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IMPLEMENTATION OF ENVIRONMENTAL COMPLIANCE FOR OPERATING RADIOACTIVE LIQUID WASTE SYSTEMS AT THE OAK RIDGE NATIONAL LABORATORY

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INTRODUCTION

This paper addresses methods being implemented at the Oak Ridge National Laboratory (ORNL) to continue operating while achieving compliance with new standards for liquid low level waste (LLLW) underground storage tank systems. The Superfund Amendment and Reauthorization Act (SARA) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) required that the Department of Energy (DOE) execute a Federal Facility Agreement (FFA) with the Environmental Protection Agency (EPA) within 6 months of listing of the ORNL on the National Priorities List. An FFA for ORNL became effective January 1, 1992 among the EPA, DOE, and the Tennessee Department of Environment and Conservation (TDEC). The agreement ensures that environmental impacts resulting from operations at the Oak Ridge Reservation are investigated and remediated to protect the public health, welfare, and environment.

This FFA differs from other compliance agreements in that it addresses active systems, as opposed to the normal CERCLA agreements which address inactive systems. ORNL is a fully functional multi-disciplinary nuclear research facility. As a consequence of the research activities, solid and liquid radioactive wastes have been generated in varying amounts over time. The LLLW has been accumulated and stored in 96 below-grade collection tanks interconnected by miles of underground piping. The LLLW system was designed to minimize radiation exposure and is not amenable to standard verification methods.

Although the FFA addresses the entire Oak Ridge Reservation, specific requirements are defined for the radioactive LLLW storage tanks and associated piping at ORNL. The objective of the FFA as it relates to these tank systems is to ensure that structural integrity, containment, leak detection capability, and LLLW source control are maintained until final remedial action. The FFA requires that leaking LLLW tank systems be immediately removed from service, and that active tank systems be doubly contained, cathodically protected, and have leak detection capability. LLLW tank systems that do not meet requirements are to be either upgraded or replaced, but can remain in service if they do not leak in the interim.

ORNL BACKGROUND

ORNL is a multi-disciplinary research facility that began operation in 1942 as part of the Manhattan Project. The original mission was to develop a prototype graphite reactor and reprocess the reactor fuel for plutonium recovery. Following World War II, the primary functions were fuel reprocessing research, radioisotopes development, and testing of nuclear reactor concepts. More recently, ORNL has increased its role in biological, environmental, energy, and materials research. As a result of these research and development activities, radioactive LLLW has been generated in varying amounts over time.

LLLW originates from radioactive liquid discarded into sinks and drains in research and development laboratories, processing facilities, nuclear reactors, and radioisotope production. LLLW is characterized as having an activity greater that the trace levels permitted in process and less than 2 Ci/gal of Strontium-90 equivalent and less than 100 nCi/g of alpha-emitting transuranic elements.

LLLW SYSTEM OVERVIEW

The LLLW handling system used for collection, neutralization, transfer, concentration, and storage of aqueous radioactive LLLW from laboratory sources consists of 96 tank systems. Fifty five tanks have been removed from service, and 41 remain in active usage. The LLLW solutions are accumulated at source buildings in collection tanks and sent to the ORNL evaporator facility for an approximate 30 to 1 concentration. The concentrate is then transferred via pipelines to storage tanks.

Most of the LLLW tank and piping system was installed more than 30 years ago. The system was designed to minimize radiation exposure to the LLLW system users and operators. The LLLW tanks system includes gravity-drained transfer pipelines, single and double contained tanks, pressure transfer pipelines from the collection tank to the central waste collection header, and remote handling capability to minimize personnel exposure. Over the years, tank systems were abandoned as their integrity was breached or as programs were terminated. As new tank systems were installed over the past 10 to 15 years, some secondary containment features and improved leak detection were incorporated.

The tank system drain piping is typically a stainless steel, singly contained pipe with a nominal diameter of 2 inches or less, that drains by gravity to an area collection tank. The collection tanks are usually stainless steel tanks located in a service building with capacities less than 3000 gallons. These tanks are periodically emptied to the central treatment system using steam jets and pumps. The discharge piping typically consists of stainless steel pipelines with a nominal diameter of 2 inches. These lines are used for batch transfers of LLLW, under pressure on an as-needed basis, to maintain inventory control at the collection tanks and to transfer LLLW to the central LLLW system for evaporation and storage.

