COMPREHENSIVE STRATEGY FOR POLLUTION PREVENTION OF RADIOACTIVE LIQUID WASTE AT THE LOS ALAMOS NATIONAL LABORATORY

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ABSTRACT

Pollution Prevention is an integral part of waste management and facility operations at Los Alamos National Laboratory (LANL) that has been extending activities to reduce or eliminate radioactive liquid waste streams. The Nuclear and Waste Operation Division (NWO) Radioactive Liquid Waste (RLW) Group manages and operates the LANL facilities used to treat/dispose of radioactive liquid waste. The primary facility is the Radioactive Liquid Waste Treatment Facility (RLWTF) located at the Technical Area (TA) 50. The RLWTF is capable of treating 12-20 million liters per year of low-level and transuranic aqueous waste supplied to the facility by an industrial collection system. The LANL Pollution Prevention Group in cooperation with NWO-RLW Group, and waste generators has developed a comprehensive strategy that targets reduction of radioactive liquid waste generated upstream of the RLWTF. This paper describes the strategy and contributions/successes to date for pollution prevention/waste minimization of radioactive liquid waste at LANL.

INTRODUCTION

Los Alamos National Laboratory (LANL) manages and operates a Radioactive Liquid Waste Treatment Facility (RLWTF) that is located on approximately 15 acres of U.S. Department of Energy (DOE) controlled land, south of the Los Alamos Town site in New Mexico. The RLWTF has been operational since 1963 and has historically treated 20-23 million liters per year (LPY) of aqueous low-level waste (LLW) supplied to the facility by an industrial collection system that connects 15 TAs, 13 facility management units, and 63 buildings with over 1,800 drains [1]. The RWLTF currently treats approximately 12 million LPY of liquid industrial/LLW wastewater, 8,700 LPY of caustic transuranic (TRU) wastewater, and 43,000 LPY of acid TRU wastewater [2] using clarifier, tubular ultra-filter, ion exchange, reverse osmosis, and electro-dialysis reversal systems that produce a concentrated waste stream that is fed to an evaporator. The RLWTF is capable of removing 99 percent of the radionuclides it receives and produces approximately 180 drums of solid LLW for disposal each year. Treated liquid effluent from the plant is discharged to a National Pollutant Discharge Elimination System permitted outfall in Mortandad Canyon.

PROBLEM

The RLWTF is currently 16 years beyond its original design life of 25 years and is using electrical/infrastructure equipment that can no longer be repaired/replaced, cannot meet current authorization basis criteria, and fails current International Building Code requirements. This limits flexibility of operations to meet regulatory requirements and respond to system failures as they occur.

These features also make the RLWTF vulnerable to major system failures that could shut down the capability for both liquid industrial/LLW and TRU treatment. Such a shut down in operations represents a single point of failure for all nuclear, environmental, and research and development operations that generate RLW at the Laboratory. LANL must retain the capability to treat both liquid industrial/LLW and TRU currently discharged to the RLWTF. This presents the following challenges:

1. The waste streams treated at the RLWTF vary significantly in volume, radioactivity, and chemical/mineral content on a daily basis.

2. RLW generators at LANL are accustomed to an "open pipe/drain" philosophy, which contributes to the discharge of off-specification waste streams that exceed and/or violate the waste acceptance criteria (WAC) for the facility.

3. The influent volume and contamination levels are influenced by multiple groups/organizations with the sole purpose of supporting current/future LANL missions.

POLLUTION PREVENTION/WASTE MINIMIZATION STRATEGY

The LANL Pollution Prevention (P2) Group in cooperation with NWO-RLW Group and waste generators is addressing the challenges presented in Section 2.0 by providing technical and engineering support to develop and implement a comprehensive pollution prevention/waste minimization strategy that targets reduction of RLW generated and treated Laboratory wide. This strategy involves the following activities:

- Identification & Assessment of Projects
- Establishment of Funding Mechanism
- Prioritization & Facilitation of Project Implementation
- Contribution to Future Operations

The following sections describe each of the activities and discuss contributions/successes to date for pollution prevention/waste minimization of radioactive liquid waste at LANL.

Identification & Assessment of Projects

RLW pollution prevention/waste minimization projects must reduce volume, radiological contamination, and/or chemical contamination discharged to the RLWTF. Projects may also promote recycling or improve process operations at the RLWTF. To date, the majority of the projects identified for implementation have been focused on upstream source reduction and include projects summarized in the "Radioactive Liquid Wastewater Treatment Facility Influent Minimization Study," LA-UR-01-5353, hereinafter referred to as the Influent Minimization Study (IMS) [3] and the "Alternative Discharge Strategy Report for Minimization of Waste Destined for Treatment at the RLWTF," hereinafter referred to as the Alternative Discharge Strategy Report (ADSR) [4].

