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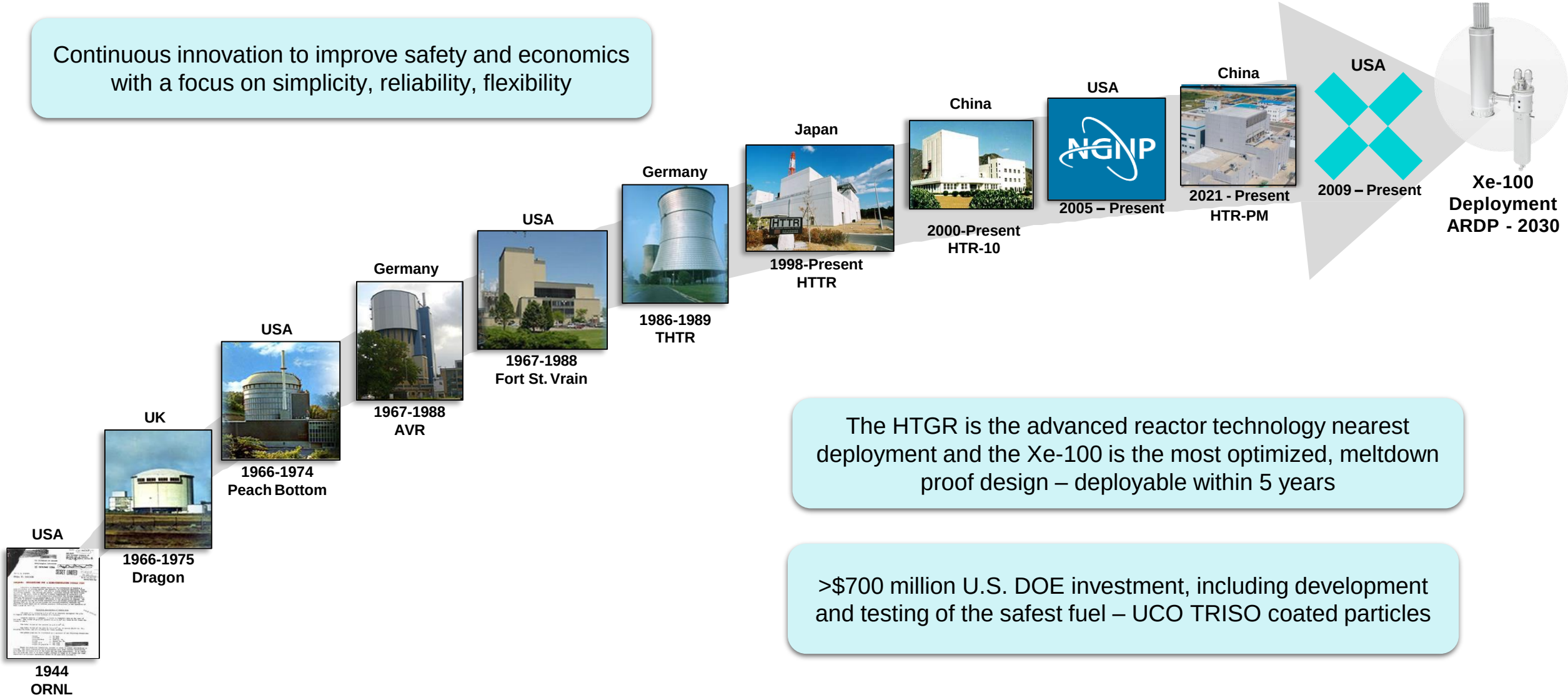
South Carolina Governor's Nuclear Advisory Council

March 31, 2025

The Xe-100 Leverages Proven Technology with Novel Integration

Continuous innovation to improve safety and economics with a focus on simplicity, reliability, flexibility



The HTGR is the advanced reactor technology nearest deployment and the Xe-100 is the most optimized, meltdown proof design – deployable within 5 years

>$700 million U.S. DOE investment, including development and testing of the safest fuel – UCO TRISO coated particles

