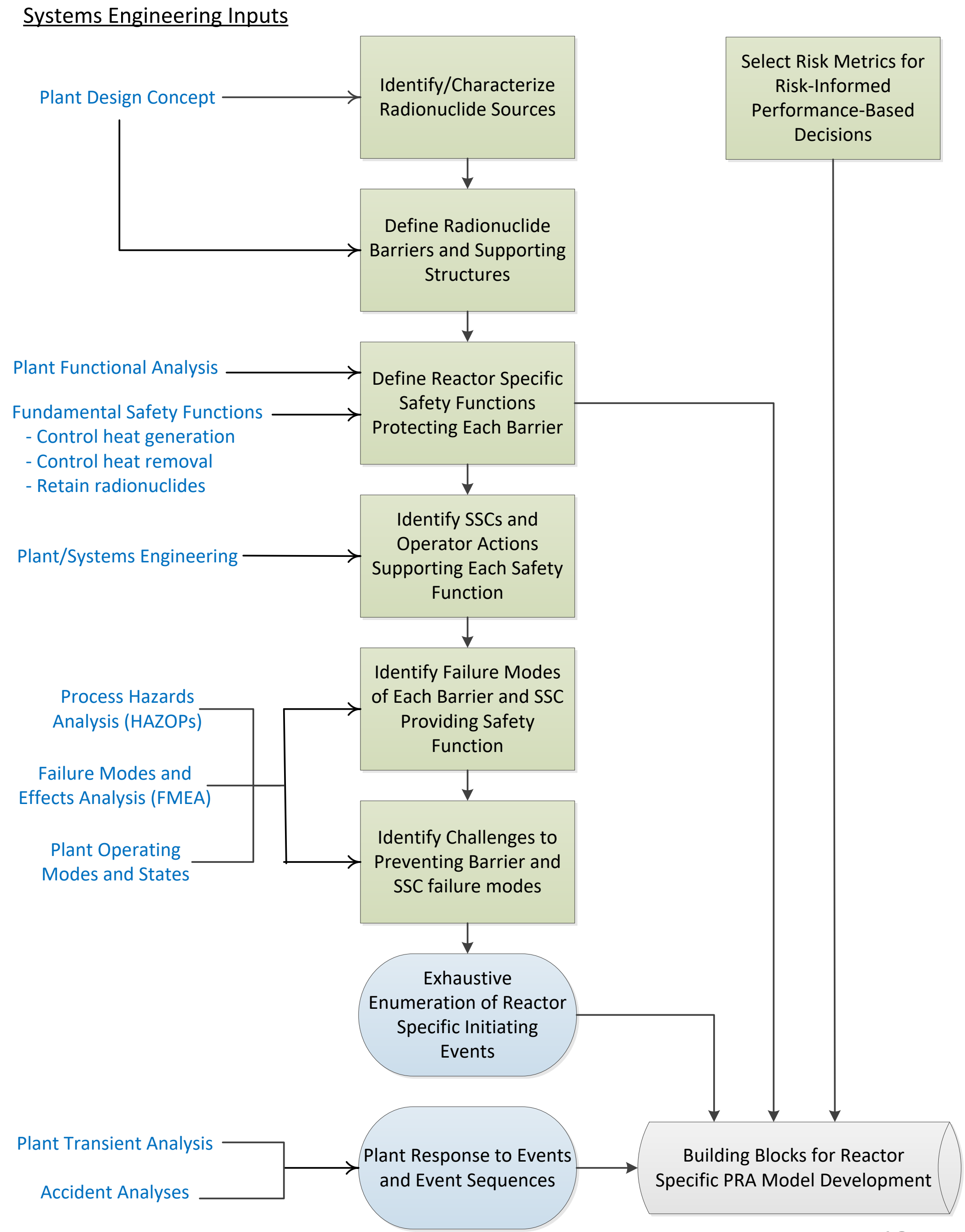
- Assist NRC to develop regulatory guidance for licensing advanced non-LWR plants.
- Present a technology inclusive approach to developing a PRA for advanced non-LWRs and to ensuring its technical adequacy

PRA Development Plan Concept

- PRA will be developed in stages keyed to evolution of design, operation and maintenance requirements, and site characteristics
- Level of detail and completeness consistent with that of the design
- Risk-informed decisions supported by the PRA will be made and updated in an iterative fashion as the design and PRA matures
- PRA models, success criteria, plant transient response to events, mechanistic source terms, and offsite consequences initially based on assumptions and replaced by supporting analyses as the analysis tools become available
- The design and PRA phases will likely be different for different non-LWRs depending on PRA history for each reactor

Flow Chart for Initial PRA Model Development

- Expands on Steps 2 and 3
- Risk metrics and criteria for LBE evaluation defined in Step 7
- Focus is on early stages of design and PRA development



Technical Issues Addressed

- Technology inclusive risk metrics and risk importance measures
- Treatment of PRA data and uncertainty
- PRA treatment of multi-module and multi-source accidents
- Technology inclusive approach for defining PRA modeled safety functions in terms of barrier protective functions
  - Application of approach to MHTGR and PRISM

Risk Importance Metrics

Measure	Abbreviation	Principle
Risk reduction	RR	$R(\text{base}) - R(x_i = 0)$
Fussell–Vesely	FV	$\frac{R(\text{base}) - R(x_i = 0)}{R(\text{base})}$
Risk reduction worth	RRW	$\frac{R(\text{base})}{R(x_i = 0)}$
Criticality importance	CR	$\frac{R(x_i = 1) - R(x_i = 0)}{R(\text{base})} \times x_i(\text{base})$
Risk achievement	RA	$R(x_i = 1) - R(\text{base})$
Risk achievement worth	RAW	$\frac{R(x_i = 1)}{R(\text{base})}$
Partial derivative	PD	$\frac{R(x_i + \partial x_i) - R(x_i)}{\partial x_i}$
Birnbaum importance	BI	$R(x_i = 1) - R(x_i = 0)$

