

DISPOSAL OF WASTE FROM FORMER GASEOUS DIFFUSION PLANT



January 24, 2008

Overview

- 2006 Authorization Request
- Gaseous Diffusion Plant Background & Operations
- DOE D&D Approach
- Clive Disposal Operation - Terminology
- Criticality Models
- Controls Listed in the NCSE
- Modeling Assumptions
- Pre-requisite D&D Activities - Foam in Piping
- Criticality – Soluble Uranium Mass Limits

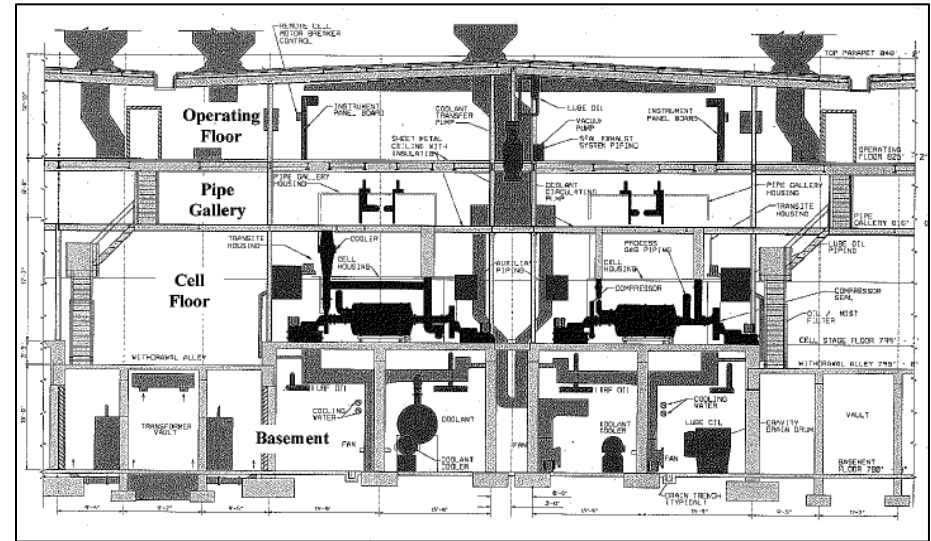
Project-Specific Authorization Request

- **EnergySolutions' Authorization Request (September 29, 2006)**
 - **Authorize receipt of waste packages complying with SNM concentration limit of 1,190 pCi/g U-235 but exceeding 350 grams of highly water soluble forms of uranium**
- **Basis of Request**
 - **License Condition 13.I (SNM Exemption Conditions)**
"EnergySolutions shall obtain NRC approval prior to changing any activities associated with the above conditions."
 - **DOE evaluation of "criticality incredible" safety controls**
 - **Prerequisite activities to ensure criticality safety prior to building dismantlement**
 - **Foaming internal void spaces of process gas equipment and pipes to fix U-235 contamination and prevent water entry**
 - **Load waste in DOT approved packages that prevent water entry**
 - **Waste is compliant with all other SNM Exemption conditions**
- **NRC Request for Additional Information (June 6, 2007)**
- **EnergySolutions' Response to RAI (September 13, 2007)**

K-25/27 Background Information

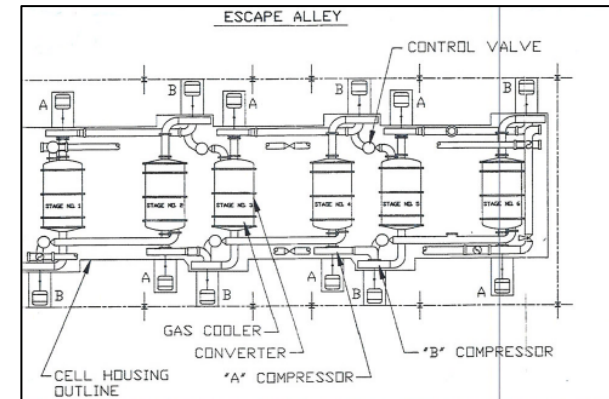


- Gaseous Diffusion Plants (cascade) constructed to supply enriched uranium for nuclear weapons production during WWII
- Operated from 1944 to 1964 (maximum enrichment of 94.8%)
- Over two million square feet of floor space (58 feet tall)
- 3,582 stages of various sizes (~22 tons of PGE per stage)



