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INTRODUCTION

Since passage of the 1984 amendments to the Resource Conservation and Recovery Act (RCRA), major changes have occurred in the regulation of hazardous waste. The U. S. Environmental Protection Agency (EPA) has also greatly modified its interpretations of how these regulations apply to wastes from federal facilities, including defense wastes from U. S. Department of Energy (DOE) sites. As a result, the regulatory distinctions between low-level radioactive waste (LLW) and hazardous waste are becoming blurred. This paper discusses recent statutory and regulatory changes and how they might affect the management of LLW at DOE facilities.

Highlights of the Hazardous and Solid Waste Amendments

The Resource Conservation and Recovery Act of 1976 represented the first attempt at the federal level to deal comprehensively with the overall problems of solid waste management in general and hazardous waste management specifically.[1] In its original form, RCRA imposed requirements on generators and transporters of hazardous materials and on owners and operators of treatment, storage, and disposal facilities to provide "cradle to grave" management of hazardous waste. Minor amendments to RCRA were made in several Congressional sessions between 1976 and 1984, but it was not until the Hazardous and Solid Waste Amendments (HSWA) of 1984 that the regulation of hazardous waste was drastically altered. The following discussion highlights some of the more significant new provisions of the law and its implementing regulations.

The HSWA represent a severe reaction to the perception that the EPA had not vigorously pursued implementation of the Congressional intent of RCRA. The 1984 amendments nearly double the length of the statute and contain unusually detailed and highly directive provisions that remove much of EPA's discretion in regulating hazardous wastes. Many so-called "hammer provisions" require EPA to implement new requirements by certain statutory deadlines, or a Congressionally formulated regulation will automatically go into effect.

The most striking feature of the amended law is the much clearer message it projects that continued reliance on land disposal of untreated hazardous chemicals is untenable over the long term. The most significant new provision calls for EPA to determine whether to ban the disposal of all RCRA-listed hazardous wastes in landfills. The land disposal ban will take effect in several phases. As of November 1986, land disposal of wastes containing dioxins or solvents is prohibited unless EPA determines that continued land disposal of these substances can be accomplished with a reasonable certainty that there will be no migration of hazardous constituents from the disposal facility. Also by November of 1986, EPA is required to publish a list of all other RCRA wastes divided into three groups based on hazard and volume of substances and provide a schedule for making a ban determination for each group. Decisions on banning the first group of highest priority substances must be made by August 1988, or the substances are automatically banned. Likewise, the second and third groups have hammer provision dates of June 1990 and May 1991. In addition, as of July 1987, the wastes already banned from land disposal in California are also banned under RCRA unless EPA provides variances.

Other significant new provisions added by the HSWA are the "minimum technological requirements" for landfills and surface impoundments. New landfills and impoundments, or expansions of existing ones, will be required to have double liners and leachate collection systems installed to prevent groundwater contamination. In addition, existing unlined surface impoundments must be retrofitted with liners unless two very limited exemption categories can be met. Applications for these exemptions must be filed by November 8 of 1986. After that time, no further requests for exemptions from retrofitting will be accepted.

EPA made it clear that the statutory requirements for double liners and leachate collection systems would be enforced in its January 1986 proposed rule for implementing the land disposal ban. This proposal, however, would have established health-based "maximum acceptable contaminant concentrations" for leachate migration. But by mid-1986, it appeared that the Agency would probably be forced to withdraw this proposal and issue a rule literally implementing the statutory "no migration" standard in response to severe Congressional pressure. Continued land disposal of untreated chemical wastes is consequently likely to become very difficult, if not impossible.

Sections 3004(u) and (v) of the amended RCRA contain provisions that are also likely to have major impacts on the regulated community. Originally, RCRA applied to active operations at treatment, storage, and disposal facilities but did not cover inactive units. Releases of hazardous constituents that occurred in the past or that are occurring now from inactive units were therefore not in RCRA's jurisdiction. New Sect. 3004(u) now gives EPA authority to require corrective action for releases from any inactive or closed solid waste (not just hazardous waste) disposal unit at a facility that is applying for a RCRA Part B permit. [Interim status facilities are covered by a similar provision

under Section 3008(h).] The issuance of a RCRA permit will be contingent upon completion of the corrective action or at least on the establishment of a compliance schedule for the corrective action. Section 3004(v) also gives EPA the authority to require corrective action beyond the facility boundary where necessary "to protect human health and the environment."