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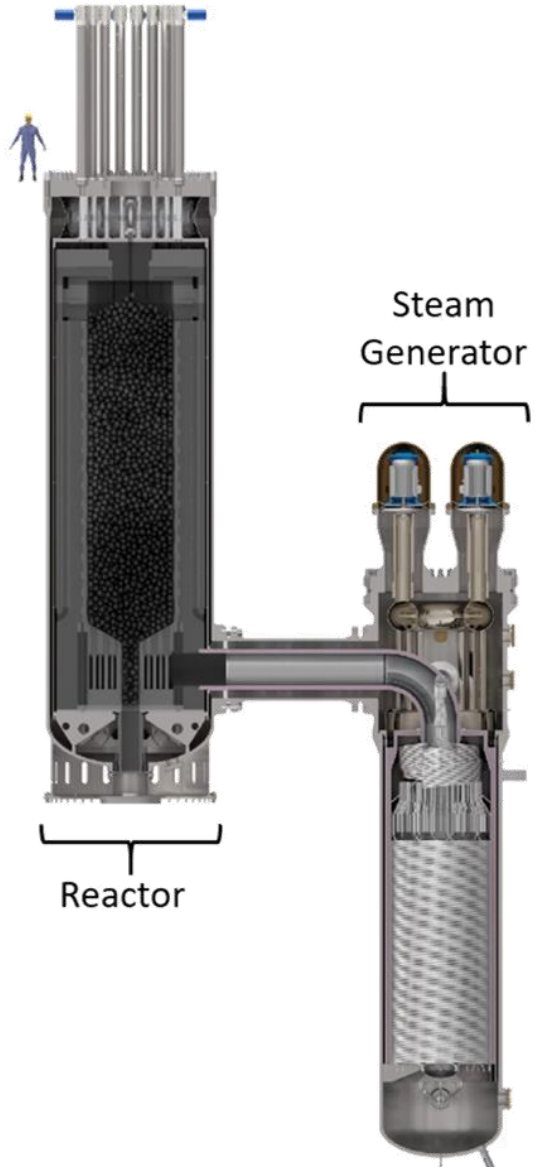
The Xe-100 Design Solution

- Proven High-Temperature Pebble Bed Reactor
- Derived from over 50 years of design and development to significantly reduce costs to enable competitive deployment
- Online refueling through an automated continuous fuel handling system
- Versatile Nuclear Steam Supply System (NSSS) that can be deployed for electricity generation and/or process heat applications
- Steam pressure and temperature designed to provide steam to multiple Commercially Off The Shelf (COTS) Steam Turbine / Generator sets (typically those used in Combined Cycle Power Plants)



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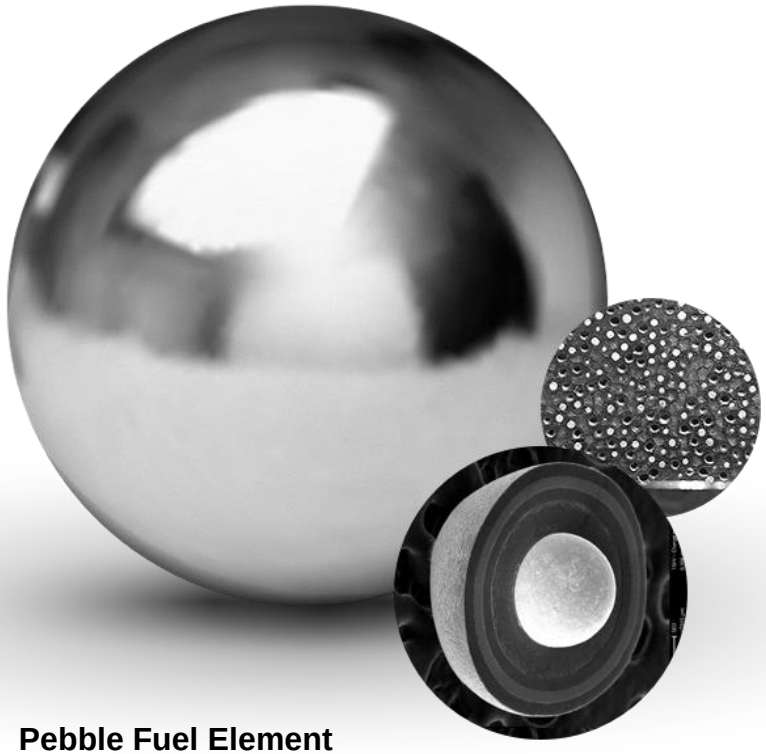
Intrinsic Safety: Our Fuel

