

Construction, Startup and Operation of a New LLRW Disposal Facility in Andrews County, Texas – 12151

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ABSTRACT

During this last year, Waste Control Specialists LLC (WCS) completed construction and achieved start of operations of a new low level radioactive waste (LLRW) disposal facility in Andrews County Texas. Disposal operations are underway for commercial LLRW, and start up evolutions are in progress for disposal of Department of Energy (DOE) LLRW. The overall approach to construction and start up are presented as well as some of the more significant challenges and how they were addressed to achieve initial operations of the first new commercial low level radioactive waste disposal facility in more than 30 years.

The WCS disposal facility consists of two LLRW disposal cells, one for Texas Compact waste, and a separate disposal cell for DOE waste. Both disposal cells have very robust and unique designs. The cells themselves are constructed entirely in very low permeability red bed clay. The cell liners include a 0.91 meter thick clay liner meeting unprecedented permeability limits, 0.3 meter thick reinforced concrete barriers, as well as the standard geosynthetic liners. Actions taken to meet performance criteria and install these liners will be discussed.

Consistent with this highly protective landfill design, WCS chose to install a zero discharge site water management system. The considerations behind the design and construction of this system will be presented.

Other activities essential to successful start of LLRW disposal operations included process and procedure development and refinement, staffing and staff development, and training. Mock ups were built and used for important evolutions and functions.

Consistent with the extensive regulation of LLRW operations, engagement with the Texas Commission on Environmental Quality (TCEQ) was continuous and highly interactive. This included daily activity conference calls, weekly coordination calls and numerous topical conference calls and meetings. TCEQ staff and consultants frequently observed specific construction evolutions, such as geological feature mapping of designated excavation faces, disposal cell clay liner installation, disposal cell concrete barrier construction, etc.

INTRODUCTION

Facility Description

The heart of the WCS LLRW disposal facility is the two disposal cells. The Compact Waste Disposal Facility (CWF) cell is for disposal of LLRW provided within the authority of the Texas LLRW Disposal Compact Commission. The Federal Waste Disposal Facility (FWF) cell is for disposal of DOE LLRW. Licensed parameters for the CWF disposal cell are 62,000 M3 disposal volume, and 3.89M curies. Licensed parameters for the FWF disposal cell are 218,000 M3 disposal volume and 5.6M curies.

Both the CWF and FWF operational areas are supported by a waste staging building and a decontamination building in each area. Facilities and support systems common to both operational areas are:

- Administration Building
- Gate Building
- Laboratory
- Secondary Water Tank and Fire Protection pump, generator, piping and control systems

There is also a comprehensive water management system, with portions of that system unique to each operational area, and portions that are common to both areas. The water management system is discussed separately below.

An aerial photograph of the complete WCS facility (the new LLRW disposal facilities and some WCS previously existing facilities) is presented in Figure 1, below.



Fig 1. Aerial Photo of WCS LLRW Disposal Facilities (October 2011).

Facility Construction and Start Up Timeline

The overall construction schedule began with selection of Delhur Industries, Inc. as the preferred contractor for LLRW disposal facilities construction. That contract was awarded in September 2010. Limited Notices to Proceed were issued over the next four months to allow

development of certain site features that did not require TCEQ authorization to construct. Authorization to construct was subsequently issued by TCEQ in January 2011, and construction began immediately. Construction of the LLRW disposal cells and facilities was scheduled for nine months for the CWF disposal cell and facilities and the common facilities, and 13 months for the FWF disposal cell and facilities. Construction progress was very much on schedule throughout 2011, and into 2012. Other related infrastructure projects, such as water supply and electrical system upgrades, were awarded separately and progressed at rates that did not impede overall project progress.

In parallel with construction, other important activities such as procedure development, staffing and training, equipment selection and procurement, etc. proceeded apace. Over one hundred and eighteen and counting procedures were developed or revised, and submitted for regulator approval in the Summer and early Fall, 2011. Staffing schedules were developed and implemented, as well as training programs and schedules for both new and existing staff. Equipment needs were identified and equipment procurement schedules were also developed and implemented. Long-lead equipment needs were systematically identified and scheduled for procurement and delivery.