STRATEGY FOR MEETING THE FFA OBJECTIVES

An ORNL FFA response plan was developed and implemented with a team of multi-disciplinary support from various ORNL organizations and divisions. The LLLW tank systems were evaluated for FFA categorization, risk assessments, upgrade and replacement plans, containment, waste characteristics, age, confidence in historical tank system data, strategic importance to ORNL, and FFA documentation requirements.

The response team categorized the tank systems and formulated plans and schedules to bring the ORNL LLLW tank system into full FFA compliance by 2002. Funding for implementation was requested prior to the affectivity of the FFA. Capital projects were initiated or modified to assure FFA compliance. Contingency plans were developed to assure continued ORNL operations after removal from service of leaking or potentially leaking systems. Per the FFA, plans and schedules were formalized and submitted to the FFA regulators for approval.

Tank systems suspected of leaking were removed from service, except for 3 tank systems that cannot be shut down immediately due to health and safety risks associated with their shutdown. Risk assessments have shown that these 3 singly contained active tank systems cannot be shut down without creating unacceptable risks to worker health and safety. However, continued operation of these tank systems will pose no immediate risk to human health or the environment. In accordance with the provisions of the FFA, these tank systems were identified and have been designated as Environmental Safety and Health (ES&H) systems that will remain in service. Risk assessments that form the basis for maintaining the ES&H tank systems in service were submitted to the FFA regulators.

IMPLEMENTATION PLANS FOR FFA COMPLIANCE

Plans being implemented at ORNL to maintain FFA compliance consist of the following tasks; 1. tank categorization, 2. tank system assessments for compliance verification, 3. tank system upgrades and replacements, 4. leak test program for periodic integrity verification to continue usage of non compliant tank systems, 5. contingency planning and implementation, 6. fulfillment of the Environmental Restoration Program (ERP) acceptance requirements, and 7. FFA documentation submittals. The required tank assessments and leak testing are complicated by the fact that the tank systems are not directly accessible due to the radioactivity associated with them. Remote inspections, decontamination, and repair procedures are being used.

Tank Categorization

The FFA defines 4 categories of tank systems; 1. Category A-new tanks, 2. Category B-existing tanks with double containment, 3. Category C-existing tanks with single containment, and 4. Category D-tanks removed from service. ORNL LLLW tank systems have been assigned to the FFA categorizes as follows: no Category A-new tanks, 30 Category B-secondarily contained tanks, 11 Category C-singly contained tanks, and 55 Category D-tanks removed from service.

The 30 category B active tank systems are either partially or fully in compliance with the FFA requirements for secondarily contained systems. The partially compliant tanks may be upgraded to meet the FFA requirements. The 11 category C active singly contained tank systems must be removed from service, but are allowed to remain in service temporarily if they can be shown not to leak until they are replaced. Sixteen of the 55 category D tanks were removed from service but had not met the ERP transfer requirements on the effective date of the FFA. ORNL is implementing the requirements for transfer of these 16 tanks to the ERP.

Tank System Assessments

The FFA requires that existing doubly contained tank systems must be evaluated to show that the secondary containment meets or can be retro-fitted to meet specific requirements for category B secondarily contained systems. These requirements include verification of the containment structural integrity, the ability to safely contain potential waste leaked from the tank systems, and have the capability of leak detection of the primary containment system. Therefore each doubly contained tank system was evaluated by drawings and specifications review, determination of tank structural condition, evaluation of the LLLW contained in the tank, and evaluating the overall tank containment system ability to contain potential leakage. These secondary containment design demonstrations will be submitted to the FFA regulators and will be used to assess the upgrades or replacements required to bring these systems into full compliance, if needed.

The FFA requires that existing singly contained tank systems be assessed for structural integrity and potential upset to the environment. The assessment also is required to show that there is no evidence of tank collapse, rupture, or failure prior to its removal from service or re-assessment. The structural integrity for the singly contained tanks must include periodic leak testing to demonstrate that they do not leak.

The demonstrations of the secondary containment and the structural integrity assessments are complicated because visual inspection of much of the tank system is not possible because of the radioactivity involved. In some cases, remote television camera inspection is being used to assist in the verification of the tank integrity.

In preparing the assessments and subsequent upgrade or removal-from-service plan, it has been assumed that tank system assessments will show compliance or that repairs can be made to maintain system operations until upgrade or replacement plans can be implemented. If leaks in the tank systems are identified, all programmatic inputs except for ES&H-related activities will be stopped, and the system will be repaired or replaced. The tank system may continue to collect non-programmatic wastes such as inleakage, inadvertent wastes from floor drains and sumps, and condensate collected in the off-gas ventilation systems during this period.

