RCRA PERMITTING STRATEGIES FOR THE DEVELOPMENT OF INNOVATIVE TECHNOLOGIES: LESSONS FROM HANFORD

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ABSTRACT

The Department of Energy (DOE) Hanford Site's huge waste inventory and environmental contamination are the result of almost 50 years of weapons plutonium production. The research, development, and demonstration (RD&D) of innovative cleanup technologies are crucial to Hanford cleanup.

RD&D activities involving hazardous and mixed waste are subject to Resource Conservation and Recovery Act (RCRA) regulations. RD&D activities are dynamic and unpredictable, and do not fit well with the RCRA permitting process, which was developed for stable commercial activities. The lengthy, highly detailed process for acquiring and modifying RCRA permits is a major barrier to the development and implementation of innovative waste treatment technologies. The challenge at Hanford is to find more flexible regulatory mechanisms to support critical RD&D activities and to work effectively with regulators to provide the regulatory logic, technical familiarity, trust, and confidence necessary to support technology development requirements.

The Hanford permit strategy team negotiated a 1-year delay of the first major RCRA permit deadline for RD&D activities to develop a more streamlined permitting and compliance plan. The team's approach had the following elements: 1) establish a vigorous dialogue with Hanford Site regulators, 2) comprehensively describe the many RD&D activities at Hanford by conducting a technology survey, 3) identify alternatives within the RCRA regulations that offered latitude and forward progress while ensuring health and safety, and 4) identify regulatory impediments and opportunities and make appropriate recommendations for practical compliance strategies.

The team analyzed the alternatives to RCRA permitting, identified more than 50 technology investigations at Hanford, and assigned each a tentative compliance pathway based on an optimum interpretation of the alternatives. The results were delivered to the regulators, along with specific recommendations regarding regulatory interpretations and strategies that would support an aggressive RD&D program without compromising public health and safety. These recommendations included interpretations designed to enhance alternatives, such as the treatability study sample exemption, and proposed new mechanisms for innovative technology permitting. These recommendations are now under consideration. The permit strategy team's current challenge is to nurture a continued healthy dialogue and partnership with the regulators in support of accelerated development and deployment of innovative cleanup technologies.

INTRODUCTION

The Hanford Site restoration is the largest waste cleanup operation in United States' history. The Hanford plutonium production mission generated the majority of all the nuclear waste, by volume, in the Department of Energy (DOE) Complex. Cleanup challenges include not only large stored volumes of radioactive, hazardous, and mixed waste, but contaminated soil and groundwater and scores of major structures slated for decontamination, decommissioning, and demolition. DOE and its contractors will need to invent much of the technology required to do the job on a timetable driven by negotiated milestones, public concerns, and budgetary constraints. This paper will discuss the effort at Hanford to develop an integrated, streamlined strategy for compliance with the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) in the conduct of research, development, and demonstration (RD&D) of innovative cleanup technologies. The aspects that will be discussed include the following:

- the background of the RD&D permitting challenge at Hanford
- approach to identifying a more streamlined permitting strategy
- permitting options in the existing regulatory framework
- Hanford technology survey results and regulatory options that offer the best fit for Hanford RD&D activities
- conclusions and recommendations made to regulatory bodies.

BACKGROUND

The Cleanup of Hanford

The nuclear materials and contamination inventory at Hanford contains roughly 6000 metric tons of nuclear materials, including irradiated nuclear fuel and unirradiated uranium. Hanford lands contain over 380,000 metric tons of buried solid waste; 110,000,000 metric tons of contaminated soil and overburden; and over 1 billion metric tons of contaminated groundwater (1).

Decontamination and decommissioning challenges include nine deactivated production reactors and assorted nuclear materials processing plants. The number one cleanup

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problem in the DOE complex is 177 underground storage tanks containing 340,000 metric tons of high-level mixed waste.

The Tri-Party Agreement and Milestones

In 1989, DOE, the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) signed the Hanford Federal Facility *Agreement* and Consent Order, generally called the Tri-Party Agreement (TPA), obligating DOE to accomplish specific cleanup goals according to a negotiated timetable. Over 1500 waste sites and 6 contaminated groundwater operable units have been identified for cleanup or mitigation. Included among the major milestones are deadlines for the filing of RCRA "Part Bs" (comprehensive permit applications), for permits to conduct RD&D activities. Anticipated RD&D activities were grouped into three generic treatment categories: thermal (Original Milestone: December 31, 1993), physical-chemical (December 31, 1994), and biological (December 31, 1995).

The Need for Innovative Technologies and the Technology Cycle

The huge volumes and diverse characteristics of waste materials and environmental contaminants at Hanford pose enormous challenges for characterization, sampling, retrieval, treatment, and conversion to acceptable final waste forms. Substantial technology development will be required to solve these problems. Technology needs for tank wastes, for example, include in-tank robotics for sensing, mapping, and retrieval; separation and pre-treatment methods; and vitrification technology for conversion to the final inert glass form.