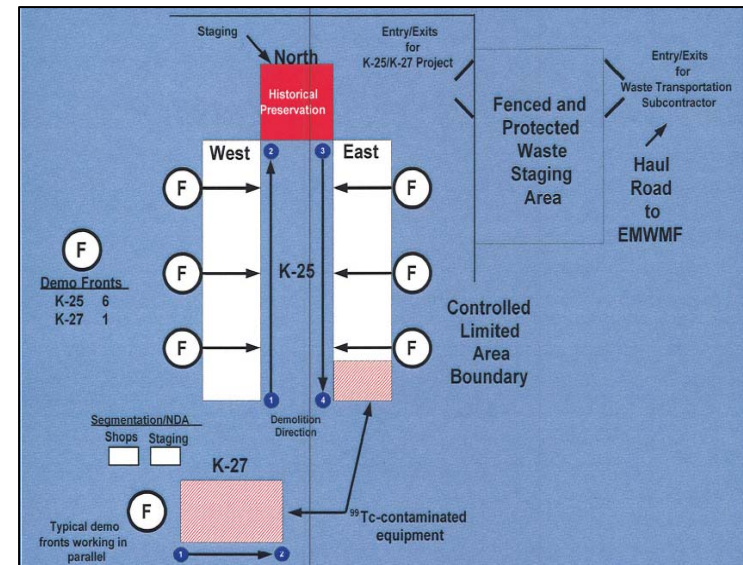
Gaseous Diffusion Plant Former Operations

- The GDP operation involved the compression and movement of highly reactive uranium gas (UF_6) through a sealed cascade of thousands of stages of converters, compressors, piping, and support systems.
- Interaction between the gas and the clean, non-passivated equipment surfaces caused very thinly distributed uranium contamination in the form of uranium pentafluoride and uranium tetrafluoride.
- Localized deposition caused by humid air inleakage around seals in compressors formed uranyl fluoride.
- Nuclear Criticality Safety Evaluation documents consider all deposition to be in the form of uranyl fluoride since this form is more reactive than other chemical forms of uranium.
- DOE typically employed uranium recovery operations to withdraw even plated enriched uranium from the surfaces prior to shutdown. Gaseous methods were used during shutdown; acid leaching was used during maintenance on dismantled components.
- Routine radiation surveys were conducted at least once every six months and weekly for higher potential areas (~42,000 surveys were performed in 1959 to identify uranium deposits)



Current D&D Strategy

- **D&D Prerequisite Activities – Performed to establish criticality safety prior to building dismantlement**
- **Building Dismantlement**
 - **Traditional demolition methods will be utilized**
 - **Seven Fronts (independent demolition systems)**
 - **Each Front consists of appropriately sized construction and material handling equipment**
 - **The primary demolition equipment will cut and size through the exterior of the building**
 - **Continuously exposing, piling, sorting, separating and staging material for disposition by support crews and equipment**



Pre-requisite D&D Activities - Ongoing

- **Process Gas Equipment Intrusive Sampling Program**
 - **Objective – Collect objective evidence to support the use of non-intrusive and visual techniques**

- **Vent, Purge, and Drain (VPD Program)**
 - **Objective – verify the identification of deposits and validate previous characterization, remove incidental liquids, prepare for foaming operations**

- **Ongoing Deposit Estimation**
 - **Objective – verify quantity of SNM masses via NDA throughout process gas equipment and piping**

Pre-requisite D&D Activities

- **High Risk Equipment Removal**
 - **Objective – Allow safe and efficient demolition of vast majority of building by removing discrete items and components with elevated SNM**

- **Foaming**
 - **Objective – Reduce potential for contamination migration, SNM concentration, and prevent entry of water**

“Criticality Incredible”

DOE Analysis - Conclusion

“This NCSE establishes that the potential for criticality during the demolition of the 306 section in K-25 will be incredible, primarily because of the low U-235 masses and the dispersion of the deposits... As long as the prerequisite controls [of section 6.5.1] are performed and verified, criticality incredibility within 306 is achieved.”

