THE MANAGEMENT OF MIXED LOW-LEVEL RADIOACTIVEWASTE IN THE NUCLEAR POWER INDUSTRY

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ABSTRACT

As a result of investigations sponsored by the nuclear power industry, the definition of mixed low-level radioactive waste (mixed waste) in the industry is clarified. A methodology for estimating the annual generation rate of mixed waste is presented and its application to a typical nuclear power plant is illustrated. Effective management practices to minimize the generation of mixed waste are described and strategies to deal with unavoidable mixed waste are identified.

INTRODUCTION

With the passage of the Low-Level Radioactive Waste Policy Act (LLRWPAA)(1) came a greater realization among regulators and the regulated community that some waste may be both radioactive and hazardous. Although the Resource Conservation and Reclamation Act (RCRA)(2) and the Hazardous and Solid Waste Amendments Act (HSWA)(3) excluded from regulation materials already regulated by the Atomic Energy Act of 1954 (AEA)(4), only material which is itself radioactive was considered to be covered by the exclusion. That is, only the radionuclides themselves were excluded from regulation under RCRA, not any other material contaminated by or containing the radionuclides. Since the radioactive and hazardous constituents are rarely separable, except at great cost and technical difficulty, wastes containing both constituents would likely be subject to dual regulation by the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Environmental Protection Agency (EPA). Congress was appraised of this potential but declined to affix sole regulatory authority to either agency through its legislation(5).

There are major philosophical differences between the regulatory approaches of the NRC and the EPA and the legislation upon which their regulatory authorities are based. Furthermore, because of additional regulation and the resultant probable modifications to plant design, operating procedures, and administrative protocol, the cost of managing such mixed (low-level radioactive and hazardous) waste was expected to be great. Thus, the nuclear power industry sought to clarify the application of hazardous waste regulations to the low-level radioactive waste (LLW) it typically generates.

Through the Nuclear Management Resources Council, Inc. an approach was developed which would clarify the definition of mixed waste, compare applicable NRC and EPA regulations, characterize the generation of mixed waste, identify affective means of managing mixed waste, and evaluate the potential radiological impacts of implementing key hazardous waste regulations(6). The results of several of these activities are reviewed in this paper.

MIXED WASTE DEFINITION

Although the NRC and EPA issued a joint statement(7) which was intended to assist interested parties in determining the status of waste under NRC(8) and EPA regulations(9), many questions were left unanswered because of the complexity of hazardous waste regulations. The flow chart offered in the joint statement was sufficiently simple that it offered only an initial explanation of what mixed LLW is. The nuclear power industry sought to eliminate ambiguities and resolve unanswered questions about the definition of mixed waste.

A revised flowchart, included as Fig. 1, was prepared which involved additional issues of particular interest to the nuclear power industry. This sequence of questions addressed mixtures of hazardous waste and other solid waste, the cause for listing, and the possibility that the waste might be regulated under the Clean Water Act.

In the process of enhancing the flowchart, several subtleties of the hazardous waste definition were identified and their application in the nuclear power industry evaluated. These are summarized below:

- If a listed waste in a mixture is listed only because of one or more of the hazardous characteristics defined in 40 CFR 261, Subpart C, the mixture is a hazardous waste, only if it exhibits one or more of those same hazardous characteristics.
- If a listed waste in a mixture is listed because of a characteristic other than those defined in 40 CFR 261, Subpart C, the mixture is a hazardous waste whether or not it exhibits any hazardous characteristics.
- Formulated substances are not hazardous wastes when discarded unless there is a sole active ingredient which is a listed waste or unless it exhibits (40 CFR 261) Subpart C hazardous characteristic.