Tank System Upgrades and Replacements,

The FFA requires a plan for removing from service all LLLW tank systems that cannot meet FFA secondary containment criteria. Tank systems that partially meet the criteria may be either upgraded or removed form service. Expense-funded projects, General Plant Projects (GPPs), and Line Item Projects (LIPs) are being planned and implemented to upgrade or replace the non compliant tank systems. Some of these projects require several years to implement; therefore, interim projects were initiated to upgrade the existing tank systems until full compliance can be achieved.

Alternate collection methods, such as bottling and trucking, are being implemented for the small volume waste generators. Source treatment is being implemented for the high-volume low radioactive waste streams. LLLW tank systems are being replaced for hot cell facilities.

GPPS are capital construction projects that have a total estimated cost less that $1.2 million. This limit is congressionally authorized, and the GPP funding level is established annually for ORNL. Each GPP is a stand-alone project and takes 4 to 5 years for completion.

LIPs are large capital construction projects with total estimated costs greater than $1.2 million. Each LIP is identified and authorized as a specific entry in the congressional budget approval process. Because of the complexity and magnitude of these types of projects, LIPs can take up to 10 years to complete; however, the LIP life cycle averages 7 years overall--three years for project planning and four years for execution.

Leak Test Program

The FFA allows tank systems that do not meet secondary containment standards to remain in service until the system can be upgraded or replaced, as long as structural integrity assessments and leak tests indicate that the tanks are unlikely to fail structurally and are not leaking. Therefore in conjunction with the tank assessments, leak testing is being performed for all the category C tank systems and all of the category B tanks that are not fully FFA compliant. Leak testing will be performed on the 3 tank system components; gravity fed drain piping from the LLLW source to a collection tank, collection tank, and the pressurized discharge piping from the collection tank to the central waste collection header.

The FFA does not define specific leak test criteria for LLLW tank systems. The planned leak test criteria is based on current leak detection technology and technical standards from relevant portions of federal regulations. This ensures that the performance requirements for the leak detection methods described in the LLLW plan are technically achievable and that the degree of environmental protection provided by the plan is consistent with other federal regulations.

Leak testing of underground tanks and pipelines in the petroleum industry and for other hazardous substances is well established; however, some issues must be considered that are unique to the ORNL LLLW system. Leak testing of unvalved piping and tanks which are under negative pressure for containment purposes, for example, requires adaptation of current technology and development of some new leak-testing technology. In addition, testing will be constrained by radiological exposure concerns, severely limited access to the system, disposal of secondary wastes produced, and limitations in modifying the system.

Contingency Plans

Because most of the upgrade and replacement projects will not be completed until the late 1990s, ORNL has initiated contingency plans for interim action projects using GPP and expense funding. Options being implemented for interim action include construction of interim waste bottling and trucking stations for collection and transport of waste, administrative actions to keep the systems in interim service, source treatment, waste reduction, process relocation, program shutdown, tank system modifications for interim use, alternative LLLW treatment or collections systems, revision of operating documents, and rerouting some transfer lines.

Environmental Restoration Acceptance Requirements

The 16 category D tanks that were removed from service, but not accepted by the ERP, when the FFA became effective will be turned over to the ERP for remediation. The ERP acceptance policy defines a 2 step process for transferring management responsibilities for surplus facilities. First, application is made by submitting available descriptive status and assessment information for each tank system. On the basis of the information submitted, a memorandum of agreement is issued that establishes the requirements the tank systems must meet for the actual acceptance into the ERP. As part of the acceptance package, the waste that resides in the tanks must be characterized to assist the ERP in determining remediation and schedules. Since the LLLW is radioactive, special sampling and analysis procedures are being defined and implemented.

SUMMARY

Since the inception of the FFA, ORNL has initiated several line items, general plant projects, and expense related projects to bring the LLLW collection, transfer and treatment system into full FFA compliance by the year 2002. The ORNL FFA response team meets routinely with the FFA regulators to keep them fully cognizant of the compliance implementation plans and status, and jointly resolves uncertainties and concerns that emerge. In addition, ORNL submits FFA required documentation to describe the ORNL compliance plans, schedules, methodology, and status. With the working relationship established among the DOE, TDEC, and the US-EPA, ORNL is confident that its operations can continue while implementing FFA compliance activities.