Conf-930873--31

PNL-SA-22895

MIXED WASTE AND WASTE MINIMIZATION: THE EFFECT OF REGULATIONS AND WASTE MINIMIZATION ON THE LABORATORY

E. B. Dagan[(a)]
K. B. Selby

August 1993

Presented at the
2nd International Mixed
Waste Symposium
August 16-20, 1993
Baltimore, Maryland

Work supported by
the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Richland, Washington 99352

(a) U.S. Department of Energy
Richland, Washington

MIXED WASTE AND WASTE MINIMIZATION

ABSTRACT: The Hanford Site is located in the State of Washington and is subject to state and federal environmental regulations that hamper waste minimization efforts. This paper addresses the negative effect of these regulations on waste minimization and mixed waste issues related to the Hanford Site. Also, issues are addressed concerning the regulations becoming more lenient. In addition to field operations, the Hanford Site is home to the Pacific Northwest Laboratory which has many ongoing waste minimization activities of particular interest to laboratories.

BACKGROUND: THE CHANGING HANFORD MISSION

The Hanford Site was acquired by the federal government in 1943. For more than 20 years, Hanford Site facilities were dedicated primarily to the production of plutonium for national defense and the management of the resulting wastes. In later years, programs at the Hanford Site were diversified to include research and development for advanced reactors, renewable energy technologies, waste disposal technologies, and cleanup of contamination from past practices.

The U.S. Department of Energy (DOE) has established a new mission for Hanford which includes:

- <u>Waste Management</u> of stored defense wastes and the handling, storage, and disposal of radioactive, hazardous, mixed, and sanitary wastes from current activities.
- <u>Environmental Restoration</u> of approximately 1,100 inactive radioactive, hazardous, and mixed waste sites and about 100 surplus facilities.
- <u>Research and Development</u> in energy, health, safety, environmental sciences, environmental restoration, waste management, and national security.
- <u>Technology Development</u> of new environmental restoration and waste management technologies, including site characterization and assessment methods; waste minimization, treatment, and remediation technology; and education outreach programs.

Facilities at the Hanford Site are no longer in a production mode. Wastes generated on the Hanford Site come from past practices and current research efforts.

THE REGULATIONS: HOW WASTE MINIMIZATION SUFFERS

Speculative Accumulation: Enforced by the State under RCRA

The Dangerous Waste Regulations in the State of Washington are codified in the Washington Administrative Code (WAC). The WAC (section 173-303-016(5)(d)) regulates speculative accumulation by limiting the amount of time a waste may be stored. There are situations in which a waste that is generated could be used or recycled further down the road, but because of the speculative accumulation period, it must be disposed of. By regulating waste in this manner the statute forces a generator to create waste instead of allowing the generator to re-use or recycle.

More specifically, under WAC section 173-303-016(5)(d), if a material is identified as a speculatively accumulated material, i.e., no use or method of recycling has been identified for the material within the calendar year, the material is classified as a solid waste and is subject to Resource Conservation Recovery Act (RCRA) storage restrictions. Therefore, unless a use or method to recycle the material is immediately available, the material automatically becomes waste.

Under WAC 173-303-016(5)(d), a material is:

> "accumulated speculatively if it is accumulated before being recycled. A material is not accumulated speculatively if it can be shown that the material is potentially recyclable and has a feasible means of being recycled and that during the calendar year . . . the amount of material that is recycled equals at least 75 percent of the amount of material accumulated at the beginning of the period."

As written, speculative accumulation does not provide for unique materials such as radioactive contaminated shielding, which could be re-used, but not always within one year. According to the statute, if the shielding is not reused or recycled within one year, it must be disposed of as waste. This puts the DOE in the unique position of generating radioactive mixed waste without being in a production mode.

As an example, facilities at the Hanford Site that have been shut down and stand to be decommissioned use large amounts of lead shielding to protect workers from exposure. The decommissioning process, which is an emerging technology, involves timely procedures for securing required permits, ensuring proper reviews, getting adequate funding, etc. Before decommissions can begin, most of the lead shielding will have been disposed of as hazardous or mixed waste because of the speculative accumulation regulations. It simply is not feasible during the decommissioning process to devise within one year a re-use or recycling procedure for lead shielding.

