



Nuclear Waste Management *Using Simulation to Reduce Risk*

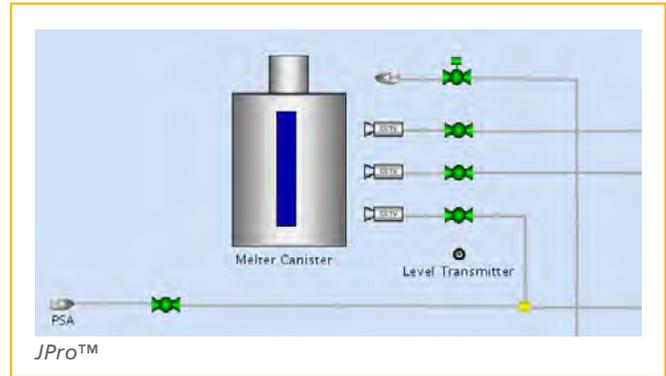
Nuclear technology for national defense, research and electricity generation has left us with an array of low level, intermediate level, and high level radioactive wastes that need to be safely managed.

Nuclear waste management processes include:

- Vitrification
- Saltstone
- Mixed-Oxide Fuel
- Evaporation
- Tank Farm Storage

High-fidelity, dynamic simulation can help waste treatment and reprocessing facilities to:

- Reduce Risk
 - Ensure the safe, continuous operation of critical and costly equipment, such as the melter in a vitrification process, and minimize downtime.
 - Verify and validate procedures through the simulation of the entire plant including auxiliary systems. One example being an introduction of electrical distribution failures to simulate loss of power and training on how to recover the plant.
- Improve Performance
 - Train operators on complex plant systems, such as switchovers to overcome any potential system failures, upsets and unplanned shutdowns.
 - Monitor systems to successfully train operators to recognize when a problem occurs and respond accordingly (radioactive waste leaks, pressure spikes, buildup of combustibles and pollutants) as well as custom design malfunctions for abnormal scenarios.
- Virtually Commission Changes
 - Test and validate new plant configurations and new or upgraded control system designs to de-risk the process.



Waste Treatment & Storage

Vitrification

High level radioactive waste can be treated utilizing the Vitrification process to immobilize the high-level liquid waste with a molten glass mixture. The vitrified product is a third of its original liquid size and now in a more stable, solid state.

Typical Simulated Systems and Processes

- Radiation Monitoring & Sampling
- Melter/Vitrification
- Actinide Removal
- Chemical Treatment
- Glass Pouring
- Canister Holding
- Ventilation
- Feed Systems (mix waste with glass reformers)
- Melter Off-Gas Systems
- CO2 System for decon
- Auxiliary Systems
 - Instrument & Process Air
 - Chilled and Demineralized Water
 - Electrical Distribution
 - Steam and Condensate

Saltstone low-level waste

Saltstone production units treat and permanently dispose of low-level waste by blending it into a cement-based form that can be sealed in concrete tanks to prevent leaching of waste into the environment.

Nuclear Waste Management: Using Simulation to Reduce Risk

Typical Simulated Systems and Processes

- Radiation Monitoring & Sampling
- Concrete Receipt System
- Radioactive Liquid Waste
- Chemical Treatment
- Concrete Pouring
- Canister Holding
- Ventilation
- Feed Systems (mix waste with concrete)
- Auxiliary Systems
 - Instrument & Process Air
 - Chilled and demineralized Water Systems
 - Electrical Distribution

Evaporator

Evaporator units are used to concentrate various levels of radioactive waste down to approximately 30% of its original volume. The water removed from the waste is then treated further for final cleanup. The leftover, concentrated high-level waste is then sent to the vitrification process.

Typical Simulated Systems and Processes

- Radiation Monitoring & Sampling
- Feed
- Slurry
- Evaporation
- Steam Condensate
- Process Condensate
- Auxiliary Systems
 - Cooling Water
 - Instrument & Process Air
 - Steam

Tank Farm

Radioactive waste is commonly held in tanks until it is moved to waste treatment units based upon its radioactivity level. Piping systems in these plant farms utilize a complex network of valves and pumps to move this waste to the various waste treatment units.

Typical Simulated Systems and Processes

- Radiation Monitoring & Sampling
- Ventilation
- Leak Detection
- Tank Transfer
- Cooling Water

Waste Reprocessing

MOX Fuel

97% of spent nuclear fuel can be recycled through the Mixed Oxide Fuel process.¹ After dissolving the fuel in nitric acid, impurities are chemically removed to produce purified plutonium that is converted back into plutonium oxide. The plutonium oxide is packaged and stored in durable cans for future production of MOX fuel pellets for commercial reactor fuel assemblies.

Simulated Systems and Processes

- Radiation Monitoring & Sampling
- Transfer with Airlifts
- Aqueous Polishing

Our Experience

GSE Systems, Inc. is a world-leader in providing simulation, training and engineering services to the power generation (nuclear and non-nuclear), oil & gas, refining, water treatment, petrochemical and chemical industries. In our 40+ years of experience we have delivered more than 1,000 simulation and training installations in 50 countries.

Nuclear Waste Management customers:

- Savannah River Site
- Washington River Protection Solutions
- Hanford Site
- Shaw AREVA MOX Services, LLC



¹ Sellafield Plan: Issue 1 August 2011

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