--- Nuclear Criticality Safety Evaluation, Demolition of K-306, NCSE-ET-K25-1632

Waste Transport and Disposal Options

- **DOE EMWMF in Oak Ridge, TN**
 - Principle option for disposal is at the local DOE CERCLA facility
 - Use truck trailers with soft tarps to package and ship waste
 - Disposal constraints for elevated Tc-99 contamination (129 pCi/g)
- **Off-Site Disposal (Process Gas Equipment and Piping)**
 - Nevada Test Site Disposal Facility – Bulk packaging shipped via truck for classified components
 - EnergySolutions Clive Disposal Facility – Bulk packaging shipped via hard-lidded gondola railcars (DOT IP-1 Fissile Excepted Package)



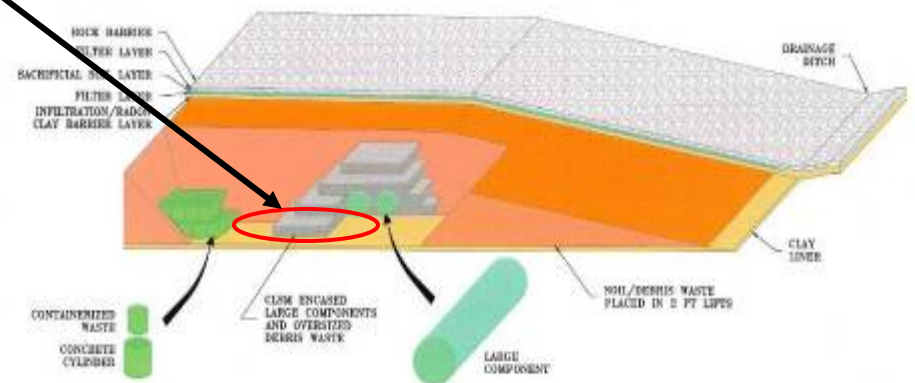
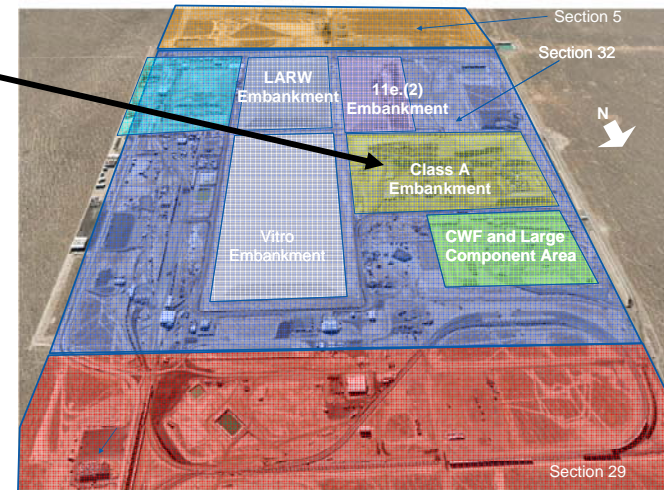
Disposal Terminology

- Disposal Embankment (Emplacement)

- Area within Clive facility where waste is buried

- Waste Lift Area (Typical)

- Smaller section within Disposal Embankment containing one or more waste items



Criticality Modeling

- Administrative & Programmatic Controls
- Design Features

Administrative & Programmatic Controls



- Waste Lifts containing K-25 piping shall not be stacked
- K-25 piping shall be placed in waste lifts within the Class A disposal embankment
- GDP piping will be placed in one continuous Controlled Low-Strength Material (CLSM) filled waste lift area and will be limited to ^{235}U mass limits

Administrative & Programmatic Controls

- Piping less than 10 inches OD and no longer than 12 feet in length may be placed in separate soil waste lifts and will be limited to ^{235}U mass limits



- Liquids shall not be used as part of the process in areas where K-25 piping is being unloaded, moved on-site, or placed in interim storage

Administrative & Programmatic Controls



- Piping shall be covered to prevent in-leakage of rain water when rainfall is expected to exceed one inch
- Piping that is stock-piled or placed in disposal waste lifts shall not exceed the most restrictive mass limits

Administrative & Programmatic Controls



- Fissile material from other sources shall be accounted for in the disposal waste lift area to ensure the total fissile mass limits are not exceeded

Design Features

- Location of the site in an arid region receiving less than 7 inches of annual precipitation
- Water table location approximately 30 feet below the surface

