SUCCESSFUL COMPLETION OF A RCRA CLOSURE FOR THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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DISCLAIMER

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ABSTRACT

This paper discusses the successful completion of a RCRA (Resource Conservation and Recovery Act) closure of a hydrofluoric acid (HF) Tank Car at the Fernald Environmental Management Project (FEMP). The FEMP is a facility owned by the Department of Energy (DOE) that is on the National Priorities List of hazardous waste sites and is undergoing CERCLA (Comprehensive Response, Liability Act) remediation. The FEMP is also subject to closure under RCRA and Ohio Hazardous Waste rules. The HF Tank Car Closure was conducted by the Fernald Environmental Management Corporation (FERMCO), the contractor responsible for FEMP facility clean up and closure. Through a combination of sound planning and team work, the HF Tank Car was closed safely and ahead of schedule. During over 22,000 hours of field work required for construction modifications and neutralization of some 9,600 gallons of HF and decontamination rinseates, there were no OSHA recordable incidents. The system design avoided additional costs for constructing a new system and subsequent dismantling for disposal or reuse at another facility by maximizing the use of existing equipment and facilities. The successful closure of the HF Tank Car demonstrated the FEMP's commitment to reducing risks and cleaning up the facility in a manner consistent with objectives of RCRA regulations and the Ohio Environmental Protection Agency (EPA) Hazardous Waste Rules. This in turn, facilitated ongoing negotiations with the Ohio EPA to integrate RCRA closure and the ongoing CERCLA remediation activities.

This paper addresses why the unit was clean closed under an approved RCRA Closure Plan. The integration of the EPA regulations for RCRA and CERCLA programs and the DOE-Orders impacting design, construction and operation of an acid neutralization system is also reviewed. The paper concludes with a discussion of lessons learned in the process of preparing the closure plan and through final project close out.

INTRODUCTION

FEMP facility clean up and closure actions must be responsive to existing enforcement actions by both the USEPA and Ohio EPA. In July of 1986, the DOE entered into a Federal Facility Compliance Agreement and initiated a preliminary Remedial Investigation and Feasibility Study. In March of 1986, the Ohio EPA filed a complaint against the DOE which ultimately lead to in a Consent Decree signed in December 1988 by DOE and the Ohio EPA. Because there are no tri-party agreements between USEPA, Ohio EPA and DOE, enforcement actions and responses have been separate and independent and the FEMP has conducted dual compliance programs. The challenge facing the DOE and FERMCO (contracted by DOE in 1993 to oversee site remediation) is to establish an approach to site remediation that integrates RCRA facility closure requirements and the CERCLA requirements for remediation of all contamination.

The success of the HF Tank Car Closure project illustrates how a project team can coordinate and integrate multiple support organizations and regulatory requirements to ensure safe, effective and timely remediation. To achieve successful completion of the project, the project team coordinated engineering, construction and operation activities with support services from multiple organizations (e.g., radiation control, safety and health, quality assurance, and etc.). The closure actions were planned and implemented in a manner that integrated the multiple requirements of DOE Orders and USEPA, OSHA, and Ohio EPA rules and regulations.

OVERVIEW OF THE HF TANK CAR CLOSURE PROJECT

The subject of this paper is the completion of RCRA clean closure of the HF Tank Car. The HF Tank Car was a circa 1940 rubber-lined steel rail car containing an estimated 5,000 gallons of 30 percent hydrofluoric acid (HF). Preliminary evaluation of the HF Tank Car determined that the age of the tank car and the highly corrosive nature of HF posed a significant threat for release. Although the car was apparently in good condition, the age of the car was a cause for concern. Had the rubber liner failed the HF would have readily corroded through the steel tank car and been released to the environment.