The IMS reviewed all facilities/activities at LANL that discharge liquid waste to the RLWCS. The scope of the IMS included the identification of wastewater sources, review of the requirements for the source, and preliminary suggestions for source elimination of some waste streams. The IMS resulted in identification of 28 industrial/LLW waste streams that could be eliminated without major impacts to LANL missions. The IMS also stimulated the removal of five, high volume, waste streams from the RLWCS in FY2001 and FY2002. Table I identifies these waste streams and volume reduced.

Table I. Waste Streams Removed in FY2001 and FY2002

Waste Stream	Volume Reduced (LPY)
TA-48-1-244, Boiler Blow Down	2,154,297
TA-21-240, Cooling Tower Blow Down	1,490,076
TA-3-29, Wing 7, Vacuum Pump	193,056
TA-3-29, Wing 7, Cooling Water Evaporator	462,672
TA-3-29-2124, Laboratory Condenser	24,960
TOTAL	**4,325,061**

LPY = liters per year

The ADSR provided a detailed analysis of the remaining 23 waste streams (i.e., those not removed in FY2001/2002) identified in the IMS. This analysis included detailed source descriptions, increased accuracy for flow estimates, a consistent approach for the identification of alternatives, an evaluation of potential problems, and preliminary cost estimates for implementation. Table II summarizes volume reductions associated with the waste streams for which preferred alternatives could be identified.

Table II. Waste Stream Projects Estimated Volume Reductions

Waste Stream	Estimated Volume Reductions (LPY)
TA-3-141 Beryllium Technology Facility Laundry	246,052
TA-3-66 Electroplating Bath Steam Condensate	850,000
TA-3-29 Liquid Ring Vacuum Pump Water	386,070
TA-3-29 Cooling Water Evaporator Blow Down	1,930,605
TA-3-29 CWE Recycle Loop	45,424
TA-3-102 ESA Shop Showers	261,885
TA-35-213 Liquid Ring Vacuum Pump Water	463,000
TA-48-1 Laboratory Sinks	1,103,760
TA-48-1 Condensers	54,720
TA-48-1 Ice Machine	80
TA-3-29 Equipment Room Showers	314,262
TA-3-66 Water Fountain	0
TA-3-29, Wing 1 Water Fountain	0
TA-3-29, Wing 2, 3, 4, 5 and 7 Water Fountains	0
TOTAL	**5,655,858**

CWE = Cooling Water Evaporator(s)
ESA = Engineering Sciences and Applications Division
LPY = liters per year

Additional projects came to the attention of P2 Group in December of 2003 as the project list was being prioritized for funding and implementation. These projects were identified by generators and the NWO-RLW Group as high priority and are briefly described below:

- **TA-48-1 Perchlorate Hoods Consolidation:** The duct washing system in the North, South, and Central wings of TA-48-1 contribute approximately 936,000 LPY of LLW water to the RLWTF. This waste stream is a primary target for elimination because it is a high volume waste stream; perchloric acid fuming/chemistry is no longer being conducted in the North and Central wings of TA-48-1; and current technology is such that localized scrubbers and isolated hoods are readily available for perchloric acid fuming/chemistry. The project involves a three phased approach that includes sampling of the ductwork, negotiation with DOE to stop washing the North and Central wings, demonstration of localized scrubber technologies, and installation of the approved technology in the South wing.

- **Engineering Sciences and Applications Division (ESA) Machine Shop Evaporator**: ESA operates a "hot" machine shop at TA-3-102 that is currently disposing of approximately 300,000 LPY of wastewater and coolant to the RLWTF. To eliminate this discharge, ESA has proposed to install an evaporator and waste water collection system that is connected to the shop drains.

- **Centrifuge Demonstration**: This project will demonstrate a centrifuge by dewatering 87,064 liters (L) of legacy chemical sludge (4-25% solids) currently in storage at the RLWTF. Sludge at the RLWTF is currently de-watered using a 40 year old vacuum filter system that concentrates it to approximately 32% solids. The vacuum filter is inefficient and the only means of dewatering sludge at the facility

- **RLW Generator Training**: This project will modify the existing generator and waste management coordinator training to include management and pollution prevention of RLW.

Establishment of Funding Mechanism

The RLW projects identified for implementation at LANL vary in complexity and cost. Originally, these projects were added to the over-target budgets for P2 Group, NWO-RLW Group, and/or the appropriate generator. However, that source of funding proved to be unreliable in the face of mission changes, safety shutdowns, and security improvements at the Laboratory. The second source of funding sought was the Generator Set-Aside Fund (GSAF), established in 1997.

The GSAF is managed by the P2 Group and was set up to collect a small fee from solid (hazardous, LLW, and TRU) waste generators and consolidate it into a fund that supports process changes at the generator level to reduce waste volume and/or radiological content. The IMS, ADSR, and the problems described in previous resulted in the GSAF program receiving an increased number of proposals aimed at minimizing RLW. This posed a significant problem because RLW generators are not required to contribute to the GSAF. It became evident that P2 Group needed to expand the GSAF program to provide a means of funding the implementation of pollution prevention/waste minimization projects for RLW. The following sections discuss the development of the RLW-GSAF program.

