Alternative Disposal for Investigation Derived Wastes (Idw) Containing Low Activity Source Material

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ABSTRACT

As part of a Remedial Investigation (RI) at a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Site, approximately 77,111 kg (85 tons) I would use the actual tons of investigation derived wastes (IDW) were generated from exploratory soil borings and as part of removal activities at a former drum burial area. Characterization of these materials indicated elevated concentrations of metals including uranium and thorium (source material). Concentrations of uranium and thorium were at levels less than 0.05% by mass, which is the threshold for exempt source material under Nuclear Regulatory Commission (NRC) regulations. Disposal of this material was evaluated as low-level radioactive waste and as exempt radioactive waste. The NRC has established a process for evaluation and review of exempt source material transfer and direct disposal in a Resource Conservation and Recovery Act (RCRA) landfill. These requests are normally approved if the dose to a member of the general public is unlikely to exceed 0.25 mSv per year (25 millirem per year). The soil was evaluated for disposal as exempt radioactive waste at a RCRA landfill, which included dose modeling to workers during transportation and disposal as well as potential dose to members of the public after closure of the disposal facility. These evaluations determined that the potential dose was very small, and review by the agreement state regulatory agency indicated that this disposal process should not result in any undue hazard to public health and safety or property. The advantage of this approach is that disposal of 77,111 kg (85 tons) of IDW at a RCRA landfill is estimated to result in a savings of $80,000 as compared to disposal as low-level radioactive waste. Alternative waste disposal of exempt source material provides more disposal options and can lead to significant cost savings.

INTRODUCTION

It is common to generate IDW during RI at CERCLA Sites. IDW is typically generated from exploratory soil borings and installation of groundwater monitoring wells. IDW is stored until analytical data is available to determine if it is hazardous so that appropriate disposal methods can be employed. This process is further complicated at sites known to have radiological contamination since IDW could be hazardous, radioactive, or mixed waste.

Usually, radioactive IDW is disposed as low-level radioactive waste. For sites that have residual radioactivity consisting of source material (uranium that is not enriched or thorium) another option exists. The NRC has defined unimportant quantities of source material in 10 CFR 40.13(a) as "any chemical mixture, compound, solution, or alloy in which the source material is by weight less than one-twentieth of 1 percent (0.05 percent) of the mixture, compound, solution or alloy". Unimportant quantities of source material are exempt from NRC regulations and do not require a license. Furthermore, the NRC has established a process that allows licensed facilities to request for disposal of materials meeting the definition of unimportant quantities of source material at a RCRA landfill. These requests are normally approved if the dose to a member of the general public is unlikely to exceed 0.25 mSv per year (25 millirem per year).

Investigation Derived Waste

As an example of this process, approximately 77,111 kg (85 tons) of IDW (soil and debris) was generated during a RI at a CERCLA site. The contaminants of concern at this site included metals, solvents, PCBs, uranium and thorium. The site, which is located in the northeastern United States, is approximately 186,155 m^2 (46 acre) and 18 areas of investigation were included in the RI. Several areas of historical on-site disposal including landfill, drum burial, and liquid process waste lagoon were identified. The IDW consisted of exploratory soil borings that were conducted in an area known to have elevated concentrations of uranium from past operations (Figure 1) and excavated soil and debris from a former drum burial area (Figure 2). Characterization of these soils indicated low concentrations of uranium and thorium and no chemical hazardous characteristics that would classify the IDW as a mixed waste.

Figure 1. Area of soil borings (Holding Basin)

Figure 2. Former Drum burial area excavation

The IDW was stored on-Site in two different types of containers. Soil from the exploratory borings was placed in 0.24 m^3 (55 gallon) drums while soil and debris from the former drum burial area was placed into 23 m^3 (30 cubic yards) roll-off containers. The total volume of IDW was estimated to be 74 m^3 (97 cubic yards) and approximately 131,500 kg (145 tons). A total of nine composite samples were collected from these materials with an average of 0.06 Bq/g (2 pCi/g) and a maximum of 0.44 Bq/g (12 pCi/g) for Th-232 and an average of 1.19 Bq/g (32 pCi/g) and a maximum of 6.82 Bq/g (184 pCi/g) for U-238 as shown in Table I.

Table I. Soil Characterization Summary

Nuclide	Min. Bq/g (pCi/g)	Max. Bq/g (pCi/g)	Avg. Bq/g (pCi/g)	Total Activity mBq (mCi)
U-234	0.002 (0.054)	0.524 (14.172)	0.092 (2.486)	12.1 (0.327)
U-235	0.001 (0.023)	0.216 (5.837)	0.032 (0.859)	4.2 (0.113)
U-238	0.022 (0.588)	6.816 (184.238)	1.187 (32.095)	156.2 (4.222)
Th-232	0.011 (0.307)	0.437 (11.823)	0.061 (1.662)	8.1 (0.219)

Disposal Options

This IDW could be disposed as Class A low-level radioactive waste to a licensed disposal site. Total costs for transportation and disposal as low-level radioactive waste were estimated to be approximately $180,000. Further review of the characterization data provided a strong indication that it could meet the criteria for unimportant quantities of source material and

potentially be disposed as exempt radioactive material. Evaluation of the data found that the IDW met the criteria for unimportant quantities of source material and could meet the WAC for the RCRA disposal site. Total costs for transportation and disposal as exempt radioactive waste were estimated to be $68,000.