HF is highly corrosive to steel and human tissue and is most corrosive at approximately 35 percent concentration. HF is also toxic, even at relatively low concentrations due to the affinity of free fluoride ions to calcium. Upon exposure to HF, workers experience extreme burning sensation in the eyes and respiratory system. However, the full effect on exposure to the skin, particularly at lower concentrations is often not felt for several hours because it is readily absorbed and migrates toward the calcium rich bones in the body. In the process, significant subcutaneous tissue damage can occur, causing gangrene in severe cases. When HF enters the body it also causes an electrolyte imbalance by removing calcium from the blood which can lead to cardiovascular difficulties.

The FEMP elected to remediate and clean close the HF Tank Car under a RCRA Closure Plan because extensive media contamination was not considered likely. The Ohio EPA had also identified the HF Tank Car as a high priority due to concerns for possible release. By completing clean closure under an approved closure plan, the FEMP increased their credibility with the Ohio EPA concerning RCRA closures which should facilitate ongoing negotiations for RCRA\CERCLA integration.

The original closure plan for the HF Tank Car was submitted in May of 1992. Implementation of closure actions were delayed by repeated cycles of Ohio EPA reviews and submittal of revised closure plans addressing Ohio EPA comments. Historically the FEMP had been reluctant to initiate closure actions prior to Ohio EPA approval. In addition, progress was hindered because the groups responsible for writing plans were not responsible for implementing actions. This created confusion and poor coordination of activities.

In February 1994, FERMCO established an integrated project team with a designated project manager and key contacts from various support organizations and DOE site representatives. The function of the project team was to coordinate, plan and schedule the field work for construction (prior to formal approval of the closure plan), and integrate the various regulatory requirements and FERMCO policies and procedures. The resolution of the final Ohio EPA comments required completion of the bench-scale testing and development of the conceptual design (see discussions below). As a result, the final approval of the Closure Plan was not received until July 1994. The proactive approach of the project team made it possible to complete the HF Tank Car closure within the required 180 days after approval.

Key to Success: **Involve and integrate support and performing organizations, including DOE, into a project team focused on how to get work done.**

The project team identified and worked through the following seven major project phases.

Phase 1 - Bench-Scale Testing

The first stage was to characterize the acid in the HF Tank Car and evaluate treatment options. Samples of the HF were collected and assayed to confirm the basic chemical properties and characteristics of the solution. Four treatment options were identified and evaluated based on health, safety, technical, and feasibility considerations. Lime slurry neutralization was selected for further testing and evaluation. A Bench-Scale Test Plan was developed to evaluate and confirm the feasibility of lime slurry neutralization, identify process limits, characterize treated waste streams, and provide data to support the design of a full-scale treatment system. The results confirmed that the best results were obtained by adding HF at a controlled rate to a prepared, agitated neutralization slurry consisting of 10 weight % solid using a mixture of 30 % calcium carbonate and 70 % lime. In

addition, analysis of the resulting neutralized solids and liquid wastes indicated they would no longer be RCRA hazardous. Table I lists the physical and chemical properties of the reagents and neutralization products determined by the bench-scale tests.

Key to Success: **Stopped making assumptions and collected hard data to characterize waste for treatability and provide data for system design.**

Phase 2 - Conceptual System Design

After confirming that lime slurry neutralization was feasible, three alternatives for neutralization and filtration were identified and evaluated for implementability, time required to implement, regulatory and site limitations, and qualitative cost impacts. Each criteria was assigned a relative ranking between a low of 1 and high of 3 and a cumulative score was calculated. The evaluation and selection of alternatives were reviewed and discussed by the project team. This process allowed early identification of interface and coordination issues (e.g., quality assurance issues and interface requirements between the project and FEMP site facilities). In addition, a preliminary hazard analysis was conducted and recommended safety controls were identified for inclusion into the detailed design.

