DEMONSTRATION TESTING AND STARTUP OF A CONTAINER FILLING SYSTEMS DESIGN AT THE FERNALD SILOS 1&2 ITP

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ABSTRACT

This paper presents the technical and operational performance milestones achieved in pretesting prototypical integrated systems prior to installation on the Environmental Remediation Project at the Fernald Silos 1&2 Site. This paper will discuss the Integrated Test Project (ITP) successes accomplished by the selected team who tested and successfully demonstrated the processes along with the integration of the remote-controlled hardware by filling the disposal containers with mixed slurry and solidification media, and then closing the IP-2 shipping containers and sealing them remotely with rivets. The ITP project demonstrated that testing and repeated operation will ensure the smooth installation and startup of a proven, integrated, container filling, handling and closure system. This paper presents problems and solutions, as well as lessons learned in rigorous preoperational testing of the fill room systems prior to installation, startup, and operational testing at the Fernald Silos 1 & 2 site.

INTRODUCTION

The Fernald Silos 1& 2 Remediation Project is located in Ross, Ohio. Duratek Federal Services (DFS) and Jacobs Engineering (JE) are teamed with Fluor, who is the prime contractor for the Fernald closure contract that is scheduled for completion in 2006. The Fernald site was operated from 1952 to 1989 to provide high purity metals by uranium processing for the Department of Defense. As a result of the uranium processing residues were produced and collected within the Fernald Silos 1 & 2. These K 65 residues, along with the Bentogrout clay, which was used to minimize the Radon emanating from the silos, are the waste slated for safe processing and offsite disposal. This is a key focus area required to ensure the on time scheduled Fernald site closure. A remediation plan was put into place to remotely extract the Silo contents and place into steel tanks for processing with subsequent transfer to the stabilization process for remote packaging, handling and transport to disposal.

In March of 2003, the Duratek Commercial Services Group (CSG) was awarded a contract to erect and test a full-scale prototype of the Container Fill-Room Process in support of the Fernald Silo 1 & 2 Waste Solidification Project. It was John North, the DFS project manager, who established this project with the primary objective of ensuring a smooth installation, system startup with tested and proven components that integrated all individual systems working as one complete system at the Fernald site.

The ITP was created to meet the proceeding function so as to align with DOE's expectations as quoted by Bob Warther, the DOE Ohio Field Office Manager, "The Silos project is clearly the critical path. We've had some problems. I think it's fair to say we're not getting the work done as fast as we would like. The bigger challenges are ahead of us as we transition from completion of construction to testing to start up. I'm looking very hard at that and the Department is working with Fluor to make sure that goes smoothly and safely so that we can quickly go through start up regimen and get into operations. We're starting on that earlier rather than later. We're looking at trying to do some creative things in terms of parallel readiness reviews and we're going to establish a new set of expectations there."

The Fernald silos contain low-level radioactive waste that will need to be extracted, made into slurry, (containing ~30%-45% solids), and subsequently conveyed to the fill room for stabilization and packaging in IP–2 containers for off-site disposal. The full-scale Fill Room prototype, called the Integrated Test Project (ITP), was used to test and prove the processes and integrated remote-controlled hardware that would be needed to fill the containers at the site. The ITP was to demonstrate remote-controlled filling of IP–2 containers with 160ft^3 of liquid slurry that was mixed with solidification media, (~70% total waste solids), and then closing of the containers with remotely placed rivets. In actual operation during the Fernald site remediation project, thirty, (30) IP-2 containers per day could be filled using two of the three supplied process aisles.

The Duratek CSG in Oak Ridge, Tennessee scope in the overall ITP project included erection of the test stand steel, the fixed installation of the specific vendor-supplied system component hardware, and providing all necessary engineering support and testing personnel to detail and eliminate installation holdups or schedule delay. The Duratek team also provided a modified facility to house the project, procured materials, and followed up with design modifications based on test results. Along with these functions, the Duratek Team also performed ALARA Reviews, the Fire Hazard Analysis (FHA), and the Process Hazard Analysis (PHA). And finally, Duratek was also responsible for site-specific safety and process guidance, as well as training for all subcontract vendors and the project team members that required on-site access. Duratek CSG in Columbia, South Carolina, designed, fabricated, tested, and obtained DOT certification of the IP–2 prototype containers that would eventually be used by the actual Project and at the ITP for operational testing.