R = CDF, LERF, or Technology Inclusive Risk Metric, e.g. QHOs

Risk Metrics Supported by PRA

- Reactor Specific Metrics
  - User defined metric, e.g. frequency of sodium boiling for SFRs
  - LBE Frequencies and consequences
- Technology Inclusive Metrics
  - Individual and societal QHOs
  - Exceedance frequencies of specific site boundary doses (e.g., LRF, 10 CFR 20)
  - Exceedance frequencies of offsite health effects
- Both relative and absolute risk metrics to be addressed

Multi-Module PRA Guidance

Category	Reference
Non-LWR Case Studies	MHTGR PRA (4 Reactor Modules) PRISM PRA (2 Reactor Modules) HTR-PM PRA (2 Reactor Modules)
LWR Case Studies	Seabrook PRA (2 Reactor Units) NRC Level 3 PRA (2 Reactor Units)
Non-LWR Guidance and Standards	ASME/ANS Non-LWR PRA Standard NGNP PRA White Paper [1]
LWR Guidance and Standards	IAEA Technical Approach to MUPSA SR 8.5 [43] IAEA TECDOC 1804 [44] CNSC International Workshop on MUPSA [47]

PRA Technical Adequacy Approach

- Integration of PRA into the design and design evaluation process
- PRA adequacy fit for purpose at each stage of design
- Adherence to non-LWR PRA standard and other PRA available technical adequacy references
- Peer review focus on PRA aspects different than LWR PRAs
- Regulatory review of RIPB applications

PRA Technical Adequacy References

- Regulatory Guidance
  - RG 1.200, RG 1.174, RG 1.206
  - SRP Chapter 19
  - NUREG-1860, NUREG-1855
- PRA Standards
  - ASME/ANS PRA Standard for Advanced non-LWRs
  - Supporting LWR PRA Standards
  - IAEA TECDOC 1804, SSG-3, SSG-4, SR-8.5
- UKAEA SAPs

ASME/ANS PRA Standard for Advanced Non-LWRs

- PRA requirements for technical adequacy developed on a reactor technology inclusive basis
  - User defined release categories and event sequence families
  - Supports back end metrics such as QHOs, frequency of dose
  - Does not use LWR metrics such as CDF, LERF or Level 1-2-3 PRA
- Roughly 80% of the requirements are common to LWR PRAs
- Supports full scope, all modes, all hazards PRA similar to LWR Level 3 PRA (sequences developed to dose)
- Supports PRAs done during pre-operational phases
- Supports PRAs on multi-reactor module plants
- Provided input to LWR PRA standard enhancements (drafted for next edition ballot)
  - Mandatory appendix for ALWRs and single unit PRAs on SMRs
  - Non-mandatory appendix for multi-unit PRAs

ASME/ANS PRA Standard for Advanced Non-LWRs

- Issued for 3-yr trial use period December 2013
- Pilot studies being performed for:
  - HTR-PM
  - GE-PRISM
  - Traveling Wave Reactor
  - ANL/KAERI Sodium Cooled Fast Reactor
  - Xe-100 HTGR (PRA in early stage)
  - MCFR (PRA in early stage)
- ANSI standard version to be developed in 2017-2018 timeframe incorporating pilot risk insights:
  - Standard found to be useful to establish technical adequacy
  - More work needs to be done to define risk significance for PRAs with both frequencies and consequences quantified
  - Issue of small numbers

PRA and Applications Peer Review

- Traditional PRA peer review scope to be addressed with more focus on items different than LWR PRAs:
  - Advanced non-LWR reactor fundamentals
  - Definition of safety functions
  - Success criteria bases
  - Selection of initiating events
  - Definition of end states and risk metrics
  - Plant response to events
  - Reactor specific phenomena
  - Data treatment for unique events and components
  - Treatment of uncertainties

NRC Involvement in ASME/ANS RA-S-1.4-2013

- Active Participation on Writing Group
- NRC review of 2008 Public Review Draft
- No NRC review of 2013 ballot
- Future participation is recommended
  - Ongoing Writing Group participation
  - Review of current trial use standard?
  - Review and endorsement of revised ANSI standard?

