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**Argonne National Laboratory, East
Hazardous Waste Shipment Data
Validation Report**

**Radioactive Waste Technical
Support Program**

September 1995

Argonne National Laboratory, East Hazardous Waste Shipment Data Validation

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ABSTRACT

At the request of EM-331, the Radioactive Waste Technical Support Program (TSP) is conducting an evaluation of data regarding past hazardous waste shipments from DOE sites to commercial TSDFs. The intent of the evaluation is to find out if, from 1984 to 1991, DOE sites could have shipped hazardous waste contaminated with DOE-added radioactivity to commercial TSDFs not licensed to receive radioactive material. A team visited Argonne National Laboratory, East (ANL-E) to find out if any data existed that would help to make such a determination at ANL-E. The team was unable to find any relevant data. The team interviewed personnel who worked in waste management at the time. All stated that ANL-E did not sample and analyze hazardous waste shipments for radioactivity. Waste generators at ANL-E relied on process knowledge to decide that their waste was not radioactive. Also, any item leaving a building where radioisotopes were used was surveyed using hand-held instrumentation. If radioactivity above the criteria in DOE Order 5400.5 was found, the item was considered radioactive. The only documentation still available is the paperwork filled out by the waste generator and initialed by a health physics technician to show no contamination was found. The team concludes that, since all waste shipped offsite was subjected at least once to health physics instrumentation scans, the waste shipped from ANL-E from 1984 to 1991 may be considered clean.

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Acronyms

DOE-HQ	Department of Energy, Headquarters
DOT	Department of Transportation
DOE-EM	Department of Energy, Environmental Restoration and Waste Management
RMMA	Radioactive Materials Management Area
TSDf	Treatment, Storage, and Disposal Facility
EPA	Environmental Protection Agency
ANL-E	Argonne National Laboratory, East
TSP	Radioactive Waste Technical Support Program
WMO	Waste Management Operations
TRU	transuranic
HPT	Health Physics Technician
NCD	no contamination detected

ARGONNE NATIONAL LABORATORY, EAST HAZARDOUS WASTE SHIPMENT DATA VALIDATION REPORT

1. Introduction and Background

In 1991, the Department of Energy, Headquarters, (DOE-HQ) discovered that individual DOE sites had been using different, and sometimes inappropriate, criteria for deciding whether hazardous waste was radioactive. These criteria ranged from "if it's above background, it's radioactive" to the Department of Transportation (DOT) criterion of 2 nCi/g. Some waste shipped from the Oak Ridge reservation in Tennessee to an incinerator in Baton Rouge, Louisiana contained small amounts of ^{235}U . The incinerator, run by Rollins, was not licensed to receive radioactive isotopes.

DOE realized this problem could extend to all DOE sites. Therefore, the Environmental Restoration and Waste Management (EM) branch required all DOE sites to cease shipments of hazardous waste from Radioactive Materials Management Areas (RMMAs) to nonlicensed commercial treatment, storage, and disposal facilities (TSDFs).¹ DOE-HQ defined RMMA for the first time for the moratorium on waste shipments.² Thus, DOE-HQ effectively stopped all shipments of hazardous waste to offsite commercial facilities until each site could determine which areas were RMMAs based on the DOE-HQ definition.

Also, DOE-HQ requested each site that had shipped hazardous waste to a commercial TSDF not licensed to receive radioactive isotopes, from 1984 to 1991, to supply data on those shipments.² The data were stored in a computer database. Each site reported manifest numbers, waste descriptions, names and Environmental Protection Agency (EPA) identification numbers of TSDFs that were either brokers for the waste or the final handlers of the waste, dates of shipment and quantities of waste. Also requested were radioisotope data, if those existed.

DOE-HQ requested the sites to categorize their waste shipments into one of four groups. To classify a waste as clean, the sites must either show that it came from outside an RMMA or have data showing that the waste contained no radioactivity above background. The data could either be from radioanalytical measurements, process knowledge, or health physics survey instruments. Waste categorized as radioactive must have data showing that DOE operations had added radioactivity above the natural background. In these cases, DOE asked the sites to include information on how they accounted for background and natural radiation.

A third category was likely clean, which included wastes from RMMAs where no data existed to show the waste was clean, but the waste was unlikely to be radioactively contaminated. The likely radioactive category was for wastes for which no data existed, but they

were similar in type or process to wastes shown to be radioactive. Definitions for the four categories are in referenced letter 2. Appendix A contains the exact wording for all four definitions and a definition of RMMA.

