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Cs-135 Content of Cesium Capsules and Strontium/Cesium Heat Sources

PRESENTED BY

Laura Price

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Outline

- Background
- Waste Characteristics
- Quantity of ^{135}Cs in cesium capsules
- Quantity of ^{135}Cs in strontium and cesium heat sources
- Conclusion

Background

- The U.S. Department of Energy manages 1,335 cesium capsules and 34 strontium and cesium heat sources at the Hanford Site
- Multiple cesium isotopes are present in the capsules
- Multiple strontium and cesium isotopes are present in the heat sources
- Of the multiple isotopes, ^{90}Sr and ^{137}Cs are of concern for storage, transfers, transportation, and preclosure and handling phases of disposal
- Of the cesium isotopes, ^{135}Cs is of concern for postclosure performance assessment of the repository in which the wastes are eventually disposed of
- The ^{135}Cs content of these wastes is not reported
- Purpose of this study is to estimate the quantity of ^{135}Cs present in these wastes

Waste Characteristics

- Cesium Capsules
  - Cesium extracted from liquid waste in tanks at Hanford between 1974 and 1983 as CsCl
  - 1,335 capsules are double-walled cylinders 21 inches tall, 3 inches in diameter
  - Stored in pools at Hanford
  - Cesium inventory information from Hanford tank inventory information and destructive testing of capsules.
  - Currently managed as high level waste
- Strontium and cesium heat sources
  - Cesium and strontium extracted from B-Plant complex at Hanford in 1986 and 1987
  - Formed into 34 glass logs 4 feet tall, 1 foot in diameter
  - Stored in six CASTOR and two GNS casks at Hanford
  - Cesium inventory information from Hanford tank inventory for B-Plant
  - Currently managed as transuranic waste

Quantity of ^{135}Cs in Cesium Capsules

- Cesium in capsules came from four reprocessing plants
  - T-plant (1956)
  - B-plant (1956)
  - REDOX (1967)
  - PUREX (1988)
- Wootan and Finfrock (2002) calculated radionuclide inventories (curies) in tanks using ORIGEN2 and DKPRO
  - Fuel type
  - Fuel burnup
  - Reactor type
  - Decay
  - Method of reprocessing
  - Decay date of January 1, 2001
- Calculated activity ratio and mass ratio of ^{135}Cs to ^{137}Cs from the averaged tank data

Quantity of ^{135}Cs in Cesium Capsules (cont'd)

- Sasmor et al. (1988) destructively tested seven cesium capsules
- They measured atom percents of the cesium isotopes in each capsule
- Derived activity ratio and mass ratio of ^{135}Cs to ^{137}Cs from the data
- Calculated activity ratio and mass ratio of ^{135}Cs to ^{137}Cs in 2016 and found the average from all eight data points
  - Activity ratio: 1.2E-5
  - Mass Ratio: 8.7E-1
- Multiplied ratios by reported total curies and mass of ^{137}Cs in the capsules as of 2016
- Result
  - 388 Curies of ^{135}Cs in the capsules
  - 337 kg of ^{135}Cs in the capsules

Quantity of ^{135}Cs in Strontium/Cesium Heat Sources

- Cesium in heat sources came from the B-Plant
- Used B-plant inventory data from Wootan and Finfrock (2002) for ^{135}Cs and ^{137}Cs
- Calculated activity and mass ratio of ^{135}Cs to ^{137}Cs from B-plant data as of 2001, then adjusted ratios to 1987, the year ^{137}Cs inventory is reported
  - Activity ratio: 9.7E-6
  - Mass ratio: 7.3E-1
- Multiplied ratios by reported total curies of ^{137}Cs in heat sources as of 1987
- Results
  - 49 Curies of ^{135}Cs in the heat sources
  - 43 kg of ^{135}Cs in the heat sources

Summary and Conclusions

- Two wastes that DOE manages contain unreported quantities of ^{135}Cs
- Quantities of ^{135}Cs need to be known for postclosure performance assessment calculations
- It is possible to estimate the quantity of ^{135}Cs in these wastes
- Quantity in capsules: 388 Curies (337 kg)
- Quantity in strontium and cesium heat sources: 49 Curies (43 kg)

References

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- Sasmor, D. J., J. D. Pierce, G. L. Tingey, H. E. Kjarmo, J. Tillis, and D. C. McKeon, 1988. "Characterization of Two WESF Capsules After Five Years of Service," SAND86-2808, Sandia National Laboratories, Albuquerque, NM.