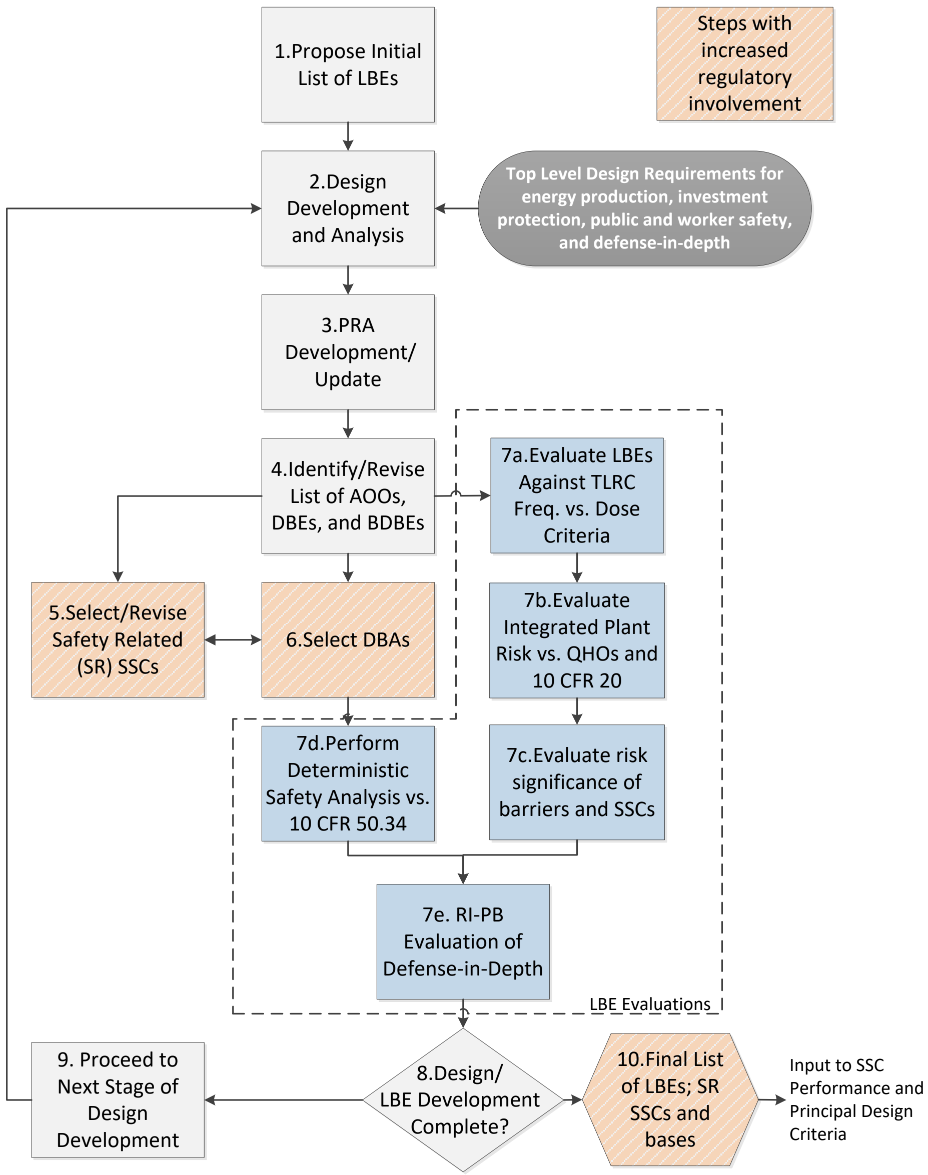
QUESTIONS?

