



Design Requirements and Special Treatments Development Process for Xe-100

PSAM 18 Conference

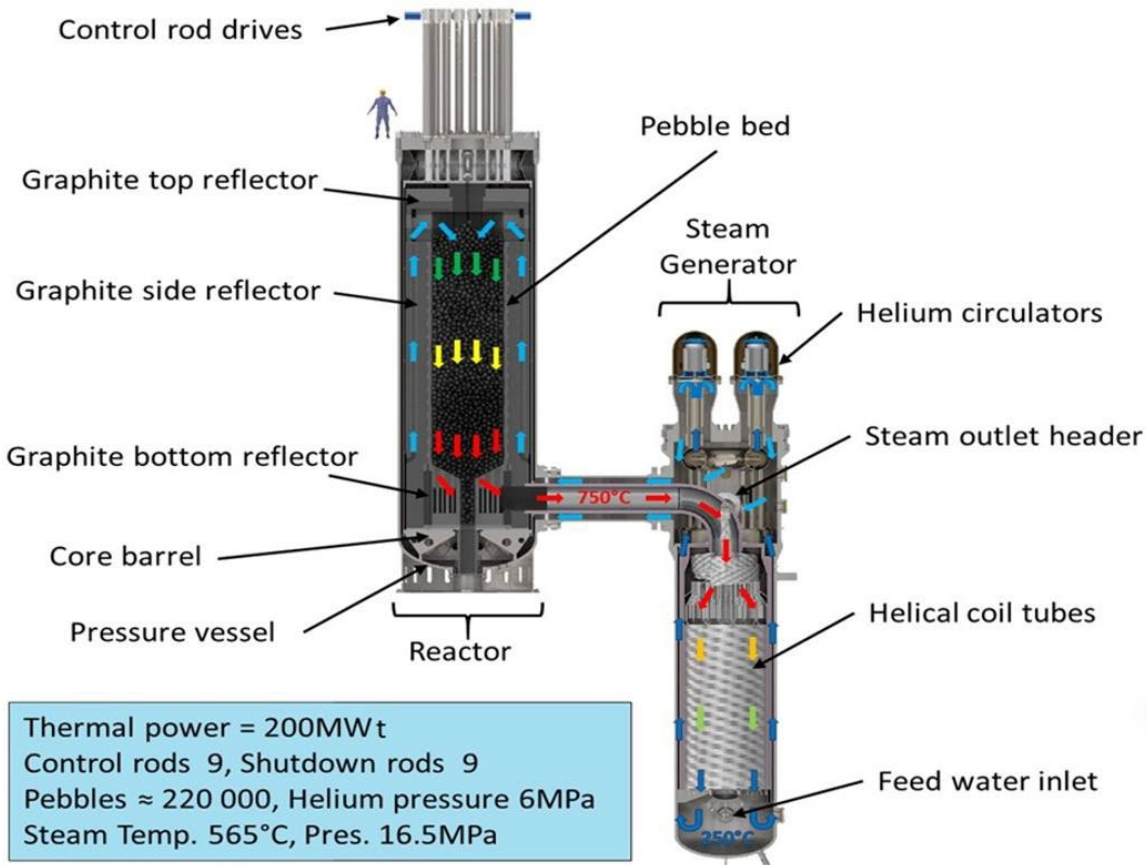
Huafei (Harry) Liao, *PRA Engineer*

hliao@x-energy.com

20th July 2026



Introduction – Xe-100



Xe-100

80 MWe Small Modular Reactor (“SMR”) that can be scaled into a ‘four-pack’ 320 MWe power plant. Capable of delivering electricity and 565°C high-temperature steam



TRISO-X

Proprietary fuel designed as cue ball-sized pebble with microscopic kernels of uranium wrapped in indestructible layers of carbon. TRISO-X fuel retains waste and fission products during all conditions and cannot melt