Physics, not mechanical systems, ensures 100% safety



Pebble Fuel Element
(60mm)

TRISO Fuel particle
(≈1mm)

- The U.S. DOE describes TRISO fuel as **"the most robust nuclear fuel on Earth,"** it retains waste and fission products within the fuel during ALL conditions, even worst-case accidents and cannot melt.

- We manufacture our own proprietary TRISO encapsulated fuel (TRISO-X) to ensure supply and quality control.

Why is this important?

- No safety related power or operator action required to ensure safety.
- TRISO fuel has 40+ years of prototype and full-scale demonstration reactors. **This is a proven safety approach.**
- The low reactor power density and self-regulating core design (i.e., if cooling stops the core shuts down), ensures the reactor is intrinsically safe.

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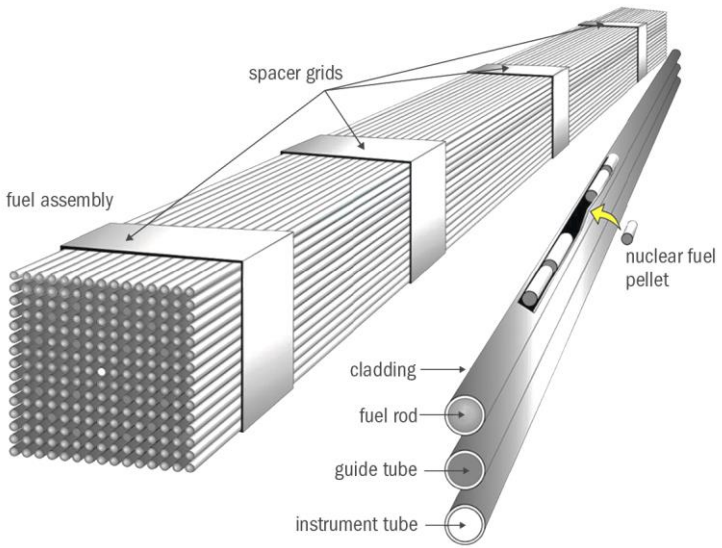
Nuclear Fuel Comparison

TRISO Fuel

- 15.5% U-235 Enrichment
- Average burnup per pebble is 168,000 MWd/t_{HM}
- 19,000 TRISO particles per pebble (6 cm)
- 224,000 pebbles per reactor
- Graphite pebbles cannot melt
- Decay heat per fuel element (1%) is 8 watt
- Spent fuel is air-cooled



https://physicsworld.com/wp-content/uploads/2021/02/Allen-fig1.png

Fuel Pellets

- 5-6% U-235 Enrichment
- Average burnup achieved per fuel element is 45,000 MWd/t_{HM}
- 18 million pellets per reactor, bundled in assemblies
- Fuel can melt in extreme cases and Zirconium cladding reacts to create hydrogen
- Decay heat per fuel element (1%) is 2.175 kW
- Spent fuel must be stored in cooling water for years before being air-cooled