As a result of the speculative accumulation requirements, new lead will have to be procured for shielding purposes because the previously used lead had to be disposed of as waste, needlessly generating additional hazardous or mixed wastes. If lead could be stored until it was needed for shielding, instead of disposing of it as waste, a substantial waste minimization savings could be realized.

Derived From Rule

The derived from rule (WAC 173-303-150) prohibits any action to evade the intent of the regulation by dividing or diluting wastes to change their designation, except for the purposes of treating, neutralizing, or detoxifying such wastes.

In effect, this increases the amount of waste generated if there should be any dilution of a waste stream other than for the purposes of treatment, neutralization, or detoxification by characterizing the entire stream as waste. In addition, WAC 173-303-082(3) stipulates that if a non-hazardous waste stream is contaminated with a "dangerous waste source" waste stream (waste codes F001-F024, K001-K087, and W001), the entire waste mixture is designated as hazardous waste.

This could mean that if one molecule of the regulated hazardous waste gets into a non-regulated waste stream, the entire stream, including any piping or equipment associated with the stream, becomes a regulated hazardous waste.

It would be ideal if waste constituents could be separated and the amounts of these constituents isolated. However, for large facilities such as those at the Hanford Site, it is not always possible to keep particular constituents separate. The derived from rule, therefore, will always act to increase the volume of waste in a stream that has some hazardous waste constituents.

Liabilities if Waste is "Sold"

Large amounts of wastes and excess chemicals are generated at the Hanford Site which could be recycled or reclaimed. Many of these materials are recycled by off-site vendors. The Hanford Site, being a government-run facility with "deep pockets", must be extremely cautious in who it contracts with to recycle/reclaim materials. If the recycler should ever dispose of hazardous wastes improperly, the DOE could become partly liable for clean-up of the waste because of RCRA Cradle-to-Grave liability.

It often takes a year or more to select a vendor for recycling hazardous materials from the Hanford Site. This time is spent auditing and verifying that the vendor is performing its work within federal, state and local laws. After a contract is established, if the "integrity" of the vendor is ever questioned, the contract is not renewed and the selection process starts again. During the time the selection of a vendor is in process, recyclable waste continues to be generated at the site. The generated waste must be disposed as hazardous waste within 90 days of generation because of the regulations prohibiting "speculative accumulation". Much waste that could be recycled ends up being disposed of as hazardous waste.

Recyclable materials generated in radiologically controlled areas pose the same problems as above, with the added concern of being potentially contaminated. Particularly troublesome are lead acid batteries, lead metal (bricks, sheeting, blankets, shot, etc.), and mercury which are all good radiation shields. Health physics technicians are reluctant to unconditionally release these items offsite because they may be "shielding" internal contamination. The generators end up disposing of the materials as mixed wastes. This issue concerning release from radiologically controlled areas has contributed to hampering waste minimization efforts at the Hanford Site. In certain situations, even packing material surrounding equipment that was taken into one of these areas could not be released and was disposed of as radioactive waste. Simple solutions such as unpacking equipment outside of the control area have been implemented. Hopefully, release procedures and control measures can be improved so that waste minimization efforts may prevail.

HOW THE REGULATIONS MAY BE CHANGING

The U.S. Environmental Protection Agency (EPA) recently issued a proposed rule "Hazardous Waste Management System; Modification of the Hazardous Waste Recycling Regulatory Program" (Federal Register, Volume 58, No. 27, Thursday, February 11, 1993, Proposed Rules).

Under the proposed rule, certain post-user items that are usually managed as hazardous wastes (e.g., used batteries and suspended/canceled pesticides) could be collected and handled under less stringent requirements. It would appear that EPA's intent is to encourage proper treatment and/or recycling of these wastes, and further facilitate separation of these wastes from the municipal waste stream.

Specifically, EPA refers to these post-user types of wastes that will be subject to less stringent requirements as "universal wastes" and identifies certain common characteristics they share. These characteristics include:

- frequently generated in a wide variety of settings other than industrial settings usually associated with hazardous wastes;
- generated by a vast community, the size of which poses implementation difficulties for both those who are regulated and the regulatory agencies charged with implementing the hazardous waste program; and
- may be present in significant volumes in the municipal waste stream.