BACK-UP SLIDES

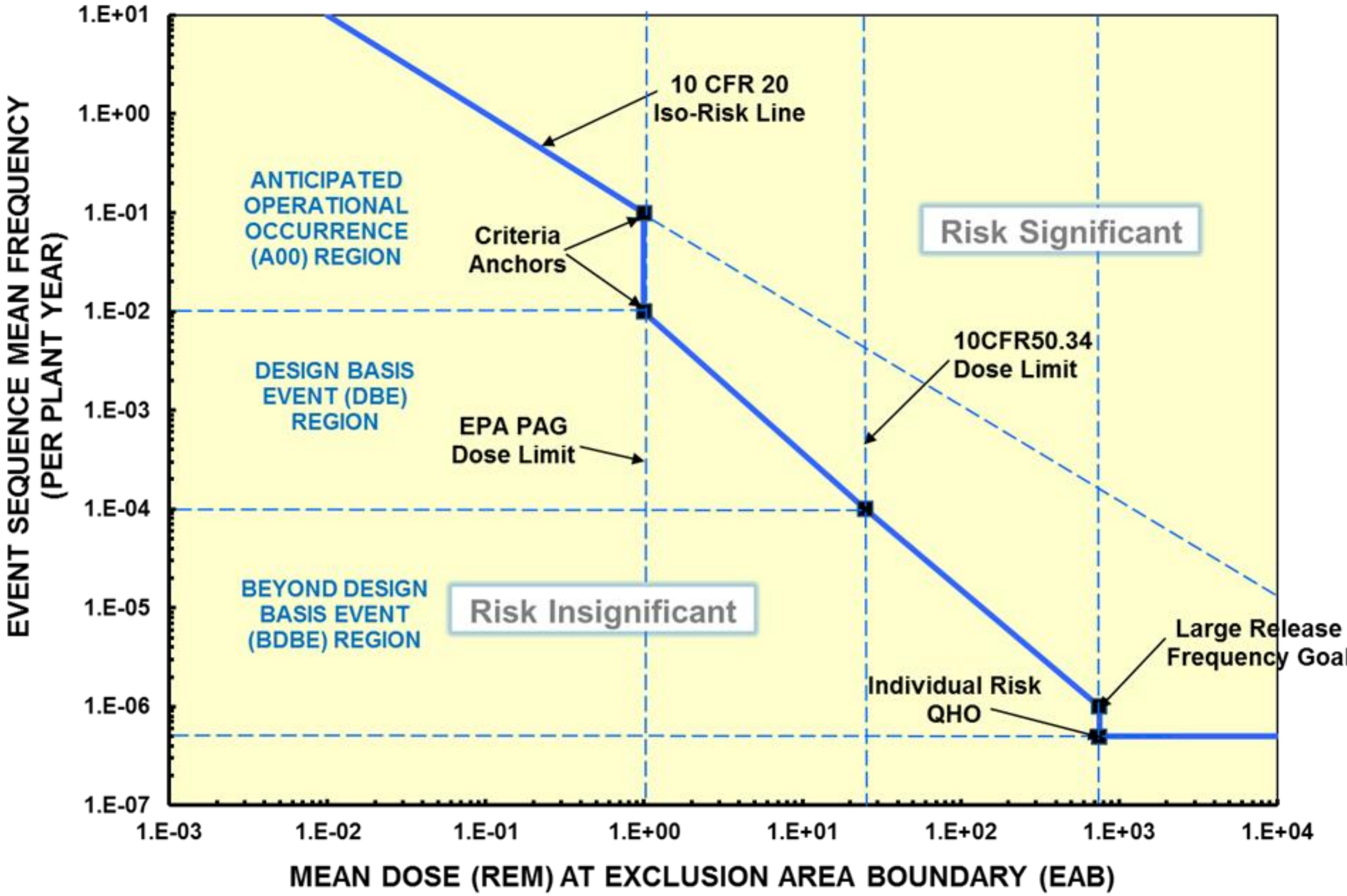
Categories of LBEs

- LBEs include all the events used to develop design bases and licensing requirements. They cover a comprehensive spectrum of events from normal operation to rare, off-normal events.
- There are four categories of LBEs:
  - **Anticipated Operational Occurrences (AOOs**) encompass planned and anticipated events. The radiological doses from AOOs are required to meet normal operation public dose requirements. AOOs are utilized to set operating limits for normal operation modes and states.
  - **Design Basis Events (DBEs**) encompass unplanned off-normal events not expected in the plant's lifetime, but which might occur in the lifetimes of a fleet of plants. The radiological doses from DBEs are required to meet accident public dose requirements. DBEs are the basis for the design, construction, and operation of the structures, systems, and components (SSCs) during accidents.
  - **Beyond Design Basis Events (BDBEs**) are rare off-normal events of lower frequency than DBEs. BDBEs are evaluated to ensure that they do not pose an unacceptable risk to the public.
  - **Design Basis Accidents (DBAs).** The DBAs for Chapter 15, "Accident Analyses," of the license application are deterministically derived from the DBEs by assuming that only SSCs classified as safety-related are available to mitigate the consequences. The conservatively estimated dose of each DBA must meet the 10 CFR §50.34 consequence limit at the Exclusion Area Boundary (EAB).

Process For Selecting and Evaluating LBEs



Frequency-Consequence Evaluation Criteria Proposed for LMP



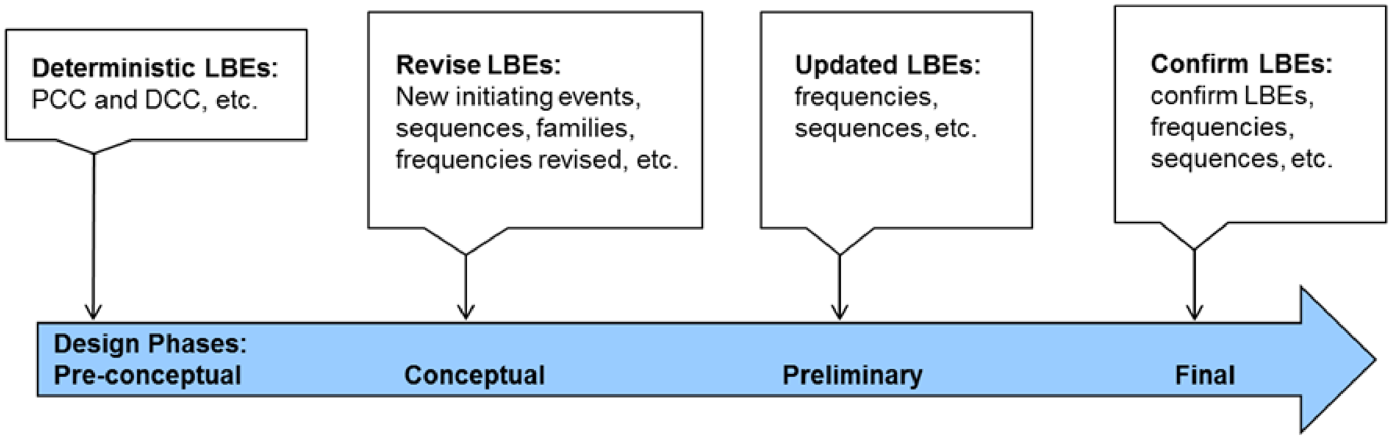
Additional PRA Objectives

- Support a full range of RI-PB decisions
  - Evaluation of design alternatives and incorporation of risk insights into the design
  - Input to the selection of licensing basis events (LBEs)
  - Input to the safety classification of systems, structures and components (SSCs)
  - election of special treatment and performance requirements for the capabilities, and reliabilities for SSCs in the prevention and mitigation of accidents
  - Risk-informed and performance based evaluation of defense-in-depth adequacy.
- Provide an approach that can be applied to known advanced non-LWRs including HTGRs, LM cooled fast reactors, molten salt reactors
- Provide roadmap for performing and upgrading the PRA as the design matures
- Define the approach to ensuring PRA technical adequacy

THE PRINCIPAL CHALLENGES

- Varying degrees of lack of experience with non-LWR PRA
- Lack of design and operational details for pre-operational PRA development
- Lack of service experience to support PRA data for unique events and components
- Increased reliance on inherent safety features and passive systems
- Increased scope of PRA to support LBEs within and beyond design basis
- New risk metrics appropriate for non-LWRs and multi-module designs
- Need to develop risk management strategies for multi-module and multi-source accidents
- Lack of experience for staff peer review teams.
- Need to address insights from PRA pilots for ASME/ANS PRA (Trial Use) Standard for Advanced non-LWRs