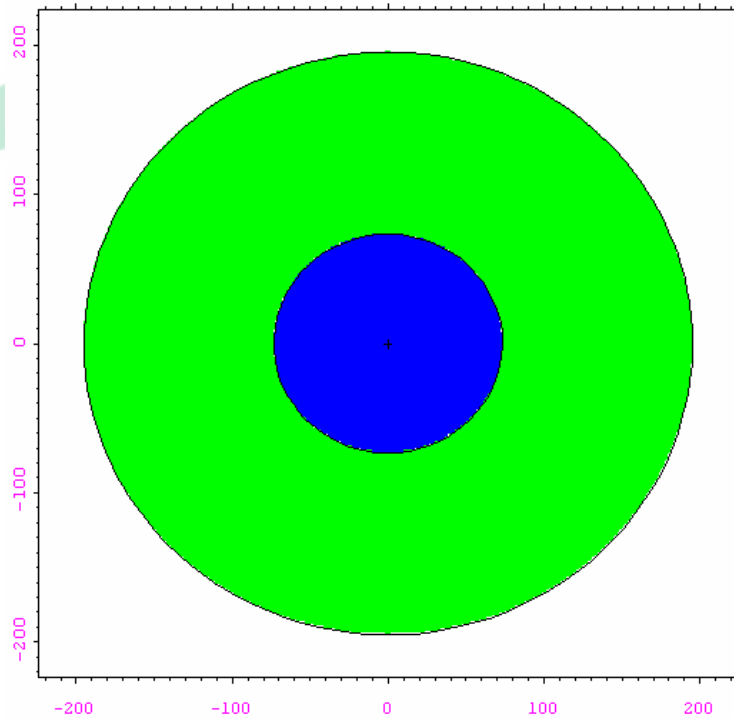


Modeling Assumptions

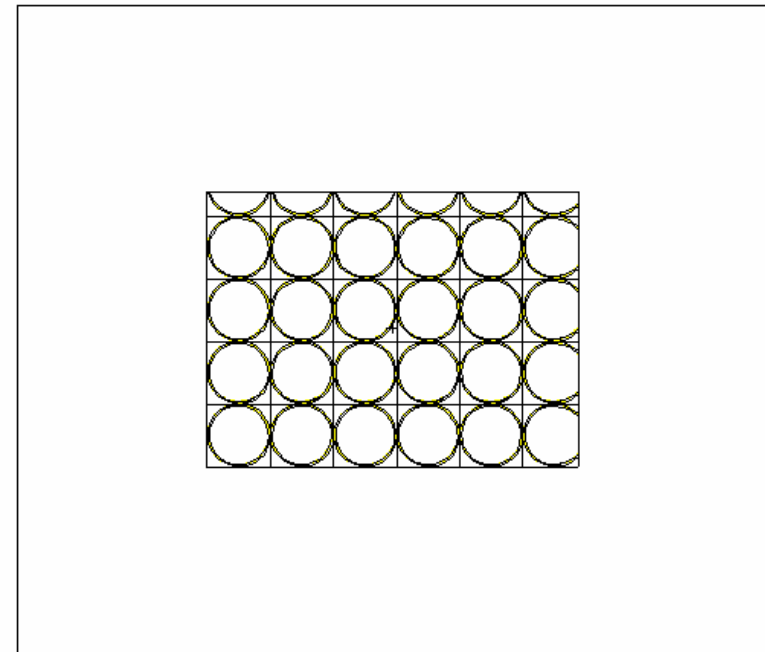
- The fissile material is ^{235}U enriched to 100% as UO_2F_2 surface contamination
- The waste will be received in gondola rail cars
- Waste mixtures conservatively modeled as spheres