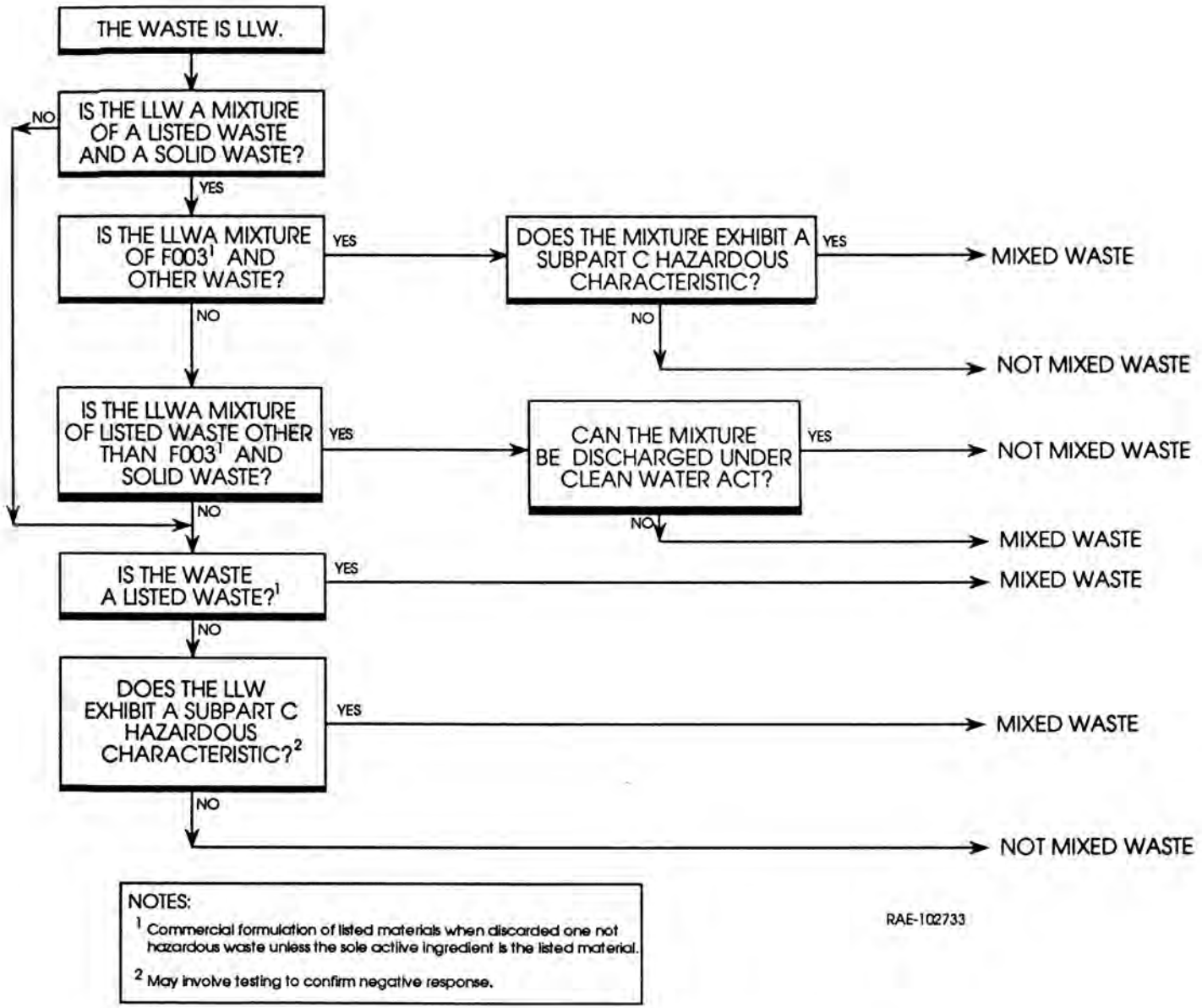

Fig. 1. Flowchart Enhanced for the Nuclear Power Industry for Identifying Status of LLW or Mixed Waste.

Clothes containing spent solvents may be hazardous waste (EPA is preparing a clarification of this matter).

- Waste oil may be a hazardous waste.
- Materials listed as spent solvents but used for other than their solvent properties may not be hazardous waste when discarded, e.g., scintillation cocktails.
- Material in a manufacturing process unit or a totally enclosed treatment facility is not considered as a waste until it is discharged from the unit or facility.
- Residues in empty containers are not hazardous waste if they satisfy certain conditions.
- Waste characterization samples are not hazardous waste if they satisfy certain conditions.
- Within specified limits, water discharges which are regulated under authority of the Clean Water Act are not regulated as hazardous waste.

These observations are useful to the nuclear power industry and should be helpful to others as well.

METHODOLOGY FOR ESTIMATING MIXED WASTE GENERATION RATES

Based on the definition of mixed waste and the numerous observations cited above, an approach to the estimation of mixed waste generation rates was prepared. A fundamental premise of the approach is the fact that hazardous materials (any material which, when discarded or intended for disposal, would be a hazardous waste) are not created, manufactured, or produced in nuclear power plants. The processes at nuclear power plants do not involve complex chemical reactions that produce new products. Rather, these processes principally involve changing the physical state of water and treating water to maintain acceptable quality. A supplementary premise is the presumption that hazardous waste is generated only when hazardous materials are discarded or through contact with hazardous materials in the power plant.