DOE began a project to evaluate selected sites to find out if they had classified their hazardous waste shipments correctly. This report discusses the results of that project at Argonne National Laboratory, East (ANL-E).

2. The Evaluation at ANL-E

EM-331 requested the Radioactive Waste Technical Support Program (TSP) to assemble a team to evaluate ANL-E hazardous waste shipments from 1984 to 1991. The team included experts in health physics, radioanalytical measurements, RCRA waste handling procedures, and chemical measurements. ANL-E Waste Management Operations (WMO) supplied "Waste Handling Procedures," dated September 18, 1986,³ and examples of the documentation from that period used for shipping hazardous waste offsite.

ANL-E is one of DOE's largest energy research centers, with an annual operating budget of about \$500 million supporting more than 200 research projects. Argonne was the nation's first national laboratory. The laboratory has about 5,000 employees, including about 1,775 scientists and engineers, of whom about 800 hold doctorate degrees.

Argonne traces its roots to the Metallurgical Laboratory, the scientific group under Enrico Fermi that achieved the world's first controlled nuclear chain reaction in 1942 as part of the World War II Manhattan Project. This group staffed ANL-E, which became the country's first national laboratory on July 1, 1946, with the mission of finding peaceful uses for atomic energy. Argonne's primary facilities are on a 1,700 acre site, 27 miles southwest of Chicago. Today, Argonne is a multi program research and development center owned by the DOE and operated by the University of Chicago.

ANL-E research falls into four broad classes. Engineering research focuses on advanced batteries and fuel cells and nuclear technology research and development. Research projects include electrochemical treatment of spent DOE fuel for disposal, and improved safety of Soviet-designed reactors and technology for decontaminating and decommissioning aging reactors. Physical research includes materials science, physics, chemistry, high-energy physics, mathematics and computer science, including high-performance computing and massively parallel computers. The Advanced Photon Source, now under construction, will provide the world's most brilliant X-ray beams for pioneering research in materials science, a cornerstone of technological competitiveness. Experiments will begin in 1996. Energy and environmental science and technology research includes projects in biology, alternate energy systems, and environmental and economic impact assessments.

Technology transfer is an important activity in moving benefits of Argonne's publicly funded research to the marketplace and strengthening the competitiveness of American industry. Argonne has been the source of more than 30 spinoff companies since 1984. The laboratory also works actively with businesses to grant exclusive licenses to Argonne inventions with commercial potential. Argonne scientists also work with private companies to solve specific scientific and technical problems under "work for others" agreements. In addition, Argonne and a private company can exchange, for six months to a year, employees working on scientific or technical problems of mutual interest.

2.1 ANL-E Hazardous Waste Shipments from 1984 to 1991

ANL-E reported 309 hazardous waste shipment manifests from 1984 to 1991, including 811 separate waste descriptions. Many of these shipments were lab packs, that is, drums containing many small waste packages, frequently of different types. Of the 811 waste descriptions, ANL-E categorized two as known radioactive. These two waste items were shipped to Quadrex, in Florida, a TSDF licensed to receive small quantities of radioisotopes. Because DOE had not intended to collect data on wastes sent to facilities licensed to receive radioisotopes, these two shipments were deleted from the database. ANL-E categorized the remaining 809 waste descriptions as clean.⁴

2.2 The ANL-E Site Visit

The team visited ANL-E in February 1995 to interview people who had participated in various aspects of hazardous waste shipments from 1984 to 1991. The intent of the visit was to find radioanalytical data that could determine if waste shipped to nonlicensed commercial TSDFs could be contaminated with radioisotopes, if such data existed. All personnel interviewed stated that neither waste generators nor WMO requested radioanalytical measurements for hazardous waste shipped offsite. Waste Management would only have considered the waste nonradioactive if the generator knew by process knowledge that it was clean. In addition, procedures required every item leaving an ANL-E building in which any radioactive operations took place to pass a Health Physics survey before classification as nonradioactive.

The team interviewed the manager of a radioanalytical laboratory where such measurements would have been done if requested. He supplied examples of positive radioanalytical data from samples that were probably from waste streams. However, no documentation existed to link those data to the waste streams so the team could determine whether WMO shipped them offsite as nonradioactive. Waste management personnel believed that if generators had requested such data, it would only be to decide what radioactive class the waste was in. The specific data sheets that the team obtained were probably for samples from the cleanup of a lab used for a radioactive experiment. However, this is not a certain assumption.