Project Overview

In support of the overall Fernald Closure Project, Duratek was awarded a contract to erect and test a full-scale prototype of a waste-solidification filling system that would be used in the remediation of two silos at this former uranium extraction facility. The silos contain low-level radioactive mixed waste that will need to be extracted, made into slurry, solidified, and packaged for off-site disposal using three parallel filling trains (process aisles). An Integrated Test Project (ITP) was established to create a working, full-scale prototype in order to test and ensure the smooth installation and startup of a proven, integrated, container filling, handling and closure system. Figure 1 shows an overview of the ITP facility.

The prototype equipment included an IP-2 container transfer car (shown in Figure 2), a gantry manipulator (shown in Figure 3) for remote closure with a riveting system, and product fill chute assembly containing two (2) 18 inch knifegate valves, a bellows isolation connector and sampling equipment. All of the preceding systems were fully tested and integrated at the ITP facility. Testing was conducted in several phases according to a well-defined test plan, which focused on resolving observed problems. The lessons learned from testing were incorporated into the final design for the on-site container fill room facilities. Equipment and controls software modifications were made, as necessary, over the course of the project to ensure operability and maintainability of components and systems. Testing was conducted in a phased approach: first, without use of any simulated media, then with water, and finally with a grout formulated to simulate the actual waste product. This was accomplished prior to completion of the final installation and startup at Fernald.

Fig. 1. The ITP prototype equipment included a container transfer car, gantry manipulator tool for remote closure with a riveting system, and product fill chute.

Fig. 2. Each IP-2 container can hold 160 cubic feet of liquid slurry mixed with solidification media is shown atop the transfer cart.

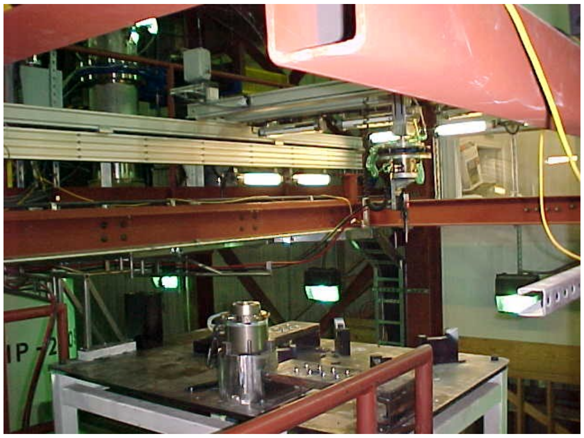

Fig. 3. Close-up of gantry manipulator tool and table components.

Design Decisions and Performance

The Duratek ITP team was involved with the design and operations group in accomplishment of design reviews, drawing, test procedures and operating procedures review meetings both before, during and after installation and testing of the systems at the ITP facility. Following completion of the prototype installation at the ITP, the ITP facility personnel tested and successfully demonstrated the processes and the integrated remote-controlled hardware by filling the disposal containers with mixed slurry and solidification media grout surrogate, and then closing the containers and sealing them remotely with rivets. In addition to construction management of a steel-testing stand furnished by Jacobs Engineering, Duratek was responsible for coordination of all vendor-supplied components as well as for all necessary engineering support and testing personnel at the facility. As part of the development process, the design of the system was continually modified based on test results. Duratek also performed the ALARA review, Fire Hazard Analysis, the Process Hazard Analysis, and was responsible for site-specific safety at the ITP facility which affirmed earlier analysis performed by Jacobs, Duratek and Fluor design and operations personnel.

