

CHARACTERIZATION CHALLENGES OF CERTAIN FUSRAP WASTE STREAMS

Hans B. Honerlah, David C. Hays, & Brian P. Hearty
U.S. Army Corps of Engineers

ABSTRACT

There are a variety of materials destined for off-site disposal from the Formerly Utilized Sites Remedial Action Program (FUSRAP) sites. The U.S. Army Corps of Engineers (USACE) characterizes each radiological waste stream to establish regulatory requirements and disposal options. In general, the materials fall into several waste types, some of which are regulated under the Atomic Energy Act (AEA), such as special nuclear material, source material and byproduct material, and some of which are not regulated under the AEA, such as naturally occurring radioactive material (NORM) and the radioactive residuals from the processing of ores at facilities not licensed by the Nuclear Regulatory Commission (NRC) at the time the Uranium Mill Tailing Recovery Act was enacted in 1978 or thereafter. There may also be hazardous waste regulated under the Resource Conservation and Recovery Act (RCRA) either separate from the radioactive materials or commingled. Finally, there may be solid waste, which is neither regulated radioactive waste nor hazardous waste. In order to determine what types of materials are present at the sites USACE assembles and reviews: historical information on operations at the site, related to both the past processing work in support of the Federal Government and to other site processes which may have involved releases of contaminants, and analytical data from site investigations. Together, the historical process information and the investigation data allow proper characterization of the materials present at each site.

When the historical information indicates that more than one process or activity contributed to the contamination, the review of the investigation data becomes critical in determining the appropriate regulatory requirements for the material. However, the proper characterization of the materials at a site becomes difficult when the site is contaminated with a combination of radionuclides such as, depleted uranium, enriched uranium, natural uranium, natural thorium, or other NORM.

INTRODUCTION

The USACE provides comprehensive environmental restoration services for the Army and for other Federal and State agencies. USACE executes hazardous, toxic, and radioactive waste cleanup projects from the earliest stages of investigation and study, through remedial design and remedial action, to site closeout and long-term monitoring. With a goal of pursuing the protection of human health and the environment, USACE strives to complete its projects in the safest, most timely, and cost-effective manner.

There are a variety of materials destined for off-site disposal from the Formerly Utilized Sites Remedial Action Program (FUSRAP) sites. The U.S. Army Corps of Engineers (USACE) characterizes each radiological waste stream to establish regulatory requirements and disposal options. There may also be hazardous waste regulated under the Resource Conservation and Recovery Act (RCRA) either separate from the radioactive materials or commingled. Finally,

there may be solid waste, which is neither regulated radioactive waste nor hazardous waste. In order to determine what types of materials are present at the sites USACE assembles and reviews: historical information on operations at the site, related to both the past processing work in support of the Federal Government and to other site processes which may have involved releases of contaminants; and analytical data from site investigations. Together, the historical process information and the investigation data allow proper characterization of the materials present at each site.

This paper will address several issues that have been identified when attempting to determine the types of material at FUSRAP sites. Below are some examples of topics to be addressed. The presentation will identify several options that have been utilized to address the issues with proper characterization of these FUSRAP materials.

- The remediation of sites that processed a combination of natural, enriched and/or depleted uranium may require the removal and disposal of materials with low levels of uranium contamination. The method used to calculate the enrichment levels of uranium uses analytical results from the U-234, U-235 and U-238 isotopes. At low uranium activities, the analytical error associated with each isotopic measurement can be high. These large errors make it difficult to determine the enrichment level accurately and thus the proper classification of the material being remediated.
- The remediation of hazardous and solid wastes (non-radiological) from FUSRAP sites poses a unique problem. Waste disposal facilities and their regulators are hesitant to accept any material from a FUSRAP site because the term FUSRAP is associated with radioactive wastes. Characterization of these materials often requires determining that the levels of radioactivity are indistinguishable from background or at extremely low levels acceptable to the facility and its regulators.
- The remediation of former thorium processing plants potentially require the removal of soils or debris contaminated with source material, unimportant quantity of source material, or radioactive residuals from the processing of ores at facilities not licensed by the NRC at the time the Uranium Mill Tailing Recovery Act was enacted in 1978 or thereafter. Due to the relatively short half-life of the thorium-232 decay chain, proper characterization becomes difficult if the contamination has been in place for decades allowing secular equilibrium to be established.