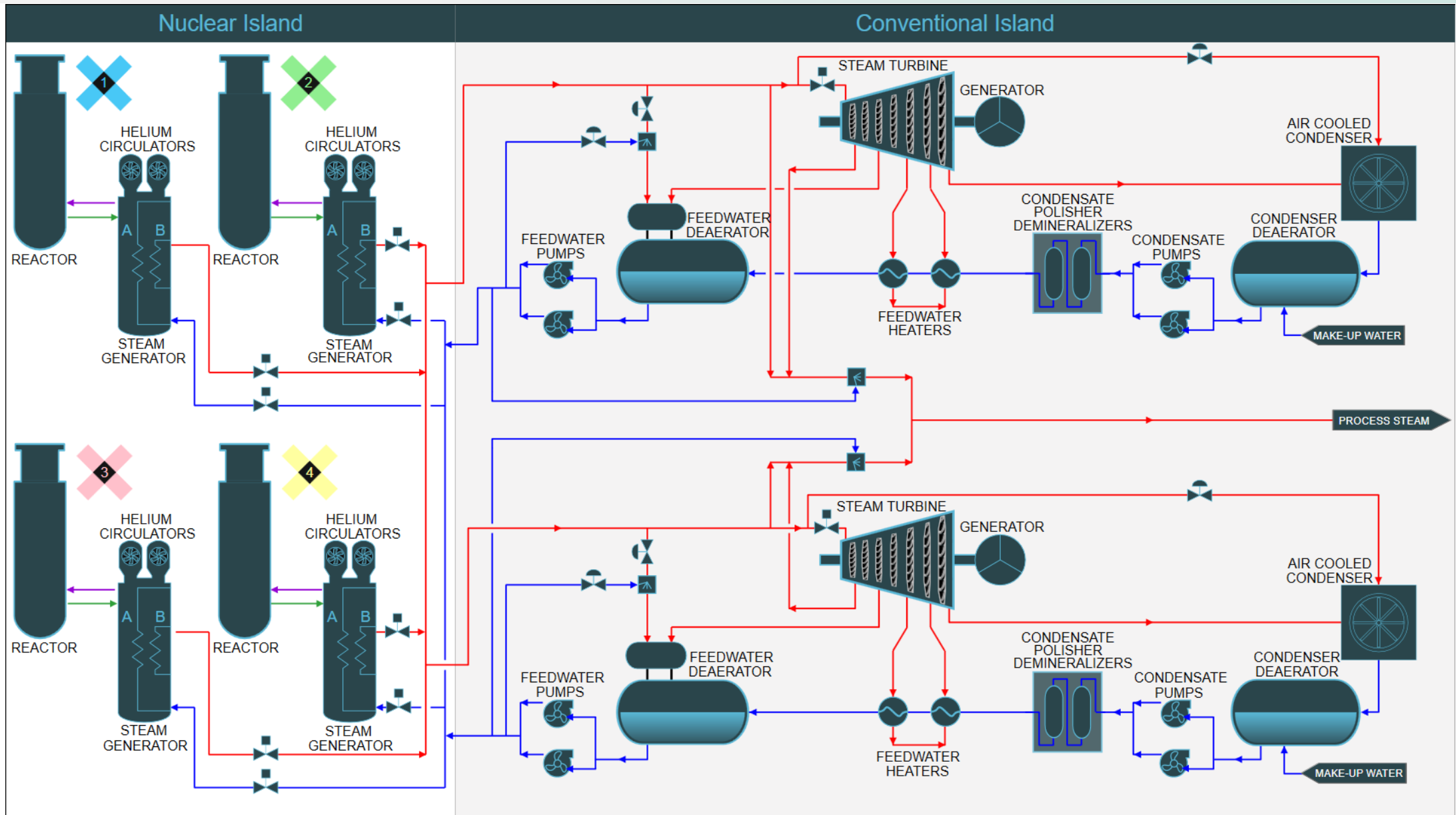


Introduction – Long Mott Generation Station (LMGS) (1/2)