Per the WCS LLRW disposal facility license, facility construction was required to be overseen by an independent Construction Quality Assurance contractor. Among other things, that contractor was responsible for providing an independent certification to TCEQ that the facility was constructed in accordance with the licensed design. The license specifically allows 60 days for TCEQ review of the independent certification report and other activities prior to authorizing start of operations. Consequently, the baseline schedule provided for two weeks following completion of construction for submittal of the construction certification report, and the 60 day TCEQ review and approval process. These review and approval processes were independently scheduled for the CWF and FWF disposal cells.

METHOD

Construction Project Management Approach

WCS formed a dedicated project management team of WCS staff and consultants to manage the construction contract within cost and schedule parameters established by executive management. Participating functional areas included Engineering, Operations, Environmental, Business and Finance, Contracts, Legal, Quality Assurance, Licensing and Health, Safety and Security. A Construction Project Management Plan was developed well in advance of construction contract award. This plan proved very beneficial in that its development allowed key processes and mechanics to be developed, tested and refined prior to the start of actual contract management and construction. It also aided the project team in development of the critical project metrics that would be established and monitored. URS Corporation, the LLRW Disposal Facility Design Agent, provided Engineer of Record functions, and other design services typically required for a Nuclear Quality Assurance-1 compliant design and construction project. As noted earlier, the WCS License required independent oversight and certification of the construction. This function was performed by Cook-Joyce, Inc.

The Primavera Software Program *Contract Management* was selected for information management on this project. Although staff was generally unfamiliar with this software at the outset, it quickly became the central hub for communications and records. Through the first ten months of the project, *Contract Management* routed and otherwise tracked over 800 contract

submittals, almost 400 Requests for Information, and 56 Design Change requests. *Contract Management* also supported the development and tracking of 20 design-related License Amendment Applications submitted to TCEQ over the course of the project.

Project Quality Assurance and Construction Certification

As with any Nuclear Quality Assurance-1 compliant project, the WCS Quality Assurance organization performed critical functions in the project. In this role, WCS QA performed countless vendor certification assessments and qualifications, conducted seven audits and 45 surveillances. From the audits, eleven deficiencies and twelve opportunities for improvement were identified and tracked. From the surveillances, five deficiencies and six opportunities for improvement were identified. All of these deficiencies and opportunities were managed and tracked to their logical conclusions. From the beginning of construction through December 2011, five non-conforming items were discovered and corrected.

As noted earlier, Cook-Joyce, Inc. provided independent Construction Quality Assurance and Quality Control services during construction. Cook-Joyce, Inc. oversaw the construction of the CWF and FWF disposal cells, sedimentation ponds, contact water storage tanks, decontamination and waste staging buildings, administration building, laboratory building, and ancillary facilities.

Cook-Joyce, Inc. performed these services in conformance with the WCS-approved Quality Assurance Program consistent with regulatory requirements, construction drawings, technical specifications and construction quality assurance plans issued by the Engineer of Record and the Cook-Joyce, Inc. Quality Assurance Plan and Procedures. These construction quality assurance oversight activities included:

- Review of final construction drawings, specifications and materials of construction issued by the Engineer of Record to ensure conformance.
- Providing on-site inspection of construction activities of infrastructure, buildings, tanks and ancillary facilities, including collection of material test data, reviewing of testing reports and results and any other samples, test materials and subcontractor test reports required to verify construction,
- Performing onsite geotechnical observation and sampling during excavation activities, including spoil disposal and earthwork placement per the *Excavation Observation and Geotechnical Sampling Plan*,
- Conducting inspections of all liner material prior to installation, overseeing liner installation, documenting installation activities, collecting samples for testing on liner materials and reviewing test results to verify construction.
- Coordinating Construction Quality Assurance activities with the WCS Construction Manager, Engineering Manager, and Engineer of Record
- Participating in daily conference calls to discuss construction and Construction Quality Assurance activities.
- Preparing weekly geotechnical and construction observation reports for submittal to TCEQ as required by the WCS license. The reports included a description of construction activities, verification testing performed and the results, monitoring well water levels, construction photos and a three-week look ahead of construction activities.
- Preparing construction certification reports for the landfill, buildings, storage tanks, sedimentation pond, and ancillary facilities for submittal to the TCEQ as required by the WCS license. The reports included descriptions of the quality assurance management

process, photos, construction drawings, redline/field change drawings, as-built drawings, analytical test reports, quality assurance observation checklists/forms, daily field reports, technical specifications, and supporting engineering documents. The certification reports for both the CWF and the FWF were separate submittals, and each set of reports was further divided into as many as 18 individual topical submittals to streamline document assembly and reviewer convenience. The certification reports for the CWF and common facilities comprised 26 three inch ring binders and consisted of almost 14,000 pages of information.

