



# Tc-99 Issues in the K-25 Building

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# K-25 Building





# Tc-99 Radiological Data

- Tc-99 is a high yield (~6.1%) fission product introduced from recycled uranium
- Feed in trace quantities (< 4 ppm)
- Estimated that there are 32 Kg in K-25 and 30 Kg in K-27, mostly in the Purge Cascades.
- Pertechnetyl fluoride ( $\text{TcO}_3\text{F}$ ) and technetium hexafluoride ( $\text{TcF}_6$ ) sufficiently volatile to enter enrichment cascade
- $\text{TcO}_3\text{F}$  has been identified in cascades
- Tc fluorides are extremely moisture-sensitive, hydrolyzing to form semi-volatile pertechnetic acid ( $\text{HTcO}_4$ ) in moist air.



# Tc-99 Distribution

- In a diffusion cascade,  $TcF_6$  separates about 60 times as fast from  $UF_6$  as  $U(-235)F_6$  does from  $U(-238)F_6$ .
- In the purge cascade, the “enriched” stream is light and intermediate molecular weight gasses, and the “depleted” stream is the  $UF_6$ .
- An intermediate gas, Tc-99 migrates up the cascade where it concentrates in purge cascades (top and side).
- K-25 (K-311-1) Side Purge established in 1953 when recycled uranium first introduced into cascade.
- K-25 (K-310-3 “Pig tail”) Purge established in 1957.
- K-402-9 and K-402-8 in the K-27 building became the Side and “Pig tail” Purges in 1977.



# Tc-99 Radiological Data

- Pure beta emitter ~ 292 KeV max
- T1/2 ~ 212,000 years
- Specific activity ~ 1.7E-2 Ci/g
- EMWMF WAC = 172 pCi/g
- NTS WAC = 1.1E11 Bq/m<sup>3</sup>.
- DAC = 1.0E-7 μCi/ml



# Tc-99 Distribution

- Tc-99 is water soluble and migrates readily. Open air demolition will require source term removal or effective immobilization.



## Existing Data - Tc-99 Characterization

- Surface survey measurements confirm Tc-99 footprint based on K-25/ K-27 D&D Project survey campaign.
  - ~500 surveys in K-25 Building and ~600 surveys in K-27 Building
- Tc-99 Isotopic Analyses
  - Assessment of Accessible Contamination at the K-25 Site (1994)
  - Limited Characterization Sampling 2000
  - Results from Hazardous Materials Abatement Waste Profile results (Very low activity Tc-99 concentration (0.3 pCi/g mean activity concentration) in areas other than Purge Cascades)
  - Intrusive Sampling 2005/6
  - Structural Sampling 2007



## Results of Tc-99 Pilot Study

- Fixatives reduce contamination spread to personnel.
- Acid rain will leach Tc-99 from fixatives sprayed onto piping and other surfaces.
- Less than 50% of contamination on metal surfaces is mobile.
- Tc-99 compounds have a strong affinity for iron oxide.
- Shearing pipes that had been filled with low-density foam did not release significant contamination.
- Pertechnetate acid is present in process gas components in units 311-1 and 310-3.
- Pertechnetate acid will corrode some forms of epoxy used in component patches.



## Potential Tc Control Measures

- Before initiating demolition on the non-Tc portion of the Tc area, demolish two units just above the Tc area. (physical and structural isolation of the Tc area)
- Foam all process gas equipment, and piping 3” and greater.
- Apply fixative to high contamination areas of structure and external surfaces of components.
- Evaluate use of scrubbers or other controls during vent, purge, and drain of process gas components.
- Minimize the amount of material on the ground during demolition.
- Implement a very robust storm water protection program.



# Potential Tc Control Measures

- Develop a new technique/material for patching process gas components.