WASTE CHARACTERIZATION PROCESS

The waste which is known to be present, or likely to be found, at FUSRAP sites falls within a variety of definitions established in Federal statutes and regulations. As part of the responsibility for execution of cleanup of hazardous substances under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 et seq. (CERCLA), whenever any materials are to be disposed off site, USACE must comply with all laws and regulations that apply to transportation, processing, treatment, storage or disposal of the materials. Those laws and regulations establish the requirements, which apply, to the various types of materials to be disposed off site. USACE must characterize these materials, to determine which laws and regulations apply to the types of materials present, and to ensure that they are managed and disposed in compliance with those laws and regulations. There is no unique or extraordinary

requirement for an agency to be qualified to characterize waste for off site disposal from FUSRAP sites. Neither is there any exception from the standard duties of generators to properly characterize their waste materials. USACE will identify through appropriate analytical methods and historic process research the types of waste at each of the FUSRAP sites, and will use that characterization to determine which facilities may accept that type of waste (or types in some instances).

A review of the applicable waste definitions reveals that an essential part of the characterization process is to gather, read and evaluate historic process information. The definitions of the waste materials depend not only on the current chemical and physical state of the material, as determined by laboratory analysis of the materials, but also on whether the materials were processed, when that processing occurred, and what was the primary purpose of that processing. Since many FUSRAP sites were the location of commercial processing facilities prior to, or after, providing support to the nation's early atomic energy program, both government historic records and available industry records must be collected and reviewed to obtain the necessary process information.

Upon completion of the historical evaluations, the site-specific analytical information will be collected and reviewed to assist in the characterization process. This review includes historical data, as well as any additional or current data collected. The radiological data, as well as the chemical data must be reviewed prior to completing the characterization process. In many instances, there has been more than one processing activity that has taken place at a site and the analytical data may be the determining factor for the waste classification.

USACE will complete the historical evaluations to determine process knowledge, review historical data, and conduct any additional sampling and analyses that may be necessary to appropriately characterize all waste for off-site disposal and to support valid CERCLA response action decisions.

CASE STUDY 1

Background

The Colonie FUSRAP Site (Site) was owned and operated from the late 1930's as an industrial facility. During these years, the facility carried out a number of processes using radioactive materials consisting primarily of depleted uranium (source material), but also of thorium (source material) and enriched uranium (special nuclear material). The Site operated under several NRC licenses and an agreement state license. New York State officials closed the facility in 1984 due to unacceptable releases from site operations. Congress authorized DOE to remediate the property, and subsequently all radioactive material was transferred to the control of DOE under their AEA authorities. The investigations conducted on the site indicate that the primary radiological contaminant of concern (COC) is uranium in the form of depleted uranium. The investigation also indicated several small pockets of thorium 232. Both of these radionuclides are source material as defined in Title 10 - Code of Federal Regulations - Part 40. The site also has a characteristic Hazardous Waste (HW) (D008, Lead), which has contaminated an area greater than the radiological COC's. All contamination is primarily in the form of soil like material at various depths.

Based on the historical information the potential waste definitions that could apply to the site are:

- Low-Level Radioactive Waste (LLRW) – (SNM or Source Material)
- Low-Level Mixed Waste (LLMW)– (LLRW and HW)
- HW – (Characteristic)
- Solid Waste (SW)
- Unimportant Quantity of Source Material

Issue 1

The analytical data from the investigation and other field activities allowed for the removal of SNM as a potential waste definition. This was a difficult determination based on the historical information, which indicated the site had operated under a license specifically for SNM. The SNM License was never terminated, however, historical documentation indicated that surveys were conducted in areas of SNM operation and one small area of the facility, which was utilized for both DU and SNM operations had slightly elevated areas of contamination. At the time of the termination request of the licensee, the NRC stated that the area would require decontamination. The licensee responded, stating that it was still a radioactive materials area for their DU operations and would be decontaminated when those operations ceased. To complicate matters further, the review of analytical data identified significant error associated with the low specific activity material. The error associated with some of the measured concentrations of U-235 and U-238 was as high as 100%. This high error affects the confidence of the enrichment calculation and therefore the determination of depleted or enriched uranium. Several options were considered to review the data and complete the determination of whether or not there is a potential for SNM at the Site. The options reviewed were 1) resample soils using more accurate methods 2) statistically compare the site data to data associated with uranium that has not been enriched, and 3) to propagate analytical error through the percent enrichment calculation to determine the error in the enrichment value. The method used in the historical data was alpha spectroscopy. USACE determined that the higher costs and additional time associated with more accurate analytical methods, such as mass spectroscopy, were not reasonable for the excavation and disposal of a large volume of material. USACE also determined that a statistical comparison of site material to the fluctuation of natural uranium would be difficult due to the fact that the site was contaminated primarily with DU. USACE began by reviewing the historical data for precision, accuracy, representativeness, completeness, and comparability of the data. After the review of data was complete it was determined that the best approach for the Site was to propagate the error associated with the analytical results. By knowing the error associated with the calculated enrichment value, USACE was able to make decisions regarding the few historical samples that appeared to be enriched when compared to the supplemental data being gathered at the site.