In a March 5, 1986, Federal Register notice (51 FR 7722) EPA addressed the definition of "facility" for federal installations. EPA determined that Sect. 3004(u) subjects federal facilities to corrective action requirements to the same extent as any private facility. Furthermore, EPA determined that federal facilities are to operate under the same propertywide definition of "facility."

Finally, a Congressional directive to re-examine the extraction procedure used to determine the "Toxicity Characteristic" was included in the HSWA. In response, EPA has proposed a new leaching test and intends to expand the list of toxic constituents for which the test must be used. Details of the new test and its implications are discussed below.

LOW-LEVEL WASTE AND THE TOXICITY CHARACTERISTIC

Historical Aspects of the Toxicity Characteristic

One criterion for defining a waste as hazardous under RCRA is if the waste exhibits the Toxicity Characteristic, which in the past has been determined using a laboratory test known as the "extraction procedure" or EP. The intent of the EP was to identify wastes with the potential for releasing specific toxic constituents when exposed to leaching media composed of low molecular weight carboxylic acids. These constituents included eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), four insecticides (endrin, lindane, methoxychlor, and toxaphene), and two herbicides (2,4-D and 2,4,5-T). Toxicity levels for these substances were set at the National Interim Primary Drinking Water Standards (DWS), and a generic factor of 100 was used to approximate the dilution/attenuation expected to occur during migration of leachate to groundwater. Thus, if any of these substances are present at concentrations 100 times their respective drinking water standards in the extract of a waste, the waste is defined as toxic and, therefore, as hazardous.

The EP was designed to simulate a "codisposal" scenario for improper waste management, that is, hazardous waste being disposed of with municipal wastes in sanitary landfills. Before 1980 municipal landfills represented one of the largest sources of groundwater pollution because they regularly contained toxic industrial waste materials that had been disposed of carelessly or illegally. The overall goal of the EP was to provide a means of calling a halt to this particularly serious form of

mismanagement. Implementation of the EP in concert with the listing of hazardous wastes was supposed to eliminate disposal of industrial wastes in municipal landfills by clearly identifying what was to be prohibited.

The Toxicity Characteristic Leaching Procedure

In the HSWA the Congress directed EPA to examine the deficiencies of the EP and to make changes in it to improve its accuracy for predicting the leaching potential of wastes when mismanaged. On June 13, 1986, EPA issued a proposed rule (51 FR 21647) amending the related regulations to (1) expand the Toxicity Characteristic to include 38 new compounds, all of which are organic [NOTE: nickel and thallium are also expected to be included in the final regulations]; (2) apply compound-specific dilution/attenuation factors generated from a groundwater transport model; and (3) introduce a second-generation leaching test, the Toxicity Characteristic Leaching Procedure (TCLP), which has been developed to address leaching and migration of both inorganic and organic compounds and to solve operational problems of the EP protocol. The TCLP is based on research performed over a 3-year period at the Oak Ridge National Laboratory [2,3] and simulates more closely than the EP the behavior of wastes under landfill conditions. Highlights of the differences between the protocols for the EP and the TCLP are as follows.[4]

Leaching Medium and pH

The EP used a 0.5-N acetic acid leaching medium made up with sufficient distilled water to produce a pH of 5. The procedure required continual adjustments of pH at 15-min intervals for up to 6 h or more. The TCLP will use a sodium acetate buffer leaching medium for neutral to acidic wastes, which eliminates the problem of pH adjustments during extraction. Note, however, that TCLP is also a two leaching fluid system depending on the pH of the waste being extracted. For moderate to high alkaline wastes, a 0.1-N pH 2.9 acetic acid solution will be required.

Particle Size Reduction

The EP protocol required particle size reduction for waste that cannot pass through a 9.5-mm sieve or has a surface area of >3.1 cm^2/g. The TCLP continues this requirement. It is important to note, however, that the EP allowed the use of the Structural Integrity Procedure, which called for the pounding of a monolithic waste with "hammerlike" blows. The EP was then conducted on the resulting partly broken up sample. The TCLP protocol does not allow this, but requires particle size reduction, that is, grinding or milling, for all wastes.

Cost

EPA states that although the TCLP is expected to be similar to the EP in cost, the analysis for 38 to 40 additional contaminants will raise the price of testing with TCLP. EPA's estimates are about $1000 for an analysis with EP vs $2000 to $4000 for TCLP. To cut analytical costs, EPA may allow the use of a prescreening test for the TCLP protocol. The prescreen will consist of a total analysis of the waste, which, if it does not contain sufficient levels of contaminants to exceed the regulatory thresholds, need not then undergo the TCLP.