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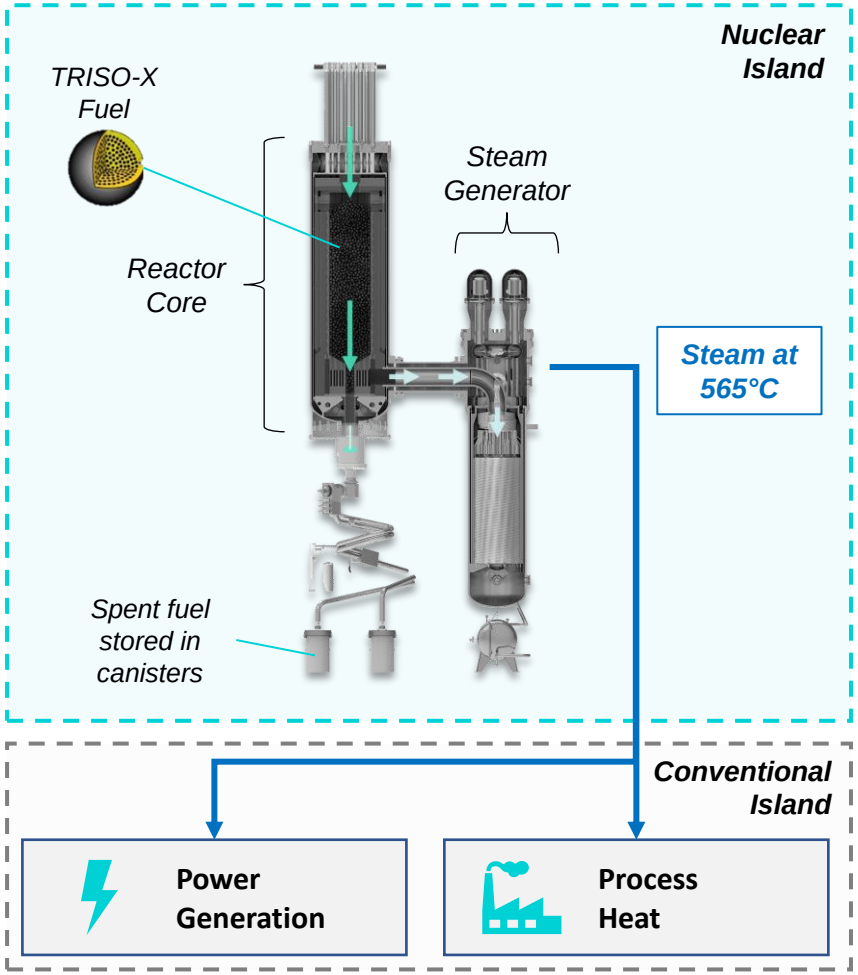
Xe-100 – A Pioneering Gen IV SMR Reactor

200 MWt/80 MWe output (per unit) designed to drive scalability, accelerated timeline and cost control

Xe-100 Schematic



Modular & Standardized

- Each reactor module can be connected to its own steam turbine generator or process heat offtake, so **modules can be constructed / operated independently, and even added as demand grows**
- Onsite work is reduced and a significant portion of quality control is shifted to centralized fabrication & integration facilities

Manufacturable, Road-Shippable Components

- Simpler, standardized design allows for **mass production of road-shippable components**
- In contrast, the complex design of traditional nuclear construction has required on-site construction

Intrinsically Safe

- **Xe-100 is designed to avoid the need for additional safety systems**
- Intrinsically safe design means **1/6th the safety systems of a traditional reactor** and fewer materials (e.g., ~95% less concrete than legacy nuclear plants)
- Simple control system with only 4 variables expected to allow for more automated operations & fewer personnel

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Xe-100 HTGR Advantages vs LWR SMRs

Helium Cooling

- No primary side water
- No boron solubility concerns
- No helium activation through core
- No LOCA analysis required

TRISO-X Fuel

- Proliferation Resistant
- Cannot melt in the reactor core
- Simplified waste disposal, no spent fuel pools

High Temp Heat

- More Efficient
  40% vs 33%
- Super heated steam
  565°C/16.5 MPa
- Numerous Process Heat Applications
- Hydrogen Production

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ARDP First Application of Advanced Reactor to Industrial Sector

DOE's Advanced Reactor Development Program ("ARDP") represents a critical advantage for Nuclear Leadership

