# Applying the Licensing Modernization Process to the PRISM Reactor

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# Licensing Modernization Process (LMP)

The process described in the LMP Guidance Document, NEI 18-04 provides a systematic and reproducible framework for selecting LBEs, defining required safety functions, and classifying SSCs.

This presentation will highlight results and insights regarding:

- Licensing Basis Events,
- Safety Classification,
- Defense-in-Depth Assessment, and
- Table Top Exercise.

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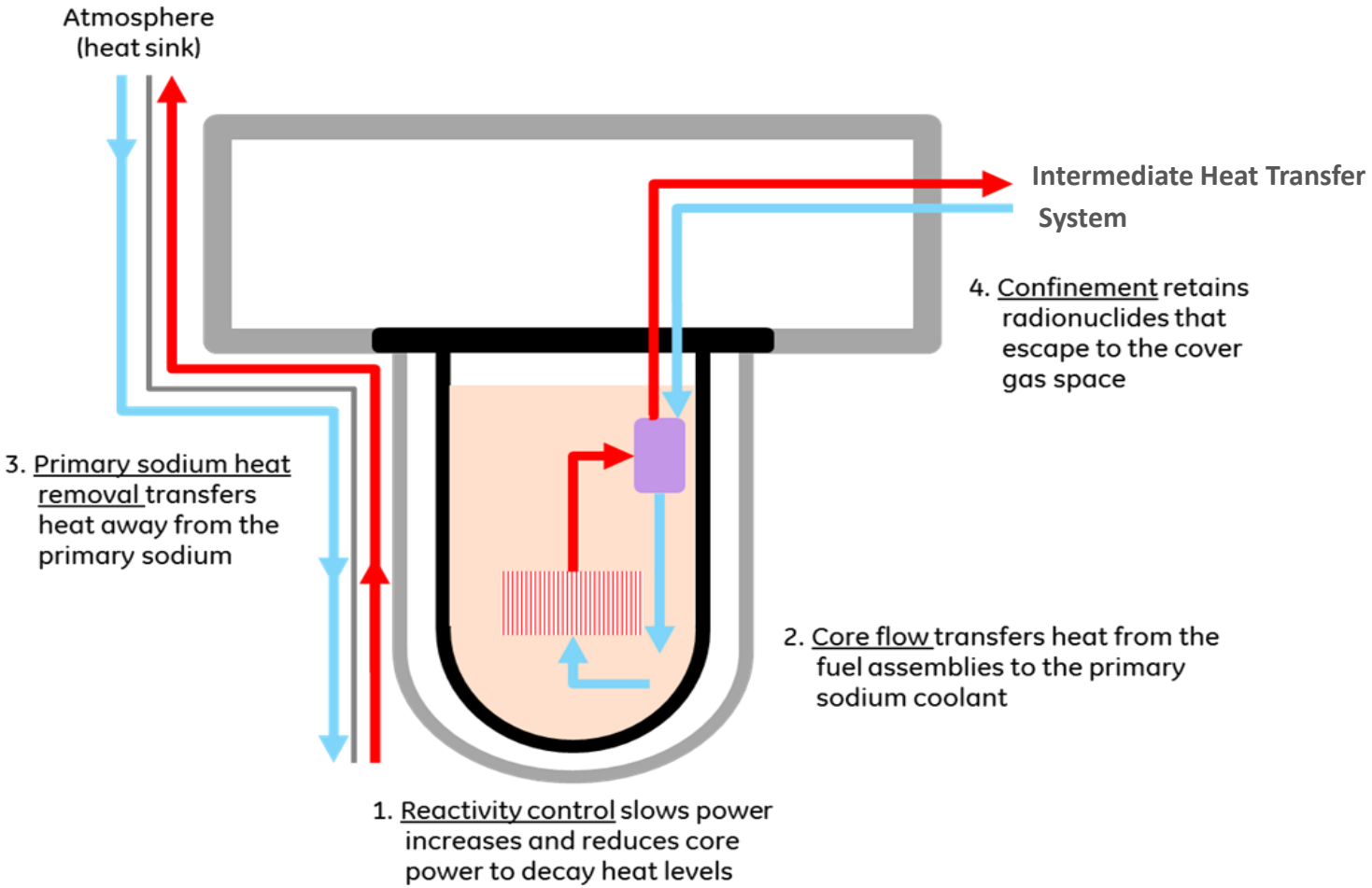
# PRISM Safety Functions

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# Licensing Basis Events

1,141 PRA Internal Events At-Power event sequences were grouped into 591 Event Sequence Families (ESF) (similar initiating event, mitigation, radiological behavior)