It would appear, therefore, that if a waste can be characterized as a "universal waste", the waste would be subject to less stringent requirements, possibly allowing more opportunities for recycling or re-use. This, however, is only a proposed rule and if promulgated does not necessarily have to be implemented by those states granted RCRA authority by the EPA.

WASTE MINIMIZATION INITIATIVES AT THE HANFORD SITE

Co-Disposal

Co-disposal is an innovative waste minimization technique being developed at the Hanford Site. Co-disposal involves using existing solid and liquid wastes, instead of clean materials, as fill material in radioactive and mixed waste landfills and trenches. This material is referred to as "waste rock".

These existing wastes, including soil washing sludge, contaminated soils, demolition rubble, fly ash, purge water, leach water, etc., would ordinarily need to be disposed of separately. Co-disposing of these wastes in landfills and trenches, rather than using clean material, saves the funds required to dispose of these existing wastes and avoids the creation of new waste from the clean materials.

The innovation of the Co-disposal project is that waste is treated as product to dispose of other waste (see Figure 1). It is estimated that Co-disposal will increase landfill capacity from 100% to 300% over traditional landfill use.

Surplus Property Management

Contaminated tools and equipment that are no longer needed are given to other on-site facilities to use. Many of these items have rough or porous surfaces, or inaccessible areas which cannot be surveyed properly. If another facility can use the material, disposal and replacement costs can be reduced. Some examples of "recycling" excess contaminated materials at Hanford are:

1. Contaminated handtools from shutdown production reactors (100-Areas) were given to 200-Area process facilities and waste management facilities.

2. Railroad ties and telephone poles from stabilized waste sites were given to tank farms for use as vehicle stops in radiologically controlled areas.

3. Chain-link fencing that surrounded contaminated or hazardous waste sites was removed when clean-up was completed. The fencing could not be economically released as free of radioactive contamination. Instead of disposing of the fencing as contaminated waste, the fencing was installed around active burial grounds.

WASTE MINIMIZATION IN THE LABORATORY: PACIFIC NORTHWEST LABORATORIES

Pacific Northwest Laboratory (PNL) operates facilities located on the Hanford Site and is under contract for Research and Development to the Department of Energy, Richland Field Office (DOE-RL). Pacific Northwest Laboratory is divided into different research centers (Centers), each providing expertise in areas of science and engineering. For example, the Materials and Chemical Sciences Center performs research in the area of physical, chemical, and radiochemical analysis techniques, while the Earth and Environmental Sciences Center performs research with regard to groundwater modeling, lysimeter research, and the effects of hazardous and radioactive substances on microbial environments.

Pacific Northwest Laboratory provides research support on various DOE-sponsored and non-DOE-sponsored work.

WASTE GENERATION

The following is a brief list of research projects PNL is currently involved in and the wastes they generate. All of these programs generate mixed waste to some degree. Efforts to seriously curtail mixed waste generation and to eliminate it if possible are underway.

Vitrification Technology

Research is being conducted on vitrification technology wherein solid and/or liquid radioactive wastes are placed inside a controlled environment (a melter) along with frit material and superheated until the waste mass is turned into a glass-like material. This material is impervious to groundwater leaching, weathering, etc. A counterpart to melter technology is In-Situ Vitrification wherein plots of soil in the environment are superheated to form this glass-like material. This program generates Low-Level Radioactive waste (LLW), mixed waste, and hazardous waste. The mixed waste generated under this program usually consists of soils contaminated with heavy metals and organics as well as liquids contaminated with same.

Groundwater Program

This program area consists of modeling the groundwater beneath the Hanford Site, as well as lysimeter research to investigate transfer rates of various substances through the soil column. Mixed waste generated from this program consists of radioactively contaminated liquids, sampling and analysis wastes (including scintillation counting wastes), and chemical reagent wastes from laboratories.

Fuels Research

Another program in which PNL is involved is research into nuclear fuels. Hot-cell facilities are used to investigate the properties of various materials when irradiated. Mixed wastes generated from this program consist of grinding and polishing solutions containing methanol and perchloric acid with a high degree of radioactivity. Another mixed waste stream generated by this program is solvent contaminated rags from the cleaning of hot-cell manipulator parts.

