NQA-1 Vendor Support of Criticality Safety at the MOX Fuel Fabrication Facility

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Overview

- What is the MOX Project?
- 10 CFR 50 Appendix B
- ASME ANSI NQA-1 Standard
- NQA-1 Suppliers for IROFS Components
- NCRs (Non Comformance Reports)
- UAIs (Use-As-Is) Justification Examples
- Lessons Learned
- Conclusion

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What is the MOX Project?

- **Primary Mission:**

  Nuclear Non-Proliferation
  - Convert multiple metric tons of surplus weapons-grade plutonium to mixed oxide (MOX) fuel for use in U.S. commercial power reactors
  - Once irradiated, plutonium will meet the spent fuel standard – making it inaccessible and unattractive for use in weapons
- **Regulated by the United States Nuclear Regulatory Commission (NRC), owned by the Department of Energy (DOE)**

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What is the MOX Project?

- **Impact**
  - Non-Proliferation Mission
  - Removes multiple warheads from the nuclear arsenal
  - Eliminates hundreds of millions per year in security costs
  - Provides clean, carbon free energy that offsets billions in imported oil costs

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Reference Plants

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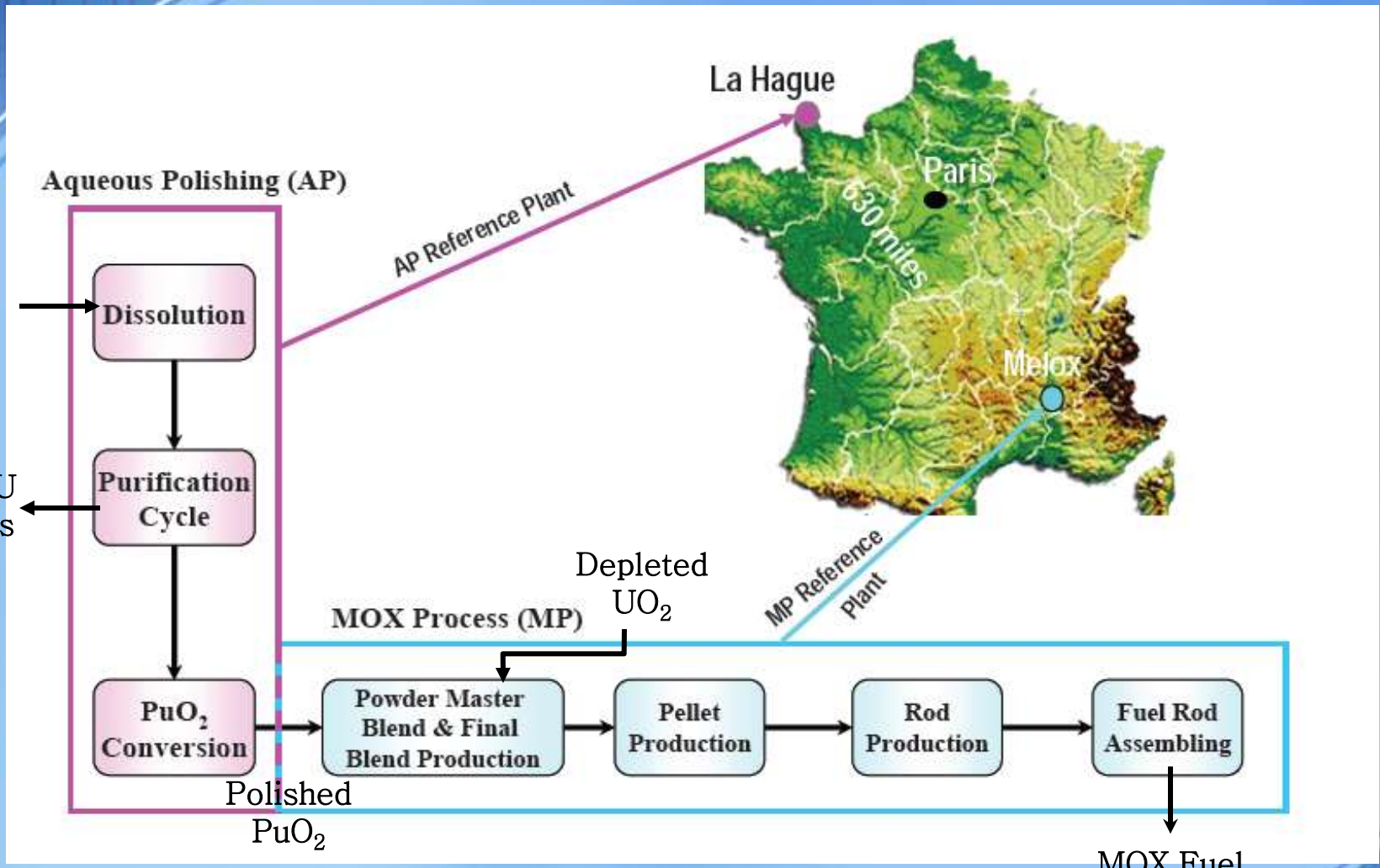