MHTGR Design and PRA Evolution



LBE selection process inputs vary by design phase:

- Initial design concept*
- Prior HTGR experience and PRAs*
- Expert insights*

- Basic design*
- Initial analyses (FMEA, HAZOPs, etc)*
- Initiate PRA development†
- Design rqmts.*
- Expert reviews*

- Updated design*
- Detailed FMEAs, etc.*
- Preliminary PRA results†
- Expert reviews*
- Regulator interaction*

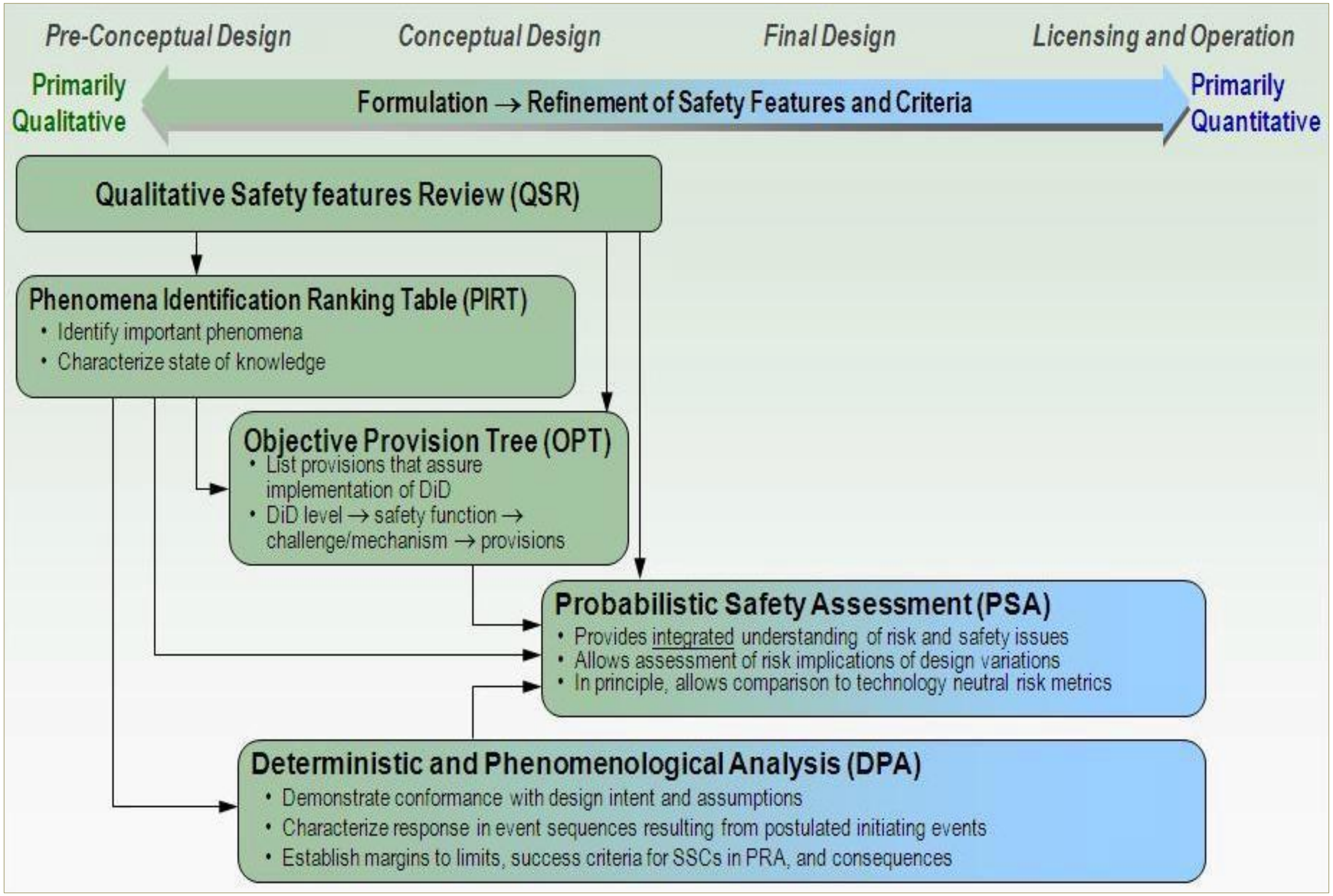
- Mature design
- Detailed FMEAs, etc.
- Complete PRA results
- Expanded PRA scope†
- Expert reviews
- Regulator feedback

* **Steps performed during MHTGR project through early preliminary design**

† **PRA scope and level of detail expands as design matures**

7

Gen IV Integrated Safety Assessment Methodology



Utility-Led Initiative for Licensing Modernization of Technical Requirements for Licensing of Non-Light Water Reactors