USACE stated the following problem and objective to address the issue:

PROBLEM: The remediation of sites that may require the removal of low levels of uranium contaminated material. The equation used to calculate the enrichment level of uranium uses analytical measurements of the U-234, U-235 and U-238 activity (converted to mass) or mass directly. The relative errors associated with the analytical

measurements generally increase with the lower measured isotopic activity. These individual errors become larger when propagated through the enrichment calculation making it difficult to accurately estimate the enrichment level of the uranium present and therefore properly classify the material being remediated.

OBJECTIVE: Determine the propagated error associated with the calculation of percent enrichment of U-235.

The following derivation is based on the condition that all individual variables in equation 1 have errors that are unrelated. (i.e. no measurable values were used to calculate more than one variable in equation 1).

Determining the U-235 enrichment percentage [Mass = (Activity U-xxx)/(Specific Activity U-xxx)].

$$E\%_{U235} = \frac{M_{235}}{M_{234} + M_{235} + M_{238}} \bullet 100 \quad (\text{Eq. 1})$$

Because the determination of enrichment is computed from two or more measurements, each of which has an error associated with it, the accumulation of errors is based on the fact that individual variances or uncertainties are additive.

$$s_{E\%U235} = \left[\left(\frac{\partial E\%}{\partial M_{234}} \right)^2 s_{M234}^2 + \left(\frac{\partial E\%}{\partial M_{235}} \right)^2 s_{M235}^2 + \left(\frac{\partial E\%}{\partial M_{238}} \right)^2 s_{M238}^2 \right]^{\frac{1}{2}} \bullet 100 \quad (\text{Eq. 2})$$

expands the first term in equation 2.

$$\left(\frac{\partial E\%}{\partial M_{234}} \right)^2 s_{M234}^2 = \left[\frac{-M_{235}}{(M_{234} + M_{235} + M_{238})^2} \right]^2 (s_{M234})^2 \quad (\text{Eq. 2.1})$$

expands the second term in equation 2.

$$\left(\frac{\partial E\%}{\partial M_{235}} \right)^2 s_{M235}^2 = \left[\frac{-M_{235}}{(M_{234} + M_{235} + M_{238})^2} + \frac{1}{M_{234} + M_{235} + M_{238}} \right]^2 (s_{M235})^2 \quad (\text{Eq.2.2})$$

expands the third term in equation 2.

$$\left(\frac{\partial E\%}{\partial M_{238}}\right)^2 s_{M_{238}}^2 = \left[\frac{-M_{235}}{(M_{234} + M_{235} + M_{238})^2}\right]^2 (s_{M_{238}})^2 \quad (\text{Eq. 2.3})$$

Equation 3 may be written as follows by combining equation. 2.1, 2.2, and 2.3 with equation 2.

$$s_{E\% U-235} = \left\{ \left[\frac{-M_{235}}{(M_{234} + M_{235} + M_{238})^2} + \frac{1}{M_{234} + M_{235} + M_{238}} \right]^2 (s_{M_{235}})^2 + \left[\frac{-M_{235}}{(M_{234} + M_{235} + M_{238})^2} \right]^2 (s_{M_{234}})^2 + \left[\frac{-M_{235}}{(M_{234} + M_{235} + M_{238})^2} \right]^2 (s_{M_{238}})^2 \right\}^{\frac{1}{2}} \bullet 100 \quad (\text{Eq. 3})$$

E% U-235 = Percent enrichment in uranium 235

M_{xxx} = Mass for specific uranium isotope [= (Activity U-xxx)/(Specific Activity U-xxx)]

∂ = Derivative

σ = Error

Table I. Examples of Site Data and Results Utilizing Parameters from Equation 3.