Tank Core Characterization Program

Pacific Northwest Laboratory provides a great deal of research support to the Tank Core Characterization Program. The Hanford Site is the home of 28 Double Shell-Tanks (DSTs) and 149 Single-Shell Tanks (SSTs) used for the storage of high-level radioactive wastes generated from the reprocessing of spent nuclear fuel during the Manhattan Project. A program is in place to characterize the contents of these tanks. Westinghouse Hanford Company (WHC) (the Management and Operations contractor at the Hanford Site) is responsible for sampling the tanks and shipping the sample material to PNL for analysis. Pacific Northwest Laboratory receives the samples into various hot-cell facilities located in the 300 Area and performs physical, chemical, and radiochemical analyses. Since PNL is heavily involved in this area with many Centers participating, this program generates a large amount and wide variety of wastes. The various solid and liquid wastes generated from this research are very high in radionuclide activity. Low-level wastes and mixed wastes are the prevalent waste streams.

WASTE DISPOSAL

DOE-generated mixed wastes have two potential disposal pathways:

Disposal to the Radioactive Liquid Waste System

Five PNL facilities in the 300 Area of the Hanford Site are connected to a WHC facility (also in the 300 Area) via underground pipeline. Liquid mixed wastes and LLW that meet certain criteria may be disposed of to the Radioactive Liquid Waste System (RLWS). The liquid wastes are received at the WHC facility (340 building) and stored in two 10,000 gallon underground storage tanks. When tanks near their capacity or the 90-day clock is approaching, the tanks are pumped into a 20,000 gallon rail car and transported to the 200W area for disposal into the DSTs. This disposal pathway is currently operated at no cost to PNL other than staff time. Therefore, there is incentive to determine if a mixed waste meets the criteria for disposal to the RLWS. In some cases, neutralization scenarios can prepare a mixed waste for RLWS disposal, thus saving the cost of disposing to the Central Waste Complex.

Disposal to the Central Waste Complex

If mixed waste does not meet the criteria for disposal to the RLWS, it must be packaged into drums and shipped to the Central Waste Complex located in the 200W area and operated by WHC. Mixed waste is stored at this facility for future treatment. The one-time cost for transportation and storage of a 55-gallon drum is approximately $2,000. This cost, coupled with the extensive paperwork and staff time involved in disposal provides great incentive for minimizing mixed waste streams.

WASTE MINIMIZATION PROGRAM AT PNL

Current Tasks

PNL's waste minimization program is still in its adolescent stage of development. Process Waste Assessments (PWA's) have been performed on 5 recurring waste streams out of the Craft Services Department. The waste streams assessed were batteries, fluorescent light tubes, fluorescent light ballasts, paint wastes, and waste oils. In addition, the research centers have developed waste minimization plans which are reviewed annually. Pacific Northwest Laboratory provides data for inclusion in annual site-wide waste minimization reports such as EPCRA 312/313 reports and the SEN-37-92 report.

Future Tasks

DOE has provided some funding for 1993 for the following tasks:

1. Develop a database to track all waste generation (LLW, mixed waste, transuranic (TRU), hazardous wastes) across PNL.

   This database is in the early stages of development. Databases currently exist for these waste streams and a centralized database is being developed that will import data from them. There is also the possibility of compatibility with the Chemical Management System (CMS). The CMS is a PNL-wide database system in which research staff log in the chemicals that they are using in their laboratories. In the future, the centralized waste database could be linked up with the CMS and with the database system that Procurement uses. The entire chemical management process, from purchasing to disposal, could then be tracked together allowing for greater implementation of waste minimization strategies.

2. Develop generator-specific waste minimization training.

   Currently, waste minimization training is one module in the Hazardous Waste Generators Training program. General waste minimization objectives and goals are presented in this class as well as techniques that can be employed to meet the objectives. Through the use of the above waste generation database, waste minimization training will be developed for each facility and will be generator-specific. For example, training in waste minimization techniques relating to paint use and solvent cleaning will be developed and presented to Craft Services staff. Waste minimization techniques related to sampling and analysis procedures will be developed and presented to various research staff involved in these areas. Waste minimization training given in this manner will ensure that specific techniques are implemented in the field in applicable areas rather than general techniques being implemented for all staff. As a result, waste minimization accomplishments will increase.

3. Develop a waste minimization incentives program to stimulate research staff in the area of waste minimization technologies.