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MOX Quality Assurance Plan

- **10 CFR Part 50**, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*

- **ASME NQA-1**, *Quality Assurance Requirements for Nuclear Facility Applications*

- **Applicable Regulatory Guides**, such as NRC Regulatory Guide 1.28, *Quality Assurance Program Requirements (Design and Construction)*

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ASME ANSI NQA-1 Standard

- Procurement Specifications in accordance with MOX QA Plan
- NRC Regulatory Guide 1.28, QA Program Requirements
- Nuclear Industry Codes & Standards
- "Available & Reliable Qualities" as defined in NUREG 1718
- Unlikely to fail to perform its safety function when called upon

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NQA-1 Suppliers IROFS Components

- Limited IROFS Component Suppliers
- Commercial Grade Dedication (CGD)
- Vendor NCRs (Non-Conformance Reports)
- Handling of Critical Components
- Verifying Vendor Quality Assurance
- Quality Control Requirements

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Items Relied Upon for Safety (IROFS)

Postulated credible high consequence events (such as criticality) are made highly unlikely based on the application of **IROFS** features:

- Application of the single failure criteria or double contingency
- Application of 10 CFR 50 Appendix B and NQA-1 quality assurance requirements
- Application of Industry Codes and Standards
- Management Measures, including surveillance of IROFS (i.e., failure detection and repair, or process shutdown capability)

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KENO Model Conservatisms

- Include Manufacturing & Other Tolerances
- Range of Moderation (H/X) to determine Bounding Tank Reactivity
- Fissile Material modeled to outside of Tank Wall not crediting presence of SS
- Gap between Cadmium Poison Panels and Tank Walls filled with water
- After individual tank calculations are performed, cell interactions calculated

Non-Conformance Reports (NCRs)

- NCS Works Closely with Vendors of IROFS Components
- NCS Safety Strategy Maintained
- Slight Deviation in Tolerances result in NCRs
- Reports readily available for analysis
- Conservative NCS Calculations utilized to bound deviation in IROFS Dimensions
- Calculation USL always maintained

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Use-As-Is Justification

- NCS Response to NCRs
- NCS Calculations maintain USL
- Model Conservatisms
- Examples: Safe Geometry Slab Tank
- Analyzed Fissile Thickness Exceeded
- Gap between Cadmium & Tank Exceeded

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Safe Geometry Slab Tank

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Slab Tank
Top View

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Calculational Model

- Individual Slab Tank (Fissile Thickness)
- Individual Slab Tank (Cad/Tank Gap Increase)
- Interaction Model (Cell Calculation)
- Model Conservatisms:
- Fissile Material modeled to outer SS Walls
- Moderator between Cadmium & Tank
- Most credible reactive solution
- Sensitivity Studies, i.e. 10% reduction in tank separation (interaction analysis)