ARDP Overview

- In May 2020, the DOE announced the ARDP to speed the transition of next generation nuclear reactors from concept to demonstration through cost-share partnerships
- In October 2020, X-energy was selected to deliver a commercial a first-of-a-kind advanced nuclear plant as well as a commercial TRISO- X fuel fabrication facility, which will be delivered in partnership with Dow Chemical
- ***The program provides 50% cost share on all costs to deliver the first plant***

Our ARDP Project With Dow Chemical

Dow Chemical Project

4-reactor Xe-100 Plant (320MW)

Seadrift, TX, Industrial Facility

What ARDP Selection Means to X-energy

✓ **Recognition from the DOE as an advanced reactor technology of choice**

- Selected out of ~50 applicants

✓ **Secures first customer deployment**

- Partnered with Dow Chemical to deploy the first advanced small modular nuclear reactor at an industrial site
  - Will utilize steam and electricity
- Customer also benefits from the 50% cost-share on their development and construction costs

✓ **Provides $1.2 billion in funding from the DOE**

- Fully funds all remaining design, licensing, and commercialization milestones of the reactor, including overnight CAPEX
- Funds the completion of the first TRISO-X fuel fabrication facility

✓ **Strengthens DOE's support of the advancement of TRISO fuel**

- ARDP funds the first TRISO fuel commercial manufacturing facility
- Exemplifies the DOE's commitment to scaling TRISO fuel production in the U.S.

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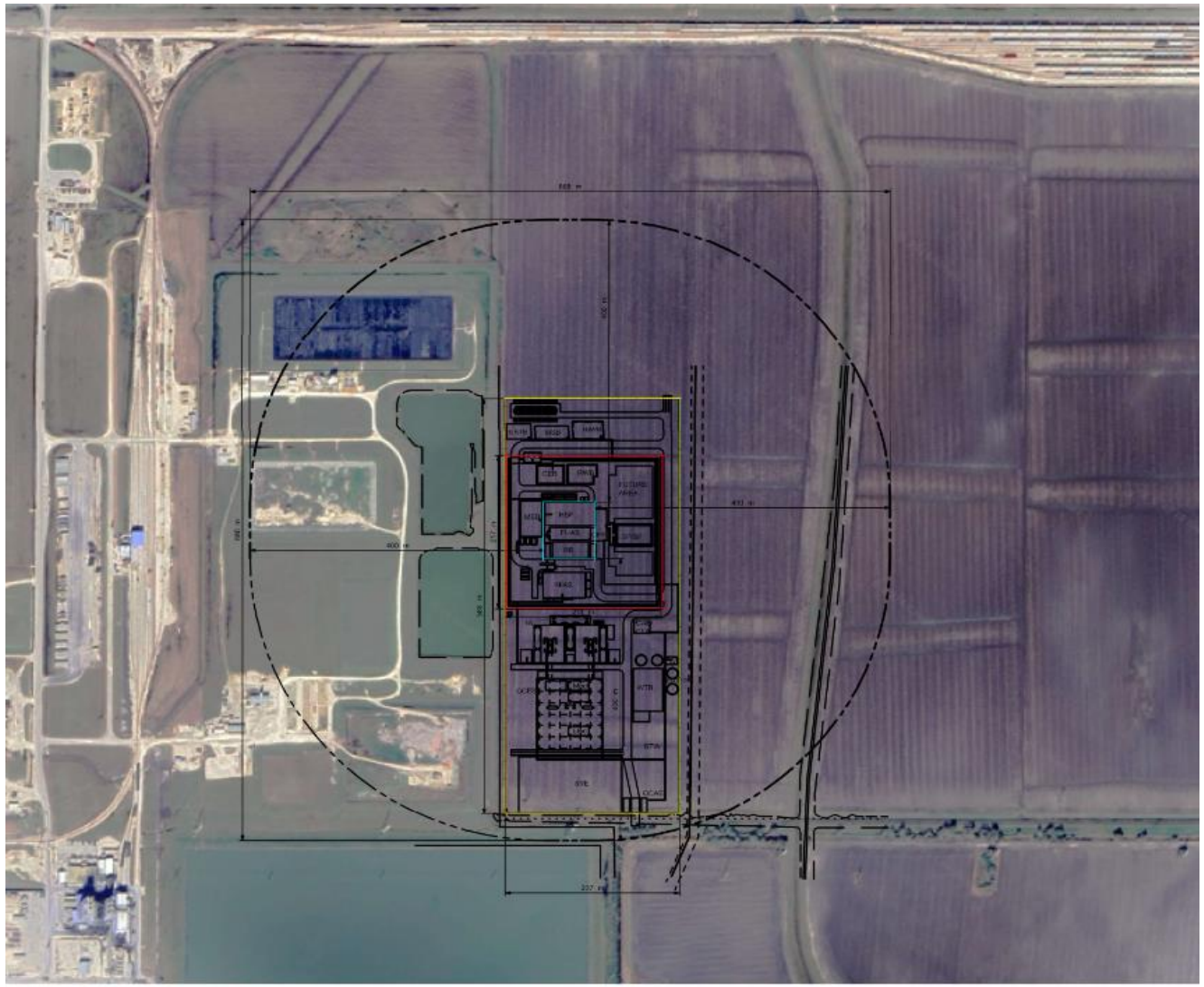
Site Comparison