Introduction of Defense-in-Depth Adequacy White Paper

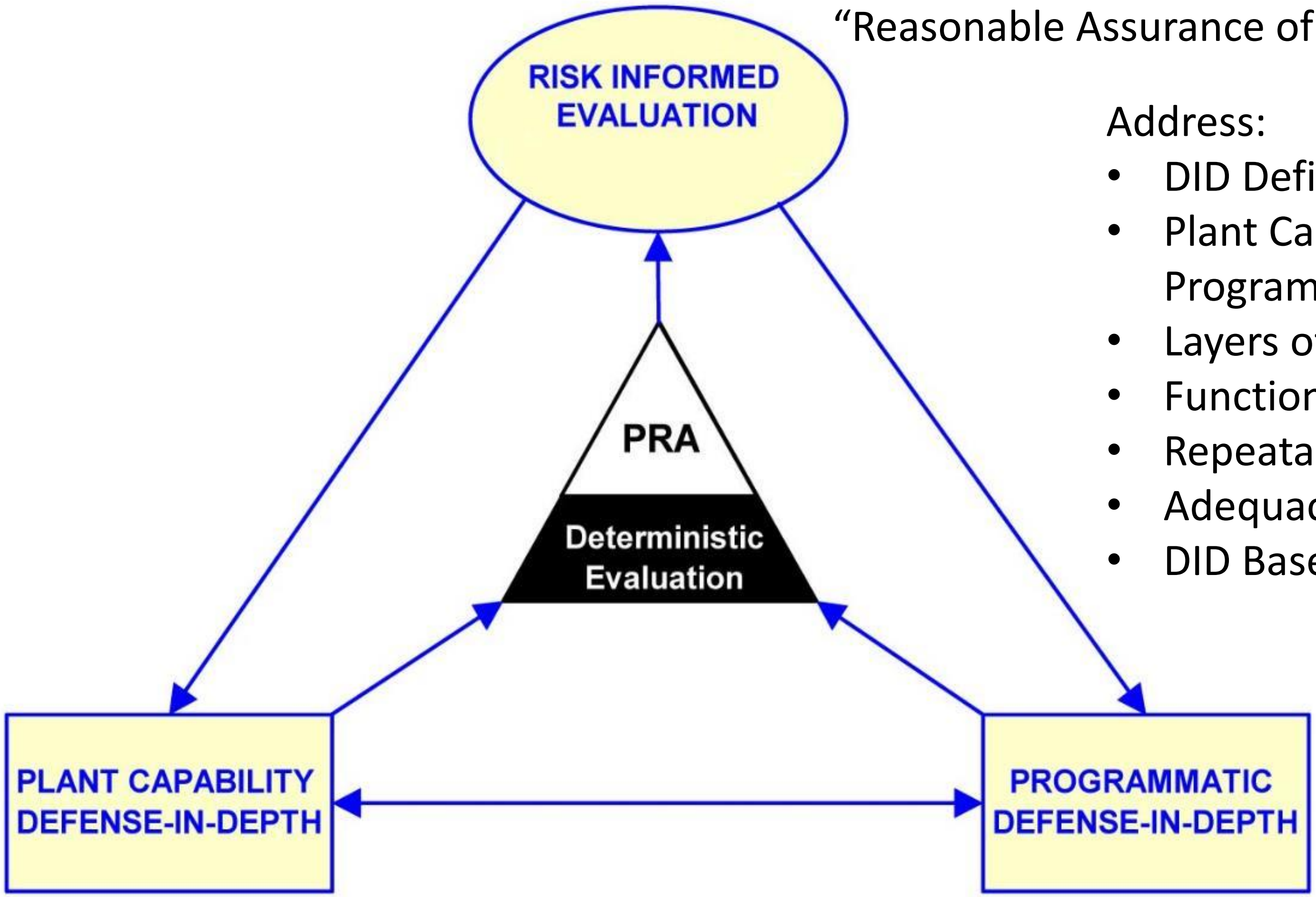
Ed Wallace, LMP Team

June 22, 2017 • USNRC, Rockville MD

Objectives of DID WP

- A stable TI-RIPB definition of DID
- A reproducible process for evaluating DID adequacy
- Identification of DID attributes and their use in decision making including:
  - Risk criteria/thresholds for evaluation
  - Guidelines for selecting supplementary actions

LMP RIPB DID Framework



"Reasonable Assurance of Adequate Protection"

Address:

- DID Definition
- Plant Capability and Programmatic DID Elements
- Layers of Defense
- Functional Barriers
- Repeatable evaluation process
- Adequacy Determination
- DID Baseline Determination

LMP RIPB Layers of Defense

NO	Prevention of abnormal operation and failures
AOO	Control of abnormal operation and failures
DBE	Control of accidents within the design basis
BDBE	Control of severe plant conditions, including prevention or accident progression and mitigation of the consequences of severe accidents
EP	Mitigation of radiological consequences of significant releases of radioactive materials

Margin

Uncertainty

NRC Meeting with Nuclear Industry Groups on Regulatory Process Improvements for Advanced Reactor Designs

Philip Moor
President
High Bridge Energy Development
on behalf of the USNIC Advanced Reactor Task Force

June 22, 2017

Introduction

- Appreciate the opportunity to present this afternoon both as a member of the USNIC Advanced Reactors Task Force and as a member of the Council's Technology Owners Group.
- The Council has been a champion for Advanced Reactor developers and an outspoken advocate for more direct engagement by the NRC with developers.
- This advocacy includes off-fee appropriations for building the agency's core competency and initiatives to spur more pre-licensing engagement, which is requisite to a quality application.

Introduction

- The Council is pleased to see Congressional support in the FY2017 omnibus Appropriations for $5 million in off-fee dollars for the NRC.
- At the same time, we are disappointed to note that the agency did not include an off-fee request in its FY2018 request. It is our hope that the Congress will act otherwise to provide off-fee FY2018 appropriations for Advanced Reactors.
- To this end, we appreciate this opportunity today to dialog face-to-face with the NRC in what the Council hopes will be first-in-a-series.
- The views that follow are exclusively the views of the High Bridge team and do not reflect the specific views of the Council or its members.