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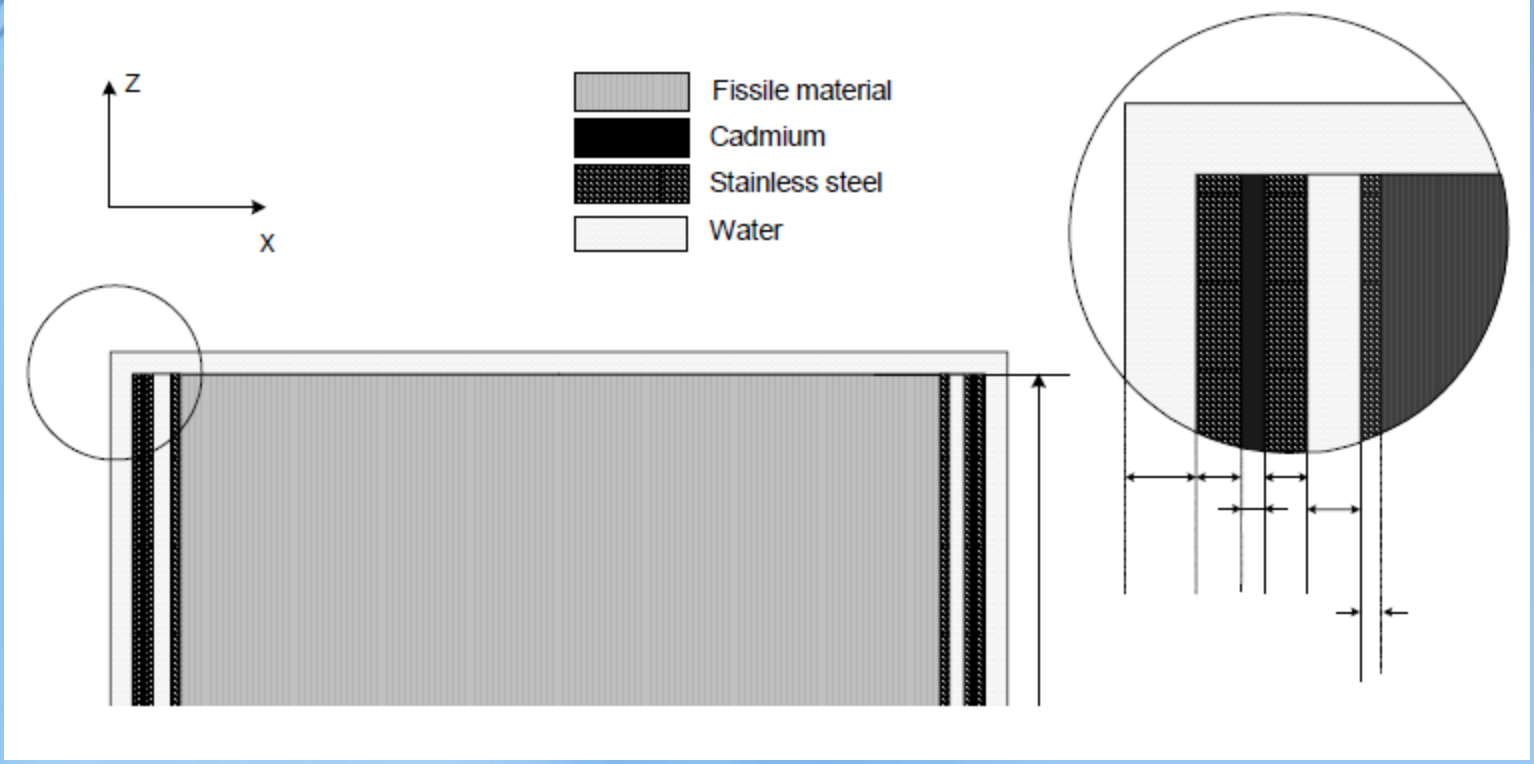
Slab Tank Model



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Interaction Model

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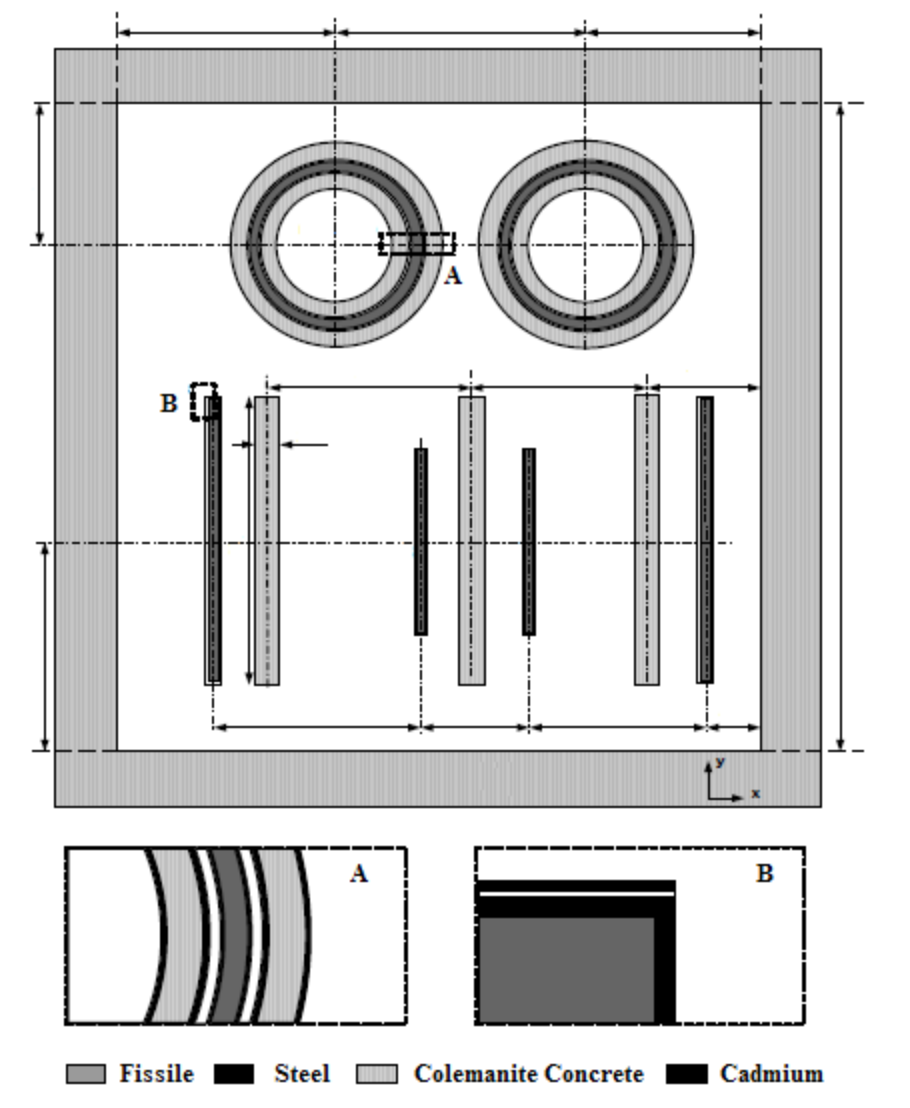