The alternative selected required new pumps, piping and controls to allow use of an existing 1,400 gallon existing tank equipped with solids feeder unit. The existing tank, located within the same general area as the HF Tank Car, had been installed for HF neutralization but had never been used. The neutralized slurry was to be transferred using portable tanks to an existing on-site operation (referenced as Plant 8) for filtration across a rotating vacuum filter drum. The filtered solids would be collected, drummed and sampled at Plant 8, to determine\confirm disposal requirements, and the filtrate would be collected, tested and discharged to the FEMP wastewater treatment system. The conceptual system design avoided additional costs for constructing a new system and subsequent dismantling for disposal or reuse at another facility by maximizing the use of existing equipment and facilities. Figure 1 is the conceptual process flow schematic.

After the conceptual design and functional design requirements were identified, a Conceptual System Implementation Plan (CSIP) for HF Tank Car Closure was prepared and submitted to DOE. The purpose of the document was to provide an integrated discussion of planning, testing and design activities to support the closure of the HF Tank Car. The CSIP was also used to evaluate and document compliance with Ohio EPA regulations, DOE Orders and FEMP policies and procedures.

Key to Success: **Integrate preliminary hazard assessment and safety concerns into conceptual design and functional design requirements.**

Table I: Physical\Chemical Properties of Reagents and Neutralization Products

Material	English Units	Value	Metric Units	Value
HF Tank Car Acid				
Acid Type	-	HF	-	HF
Concentration	wt.%	28.7	wt.%	28.7
Density (estimated)	lb/gal	9.02	g/ml	1.086
Lime/CaCO3 Slurry				
Solids Content	wt.%	10	wt.%	10
Lime % of Solids	wt.%	70	wt.%	70
CaCO3 % of Solids	wt.%	30	wt.%	30
Slurry Density	lb/gal	8.8	g/ml	1.06
pH	unit	12.4	unit	12.4
Neutralized Slurry				
Solids Content	wt.%	8.8	wt.%	8.8
Density (estimated)	lb/gal	8.8	g/ml	1.06
pH	unit	6-8	unit	6-8
Viscosity	cp	30	cp	30
Solids Settling Velocity	in/min	0.03	cm/min	0.08
Temperature	°F	130	°C	54
Heat Evolved	BTU/lb HF	1209	cal/g HF	672
Filtered Solids				
Solids Content	wt.%	51.6	wt.%	51.6
Density	lb/cu. ft.	70.9	g/cc	1.1355
pH	unit	6-8	unit	6-8
Solids Composition:				
CaF2, % (estimated)	wt.%	85	wt.%	85
CaCO3, % (estimated)	wt.%	3	wt.%	3
Ca (OH)2, % (estimated)	wt.%	12	wt.%	12
Filtrate				
Solids Content (estimated)	ppm	<20	ppm	<20
Density	lb/gal	8.3	g/ml	1.0
pH	unit	6-8	unit	6-8

