

DISPOSAL OF WASTE FROM FORMER GASEOUS DIFFUSION PLANT



September 5, 2008

Overview



- **2006 Authorization Request - Timeline**
- **Gaseous Diffusion Plant Background & Operations**
- **DOE D&D Approach**
- **Pre-requisite D&D Activities**
- **Clive Disposal Operation**
- **Site Security Plan**
- **Post-Closure Monitoring**

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

Timeline

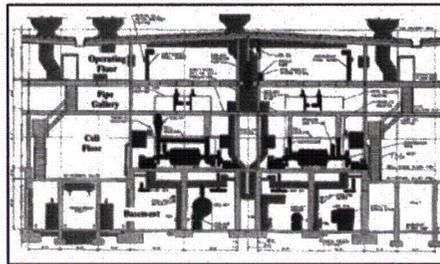
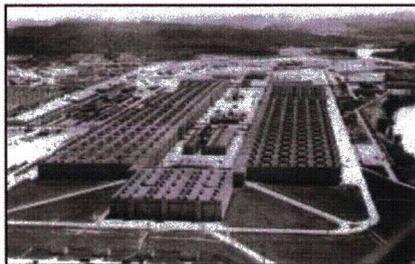


Action	Date
EnergySolutions' Authorization Request	September 29, 2006
Meeting with NRC to discuss project status	October 23, 2006
NRC Request for Additional Information	June 6, 2007
EnergySolutions' Response to RAI	September 13, 2007
Meeting with NRC to discuss project status	January 24, 2008
Meeting with NRC to discuss security issues	September 5, 2008

K-25/27 Background Information



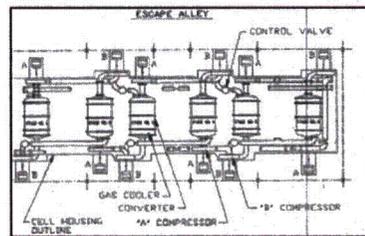
- Gaseous Diffusion Plants (cascade) constructed to supply enriched uranium for nuclear weapons production during WWII
- Operated from 1944 to 1964 (maximum enrichment of 94.8%)
- Over two million square feet of floor space (58 feet tall)
- 3,582 stages of various sizes (~22 tons of PGE per stage)



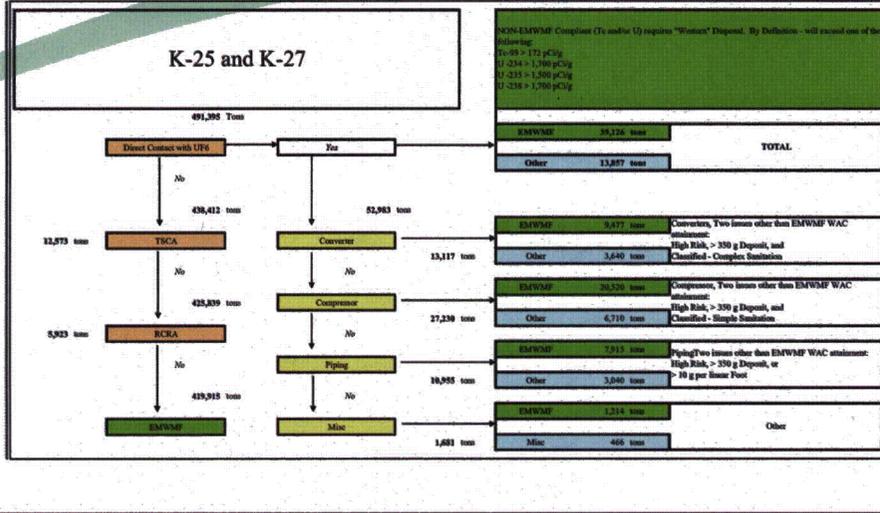
Gaseous Diffusion Plant Former Operations



- 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)