Application of the Toxicity Characteristic to LLW

Disposal of Lead

Lead is used extensively in the DOE system because of its excellent ability to attenuate radiation. It has been integrated into many operations with radioactive materials and wastes, including the packaging, transportation, and burial of these materials. In fact, data collected by various DOE contractors indicate that the majority of DOE wastes may contain lead.[5] When lead-bearing LLW, such as lead bricks and lead sheets, are subjected to the EP, however, the resulting leachates in almost every case contain lead levels above the regulatory threshold. And although items such as leaded glass, leaded gloves and aprons, and similar materials with durable outer coatings might pass the EP, the requirement for grinding all test substances in the TCLP protocol is apt to cause even these materials to fail the test. The result is that most, if not all, lead-bearing LLW could become subject to regulation under RCRA as hazardous waste. Operational concerns stemming from this regulatory issue have already forced temporary closures of the burial grounds at Savannah River and Oak Ridge, and lead disposal has been banned at the Nevada Test Site.

The Codisposal Scenario

Disposal practices that allow burial of materials such as cardboard, contaminated trash, etc., are likely to produce organic acid leachates in LLW trenches. This situation also encourages EPA to view LLW sites as candidates for regulation under RCRA because of the conformity of these practices to the "codisposal" scenario for waste mismanagement.

Implications of Regulating LLW under RCRA

The possibility that LLW could become widely subject to regulation under RCRA would have impacts on DOE waste management operations in two

major areas. First would be the necessity to conform to RCRA requirements governing generation, treatment, storage, and disposal. These would include, among many others, requirements for permitting, adopting minimum technology for landfills, monitoring, testing of wastes for hazardous constituents in leachates, and possibly the need to cope with severe restrictions, if not a ban altogether, on the disposal of lead-bearing LLW if no satisfactory method of eliminating the migration of lead leachates could be found. All of these would certainly entail increases in operating costs and demands on other resources that must be dedicated to waste management. Second, regulation of LLW under RCRA may introduce conflicts with, and contradictions of, well-established philosophies and approaches to safe handling of radioactive materials. For example, strict adherence to some RCRA requirements could result in radiation exposure. These conflicts will necessitate that variances from RCRA requirements be established for handling of some radioactive materials. Although EPA has recognized this need, no overall plan for the appropriate variances has yet been formulated. In addition, the use of solidification, fixation, or stabilization techniques, which have long been acceptable in LLW management, is largely negated by the RCRA/TCLP requirement for grinding of all wastes. Few materials containing listed constituents would fail to produce leachates above regulatory thresholds when ground, although they may be highly stable and inert in the form in which they are actually disposed.

It should, however, be kept in mind that whether or not LLW is to be subject to regulation as hazardous waste, it is a near certainty that procedures for waste management will have to be modified in the future. Even simply avoiding RCRA regulation will make this true. The presence of effective leaching media in LLW burial grounds might, for example, be prevented by segregation and removal of all materials that are likely to generate low molecular weight carboxylic acids. Use of an arid disposal environment might also provide conditions that would allow the continued use of shallow land burial. To ensure that EPA agrees that such strategies are environmentally acceptable, DOE will probably have to commit itself to new policies that end practices that may be construed as "codisposal." Similarly, methods of handling lead that both minimize the introduction of new lead into the DOE system and that maximize the potential for its future recycling will probably have to be adopted. For example, all new lead materials entering the system could be required to have a strippable coating that could be removed and discarded, allowing continuing recycling instead of disposal of the lead.[5]

There is a real need for interagency negotiations to establish alternative LLW management strategies that take into consideration the intrinsic characteristics of the waste, the effect of stabilization techniques, and the actual disposal environment. EPA may have to be persuaded to accept the use of stabilization techniques and to forego the requirement for analysis of LLW with the TCLP or, at a minimum, forego the requirement for grinding of these wastes. The ultimate goal should be to ensure that the distinctions between LLW and hazardous waste are clearly maintained so that LLW management activities do not, and need not, require RCRA permits.

CORRECTIVE ACTION UNDER RCRA

Statutory Framework for Corrective Action

The HSWA provided authority for EPA to require corrective action at all facilities either pursuing RCRA permits or operating under interim status. The intent of the Congress was to correct shortcomings in existing regulations that allow permits to be issued to operating facilities without addressing releases of contamination that occurred in the past or are occurring now from closed units at these facilities. EPA's interpretation is that all permit applicants must now (1) identify all solid waste management units at a facility, (2) identify any releases that have occurred or are occurring, (3) clean up those releases with appropriate corrective measures, and (4) demonstrate financial assurance for such corrective measures. The pertinent statutory provisions are as follows:

Section 3004(u), Continuing Releases at Permitted Facilities - This section specifies that RCRA permits issued by EPA or the states will include corrective action requirements for "all releases of hazardous waste or constituents from any solid waste management unit at a treatment, storage, or disposal facility seeking a permit ... regardless of the time at which the waste was placed in such unit." Permits may be issued before corrective action is completed, but the RCRA permit must contain a schedule of compliance for the corrective action.