2.3 RMMAs

In many buildings at ANL-E, several different experimenters in succession might use a specific laboratory. Sometimes, experimenters used laboratories alternately for radioactive and nonradioactive experiments. ANL-E kept no relevant records so appropriate RMMA designations could now be made. Therefore, the evaluation team considers most areas at ANL-E to be potential RMMAs. In the Chemistry Building, M-wing was kept isolated for work with transuranics (TRU). The Director of Operations for the Chemistry Division, who was in that position during the period in question, stated that no radioactive work was allowed in the rest of the building. All waste that left the TRU wing was considered radioactive. No hazardous substance that entered the wing would leave it again except as known radioactive waste.

The M-wing is an RMMA, while the rest of the building is not an RMMA. Any wastes shipped from the non-TRU wings of this building must be classified clean, since they were not shipped from an RMMA. Also, any item from any part of the building was required to undergo a Health Physics Technician (HPT) survey before leaving the building. This system was probably not used in any other building at ANL-E. However, HPTs surveyed all items that left buildings in which any process involving radioactivity was performed.

3. Health Physics Evaluation

During the visit the team interviewed personnel. These individuals included WMO personnel, facility and laboratory managers, health physics, and waste generators. The team also toured several chemical laboratories. No analytical data were found that could confirm that hazardous wastes did not contain radioactive material.

"Waste Handling Procedures" is a comprehensive document covering all waste streams produced at the lab during the period in question. The procedures gave instructions for the management of the waste streams by WMO, waste generators, health physics, and industrial hygiene. According to the procedure, HPTs must survey all containerized waste before release from a given area and again before shipment. If the survey detected no contamination, the HPT recorded NCD on the waste requisition form. The HPT then signed the form and dated it. Although the procedure contained an appendix titled "Maximum Permissible Concentrations (MPC) Above Background of Radionuclides in Air and Water," from DOE Order 5480.1 Change 2, the procedure stated no specific release limits for container surveys. The health physics manager, who was also the manager at the time, stated that the release limits are from a table for surface contamination in DOE Order 5400.5. Appendix B contains a copy of an example of the waste requisition form.

During the interview process all personnel said that they avoided cross contamination of hazardous waste with radioactive material through segregation. Process knowledge ensured that hazardous waste released from these areas was clean, and direct radiation surveys were done to

confirm this. Annual training on segregation and waste management was required for all waste generators and HPTs. HPTs routinely surveyed hazardous waste storage areas. In addition, mixed wastes, such as scintillation fluids containing xylene and toluene, were stored separately from the hazardous and radioactive wastes.

Chemistry laboratories where radioactive materials were handled were posted as Radiological Control Areas. HPTs performed swipe and direct radiation surveys of all items exiting these areas. Chemists were responsible for segregating clean and radioactive materials.

The waste management program at ANL-E has not changed much since the 1980s. Waste generators keep hazardous wastes free of DOE-added radioactive material through process knowledge and segregation. This is supported by a training program and external radiological surveys. Using the DOE-HQ waste definitions, hazardous wastes shipped to commercial TSDFs are clean, because ANL-E used the values from DOE Order 5400.5 to define them as clean.

4. Process Knowledge

ANL-E used a combination of process knowledge and HPT surface surveys to ensure that no hazardous waste contaminated with radioactivity was shipped as nonradioactive. During the period 1984-1991, no coherent set of requirements for documenting process knowledge had been developed. It was assumed that a generator of waste would know whether his waste could possibly be radioactive. When no radioactive substances ever entered a building or laboratory, so the area was not an RMMA, concluding that DOE-added radioactivity could not contaminate the waste is easy. However, in areas where both radioactive and hazardous substances were used or stored, the chance exists for hazardous waste to be contaminated with radioactivity.

ANL-E personnel stated that they were all aware of the difficulties that would follow a radioactive release in a well-populated area such as that around the lab. They believed that this made them especially alert to keeping hazardous and radioactive substances separate, especially to avoid making mixed waste. During the period in question, mixed waste became increasingly difficult and expensive to dispose of, so ANL-E personnel were highly motivated not to create mixed waste.

All these factors are likely true. The system at ANL-E that personnel remembered as in place at the time was a reasonable one, and no doubt personnel were alert to avoid radioactively contaminating hazardous waste. HPT surveys provided another layer of assurance. However, no HPT survey, either at the time or now, could guarantee that no DOE-added radioactivity would inadvertently be shipped out in hazardous waste.

On the other hand, the HPT surveys employed at the time complied with DOE Order 5400.5. By the DOE-HQ definition, all shipments that passed DOE Order 5400.5 criteria are

clean. All hazardous waste shipments were subjected to at least one HPT survey before offsite release. While the team did not examine all such documentation for all waste sent offsite from 1984 to 1991, all such documentation examined did include a determination of no contamination detected (NCD). A much more extensive review of records would be necessary to ensure that all shipments had paperwork showing that no contamination was detected. The team concluded that such an extensive review would have very little real value.