K-25 and 27 Waste Flow



Major GDP Systems



CONVERTERS													
Plant Section	Cell Number	Size	#	length	Diameter	Volume	cooler	shell/base	bundle	Component Total wgt	TOTAL volume	TOTAL wgt	Total In place Density
-3	311	3	54	10.67	5.71	273	1,300	2,550	1,300	5,150	14,734	278,100	18.88
-2	310	2	96	10.67	5.71	273	1,850	5,875	2,450	10,175	26,191	978,800	37.29
-2	310	2	30	10.67	5.71	273	1,850	5,875	2,450	10,175	8,185	305,250	37.29
-1	309	1	90	11.25	6.71	397	3,000	5,500	4,000	12,500	35,768	1,125,000	31.45
1	302	1	222	11.25	6.71	397	3,000	5,500	4,000	12,500	88,228	2,775,000	31.45
2a	302	2	180	10.67	5.71	273	1,850	5,875	2,450	10,175	49,112	1,831,500	37.29
2a	303	2	96	10.67	5.71	273	1,850	5,875	2,450	10,175	26,191	978,800	37.29
2b	303	2	402	10.67	5.71	273	1,850	5,875	2,450	10,175	109,684	4,090,350	37.29
2b	303	2	54	10.67	5.71	273	1,850	5,875	2,450	10,175	14,734	549,450	37.29
2b	303	2	90	11.13	5.71	285	1,850	5,875	2,450	10,175	25,611	915,750	35.76
3a	304	3	288	8.33	4.17	114	1,300	2,550	1,300	5,150	32,708	1,483,200	45.35
3b	305	3	708	8.33	4.17	114	1,300	2,550	1,300	5,150	80,408	3,646,200	45.35
4	306	4	576	5.50	3.67	58	600	1,900	600	3,100	33,435	1,785,600	53.41
k-27	k-27	2	540	10.67	5.71	273	1,850	5,875	2,450	10,175	147,337	5,494,500	37.29
TOTALS			3426								692,330	13,117	

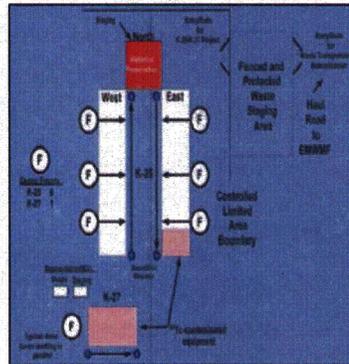
COMPRESSORS						
#	length (in)	width (in)	height (in)	cf per	unit wgt	tons total
306	1,152	56	35	42	48	4,900
k-25 remaining	5,700	107	67	80	91	7,200
K-27	1,080	107	67	80	91	7,200
	7,932					27,230

Consolidated breakout (EUCAL, Inesco, etc.)					
	Tons		%		Sum
	K-25	K-27	%	%	
Equipment	49,778	3,350	94%	6%	53,127
Converters	10,436	2,747	79%	21%	13,183
Compressors	14,922	2,853	84%	16%	17,775
Process Pipe System	8,546	4,090	68%	32%	12,635
Building Debris	39,135	52,049	43%	57%	91,184

DOE D&D Strategy

ENERGYSOLUTIONS

- **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

ENERGYSOLUTIONS

- **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

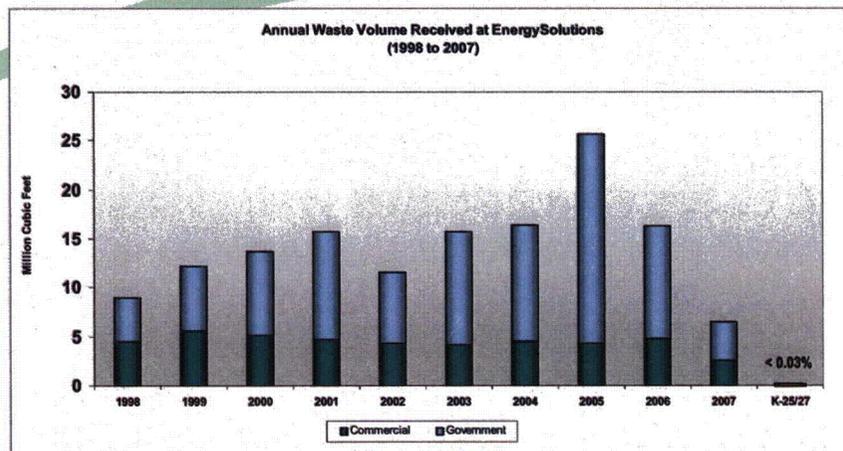


- **DOE EMWMF in Oak Ridge, TN**
 - Principle option for disposal is at the local DOE CERCLA facility
 - Use truck trailers with soft tarps to package and ship waste
 - Disposal constraints for elevated Tc-99 contamination (172 pCi/g)