Modeling Assumptions



Model of $\text{UO}_2\text{F}_2/\text{Sand}$
Reflected by CLSM

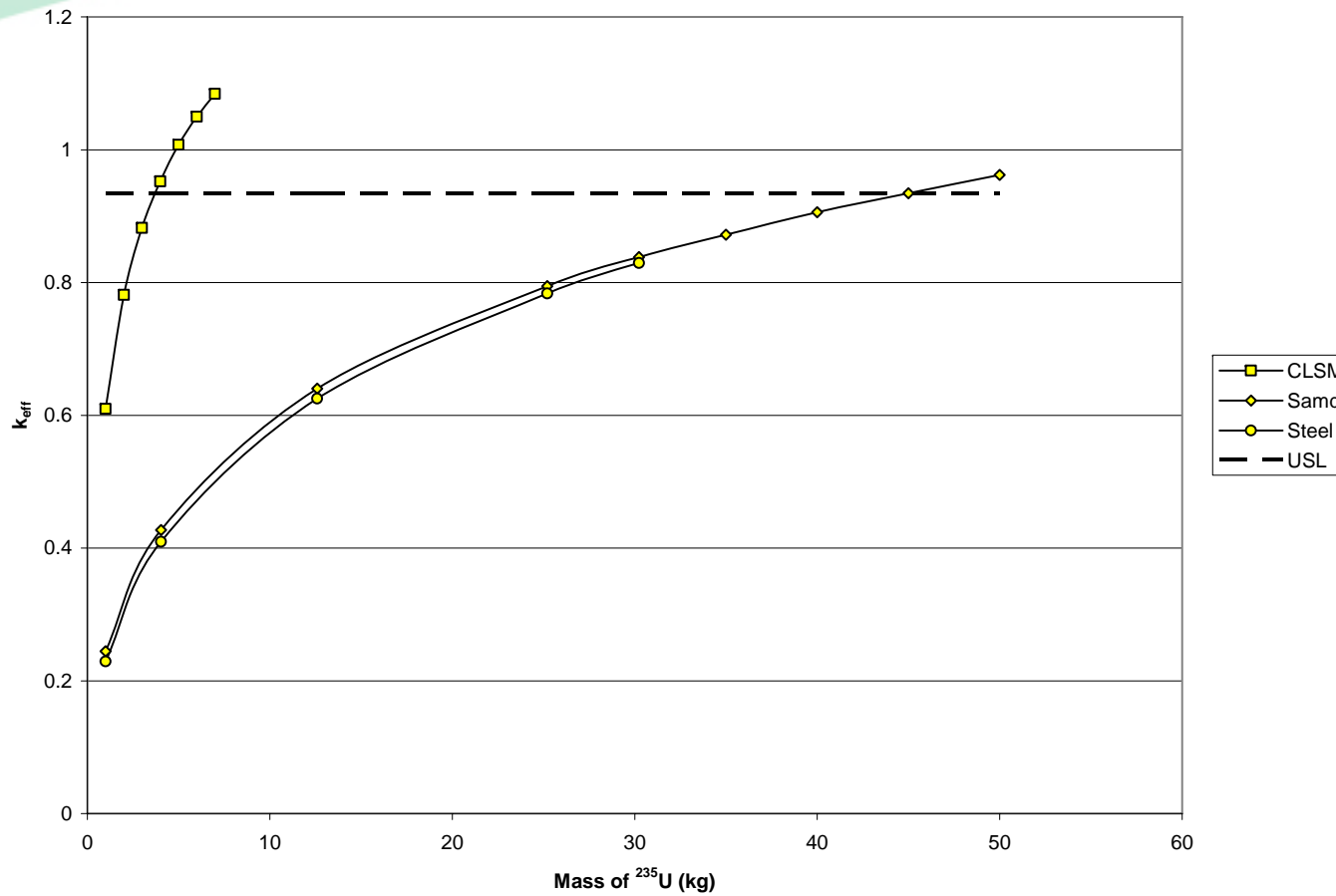


Model of Pipe Array

Foam in Containers

- Pre-requisite activities for removal of piping from K-25 include visual inspection and foaming
- Visual inspection and foaming only performed on process gas equipment and piping greater than 3 in. nominal OD
- Foam is an isocyanate/resin-based foam (urethane foam) with density of 2 lb/ft³ (0.032 g/cm³)

Criticality Limits with Various Disposal Media



Criticality Limits

- No more than 40 kg of ^{235}U is placed in a single disposal soil waste lift area
- No more than 3.6 kg of ^{235}U is placed in a single disposal waste lift area filled with CLSM

Conclusion

The NCSE demonstrates that criticality is not credible at the specified limits during disposal of GDP piping at the Clive disposal site.