Given the two premises stated above, the development of the methodology for estimating mixed waste generation rates was substantially simplified. The methodology involved:

- Determining the supply of hazardous materials to the power block of a nuclear power plant.
- Identifying activities which consume or utilize hazardous materials in the power block.
- Estimating the waste produced by each such activity.
- Determining whether each waste is a hazardous waste.
- Determining whether each waste is radioactively contaminated.
- Estimating the annual mixed waste volume generation rate.
- Characterizing mixed waste in terms of hazardous and radioactive content.

Numerous contacts to knowledgeable individuals were made within several nuclear utilities to complete the activities listed above. It quickly became apparent that relatively little information was available in a convenient and referenceable form upon which concise volume estimates could be based. Therefore, informed judgments of experienced individuals was the basis for the volume estimates which resulted from the application of the methodology described above.

Because of the limitation in available information described above, and because of numerous generator specific conditions which significantly influence the magnitude of the volume estimate, two cautions about the volume estimates should be carefully considered. First, the volume estimates were prepared only to illustrate application of the estimation methodology. The volume estimates are not intended to declare the actual mixed waste generation rate at any power plant or for the nuclear power industry as a whole.

Second, an effort was made to identify potential sources of mixed waste. Therefore, conservative assumptions were made to identify the largest reasonable number of potential mixed waste sources. Because of unique conditions at individual power plants (e.g., plant design, operating procedures, hazardous material usage, and state- or region-specific regulatory implementation), each potential source of mixed waste should be evaluated against plant-specific conditions to determine whether mixed waste might actually be generated by the potential source.

EFFECTIVE MIXED WASTE MANAGEMENT PRACTICES

From the foregoing project activities, several effective practices for mixed waste management were identified and are summarized here. In all these, the first objective is generally to avoid generating as much mixed waste as possible. Since it is realistic to expect that some mixed waste generation cannot be avoided, the objective might be to render the waste non-hazardous. Finally, it is likely that even this strategy will leave mixed waste which must be managed. In this condition, there are other opportunities available to minimize the impact on mixed waste generators.

Mixed waste generation can be minimized by tightly controlling the admission of hazardous materials into and the use of hazardous materials within the power block. Since hazardous (mixed) waste can only be generated through contact with or disposal of hazardous materials in the power block, reducing their availability in areas where radiological contamination is possible is an effective management technique. Carefully designed materials control programs coupled with personnel training can implement this approach to minimizing mixed waste generation. To the extent possible, non-hazardous materials should be substituted for hazardous materials. However, this may not always be possible. Therefore, where hazardous materials are necessary their use should be strictly controlled to reduce the potential for radiological contamination.

Where the hazardous material required is a solvent, consideration should be given to the use of solvents listed

only for their ignitability characteristic (F003 Solvents, 40 CFR 261, Subpart D). The use of F003 solvents provides the possibility of rendering the waste non-hazardous through treatment or processing so it can be managed as other than hazardous waste (i.e., not mixed waste).

Where treatment or processing is possible to remove a hazardous characteristic, it may be accomplished under hazardous waste regulations without a treatment permit the waste is treated or processed in its accumulation tank or container and within the generators' accumulation time (90, 180, or 270 days depending on the generators' status).

To the extent possible, recoverable materials should be recycled. This approach can be useful for spent solvents and waste oil.

For mixed waste whose generation cannot be avoided, there are a few alternatives to minimize the impacts of dual regulation:

- Treat in accumulation tank or container within generators' accumulation time to avoid the need for a treatment permit.
- Store mixed waste at a central permitted mixed waste storage facility to avoid the need to obtain storage permits at individual generation sites (storage is necessitated since no mixed waste disposal facilities presently exist).
- Petition the EPA to delist a waste at an individual facility.
- Petition the EPA to revise a rule.
- Dispose the waste under a Below Regulatory concern rule, when available and as appropriate.

SUMMARY

The definition of mixed waste as it applies at nuclear power plants has been extended and subtleties of hazardous waste definitions clarified. A methodology for estimating the generation of mixed waste at a nuclear power plant was developed and applied using very conservative assumptions. The methodology can be used by individual generators to estimate mixed waste generation at their facilities. Effective management practices and techniques have been identified in order to minimize the amount of mixed waste being generated and to minimize the impacts of dual regulation.

REFERENCES

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