- ❑ Four-unit plant to generate electricity and process steam for the Seadrift Operations (SDO)
- ❑ LMGS consists of one nuclear island (NI) and one conventional island (CI)
- ❑ Four units share several systems and structures.
 - Each unit consists of a reactor and SG pair coupled to shared CI systems.
 - A common steam header accepts steam from each of the four SGs and supplies steam to each of the two steam turbines
 - A common feedwater header supplies feedwater to each of the four SGs
 - Each reactor has a dedicated Reactor Protection System (RPS), Investment Protection System (IPS), and Reactor Cavity Cooling System (RCCS) that shares an active heat removal train
 - The reactor and SG pairs of the four units are co-located in the same Reactor Building (RB)



Introduction – Long Mott Generation Station (LMGS) (2/2)





Design Requirement and Special Treatment

- ❑ Design requirement: all requirements related to the physical configuration of the facility and apply to either the plant as a whole or specific structures, systems, and components (SSCs).
- ❑ Special Treatment
 - Requirements that provide increased assurance beyond normal industrial practices that SSCs perform their design-basis functions
 - Design requirements along with the QA controls and engineering programs assigned to maintain or validate that the reliability and capability targets can be maintained throughout the life of safety-significant SSCs.



NEI 18-04 Special Treatment Guidance

Special Treatment Category	Applicability ¹		
	SR SSC	NSRST SSC	NST SSC
Requirements Associated with SSC Safety Classification			
Document basis for SSC categorization by Integrated Decision-Making Process ⁵	√	√	√
Document evaluation of adequacy of special treatment to support SSC categorization	√	√	
Change control process to monitor performance and manage SSC categorization changes	√	√	
Basic Requirements for all Safety-Significant SSCs			
Reliability Assurance Program including reliability and availability targets for SSCs in performance of PRA Safety Functions	√	√	
Design Requirements for SSC capability to mitigate challenges reflected in LBEs	√	√	
Maintenance Program that assures targets for SSC availability and effectiveness of maintenance to meet SSC reliability targets	√	√	
Licensee Event Reports	√	√	

Special Treatment Category	Applicability ¹		
	SR SSC	NSRST SSC	NST SSC
10 CFR 50 Appendix B Quality Assurance Program	√		
User provided Quality Assurance (QA) Program for non-safety SSCs		√	
Additional Special Treatment Requirements			
Required Functional Design Criteria	√		
Technical Specifications	√	²	
Seismic design basis	√	³	³
Seismic qualification testing	√		
Protection against design basis external events	√		
Equipment qualification testing	√		
Materials surveillance testing	√		
Pre-service and risk-informed in-service inspections	√	²	
Pre-service and in-service testing	√	²	



Xe-100 Special Treatment

- ❑ Developed for each safety-significant system following NEI 18-04 guidance
- ❑ Established in accordance with SSC safety classification and safety significance through a risk-informed, performance-based process
- ❑ Two categories:
 - Design, procurement and construction special treatments
 - Operational special treatments



Xe-100 Special Treatment Development Process

- ❑ Identify system safety functions
- ❑ Identify relevant licensing basis events (LBEs)
- ❑ Identify component safety classification, reliability target and capability target
- ❑ Identify support systems
- ❑ Identify design requirements concerning internal and external hazards
- ❑ Identify programmatic special treatment requirements



Reliability and Capability Targets

- ❑ Reliability target: a design requirement established for the likelihood that an SSC will perform its specified function in order to achieve plant-level risk and reliability goals.
- ❑ Capability target: a design requirement used to establish the successful mitigation of licensing basis events (LBEs) and is linked to the success criterion used to quantify the failure probability in the PRA.
- ❑ The targets are determined using a top-down process and can be established at the plant, functional, system, and component levels.