	M ₂₃₄	sM ₂₃₄	M ₂₃₅	sM ₂₃₅	M ₂₃₈	sM ₂₃₈	E% U-235	sE% U-235
1	0.004	0.001	3.144	0.786	413.44	94.30	0.75	0.25
2	0.004	0.001	2.820	0.786	380.73	91.32	0.74	0.27
3	0.003	0.002	1.664	1.433	201.67	68.71	0.82	0.75
4	0.002	0.001	1.757	1.341	235.28	121.06	0.74	0.68
5	0.001	0.001	1.618	0.786	208.21	80.61	0.72	0.46

M_{xxx} and sM_{xxx} in µg

CONCLUSION: Equation 3 calculates the error associated with the analytical results in the determination of enrichment levels of uranium. This allows for appropriate risk management decisions to be made when classifying materials prior to and during the remedial action process.

Issue 2

USACE requested a position from the NRC concerning the ability to utilize a disposal facility not licensed by the NRC or Agreement State to dispose of material containing an unimportant quantity of source material as described in 10 CFR 40.13(a) "Any person is exempt from the regulations in this part and from the requirements for a license set forth in section 62 of the Act

to the extent that such person receives, possesses, uses, transfers or delivers source material in 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. The exemption contained in this paragraph does not include byproduct material as defined in this part". The NRC has addressed this issue SECY-98-284 and SECY 99-259(1,2). The SECY papers have made specific recommendations and currently the NRC is developing rulemaking to address the issues associated with transfer of exempt material. In the interim, the NRC has chosen to address the disposal of an unimportant quantity of source material on a case-by-case basis. In the response to USACE the NRC stated they do not regulate activities at FUSRAP sites, however, the NRC staff does not object to the transfer, for disposal, of licensed material qualifying as unimportant quantities of source material, provided that the material for disposal will result in individual doses of less than 1 millisievert per year (100 mrem/year) (3).

USACE has worked with potential disposal facilities to evaluate the potential dose associated with the disposal of the site material and ensuring that we meet the intent of the NRC position. USACE has also worked with the RCRA disposal facility regulators to ensure compliance with each facility permit and the State regulations that apply to that disposal facility. This has been accomplished by preparing a package for the facility regulators, describing the methods and sampling of the material being segregated for disposal as an unimportant quantity of source material. The first step in the segregation process involved was developing a correlation in cpm, for a field instrument for detection of low energy radiation (FIDLER), to a Bq/g (pCi/g) concentration of depleted uranium in surface soils. This instrument is used to guide the excavator during the removal action. As the material is removed from the excavation, it is placed into 250 cubic yard stockpiles, sampled, and analyzed by on-site gamma spectroscopy. Currently USACE is utilizing the process described above to segregate the material based on the radiological activity to allow for the alternate disposal option of an unimportant quantity of source material.

Issue 3

USACE reviewed the historical information, which indicated that there is not a listed HW associated with the Site. The analytical data indicated the presence of a characteristic HW (D008, Lead). The HW component has the potential to cause the LLRW to be a LLMW. However, it will not effect the determination of the unimportant quantity of source material characterization. Utilizing the segregation process described above, USACE also samples the stockpiled material for Toxicity Characteristic Leaching Procedures (TCLP). If the material exhibits a characteristic HW it is placed into a treatment system onsite that stabilizes the lead and therefore removes the HW characteristic. At the completion each stockpile is re-sampled to ensure the treatment objectives have been met. All waste material must still comply with the applicable land disposal restrictions identified within 40 CFR 268, including 40 CFR 268.7, 40 CFR 268.9, 40 CFR 268.40, 40 CFR 268.48, and 40 CFR 268.49, which relate to notification and treatment requirements. Underlying hazardous constituents in waste being shipped offsite are expected to meet all applicable treatment standards in 40 CFR 268.48 and/or 40 CFR 268.49, such that the waste qualifies for direct land disposal without additional treatment. Upon completion of the treatment process the material is classified as LLRW or an unimportant quantity of source material based upon the radiological activity.