Successful new technologies advance from laboratory scale to bench, to pilot, and ultimately to commercial scale. Pacific Northwest Laboratory's (PNL's) charter is to nurture new technologies to the point where they can be placed in the field; at this point the technologies are handed off to Westinghouse Hanford Company (WHC), the operations and maintenance contractor.

The Legal Framework

Although some technology activities are conducted onsite under CERCLA authority, most RD&D activities which use hazardous or mixed waste take place in a laboratory or testing facility and are regulated by RCRA. Ecology has jurisdiction over most of the permitting elements of RCRA, although under the TPA, Ecology and EPA work closely together to make major regulatory decisions at Hanford.

The RCRA permit was designed primarily for relatively stable commercial waste management and treatment activities. The permit process is lengthy and complex, and the detailed requirements are not very compatible with the dynamic and experimental nature of RD&D activities. The difficulties of fitting experimental and highly variable activities into the RCRA permitting process and the urgency of technology development meant that DOE, PNL, and WHC had to join with Hanford regulators to develop a better way.

APPROACH TO IDENTIFYING A STREAMLINED STRATEGY

The Omnibus "Part As"

The omnibus "Part As" (initial RCRA permit "notification" applications) for thermal, physical/chemical, and biological RD&D activities were predicated upon the belief that the regulatory agencies would allow permitting of technologies or groups of technologies without regard to their physical location, i.e., a sort of "mobile (or flexible) R&D" permitting. There were several problems with this approach. Some of the technologies described in the Part As were not under active investigation. Some technology investigations fit into more than one category. Most significantly, these RD&D activities are so dynamic that they could not be individually, let alone collectively, described in the great detail required by Part Bs. Extensive location information was required for permitting. Finally, the 2- to 5-year timetable for acquisition of a final permit and the notice, review, and comment requirements for permit modifications posed a daunting administrative barrier to the aggressive conduct of a rapidly changing class of activities under the time and budget pressures that drive RD&D and cleanup efforts.

Strategy

DOE Richland Operations Office, PNL, and WHC approached EPA and Ecology to propose the development of a more effective strategy for meeting regulatory requirements and getting the technology job done. The agreed-upon plan included the following elements:

- secure a 1-year extension of the thermal treatment Part B milestone
- establish a more vigorous dialogue with regulators regarding permit options and flexible applications of the regulations to RD&D activities
- complete a detailed evaluation of the regulatory framework
- perform an exhaustive survey of the RD&D activities at the Hanford Site and identify the optimum regulatory pathway for each one
- identify impediments and opportunities and formulate rational possibilities for regulatory relief which do not compromise the basic intent of the legal framework.

A series of meetings among DOE, contractors, and regulators were held throughout the summer and fall of 1993 in order to provide status reports on the regulatory analysis and technology survey, and to discuss regulatory problems and opportunities on an "as we go" basis. The communication premise was "no surprises."

REGULATORY PERMITTING OPTIONS

Some field investigations at Hanford, such the Volatile Organic Contaminant Integrated Demonstration for arid climates, are being conducted on CERCLA cleanup sites. Because of the permit exemption contained in CERCLA, these RD&D activities do not require RCRA permits. However, such activities must meet the substantive requirements of applicable regulations (including RCRA), and the TPA provides for a substitute administrative procedure for exempted activities. Most of the technology investiga tions at Hanford, however, are taking place in laboratories or testing facilities

away from the CERCLA cleanup units. RCRA regulations therefore became the primary focus of the study. The following RCRA mechanisms were examined:

- Analytical Sample Exclusion
- Treatment by Generator
- Treatability Study Sample Exemption
- Land Treatment Demonstration Permit
- Permits by Rule
- RD&D Permit
- RCRA Permit (Part B).

Analytical Sample Exclusion (40 CFR 261.4): RCRA regulations exclude hazardous waste samples collected solely to determine their characteristics or composition. While investigators had occasional difficulty distinguishing between analytical procedures and treatability studies, those activities covered by this exclusion were generally self-evident.

Treatment by Generator (Interpretation/Guidance): If certain hazardous waste, reporting, accumulation, and storage time limit provisions are complied with, EPA allows generators to treat waste in accumulation tanks without a RCRA permit. This mechanism is not explicitly described in federal or Washington State regulations, but rather is a creature of regulatory interpretation and guidance (56 FR 10168, March 24, 1986). At Hanford, this option may enable some operations to reduce administrative burdens and disposal costs by reducing generation of hazardous waste. This approach would be in line with developing pollution prevention goals. Treatment by generator does not appear, however, to be a viable option for streamlining RD&D permitting efforts.

