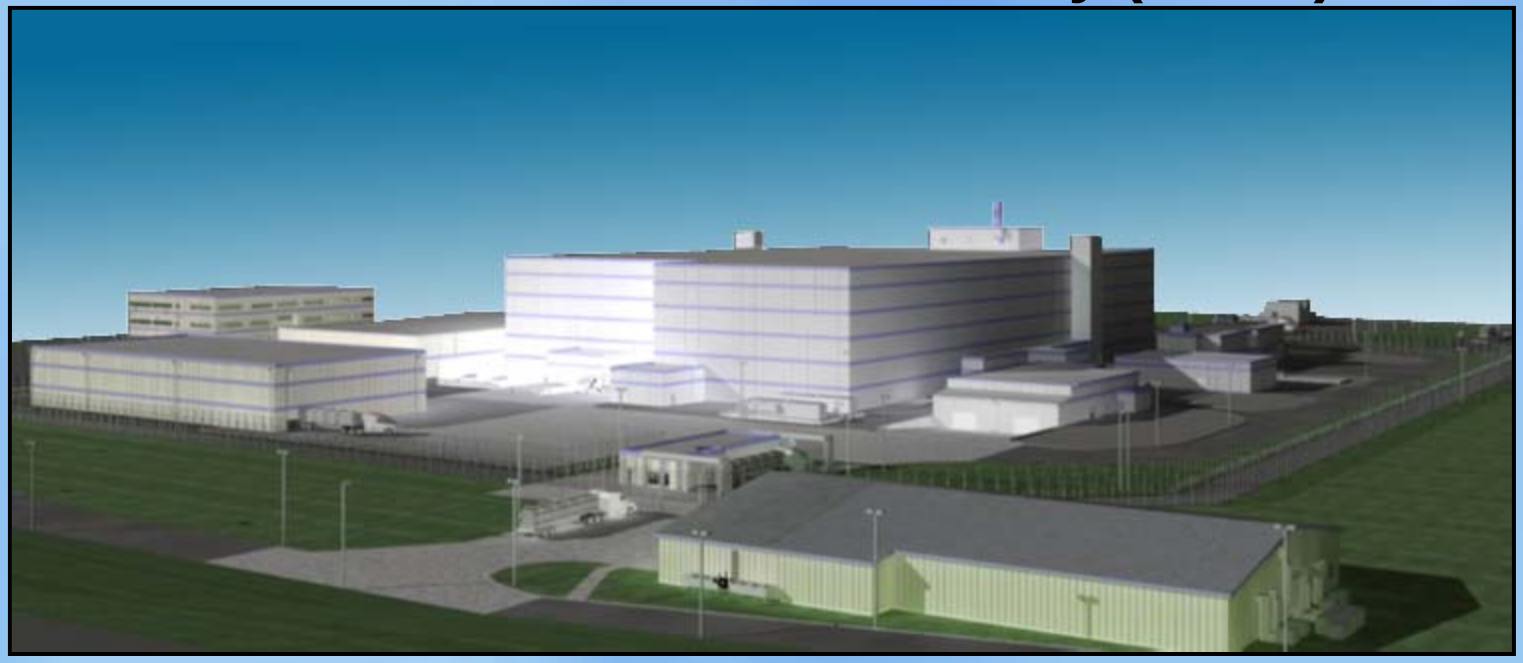
MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

DOE 2010 ISM Champions Workshop

The Safety Component of Design for the MOX Fuel Fabrication Facility (MFFF)



ISA: Safety Component of Design for Electrolyzers

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Presenter

- Tom Henry is a nuclear engineer in the Nuclear Safety Group working on the MOX Project for Shaw AREVA MOX Services here at Savannah River Site (SRS). He is an employee of AREVA Federal Services. He has worked on the MOX Project since 1999.
- Mr. Henry has 35 years of experience in the nuclear field. Mr. Henry supports updates to the Integrated Safety Analysis, the License Application, and the Fire Nuclear Safety Evaluation for the MOX Fuel Fabrication Facility (MFFF) under construction at SRS. Mr. Henry has lived in Aiken and supported projects at SRS since 1989.

MFFF Electrolyzers

- The MFFF is equipped with three electrolyzers in the AP process.
- Electrolyzers are designed to dissolve plutonium oxide powder in nitric acid medium to purify the oxide powder.
- The electrolyzer body is constructed of titanium as required by the chemical environment necessary for the dissolution of plutonium oxide powder.
- The electrolyzer utilizes a cathode and anode to dissolve chlorinated and non-chlorinated plutonium powder.

Titanium Fire Concerns

- Titanium has two properties that can combine to make it vulnerable to combustion: (1) unlike most other structural metals, titanium ignites at a lower temperature than it melts, and (2) it has a lower heat conductivity.
- Thus, heat may not be readily carried away from its source, thereby permitting the titanium to more rapidly reach its ignition temperature. Therefore, an electrical arc, due to welding or break down of insulation, could cause localized heating of titanium causing ignition.

Titanium Fire Concerns (Cont'd)

- Once ignited, titanium combustion can continue until the titanium is depleted.
- Titanium fires are fast burning and extremely intense.
- The molten particles in titanium fires generate highly erosive hot sprays that can burn through metal structural components.

Titanium Fire Safety Strategy

- Although fires involving bulk quantities of relatively thick titanium metal do not occur, it is nevertheless hypothesized for completeness that the bulk metal of the body of the electrolyzer can be ignited by electrode arcing.
- Dose consequences could exceed the performance criteria of 10 CFR §70.61 for all receptors.
- Thus, the fire safety strategy is to prevent a titanium fire.

Safety Features Identified to Prevent Titanium Fire

- Electrolyzer Insulators/Isolators (which prevent electrical arcing that could lead to a titanium fire) and
- Administrative controls on electrolyzer maintenance activities have been selected.

Safety feature selection evolved over time.

Electrolyzer Insulators/Isolators

- The electrolyzer is protected from static discharge and ground faults by means of electrical isolators or insulators.
- The electrolyzer insulators/isolators are passive engineered design features and are compatible with the electrolyzer chemical environment.
- The electrolyzer insulators/isolators are routinely checked and inspected in accordance with an established surveillance schedule.

Administrative Controls

Administrative controls on electrolyzer maintenance activities ensure the following:

- Fissile material is removed from the electrolyzer, connecting pipes, or receiving tanks prior to performing the maintenance activity.
- The power supply to the electrolyzer is locked out, when the electrolyzer is drained.

Summary

- The electrical isolation of components leading to the titanium body to prevent arcing is designed to ensure safe operation of the electrolyzer.
- Administrative controls ensure maintenance performed safely.
- The application of the selected safety features ensures that a titanium fire is highly unlikely and the performance requirements of 10 CFR §70.61 are satisfied.

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