The facility filling systems underwent (startup) testing and operator training prior to installation and startup for production runs at the Fernald Site. An aggressive design review, consisting of a thorough operational testing procedure, step verified which ensured proper operation at the earliest point of the project. After completion of this extensive operational testing, the system worked successfully prior to installation of the three production systems on site. This approach allowed earlier-than-planned, on-site installation and startup, resulting in an aggressive project completion schedule. The work at the ITP was completed without a single OSHA Recordable or lost time accident or restricted workday and was used in support of training the Fernald operations personnel prior to operational startup at the site.

Project Results and Goals Achieved

The culmination of Phase 1 was the construction and functional operation demonstration of the complete integrated system at the ITP facility. This was demonstrated for project personnel from Fluor-Fernald, DOE, Fernald Operations, and the Critical Analysis Team (CAT) on November 18, 2003. The response of the CAT team was positive and they were very complementary to all involved in the project. The Critical Analysis Team (CAT) stated that the ITP Demo report was the best Fernald had ever received. The Duratek Team "appeared competent, engaged, knowledgeable and willing to meet the project's challenges". Duratek's follow up to the actual testing at ITP recommended modifications and innovations to the following components: the Fill Chute, (including the 18-inch Slide Gate Valves and Catch Tray), Rivet Size, Riveting System Hardware Operation, the Video Camera System and the Control System Software. Table I presents a partial list of these problems and the solutions provided to correct the problem.

Phase 2 of the ITP project began in January 2004. This phase included the completion of the modified 18-inch valves and subsequent testing, fill-chute testing, and the performance of operational tests to ensure that the reliability and maintenance operations would meet the client's expectations. This part of the project was completed in May 2004. Next a training program was developed by the Duratek ITP Team, to train the Fernald operators, in the proper use of all the Container Fill Room integrated systems used at the ITP facility which are virtually identical to the systems at the Fernald site. Two teams of eight Fluor operators and supervisors have been trained at the ITP through mid July. The same Duratek ITP team was also used to assist the Project Team during process equipment installation and startup of the systems to demonstrate operational readiness at the Fernald site. The total facility startup and turnover to the Fernald operations group is planned for early February of 2005.

Table I. Problems and Solutions at the ITP

Problem	Solution
18 " Top and Bottom Fill Chute Valves had excessive leakage	Machined valve guides to effect precise repeatable closure and seal
Gantry Manipulator rivet installation not repeatable	Changed area lighting, paint gloss reduction and software program
Transfer Car tolerance limits caused shut down during filling of container due to impact of materials dropped into the container	The functional tolerance limits for the Transfer Car were set to a higher value which allowed fill processing to continue
Fill Tray interfered with the fill chute and container	Modified the tray design to remove interference experienced
Excessive flush water was required for valve and bonnet flushing during planned operation	Multiple testing of the valve, varying the spray nozzle quantity, size and locations
No attention to flush water management	Implemented a means to recycle valve flush water and package effectively
IP-2 Container size and painting not repeatable	Effected design tolerances to ensure dimensional repeatability for system operation
Flexible connection to permit isolation of the fill chute from the batch mixer was inadequate	Redesigned, tested and replaced with a steel bellows design
Rivet closure problems	Recommended longer rivet lengths
Rivet system maintenance	Recommended a rivet blow off block for testing and calibration purposes.

CONCLUSIONS

The lessons learned on this most challenging environmental restoration project related to safely meeting an aggressive schedule while thoroughly testing full-scale systems prior to on site installation. Duratek's follow up to the actual testing at ITP recommended modifications and innovations to the following components: the fill chute, (including the 18-inch slide gate valves and catch tray), rivet size, riveting system hardware operation, the video camera system and the control system software. These recommendations and problem solving efforts shortened the installation and preoperational testing by at least four months. In summary funding the ITP saved both time and money to the Fernald Silos 1&2 project.

The ITP project was a team effort led by Marty Brownstein with key individual support by Mike Welch, Doug West, Tim Elliott, Larry Grob, Mike Campbell, Gerard Policastro, Dave Weigle and Lance Lowe, reporting to John North as the overall Project Manager who's efforts created this project.