Treatability Study Sample Exemption (40 CFR 261.4 (e-f)): The treatability study sample exemption (TSSE) allows the collection and use of sample hazardous wastes without a RCRA hazardous waste permit in support of studies to determine waste treatment requirements, process dynamics, and residue characteristics. The quantities of sample materials that can be shipped, stored, and treated under the TSSE are limited. There is also a limit on the amount that may be fed into all treatability studies at a testing facility in one day. In Washington State, the quantity limits are as follows:

- Shipment - 1000 kg of "as received" dangerous waste; 1 kg of acutely hazardous waste; or 250 kg of soils, water, or debris contaminated with acutely hazardous waste per shipment.
- Storage - 1000 kg of dangerous waste, which may include 500 kg of soils, water, or debris contaminated with acutely hazardous waste or 1 kg of acutely hazardous waste may be stored at the testing facility.
- Treatment - 1000 kg of dangerous waste; 250 kg of soils, water, or debris contaminated with acutely hazardous waste; or 1 kg of acutely hazardous waste may be treated for **each waste stream and for each treatment process**. The entire testing facility is limited, however, to initiating treatment on no more than 250 kg of waste per day.

The TSSE is a crucially important option for the aggressive investigation of multiple innovative treatment technologies; its utility at Hanford depends upon a pragmatic interpretation of two key definitions: 1) "Waste Stream" and 2) "Laboratory or Testing Facility."

"Waste Stream" Definition

Because the regulations allow treatment of the designated waste quantity for each waste stream tested by a particular process, the definition of "waste stream" is a critical determinant of the number of studies that may be undertaken by each new technology. If the waste stream were defined by common residence in a single source, such as a tank, a treatability study using a particular process could only be undertaken once on the waste from that specific tank in order to stay within the exemption. However, a single Hanford waste source may contain several more or less distinct waste streams which differ significantly in their physical and chemical characteristics due to stratification, chemical interaction, migration, vintage, and other variables. The high-level waste tanks at Hanford, for instance, were placed into service and filled throughout the almost 50 years of plutonium production. In addition to containing wastes in gaseous, liquid, solid, and semi-solid states, the contents of the tanks have evolved a chemical geography which varies not only vertically but also horizontally throughout the tanks. These tanks will yield multiple waste streams, many of which may require different treatment and disposal processes. One Hanford tank waste pretreatment study is slated to evaluate between 20 and 39 chemically distinct waste streams from a single tank.

"Laboratory or Testing Facility" Definition

RCRA and Washington State dangerous waste regulations provide that the sample waste quantity limits apply in the aggregate to all treatability study sample materials at a single testing facility. This is of concern at Hanford, since under the TPA Hanford is considered a single RCRA facility and has been assigned a single EPA ID number. If sample quantity limitations were to be applied to Hanford as a whole, it would pose a severe restriction on the number of such studies that can be conducted at the many laboratories and locations across the Site. For example, the 250-kg daily use limitation would apply collectively to all the laboratories throughout the entire Site. The regulations themselves seem clear that the term "laboratory or testing facility" was not intended to be synonymous with the RCRA definition of "facility."

EPA Proposed Rule on Quantity Limits

EPA recently raised the quantity limits for the federal rule by a factor of 10 (see 59 FR 8362, February 18, 1994). If Washington followed suit, it would materially promote aggressive investigation of multiple innovative technologies at Hanford.

Land Treatment Demonstration Permit (40 CFR 264.272, 270.63): The land treatment demonstration permit is structured similarly to the RD&D and Part B Permits. The permit process is divided into two phases. Phase I allows field testing or laboratory analysis, much like an RD&D permit (discussed below). Phase II addresses design, construction, and operation of the land treatment unit in accordance with Part 264 Subpart M requirements. EPA Region X and Washington have no experience with this permit option; at Hanford the RD&D permit option offers greater certainty and acceptance as an innovative permitting vehicle.

Permits by Rule (40 CFR 270.1(c), 270.60): Facilities that already have Underground Injection Control or National Pollutant Discharge Elimination System (NPDES) permits for discharges need only meet a subset of the RCRA regulations. Also, operations which meet the definition of "totally enclosed

treatment facilities" and have a NPDES permit, state water discharge permit, or pretreatment permit for discharges are permitted by rule as long as they employ all known, available, and reasonable methods of prevention, control, and treatment prior to discharge. Needless to say, RD&D technologies are by their very nature unlikely to have such a collateral permit.