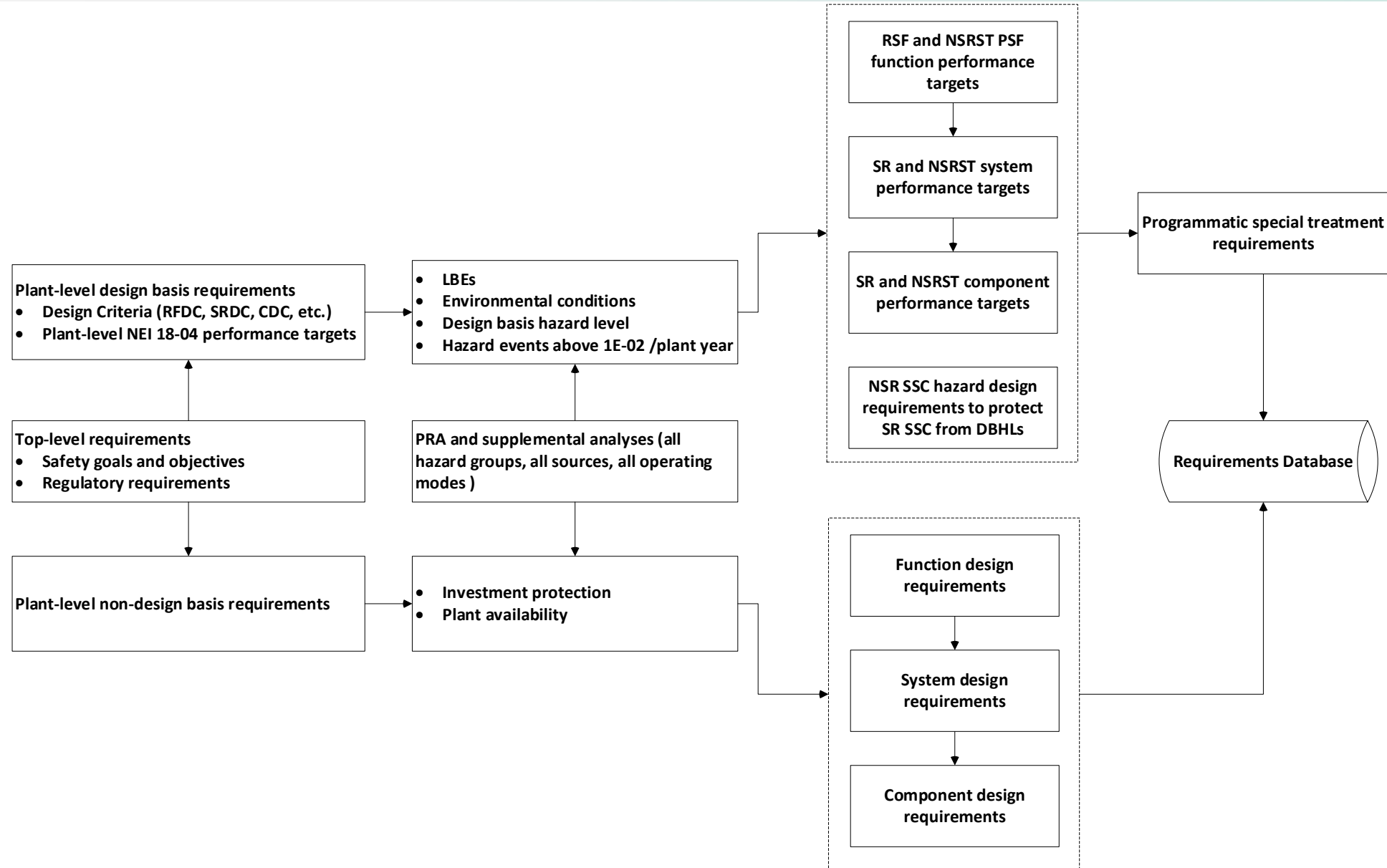


Programmatic Special Treatment Requirements

- ❑ Design, procurement and construction programmatic special treatments, including:
 - Environmental testing and/or analysis requirements
 - Initial test program
 - Quality assurance requirements
- ❑ Operational programmatic special treatments, including:
 - Reliability and Integrity Management (RIM) Program
 - OM-2 program
 - Maintenance Rule program
 - EQ program



Process for Flowing Down Design Requirements





Questions and Comments