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High Level Dose Offsite Dose Analysis

Site boundary is 400 meters from the edge of the Reactor Building (RB), the Fuel Handling Annex Building (FHAB) and the Helium Service Facility (HSF) and includes:

- Low Population Zone (LPZ)
- Exclusion Area Boundary (EAB)
- Emergency Planning Zone (EPZ)

- Offsite consequences and risk within 50-mile radius of the PLM site evaluated for potential accident at the PLM site
- For the Construction Permit Application, a single, conservative accident is evaluated
  - Additional accidents will be considered as design progresses with additional analysis presented in the Operating License Application
  - This provides confidence the overall severe accident risk profile will be acceptable based on the margin available

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Radiological Impacts from Normal Operations

- Liquid radiological waste assumed to be shipped offsite to a permitted treatment/storage/disposal facility
- MEI doses are significantly less than regulatory limits and much less than from natural background (310 mrem/yr)
- Population doses are much less than from natural background (7.28E+04 person-rem/yr)

Exposure Type	Exposure	10 CFR 20.1301 Limits	Percent of limit
Annual TEDE Dose to Nearest Resident (mrem/yr)	7.03E-03	1.00E+02	0.00703%
Annual TEDE Dose to MEI at Site Boundary (mrem/yr) (8760 hr/yr occupancy)	1.63E-01	1.00E+02	0.163%
Dose from External Sources to Site Boundary in 1 Hour (mrem/hr)	1.66E-05	2	0.000831%

Pathway	50-Mile Population Dose (person-rem/yr)(Four Units)	
	Total Body	Max Organ
Plume	1.34E-03	1.35E-03
Ground	2.82E-04	2.82E-04
Inhalation	3.19E-05	2.13E-04
Vegetables	5.89E-05	1.11E-04
Milk	4.10E-05	5.42E-04
Meat	1.19E-05	3.60E-05
Total	1.77E-03	2.44E-03

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Severe Accident Impact

Comparison of Site Environmental Risks with Risks for Current Nuclear Plants Undergoing License Renewal Review

Reactor Facility	Severe Accident Frequency (per reactor year)	50-mi Population Dose Risk (person-rem per reactor year)
Current Reactor Maximum	2 .4E-04	6.90E+01
Current Reactor Mean	3.10E-05	1.50E+01
Current Reactor Median	2.50E-05	1.30E+01
Current Reactor Minimum	1.90E-06	5.50E-01
LMGS	1.90E-05	3.80E-02

Comparison of Population Dose Risk within a 50-Mile Radius for Severe Accidents and Normal Operation

LMGS LD-DBA Population Dose Risk (person-rem per plant year)	LMGS Normal Operation Dose Risk (person-rem per plant year)		US-APWR Normal Operation at a PSEG Site (person-rem per reactor year)
Total	Four Units	Per Unit	Total
3.76E-02	1.77E-03	4.41E-04	6.59E+01

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Questions

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