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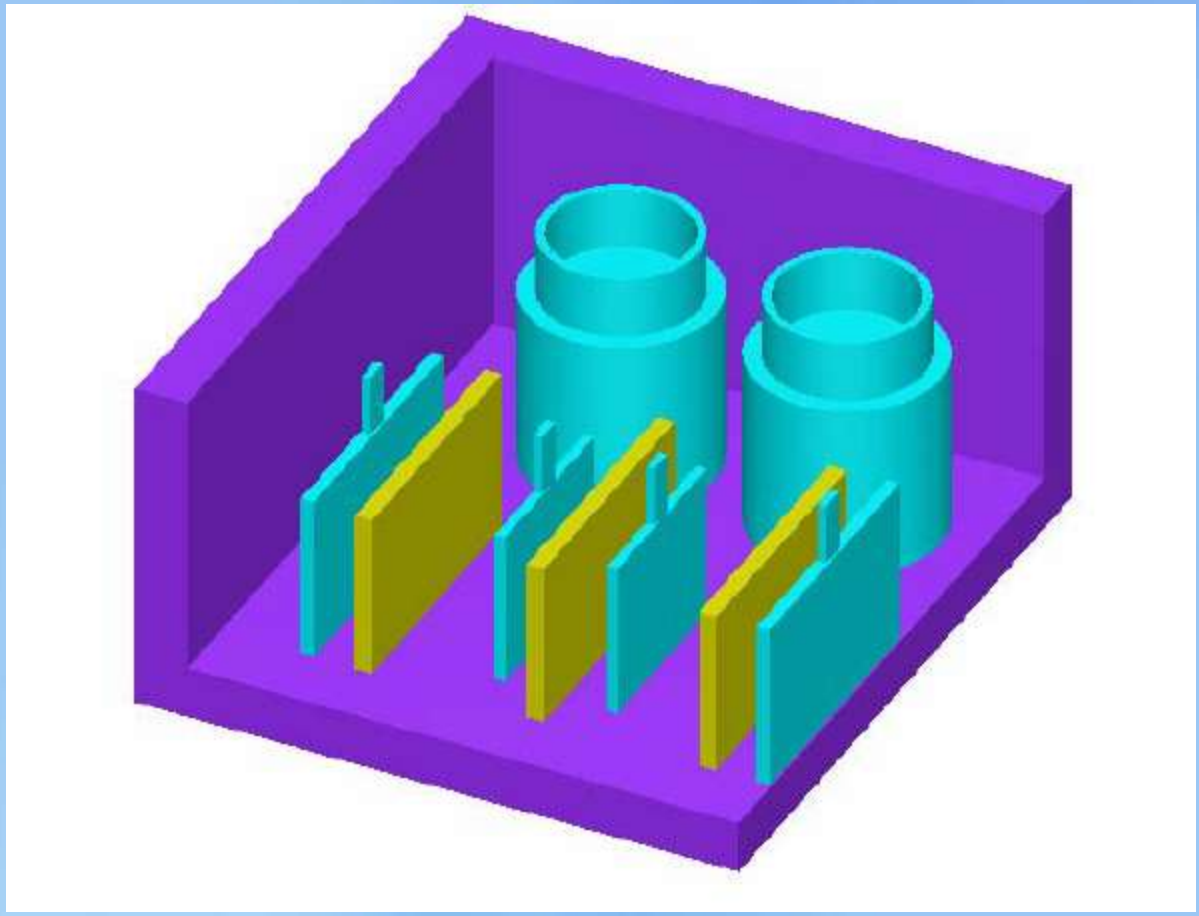
KENO 3D Model