   This task involves developing a program that provides funding for waste minimization technologies to be applied in research applications. One idea is to organize a contest in which research staff submit technologies that would aid in minimizing their wastes. The staff submitting the technology that has the best cost/benefit ratio would receive funding to purchase the technology. Examples include: a scintillation counter that requires less cocktail per sample, vial crusher/extractor, and others.

WASTE MINIMIZATION SUCCESS STORIES

There have been specific waste minimization techniques implemented within the last two years at PNL that have resulted in significant waste reduction and cost savings.

Product Substitution:

Generation: PNL routinely uses scintillation cocktails for counting radioactivity in SST/DST core samples and other radiochemistry efforts at the Hanford Site. Older cocktails contained xylene, toluene, methanol, and pseudocumene, all of which are regulated as hazardous wastes and are flammable, creating a fire hazard and limiting storage capabilities within the laboratories. The use of these cocktails generated mixed waste which costs approximately $200.00/ft^3 to dispose of (a 55-gallon labpacked drum would therefore cost $1,500.00).

Product Substitution: Two new non-regulated scintillation cocktails were evaluated: Ultima Gold and Opti-Fluor. These cocktails do not contain RCRA or State-regulated constituents and therefore do not result in mixed waste generation. Normally, these wastes would be absorbed onto diatomaceous earth and disposed of as LLW (at the cost of approximately $500.00 for a 55-gallon drum). However, these waste cocktails fit the criteria for disposal to the RLWS and thus, disposal cost nothing. Other benefits besides cost savings include safer working environment due to non-flammability, no 90-day clock or satellite accumulation regulatory issues, and less staff time spent on disposal (paperwork, labeling, inspection, etc.).

Cost Savings: As a result of product substitution, approximately 350 gallons/yr of mixed waste was not generated. This resulted in a cost savings of $26,000.00.

Waste Reduction Combined with Product Substitution:

Waste Generation: Research staff were using a regulated scintillation cocktail in a liquid scintillation counter that used 20 ml vials per sample. This generated a significant amount of mixed waste requiring disposal at approximately $200.00/ft^3 (a 55-gallon labpacked drum would therefore cost $1,500.00).

Waste Reduction/ Product Substitution: PNL research staff investigated the use of 7 ml vials in place of the 20 ml vials and confirmed that this would not require a new scintillation counter (special carriers would be used) and this switch would still produce statistically valid sample results. This resulted in a 3:1 reduction.

Then, the staff switched to Ultima Gold, a non-regulated scintillation cocktail (see PNL Success Story Number 1) thus ceasing the generation of mixed waste.

Finally, the staff researched and purchased a liquid scintillation counter that uses plates instead of the 7 ml vials. Each plate has 96 wells and each well uses 0.2 mls cocktail. This resulted in a 35:1 reduction.

Cost Savings/ Benefits: Total waste reduction from 20 ml vials to .2 ml wells per sample is 100:1 reduction. The cost savings amounts to approximately $12,000/yr in disposal costs alone.

Benefits include: vastly decreased staff time spent on disposal paperwork/handling, much greater numbers of samples can be run during a single counting, flammability hazards of cocktail have been removed by switching to non-flammable cocktail, and much less liquid wastes are handled thus reducing the hazard of radionuclide contamination.

This waste minimization activity is unique in that the staff combined two waste minimization techniques and thus produced a hundred-fold reduction. Combining of waste minimization techniques should be investigated in all waste minimization scenarios.

Product Substitution:

Waste Generation: Research staff were using 1,1,1-Trichloroethane with rags to clean manipulator parts for use in hot cells. This activity resulted in approximately 2 drums of mixed waste per year.

Product Substitution: Staff investigated and confirmed that switching to a non-hazardous degreaser was feasible.

Cost Savings: Implementing this waste minimization technique eliminated the generation of two drums of mixed waste per year resulting in cost savings of approximately $2,500.00/yr.

SUMMARY

The current state and federal environmental regulations important to activities at the Hanford Site were not originally promulgated with waste minimization in mind. It is important to seek changes in this area so that reuse and recycling opportunities can be administered.

Waste minimization is a rapidly developing area and one of vital environmental importance. It not only applies to large operating facilities, but to laboratories and small quantity generators as well. As the waste minimization program at PNL continues to grow, waste generation should decrease significantly thus saving time, money, and effort while making the workplace safer for PNL staff.

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