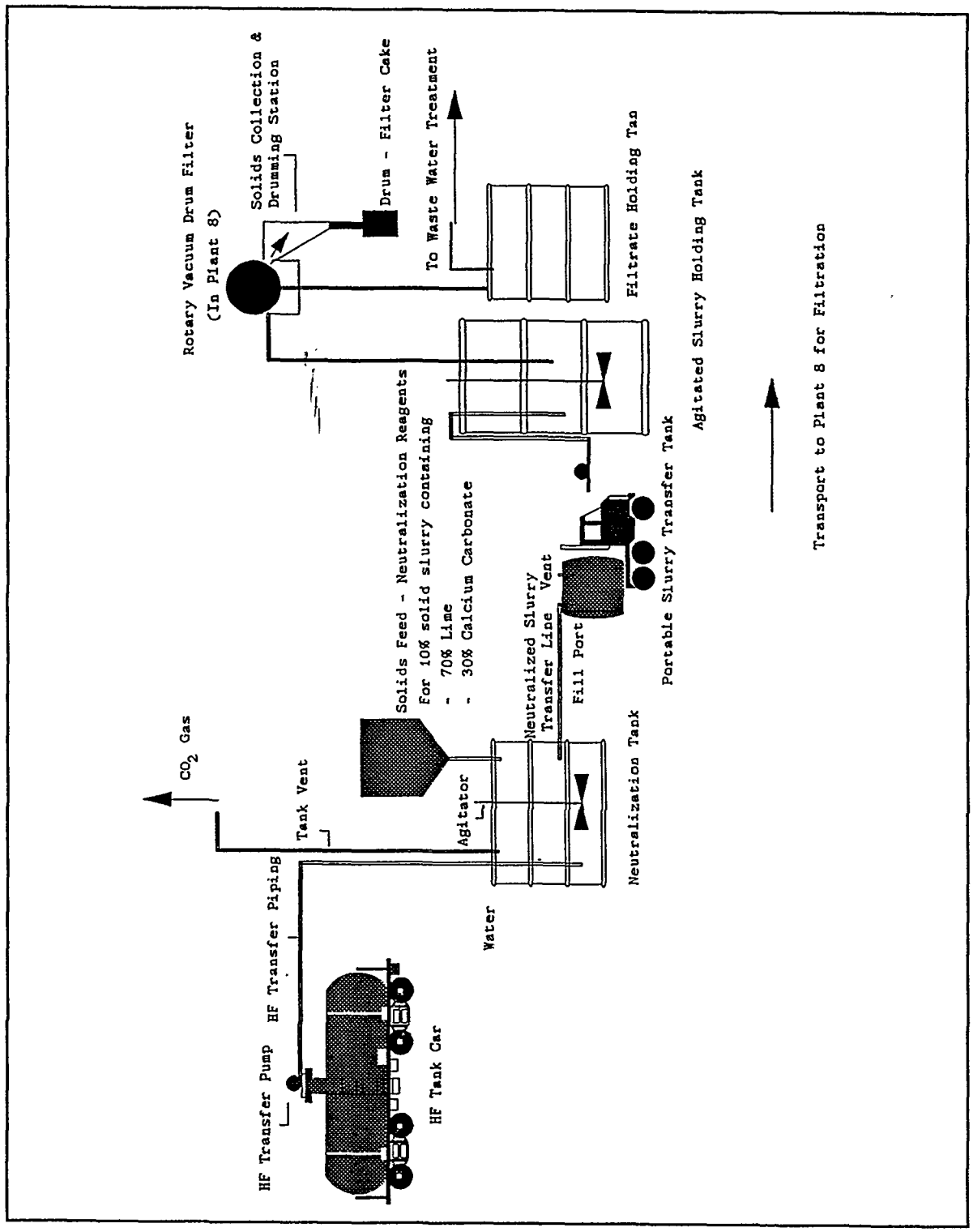

Figure 1 Lime Slurry - Elementary Neutralization Process Flow Schematic

Phase 3 - Detailed System Design

The detailed system design defined requirements and specifications necessary for construction and use of the HF neutralization system. Detailed design included specifications and drawings for the modifications necessary to provide a metering pump, water supply piping and batch controller, piping and valves to transfer HF from the tank car to the neutralization tank, piping and valves to transfer neutralized slurry to portable tanks for transport to the Plant 8 for filtration, and minor modification to the portable tanks to provide agitation and hose connections for neutralized slurry loading and unloading. The final design provided additional process control instruments, with interlocks to the HF transfer pump power, to stop HF addition if the temperature, pH, level, or pressure exceeded process design limitations.

Design reviews were performed by the project team for the initial and final design packages. An independent review was performed on the final design package. After resolving all comments, a final Certified-for-Construction (CFC) Design package was issued. After CFC, all drawings and specifications were controlled and could only be changed through a formal design change procedure.

After CFC and before major construction activities began, a secondary design review was conducted and a revised CFC package was issued. This design review was conducted to ensure consistency with recent changes to the FERMCO engineering procedures and to ensure that design problems that had been recently encountered on another similar FEMP project were not repeated.