Section 3004(v), Corrective Actions Beyond Facility Boundary - This section requires that corrective action be taken beyond the facility boundary where necessary "to protect human health and the environment" from contamination that has migrated from a facility's regulated and solid waste management units. Section 3004(v) applies to all permitted facilities and all landfills, surface impoundments, and waste pile units that received hazardous waste after July 26, 1982.

Section 3008(h), Interim Status Corrective Action Orders - This section allows EPA to require corrective action at interim status facilities. EPA is authorized to revoke interim status for any person failing to comply with an interim status corrective action order in the time specified for compliance and may assess fines of $25,000 per day of noncompliance.

Other Aspects of the Corrective Action Requirements

EPA's authority to require corrective action extends to all "solid waste management units" at a facility, not just hazardous waste management units. "Unit" means containers and container storage areas, tanks (including 90-d accumulation tanks), surface impoundments, waste piles, land treatment units, landfills, incinerators, underground injection wells, transfer stations, and waste recycling operations. "Facility"

means "all contiguous property under the owner's or operator's control." "Release" is interpreted as it is under CERCLA, that is, any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing not covered by a discharge permit.[8]

On March 28, 1986, EPA proposed a rule implementing corrective action that adds new information requirements to applications for Part B RCRA permits. Owners and operators of facilities seeking RCRA permits will now be required to submit additional information for all active or inactive solid waste management units at a facility. For each unit the following information must be submitted: type of unit, location of each unit on a topographic map, general dimensions, when the unit was operated, a description of the wastes that were placed in the unit, and all information available to the owner or operator on whether or not any releases have occurred from any solid waste management unit at the facility. EPA would determine whether there is evidence that there has been a release from a review of all available information, which constitutes a Preliminary Assessment. If necessary, a Site Investigation follow-up may then be required in which the owner or operator may have to conduct sampling and analysis of groundwater (including installation of wells), land surface and subsurface strata, surface water, or air where EPA ascertains that such an investigation is warranted. A Preliminary Assessment/Site Investigation under RCRA may be followed by various levels of remedial investigation and possibly corrective action.

Interface With CERCLA Program

Clearly, there are strong similarities between EPA's proposed approach to RCRA-oriented corrective action and the activities now under way in the CERCLA program. The similarity in fact brings up an interesting question with regard to which sites would be considered candidates for treatment under RCRA instead of CERCLA. Evidently, it is EPA's general policy to handle as much under RCRA as possible. In the Agency's view, necessary remedial actions at actively operating facilities would be RCRA, not CERCLA, sites. EPA has already published a notice that it intends to reclassify CERCLA sites, including many of those listed on the National Priorities List, as RCRA 3004(u) corrective action sites where possible.

For DOE, this may mean that the only "CERCLA" sites left in the system would be those at facilities that are actually shut down or those few that contain only radioactive, but not mixed, waste. The positive side of this is that it might enable DOE to avoid having any of its sites listed on the National Priorities List. On the other hand, it may also mean that cleanup, closure, etc., would have to be performed according to RCRA standards, which are more involved than what might have been required under CERCLA. (This may, however, be irrelevant, because the CERCLA reauthorization provisions approved in Congressional conference thus far apparently require application of RCRA standards for CERCLA cleanups anyway.) Personnel in the CERCLA program have said that any information collected for CERCLA would, of course, be applied to 3004(u) remedial investigations "to the extent possible," implying that the work that has already been done may not always be considered adequate for 3004(u)

purposes. Finally, it should be noted that the reclassification of DOE disposal sites would represent yet another mechanism by which LLW and transuranic waste may enter the RCRA regulatory arena.

SUMMARY

The HSWA of 1984 have greatly expanded the universe of what, and who, is regulated under RCRA. Handling requirements for hazardous waste are becoming increasingly more stringent, particularly where land disposal is concerned. DOE needs to begin actively pursuing strategies directed at keeping the management of LLW clearly separated from wastes that are legitimately regulated under RCRA. Such strategies would include instituting systemwide changes in internal management practices, establishing improved location standards for LLW disposal, and negotiating interagency compromise agreements to obtain variances from RCRA requirements where necessary and appropriate.

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