High Bridge Energy Development, LLC
Multi-Purpose Project for
Advanced Reactor Deployment

Who are We?

- High Bridge Energy Development, LLC
  - Dedicated to the commercializing Small Modular Reactors (SMRs)
  - A subsidiary of High Bridge Associates, an established project management services company
- We have assembled a team of American nuclear leaders
  - GE Hitachi
  - AECOM
  - Exelon
  - High Bridge Associates
- Industry support
  - North American Building Trades Unions
  - NEI
  - US NIC

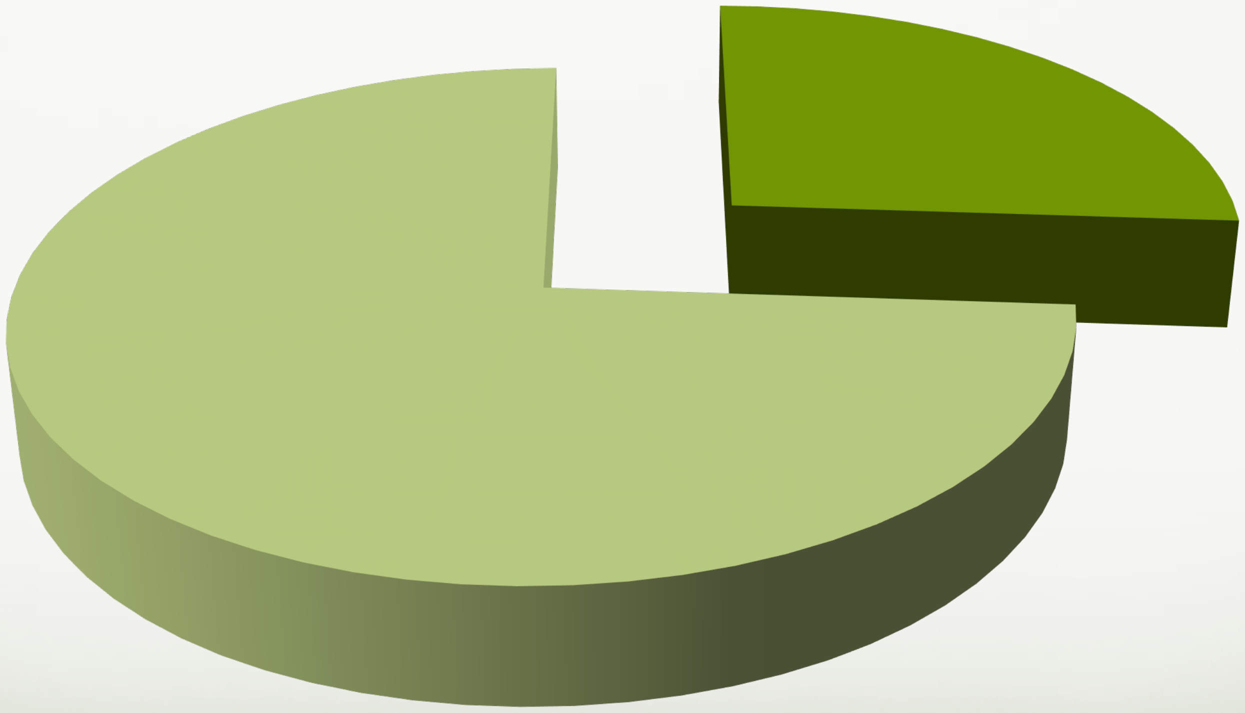
What are we trying to do?

- This project will license and construct two multi-purposed GEH PRISM reactors via a public/private partnership
- We have submitted an unsolicited proposal to DOE to build PRISM reactors to serve as US-based test reactors
  - We intend to build two, MOD-A PRISM reactors at INL
  - We will contract with the lab to use them to irradiate experiments
  - The units will also provide electricity to the local grid
- We are requesting federal funding to support permitting of the project
- We have plans to build four more projects using identical reactors designs

Why is it important?

- Currently the US has no fast neutron test reactor for R&D
  - Experiments currently are sent to Russian test reactor(s)
- Advanced reactor technologies require higher temperatures and different chemistry of fuel and coolants.
- The PRISM design can perform 80% to 90% of the types of tests expected to be needed by NEAC
- The project will also
  - Create American Jobs
  - Demonstrate advanced reactor technology and economics
  - Be a docketed project that provides the opportunity to streamline regulation
  - Prove SMR economics