Phase 4 - Construction and System Testing

Construction activities were conducted in accordance with the CFC drawings. Configuration Management was maintained to document construction and confirm design requirements were not compromised. Based on the Safety Assessment, a high level of documentation and quality assurance was required. Test plans for construction acceptance testing and system operability testing were prepared and implemented to confirm that the system was constructed and operated in accordance with the design. Although more problems than expected were encountered in servicing existing equipment and instrumentation, construction and testing was completed without incident.

Key to Success: **Proper configuration control precludes making field changes inconsistent with the design and operating requirements.**

Phase 5 - Operating Procedures and Operator Training

In order to complete the HF Tank Car closure within the required 180 day regulatory limit, it was not possible to wait until the system construction was completed before preparing the operating procedures and initiating operator training. To compensate, the procedures were initially developed based on the engineering specifications and drawings. A selected working group of project team members conducted a series of joint table top reviews. The operator training was set up in modules designed to maximize the ability to defer training on system components until the construction was completed and a field walk through could be conducted. As part of their training, the operators were tasked to walk through and verify the procedures in the field. They were encouraged to provide comment for improvement of the procedures. When construction was completed, the final procedures were completed and incorporated many of the operators comments. The final procedures were reviewed with the operators and a final field walk through was conducted. The operations manager then qualified each operator by oral exam and field simulation. In addition, the operators were involved in the conduct of the final system operability testing to increase their understanding of how the system functioned. Because of their involvement in the development of procedures and testing of the system, operator acceptance of the procedures and performance during operations were noticeably above average.

Key to Success: **Enhancement of operator acceptance and performance through their involvement in developing procedures and testing and evaluating system operations.**

Phase 6 - Operation and Processing

The neutralization of acid and decontamination rinseate was initiated on June 12, 1995 and completed on July 21, 1995. Within days of the system start up, operations personnel identified opportunities for improvement which decreased the time required for slurry preparation. The 9,600 gallons of acid and rinseate neutralized included 1,082 gallons more HF and 2,712 more rinseate than originally estimated. Despite the increased volumes, expedited processing was achieved and neutralization was completed 3 weeks ahead of schedule.

On at least 3 occasions, potential problems were identified and averted by Operations personnel based on system walk downs and inspections prior to initiating HF transfer (as required by the Operation's Standing Orders prepared to comply with DOE Conduct of Operations).

SUMMARY AND CONCLUSIONS

The highlighted keys to the HF Tank Car Project success are applicable to most any project and illustrate ways to improve project performance. In summary:

- A team approach improves the ability to identify, schedule and address tasks and issues before they become obstacles and cause delays. Keep a focus on the work to be done.

- Don't make assumptions, characterize waste for treatability not just for hazardous waste determinations.

- Define and verify process chemistry and operational requirements to be addressed in design of treatment system.

- Integrate safety requirements into system design, as early as possible.

- Once the design has been certified-for-construction, configuration management is essential. Without a detailed understanding of how the design components interact, minor changes can have major impacts.

- Involvement of operating personnel in the process of developing procedures and systems testing enhances operator acceptance and performance.

The establishment of a project team focused on how to get the work done represented a fundamental change in approach. Focusing on planning and design based on technical requirements to implement the work is critical. It is all too easy to fall into the trap of trying to design work to fit EPA regulations or DOE Orders. Regulations and orders define what you need to do, not how. Limited progress was made on HF Tank Car project between May 1992 and February 1994. However, once the project team focused on determining the technical requirements the project began to move forward. The most direct indicators of the effectiveness of the project team were the safety record and expedited processing of HF. Without compromising safety, the neutralization of HF and decontamination rinseates was completed 3 weeks ahead of schedule and included processing 1,082 gallons more HF and 2,712 gallons more rinseate than scheduled. There were no OSHA reportable incidents during the 22,000 hours of field work required for construction modifications and neutralization of the 9,600 gallons of HF and decontamination rinseates.