591 ESFs were reduced to 70 ESFs above truncation limit

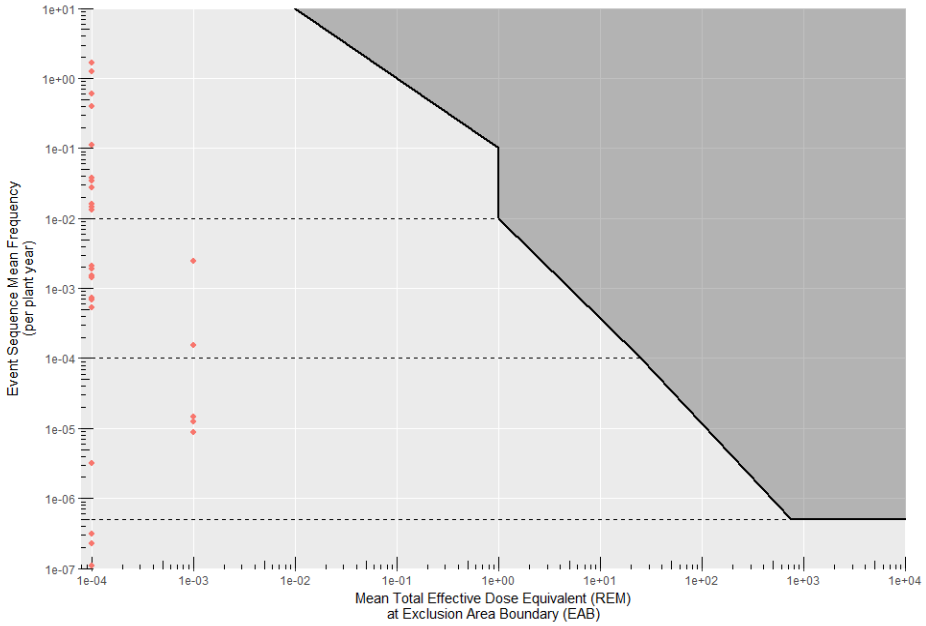
Grouped into 26 Licensing Basis Events:

| | |
|---|---|
| AOOs | 11 |
| DBEs | 10 |
| BDBEs | 5 |

6 DBAs

# Licensing Basis Events

The chart for the PRISM Internal Events At-Power scope is displayed below and illustrates that all LBEs are within the F-C Target.




Proposed changes in reliability or redundancy are projected relative to impact on the F-C chart.

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# Safety Classification

A Required Safety Function is one that must be fulfilled to meet the dose requirements for the DBAs using conservative assumptions

- Case Studies crediting various combinations of Key Safety Functions identified a minimum set of Required Safety Functions:

| Case | Reactivity Control | Heat Removal | Core Flow | Confinement | Result |
|---|---|---|---|---|---|
| 1 | ✓ | ✓ | ✓ | | Meets target |
| 2 | ✓ | ✓ | | | Meets target – core flow only important for losses of reactivity control **[Required Safety Functions]** |
| 3 | | ✓ | | | Does not meet target – heat generation due to losses of reactivity control exceed heat removal capacities |
| 4 | ✓ | | ✓ | ✓ | Does not meet target |

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# Safety Classification

Systems and components found to be available on all Design Basis Events (DBE) and that mitigate the consequences of DBEs to within the F-C Target include:

- Digital I&C logic
- Control rods and drives and associated operator actions
- Electromagnetic pump supply breakers and associated operator actions
- 120 VAC equipment
- 125 VDC equipment
- Reactor Vessel Auxiliary Cooling System

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# Defense-in-Depth

Comprehensive querying of defense levels to prevent and mitigate accident progression

| Layer[a] | Layer Guideline | | Overall Guidelines | |
|---|---|---|---|---|
| | Quantitative | Qualitative | Quantitative | Qualitative |
| 1) Prevent off-normal operation and AOOs | Maintain frequency of plant transients within designed cycles; meet owner requirements for plant reliability and availability[b] | | Meet F-C Target for all LBEs and cumulative risk metric targets with sufficient[d] margins | No single design or operational feature,[c] no matter how robust, is exclusively relied upon to satisfy the five layers of defense |
| 2) Control abnormal operation, detect failures, and prevent DBEs | Maintain frequency of all DBEs < $10^{-2}$/plant-year | Minimize frequency of challenges to SR SSCs | | |

Example: Layer 2 Qualitative Assessment

RVACS is only challenged if the Intermediate Heat Transfer System fails or Alternate Cooling System (SG Shell Heat Removal) fails. To minimize the frequency of challenges to RVACS, the following were classified as NSRST:

- SG shell and tubes
- IHTS
- Forced Air Cooling mode of ACS
- SG Sodium/Water Protection System detection and mitigation

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# Table Top Exercise

GEH demonstrated several elements of LMP:

- Selecting LBEs based on PRISM PRA event sequences,
- Estimating offsite radiological doses for each LBE,
- Identifying required safety functions,
- Selecting safety-related SSCs, and
- Evaluating Defense-in-Depth adequacy.

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# Insights

The PRISM PRA is capable of being directly queried to show the effect of different assumptions on the position of LBEs relative to the F-C Target.

Sensitivity studies are invaluable – it is therefore important to prepare quantification files for batch processing.

Process steps were repeated for the VTR design project with similar results.

> Synchronizing risk-informed LMP with the design process is a new challenge.

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