RD&D Permit (40 CFR 270.65): RD&D permits can be issued by EPA for innovative and experimental treatment technologies for which national standards do not exist. Permits are issued for up to 360 operating days, although they may be renewed three times. Issuance of RD&D permits follows a more streamlined process than a standard RCRA treatment, storage and/or disposal permit and should take about 12 to 18 months (compared to 2-5 years for processing a Part B). EPA may modify or waive most of the usual permit application and issuance requirements as long as human health and the environment are protected. While administrative authority for RD&D permits currently resides in EPA in Washington (pending delegation of Hazardous and Solid Waste Amendments Act of 1984 authority to Washington), availability of such permits depends upon Ecology's concomitant decisions regarding requirement of a RCRA permit for the subject activities. This highlights the importance of an effective working relationship and ready flow of information among DOE, Hanford contractors, EPA, and Ecology. EPA Region X is just now issuing the first RD&D permit for Hanford's 300 Area waste water pilot plant; this experience will contribute greatly to employment of this more flexible regulatory vehicle.

RCRA Permit (Part B) (40 CFR 270 Subpart B): Those activities that do not qualify for any of the above options will be subject to the Part B application requirements. This application involves a very detailed description of the environment, facility, components, process parameters, environmental health implications, and other aspects of the activity. Significant changes in the activity would involve a detailed modification procedure which requires public notice and comment.

TECHNOLOGY SURVEY RESULTS

The team distributed a sitewide survey to technology program and line managers and interviewed over 100 researchers and program managers across Hanford. The technology survey identified 57 existing or planned RD&D investigations at varying points in the technology development cycle. These investigations were assigned tentative permitting pathways based on purpose, location, waste quantities, and duration. The results are shown on the following Table I.

These results reflect activities at Hanford in September 1993. The very nature of RD&D work ensures that some of these projects have been abandoned and others have sprung into being. It is this highly dynamic character that defies efforts to force RD&D activities into the traditional Part B process. In addition, many RD&D activities are being conducted with modest waste quantities purposely to stay within quantity limitations or with simulants to avoid applicability of the regulations.

CONCLUSIONS AND RECOMMENDATIONS

The DOE Richland Operations Office and its contractors made the following recommendations to EPA and Ecology based on the regulatory analysis and the technology survey (see Table II).

These recommendations are now under consideration at EPA and Ecology and have been circulated to other federal facilities and bodies with an interest in regulatory reform, such as the Western Governors' Association. They are intended to be the vanguard of other ideas for regulatory flexibility and reform. Although it's early in the process at Hanford, and specific determinations have been difficult to come by, some lessons have emerged.

- There are existing mechanisms in the regulations that, used creatively and pragmatically, can help support aggressive RD&D programs.
- Use of these mechanisms depends on a negotiated compliance approach based upon flexibility, open dialogue, a demonstrated dedication to protection of human health and the environment, and a resolution by all parties to *find a way* to make it work. The two-pronged approach taken at Hanford has involved a dialogue with the policy makers for innovation and reform and a parallel dialogue with working regulators to build trust and familiarity among individuals and greater familiarity with technology needs, activities, and plans.
- There is a window of opportunity now for innovation and cooperation. The national and state political climates are ripe for reform and demonstrated progress. The Western Governors' Association and its

TABLE I
Hanford RD&D Technology Survey

Options	# activities
CERCLA	6
TSSE	33
RD&D/Part B	18

TABLE II
DOE Recommendations to EPA and Ecology

Treatability Studies
The definition of "waste stream" for purposes of the TSSE should be based upon the physical and chemical characteristics of the waste mixtures under investigation.
Each physical laboratory should be considered a single "laboratory or testing facility."
Quantity limits should be raised by EPA and the State of Washington.
Liberal quantity limits should be created for radioactive mixed tank wastes.
RD&D Permits
RD&D permits should be written on a programmatic basis rather than on an individual project basis, where sensible.
RCRA (Part B) Permits
Permits should be issued for particular buildings or laboratories, and written so as to accommodate experimental changes as Class I modifications.
Hybrid operations and experimental technology permits should be written.

regulatory reform task force have joined this movement. The Secretary of Energy and the Director of Ecology have called for a new age of regulatory partnership. Hanford itself has been named the "innovation" flagship for the DOE complex.

- This is a process, and the process demands an investment of time and patience. The shift from environmental "cops and robbers" to environmental cleanup partnership is not easy. Risk aversion is a difficult habit to break for everyone. "Zero mistakes" mandates are not the mothers of invention.
- Sharing experiences, ideas, and breakthroughs among the sites will help the process.

CONCLUSION

In the best of all RD&D worlds, the developing dialogue will support a vigorous partnership among the regulators, DOE, and its contractors to find ways to honor the intent of the legal framework, protect human health and the environment, and find ways to get the job done.

REFERENCES

1."Hanford Mission Plan, Volume 1: Site Guidance." DOE/RL-93-08, U.S. Department of Energy, Richland, Washington (August 1993).