Radioanalytical data would be the best way to find out if any of the waste shipped was contaminated with radioactivity above background. However, no hazardous waste that a generator knew to be clean was analyzed for radioactivity. No hazardous waste suspected to be contaminated with radioactivity was shipped as nonradioactive. Therefore, any waste shipped to an unlicensed offsite TSDF would not have been analyzed for radioactivity.

Thus, the only documentation found to determine if the hazardous waste shipped offsite was clean are the forms used by HPTs to document that they had detected no contamination, using 5400.5 guidelines. The team therefore concludes that classifying all waste shipments from ANL-E during the period in question as clean is correct, using the DOE-HQ definitions.

5. Conclusions

ANL-E personnel used process knowledge to be sure that hazardous waste did not contain radioactive contamination. At the time, process knowledge usually meant that the generator knew that the waste could not be contaminated. No waste samples known to be uncontaminated because of generator knowledge were analyzed for radioisotopes. HPTs surveyed all items, materials or wastes, leaving ANL-E buildings where radioactive contamination was possible, using HPT instrumentation. If the HPT survey found radioactivity above the DOE Order 5400.5 limits, the item was considered radioactive.

The routine use of HPT instrumentation and DOE Order 5400.5 limits make it possible to consider the ANL-E hazardous wastes clean, using the DOE-HQ definition. The only documents available concerning these waste shipments, other than shipment manifests, are the forms used by the HPTs to say that they had detected no contamination.

However, neither process knowledge, undocumented as it was at the time, nor HPT surveys are certain guarantees that no ANL-E waste shipments contained any radioactivity above background. Process knowledge can be incorrect, and when no documentation was kept to show how the process knowledge was applied, isolating any cases of incorrect process knowledge is now impossible. HPT instrumentation will not always detect all radioactivity above background.

Nonetheless, by the definitions found in the Performance Objective, the waste shipments made by ANL-E from 1984 to 1991 can be considered clean.

REFERENCES

1. Letter, Jill E. Lytle to Distribution, May 17, 1991.
2. Letter, Jill E. Lytle to Distribution, June 7, 1991 and letter, Leo P. Duffy to Distribution, August 26, 1991.
3. Argonne National Laboratory, *Waste Handling Procedures*, Sept. 18, 1986.
4. Page, Lisa A., Rohe, Michael J., and Casey, Coreen, *Offsite Hazardous Waste Shipment Data Collection*, DOE/LLW-164, December, 1992.

APPENDIX A

DEFINITIONS

Radioactive Materials Management Area (RMMA): An RMMA is an area in which the potential exists for contamination due to the presence of unencapsulated or unconfined radioactive material or an area that is exposed to beams or other sources of particles (neutrons, protons, etc.) capable of causing activation. Accident or variant conditions may require areas to be designated as temporary RMMAs until conditions are corrected. The delineation of RMMAs is a complex technical process which is central to the management of waste at DOE facilities where radioactive materials are present

Known Radioactive Waste: For known radioactive waste, sampling and analysis data show radioactivity above background (background includes natural levels of radiation in materials) or surface contamination exceeds DOE Order 5400.5, "Radiation Protection of the Environment and Public," guidelines. Thus, this is waste with radioactivity that was added to the volume or bulk of the waste as a result of DOE operations, as indicated by sampling and analysis, or waste that has excessive surface contamination due to DOE operations as shown by surface survey results.

Clean Waste: Clean waste originates outside an RMMA or is waste that originates within an RMMA for which documented evidence of administrative controls, process knowledge, or sampling and analysis data shows that no radioactivity was added to the waste bulk or volume by DOE operations, and the surface contamination is less than DOE Order 5400.5 guidelines.

Likely Radioactive Waste: Likely radioactive waste is not categorized as known radioactive or clean but is similar in form/type and originates from the same process/areas as known radioactive waste. For these wastes, documented evidence of administrative controls, process knowledge, or analytical data is not available to show that no radioactivity was added to the waste bulk or volume by DOE operations.

Likely Clean Waste: Likely clean waste is waste that originated in an RMMA but is not categorized as known radioactive, likely radioactive, or clean. For these wastes, documented evidence of administrative controls, process knowledge, or analytical data is not available to show that no radioactivity was added to the waste bulk or volume by DOE operations, or that surface contamination is less than DOE Order 5400.5 guidelines.