Issue 4

USACE has an agreed cleanup criteria associated with the contaminants of concern at the Site. The potential exists for material to meet the cleanup criteria associated with the radiological contaminants but have an elevated chemical COC that requires excavation. This type of material is excavated and sampled for TCLP to determine the potential for a characteristic HW. If the material fails TCLP analysis it is treated and re-sampled by TCLP. Upon completion of the treatment, the material is characterized as a solid waste. Due to limitations on site it may not be possible to meet criteria associated with the placement of a solid waste disposal cell on the property. This material should be eligible for disposal at a local solid waste disposal facility, however, due to the fact that the material is being removed from a FUSRAP Site, it has become difficult to place this type of solid waste into a local facility. USACE is currently seeking additional disposal facilities for solid waste material that may not be inconsistent with other wastes that are disposed of at solid waste facilities. There are currently other Federal agencies that have positions on similar matters, the Department of Energy has outlined their position within DOE Orders and a Radiological Control Technical Position that describe requirements for off-site disposal of solid and hazardous wastes (4,5). These DOE positions allow for the release of property containing residual radioactive material at or below the applicable authorized limit (i.e. cleanup criteria). Similar wastes that may contain elevated levels of radionuclides are routinely disposed of in solid waste landfills. For example, the Environmental Protection Agency currently exempts large volume coal fired utility wastes from regulation as a HW and it does not consider the elevated levels of NORM (6). Much of this waste does not have the regulatory history of the FUSRAP material described above, however it can contain residual NORM that has been concentrated to levels above the Site cleanup criteria. This issue may be important at any of the FUSRAP sites where USACE is remediating material for its chemical, in addition to its radiological, constituents.

Summary

Virtually all the material associated with Case Study 1 requires treatment to remove the characteristic HW. The material is then being segregated based upon the radiological activity into three categories 1) LLRW (source material above 0.05% by weight) 2) unimportant quantity of source material, and 3) material that meets the site-specific radiological release criteria. Current disposal options being implemented are disposal of LLRW at a licensed LLRW disposal facility and an unimportant quantity of source material at a RCRA Subtitle C disposal facility permitted to accept the material. The segregation of the material based upon its radiological activity has shown significant cost savings while still being protective to human health and the environment. USACE is still reviewing other options that may come available and once again provide significant cost savings and being protective to human health and the environment.

CASE STUDY 2

Background

There are several FUSRAP sites associated with this case study. These sites have operated as industrial facilities since the early 1900's and were involved in the processing of ores for the AEC and commercial activities along with other industrial operations. The facilities extracted thorium from monazite sands for many commercial uses such as lantern mantles, as well as for the AEC. Several facilities also conducted commercial activities associated with the extraction of rare earths from ores (monazite sand). The sites were typically authorized under an AEC license to receive unlimited quantities of raw source material primarily in the form of monazite sands.

Based on the historical information the potential waste definitions that could apply to these sites are:

- radioactive residuals from the processing of ores at facilities not licensed by the Nuclear Regulatory Commission (NRC) at the time the Uranium Mill Tailing Recovery Act was enacted in 1978 or thereafter. (ore residuals)
- 11e.(2) byproduct material
- LLRW – (Source Material)
- LLMW – (LLRW and HW)
- HW – (Characteristic)
- SW
- Unimportant Quantity of Source Material

Issue 1

The facilities involvement in both rare earth extraction and thorium extraction from the same material creates the potential for waste material that has been processed for its source material content (11e.(2) byproduct material or ore residuals) and for waste material that has not been processed for its source material content (LLRW or source material). Typically, wastes from monazite sand processed for the source material/thorium (Th-232 and Th-228) would have elevated levels of the other than thorium isotopes in the thorium decay series. Wastes from monazite sand processed for rare earths would have elevated levels of all isotopes in the thorium decay series, including thorium. Therefore, distinguishing between the two wastes could be accomplished by reviewing the isotopic equilibrium of the thorium decay series. This is complicated by the fact that the thorium decay chain reestablishes equilibrium in the byproduct waste stream in approximately 40 years and many of these site activities have taken place prior to 1960. This is further complicated by the fact that the same waste area may have been utilized for 11e.(2) byproduct wastes, ore residuals, and source material wastes from the rare earths processing (along with wastes from other facility operations). Analytical data from waste burial areas indicates a wide range of radionuclide activities. Comparison of the activity in the waste, to that found in unprocessed monazite sand, indicates that thorium has been extracted. However, the thorium decay series can essentially be considered to be in equilibrium. Detailed analysis of

historical records for the FUSRAP sites such as operating procedures, photographs, and AEC inspection records showed that the majority of the waste material was produced as ore residuals.