The RLW-GSAF is designed to collect a small fee from all waste generators that discharge RLW for treatment/disposal at the RLWTF. The rate structure for the RLW-GSAF was developed by conducting an analysis of the base flow rates. This analysis included review of the active waste profile forms (WPF), interpretation of available flow meter data, and estimates from facility/equipment maintenance discharges. The rates for FY2005 are provided in Table III.

Table III. Fiscal Year 2005 RLW-GSAF Rate Structure

Waste Type	Fiscal Year 2005 Rate ($/Liter)
Industrial	$0.06
Low Level Waste	$0.06
Transuranic	$0.10
Off-specification	$0.15
Off-specification (with Non-Conformance Report)	$0.30

The rate structure is divided into five categories based upon radiological contamination and compliance with the WAC. The rate structure will be modified yearly to reflect the generators compliance with the WAC and the submittal of WPFs.

The RLW-GSAF program proposals are peer-reviewed based upon the following criteria:

- Waste Stream Type (e.g., TRU, LLW)
- Volume (reduced/removed)
- Radiological Content
- Chemical/Mineral Content
- Project Description
- Cost Estimate
- Project Implementation/Execution
- Return-on-investment

Proposals are required to address the waste volumes, radioactive/chemical content, and/or process changes to be implemented. P2 Group anticipates that this proposal process will serve as the primary means for identifying, assessing, and prioritizing RLW minimization projects in the future.

Prioritization & Facilitation of Project Implementation

Projects are prioritized based upon the waste stream type (e.g., TRU, LLW, Industrial), volume (reduced/removed), radiological/chemical/mineral content, impact to LANL mission, impact to existing RLWTF operations, impact to health and safety, and cost to implement. Table IV provides the FY2005/2006 prioritized list of RLW pollution prevention projects.

Table IV. Prioritized RLW Project List

Rank	Project Title
1	Beryllium Technology Facility Laundry Facility
2	TA-48 Perchlorate Hood Consolidation
3	RLWTF Centrifuge Demonstration
4	Generator Training
5	TA-3-102 ESA Machine Shop Evaporator
6	TA-3-66 Electroplating Bath Steam Condensate
7	TA-35-213 Liquid Ring Vacuum Pump Water
8	TA-3-102 ESA Shop Showers

Implementation of the projects listed in Table IV varies significantly in cost and complexity. So in addition to providing prioritization of the projects, P2 Group determined that it was necessary to provide engineering and technical support to ensure completion of the project such that pollution prevention/waste minimization is achieved. P2 Group is currently providing two part time process/chemical engineers to support each of these projects through completion.

Contribute to Future Operations

The aging RLWTF is vulnerable to major system failures that represent a single point of failure for all nuclear, environmental, and research and development operations at LANL. DOE has recognized this and is currently working with NWO-RLW to design and build and upgraded or new RLWTF. P2 Group has been an active contributor to this process to facilitate generator objectives, develop comprehensive influent design basis information, and provide pollution prevention/waste minimization oversight for input to the design and construction of future RLWTF operations. These activities include:

- **Design Charette:** In April 2004, P2 Group sponsored a design charette to determine the goals and programmatic requirements for the future of RLWTF operations at LANL. The charette included an overview of the existing RLWTF operations, validation of current project goals, and further definition

of the programmatic goals for RLW treatment capability [5]. The discussion provided by this charette resulted in DOE funding for design and construction of a new or upgraded RLWTF.

- **Influent Boundary Condition Assessment Report:** The "Influent Boundary Condition Assessment Report," [6] was prepared by P2 Group to provide boundary conditions for the preliminary influent design basis of a new and/or upgraded RLWTF. Development of these boundaries included analysis of analytical data and operational knowledge dating back 10 years and a scope that encompassed future pollution prevention/waste minimization projects and mission changes.

- **Pollution Prevention/Waste Minimization Oversight for Design:** The RLW pollution prevention experts from the P2 Group are considered valuable members of the project team for the design and construction of a new or upgraded RLWTF. Contributions to date have included review and input to the preliminary conceptual design effort, inclusion of sustainable design requirements in the request for proposal, and providing process/chemical engineering review for conceptual and title design efforts during FY2005 – FY2008.

CONCLUSIONS

Pollution prevention/waste minimization efforts have resulted in responsible for the steady decline of influent to the RLWTF since 1998. These efforts have included removal of 4,325,061 LPY of waste water discharged from the Chemistry and Metallurgy Research (CMR) building, TA-48 boiler, and the TA-21 cooling towers at LANL. Effective implementation of the pollution prevention/waste minimization strategy described in the previous sections will produce a projected 2,744,937 LPY of waste water in additional volume reductions, treat 87,064 L of legacy sludge, and provide RLW generator education that encourages pollution prevention/waste minimization upstream of the RLWTF.

REFERENCES

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