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LESSONS LEARNED

- Build Conservatism into Models Up Front
- Sensitivity Studies
- Increase Fissile Material Dimensions
- Interaction: Reduction in Spacing
- NQA-1 Vendor Realities
- Tight Manufacturing Tolerances
- Anticipate Upsets as much as possible

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Conclusion

- MOX Services Continues to Meet the Challenge
  - Managing Design Change Process
  - Procurement of IROFS Equipment
- Approaching Cold Start-Up
  - Operational Limits Manual
  - Procedural Development
- Paving the Way for the Nuclear Renaissance
  - Non-Proliferation & Energy Independence

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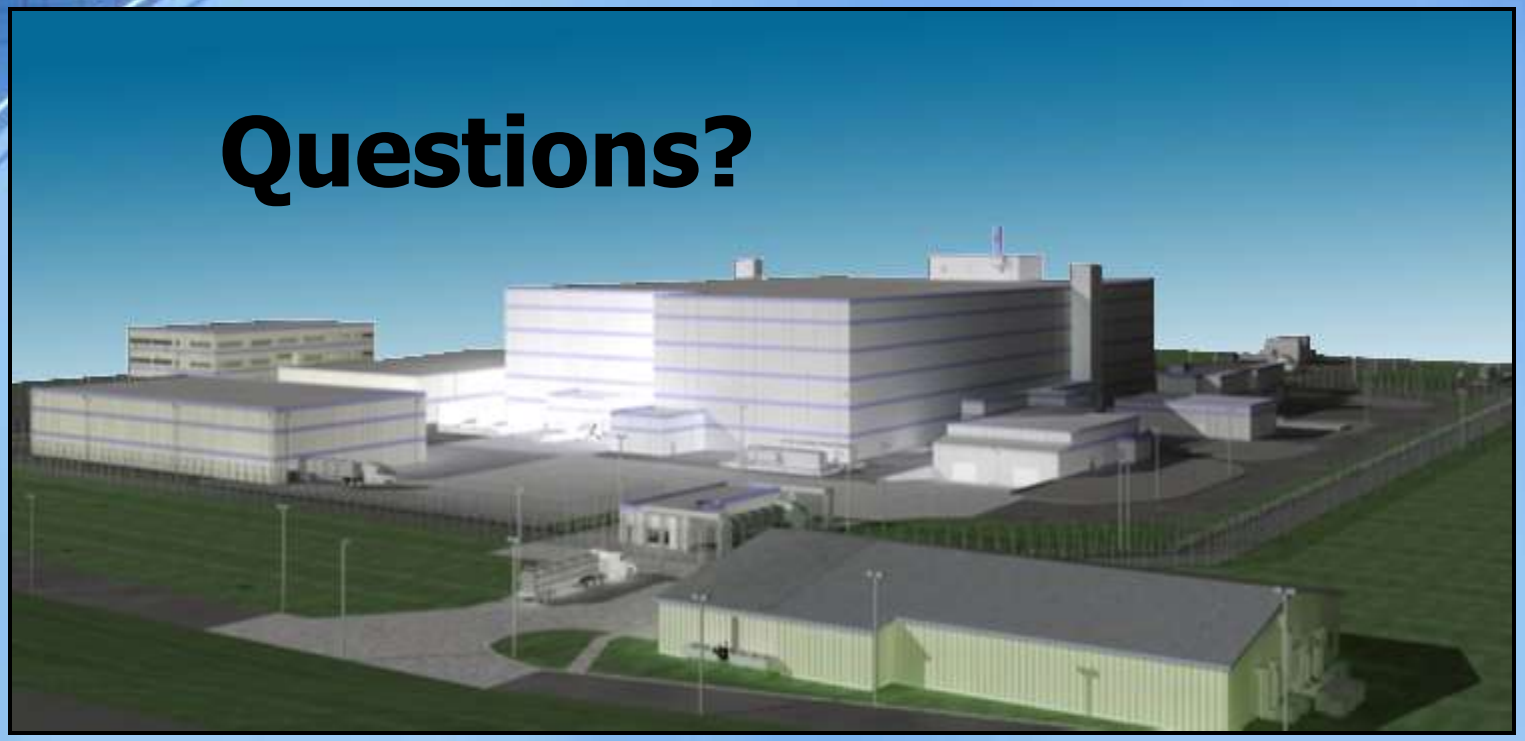

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