Issue 2

The many industrial processes at the facility and use of common waste areas introduce the potential for HW not associated with processing of monazite sands for its source material content. While other potential materials in the monazite sand and chemicals in the 11e.(2) byproduct material (as a result of the process) are exempt from RCRA, any other HW commingled with these materials is not. To complicate matters further, the NRC has stated that ore residuals should comply with the requirements of RCRA and the EPA has stated that if the ore residuals are similar to 11e.(2) and if placed into an 11e.(2) disposal cell they, would be exempt from RCRA(7). If HW is commingled with byproduct material or ore residuals a very unique disposal issue is raised. There are potentially three combinations of waste classifications that apply 1) 11e.(2) mixed with HW 2) ore residuals mixed with HW, and 3) ore residuals. New interim guidance is currently available for 11e.(2) byproduct material disposal facilities to accept ore residuals or 11e.(2) mixed with HW if it meets the requirements defined by the NRC(8). The guidance requirements are summarized below:

- SNM and 11e.(1) can not be disposed of in a 11e.(2) disposal cell
- Must obtain approval from State or EPA RCRA departments
- Licensee must demonstrate that there will be no significant environmental impact from the disposal
- Licensee must demonstrate that the disposal will not interfere with the reclamation/closure of the cell
- Must have approval from LLRW Compact (if applicable)
- Long term custodian (typically DOE) must approve of the disposal
- Licensee must amend their license to accept that material.

USACE believes this to be a reasonable approach, however, it remains to be seen if disposal facilities and their regulators agree. Until these issues can be completely resolved disposal of ore residuals, ore residuals mixed with HW, and 11e.(2) byproduct material mixed with HW is dealt with on a case-by-case basis.

Issue 3

Several of the facilities operated prior to the AEA for both governmental and non-government commercial purposes. This leads to the question whether waste material from thorium processing activities prior to the AEA can be classified or regulated by the AEA. USACE has reviewed the disposal actions and legal issues involving other facilities, operated prior to the AEA in support of the gas lighting industry, to aid in determination of disposal options for FUSRAP sites. Additionally, the historical site assessments indicate that some waste areas have been used prior to and after the AEA thus creating a mix of potentially non-AEA and AEA material. Consistent with the approaches taken at other facilities these materials are evaluated by using definitions from the AEA and reviewing historical information associated with all site operations.

Summary

The Case Study 2 facilities involve numerous legal and technical issues. USACE uses a legal and technical team to work with the DOE, NRC, EPA, Compacts, States, and disposal facilities to insure that material is disposed of in a manner that is protective of human health and the environment and cost effective. Current disposal options, for material determined to be 11e.(2) byproduct material, being implemented or considered, are disposal of byproduct material at licensed 11e.(2) byproduct material disposal facilities. Current disposal options for ore residuals are licensed 11e.(2) byproduct material disposal cells and RCRA Subtitle C disposal facilities permitted to accept the material.

CONCLUSION

In order to achieve the Congressional mandate of completing cleanup work under FUSRAP in a more cost effective, timely manner, while assuring protection of public health and safety, USACE will determine all disposal options that are available for the types of waste at each of the FUSRAP sites. This determination is made for each specific waste stream identified from each FUSRAP site. In many instances there is more than one waste stream associated with each FUSRAP site. The difference in the waste stream is determined based on historical site assessment, historical data and USACE supplemental data. The challenges with the analytical data in determining the waste types are associated with the error of the analytical methods, the ability of the analytical data to specifically determine process activities associated with the waste stream, and the potential co-location of other process waste streams. The challenges with the historical assessment in determining the waste types are associated with the following: lack of environmental and process documentation prior to the 1950's; availability of documents from government activities conducted several decades ago; availability of documents from commercial activities conducted several decades ago; and that available documents may have made assumptions of activities and process that may not be accurate. Typically there is a combination of the issues at each FUSRAP site. The methods identified above are used to resolve the issues and to properly characterizing the waste streams. This information is assembled and reviewed by the USACE technical and legal team prior to making a waste characterization. In making the determination for each specific waste stream, it may not be possible to identify only one waste definition; therefore professional judgement is used to determine which waste definition best represents the waste stream. If it is determined that there are two wastes within one waste stream a determination is made on whether the wastes can be segregated. If the wastes can be segregated cost effectively an attempt to do so may be accomplished. Upon determining the waste characterization USACE works with stakeholders (NRC, EPA, DOE, State Agencies, and disposal facilities) to ensure that the material will be disposed of in a manner that is protective of human health and the environment.

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