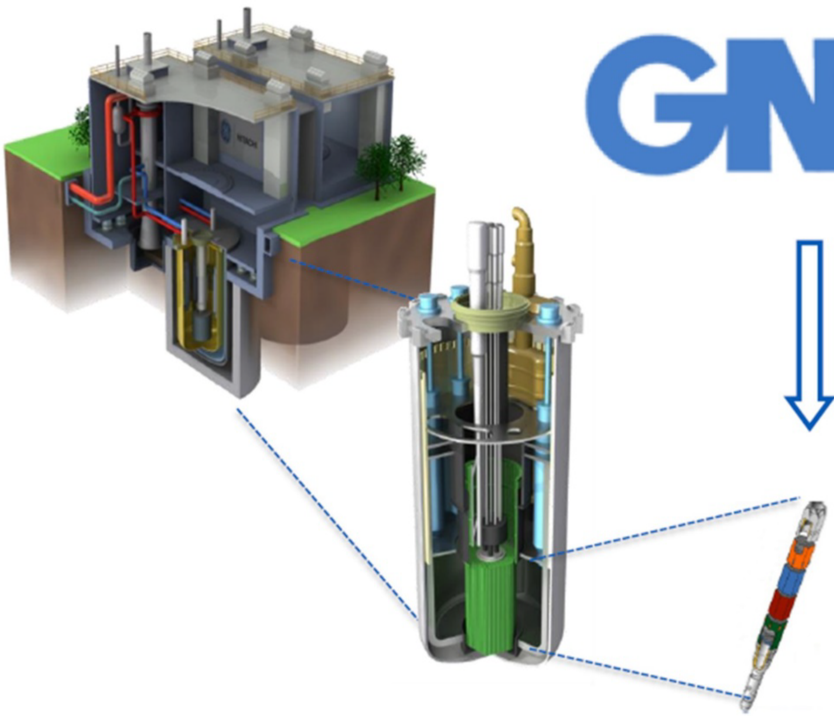
Public/Private Partnership



What is Our Licensing Plan?

- Reactors to be licensed as power reactors
- Communicate the schedule and licensing plan to reach mutual agreement early
  - use 10CFR50
  - employ the prototype provision of 10CFR50.43(e)
  - nuclear safety approaches described in NUREG-1368
- Core design to be based on fresh uranium fuel

PRISM Fuel Qualification Plan



GNF

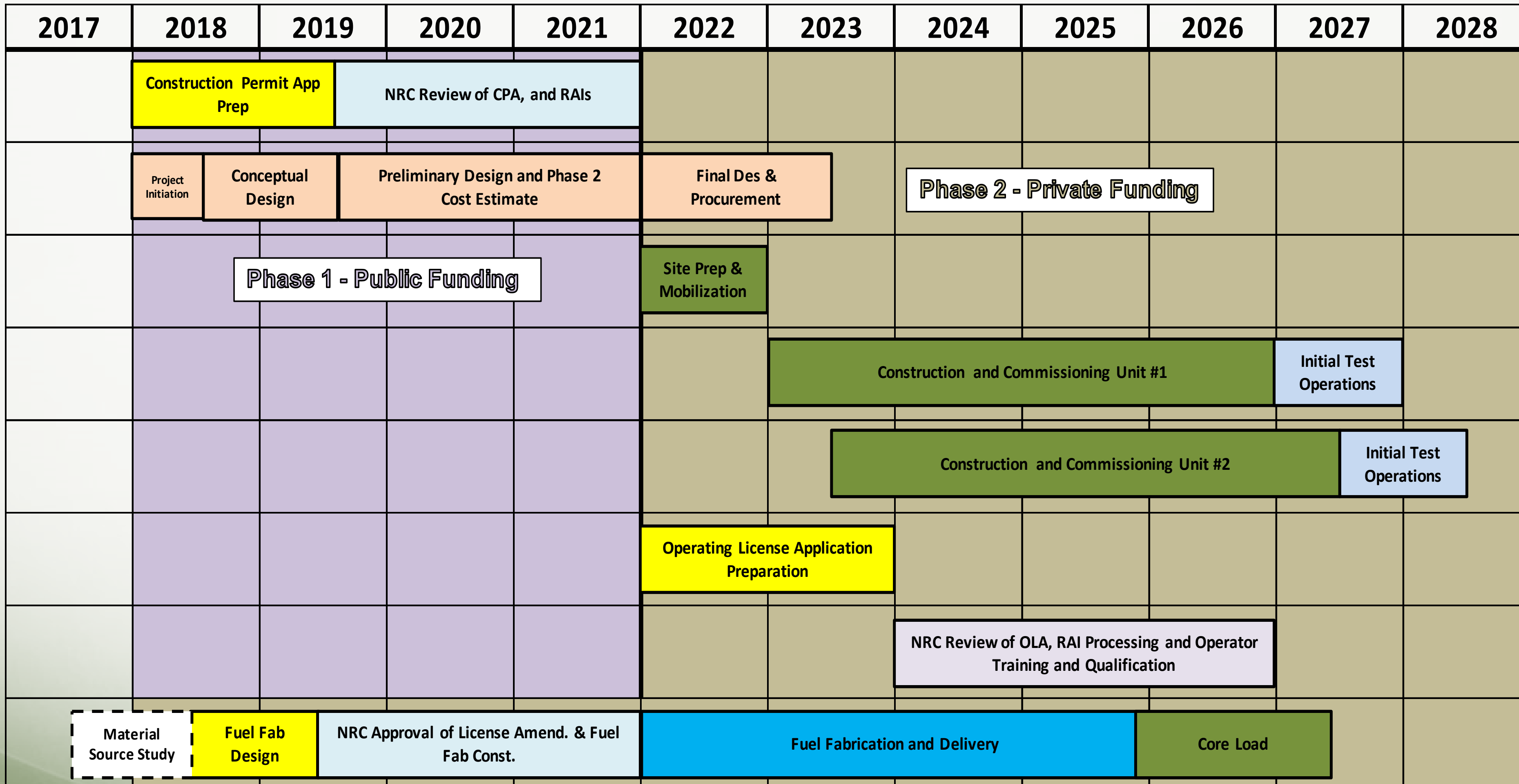
- Use NUREG-1368 to drive qualification
- Resurrect "LIFE-METAL", etc. codes.
- Inform the NRC on plans
- GNF develops/implements licensing roadmap
- GNF communicates progress to INL
- GNF delivers fuel to PRISM at INL

Use NUREG-1368 as the guide;

modernize past development efforts

HITACHI

Notional Schedule



Thank you

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