- **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)



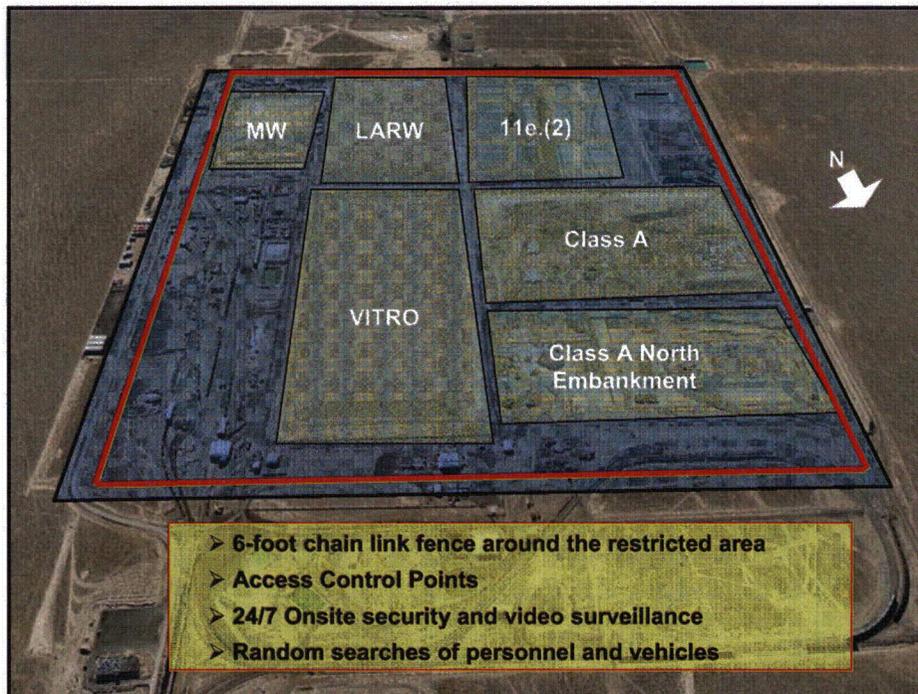
Annual Waste Volume



Clive Site Characteristics



- ❖ Arid, desert climate
- ❖ Remote location – Nearest town about 45 miles away
- ❖ Less than 6 inches of precipitation per year
- ❖ Over 60 inches of evapotranspiration
- ❖ Groundwater is non-potable and is contained in a low-yield aquifer that moves less than two feet per year
 - The State of Utah requires EnergySolutions to design and construct the disposal embankment to protect groundwater to drinking water standards.



Clive Facility Security



- Site Radiological Security Plan- “to prevent radioactive waste material(s) and contaminated equipment without authorization from being used or exiting the facility.”
 - Access Control Points
 - 6-foot chain link fence
 - 24/7 Onsite Security
 - Minimum three patrols per 24-hour period
 - Random searches of personnel and vehicles
- Local Law Enforcement Agency Plan - QoC
- DOE UCNI and Export Controlled Waste

No Services at Clive Low traffic



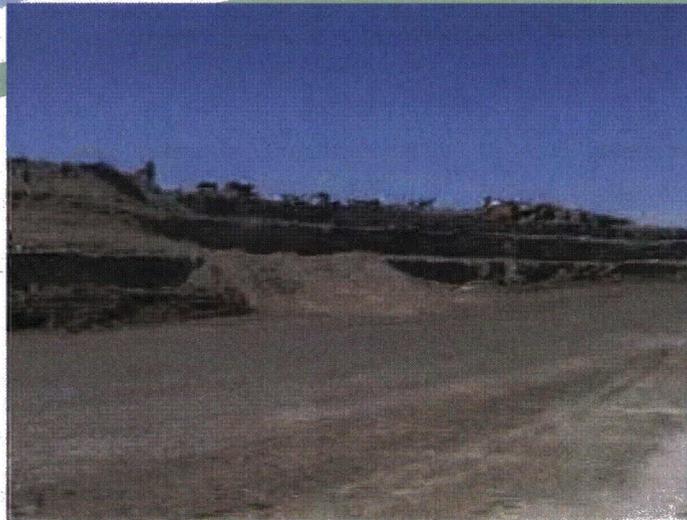
Soil Lift Disposal

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CLSM Disposal Lifts

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CLSM Disposal - Concrete Pyramids Adversarial Intrusion?