In order to meet the WAC requirement for disposal at the RCRA site as exempt radioactive waste, a sampling density of at least one sample per 15 m^3 (20 cubic yards) was needed. In addition, source material concentrations for exempt radioactive waste in the WAC are 2.02 Bq/g (54.5 pCi/g) for Th-232 and 6.16 Bq/g (166.5 pCi/g) for U-238 assuming that U-235 and U-234 are present in their natural abundance ratios or less. Furthermore, no single measurement that exceeds 10 times the exemption criteria shall be used to calculate an average volumetric concentration. One characterization sample exceeded the exemption criteria for U-238 and another sample was collected from the roll-off container with results well below the exemption criteria for U-238 in order to meet the averaging criteria.

The NRC has established a process for evaluation and review of exempt source material transfer and direct disposal in a Resource Conservation and Recovery Act (RCRA) landfill. These requests are normally approved if the dose to a member of the general public is unlikely to exceed 0.25 mSv per year (25 millirem per year). A request for disposal of this IDW as exempt radioactive material was submitted to the agreement state with regulatory authority for the radioactive materials license at this site. This request included the information that the NRC would require for this process - an evaluation of the characterization data, radiological dose estimates to workers and public during loading, transportation, and unloading at the disposal facility along with potential dose in the future from these materials being placed in the RCRA landfill. The agreement state granted approval for disposal as exempt material since it would not result in any undue hazards to public health and safety or property. Regulatory review and approval by the agreement state took about nine months. Once these materials were approved for disposal as exempt material by the Agreement State, a profile of the IDW was submitted to the disposal facility for review and approval. Regulatory review and approval by the state overseeing the disposal site takes 20 business days.

Dose Modeling

Two different dose models were used for the disposal of this IDW. The first provided radiological dose estimates to workers and public during loading, transportation, and unloading at the disposal facility while the second provided potential dose in the future from these materials being placed in the RCRA landfill. Radiological dose estimates to facility workers and the surrounding public at treatment, storage, and disposal (TSD) facilitities from shipments of hazardous waste which may contain small amounts of radionuclides was performed with the TSD-Dose computer code derived by Argonne National Laboratory. Radiological dose estimates under future exposure scenarios was performed with the RESidual RADioactivity (RESRAD) code. RESRAD allows for pathway modeling of radionuclides through the environment and calculates potential doses to individuals in various exposure scenarios.

The results from both of the dose modeling programs were very low. In fact, the dose to individuals during transportation, handling, and disposal are all calculated to be less than 0.01

mSv (1 mrem). The collective dose from disposal of this IDW is less than 3.0E-6 person-sievert (3.0E-3 persom-rem) under all exposure scenarios. The dose modeling strongly supported exempt disposal of this IDW as the public dose limit is 1 mSv per year (100 mrem per year) and 0.25 mSv per year (25 mrem per year) criteria for unrestricted license termination.

Disposal

The IDW was stored in drums and roll-off containers and transferred into 3.8 m^3 (5 yd^3) reinforced sacks as shown in Figure 3. A total of 19 sacks were loaded with the IDW for a total of 77,111 kg (85 tons) and 72 m^3 (95 yd^3). The sacks were loaded onto dump trailers and driven to a rail yard about 56 km (35 miles) from the Site. At the rail yard the sacks were placed into gondola rail cars for shipment to the disposal site. It took approximately 14 days for the IDW to reach the disposal site by rail. The disposal process was simplified since the concentrations of uranium and thorium in the IDW were below the threshold to be considered radioactive material for transportation by Department of Transportation (DOT) regulations. In addition, NRC Forms 540 / 541 (Uniform Low-Level Radioactive Waste Manifest) were not required since the IDW is being disposed as exempt radioactive material and not as low-level radioactive waste.

Figure 3. Storage and disposal containers

CONCLUSION

Alternative waste disposal as exempt radioactive waste does take more time and some additional upfront cost in order to get the initial regulatory approval for disposal as exempt material. This is primarily due to the time and effort necessary to evaluate the materials with respect to exempt source material criteria and dose modeling. However, the advantage of this approach is that disposal of 77,111 kg (85 tons) of IDW at a RCRA landfill is estimated to result in a savings of $80,000 as compared to disposal as low-level radioactive waste. The initial time and cost associated with regulatory approval for alternative disposal would not increase significantly for

much larger quantities of material of disposal. Therefore the potential cost-savings for exempt disposal for large volumes of waste will be much greater. As shown in this case, alternative waste disposal can be used to dispose of material with very low concentrations of source material with essentially no increase in radiation dose and no undue hazards to public health and safety or property. Alternative waste disposal of exempt source material provides more disposal options and can lead to significant cost savings.

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