ENERGYSOLUTIONS



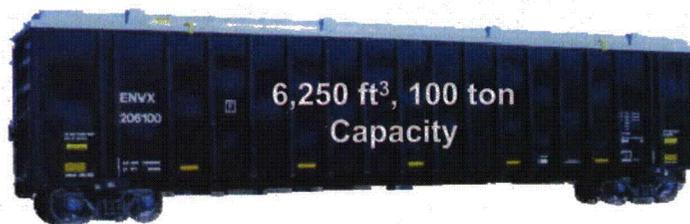
Clive Disposal Operations

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- ❖ EnergySolutions is currently licensed to receive the K-25 waste in smaller containers with enriched uranium < 350 grams per package



- ❖ Most efficient and secure package is the gondola railcar



Administrative & Programmatic Controls



- Waste Lifts containing K-25 waste shall not be stacked
- K-25 waste shall be placed in waste lifts within the Class A disposal embankment
- GDP waste 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



- Waste shall be covered to prevent in-leakage of rain water when rainfall is expected to exceed one inch
- Waste 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

Post-Closure Surveillance

- **Post-Closure Monitoring Fund**
 - 0 to 100 years after closure
 - Custodial agency shall physically control access to the disposal site
 - 6-foot chain link fence
 - Periodic surveillance by Utah Division of Radiation Control
 - Over \$50MM in closure and post-closure fund
- **Perpetual Care and Maintenance Fund (beginning 100 years after closure)**
 - Current value of \$13MM PCMF

Criticality Modeling

Modeling Assumptions

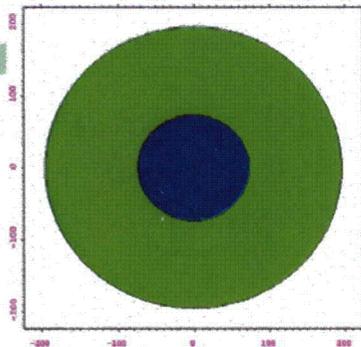
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- The fissile material is ^{235}U enriched to 100% as UO_2F_2 surface contamination
- The waste will be received in gondola rail cars
- Waste mixtures conservatively modeled as spheres

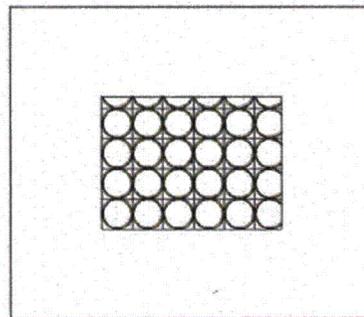


Modeling Assumptions

ENERGYSOLUTIONS



Model of UO_2F_2 /Sand Reflected by CLSM

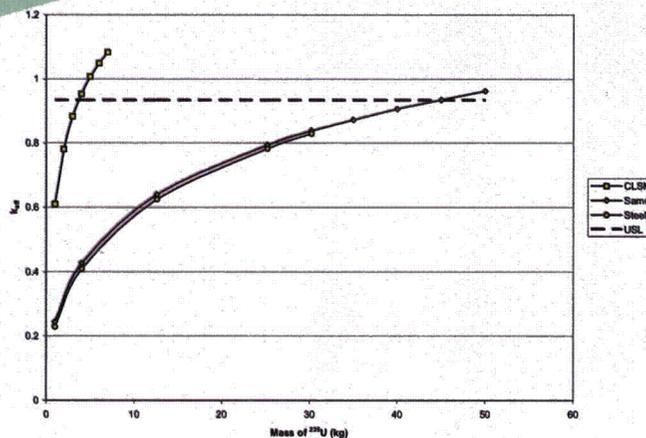


Model of Pipe Array

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 waste at the Clive disposal site.