Real Time Communications with Regulatory Authorities

Frequent, timely and accurate communications between TCEQ and WCS was critical to avoiding misunderstandings and consequently potential rework or other cost and schedule impacting challenges that can arise from poor communications. Avoiding communications-based misunderstandings is an important parameter in allowing projects to move forward on efficient, compliant and accelerated schedules. To that end, WCS was very driven to fully comply with License requirements for reporting (such as the weekly reports described above).

Beyond that, however, both TCEQ and WCS saw significant benefit in other frequent communications exchanges that included:

- Daily status conference calls that included TCEQ, WCS, DelHur, Inc. and Cook-Joyce, Inc. addressing what work was accomplished that day, and what work was coming up in the next few days.
- Weekly coordination calls on what work had been performed in the previous week, what work was coming up, and the status of future proposed license amendment applications (both from the standpoint of upcoming WCS submittals, as well as the status of the TCEQ review and evaluation of submitted amendment applications). These calls also included reviews of schedules for upcoming events (calls and meetings, etc.) to assure good schedule coordination.
- Topical conference calls on specific issues and/or amendment applications, as arranged.
- Forewarning and coordination for activities that necessitated advance notification for TCEQ participation (participation in excavation wall mapping, observation of clay liner installation, etc.).
- Independent and split sampling and analysis events by TCEQ at certain progress thresholds.
- Full time presence, engagement, observation and oversight by the two full-time TCEQ resident inspectors assigned to the WCS facility.
- WCS and TCEQ executive-level discussions and coordination.

Unprecedented Disposal Cell Design Features

Both the CWF and FWF disposal cells have 2.13 meter composite liners. A key element of both liners is a 0.91 meter thick clay liner. This clay liner has a mandated performance test value for hydraulic conductivity of 4×10^{-9} cm/sec, 25 times lower than most landfills. Accordingly, the moisture and density requirements of the compacted clay needed to be more refined to assure consistent liner quality as the clay was placed. Rather than following the common practice of using single clay samples for defining optimal moisture to attain a maximum clay density, dozens of samples taken over the years from onsite clay were plotted to demonstrate in more detail how maximum densities varied at different moisture contents of the clay. A zone of

moistures and densities that produce optimum results were determined from the data. The contractor was required to produce compacted liner that met these zones of optimum moistures and maximum clay densities (termed the “acceptability envelope”).

Once the test standards were defined, clay performance pads were built by the contractor using varying clay preparation and compaction techniques. Through this effort, the contractor demonstrated that the screener/pug mill clay hydration equipment, clay stockpiling methods, compaction equipment, and number of equipment passes would yield compacted clay liner meeting the acceptability envelope and hydraulic conductivity performance standards.

Finally during construction, compacted clay moisture and density were tested in-place an average of 20 times for each 15 cm thick layer of the 1.16 hectares liner constructed in the CWF landfill. If results did not fall within the acceptability envelope, the clay’s moisture was adjusted and it was re-compacted until acceptable results were measured. A total of 24 hydraulic conductivity tests were conducted on undisturbed samples of each 15 cm layer of the liner. All samples performed better than the required 4×10^{-9} cm/sec.



Fig 2. Installation of the Three Foot Clay Liner.

The disposal cell liner system also includes a 0.3 meter thick reinforced concrete barrier. To the best of our knowledge, this barrier sets a new precedent in the United States, and probably the world. Installation of this barrier system was done in relatively large pours (typically on the order of 200 M3), and was generally performed at night, when atmospheric temperatures were lower and more favorable for concrete installation activities.



Fig 3. Installation of the One Foot Concrete Barrier.

Zero Discharge Water Management System

Wastewater and non-contact storm water generated at the LLRW facilities will be disposed of via evaporation and will not be discharged. Storm water runoff from areas outside the active disposal areas will be managed as non-contact storm water in a collection and management system that is separate from the wastewater system. A description of the non-contact storm water system follows the description of the wastewater management system.

Wastewater Management

Separate wastewater management systems are provided for the FWF and CWF facilities. Routinely generated wastewater will include the following:

- Leachate accumulating above the primary liner system;
- Any leak detection system water collected from between the primary and secondary liners (FWF only);
- Contact storm water collected within the active waste disposal cells;
- Decontamination building water; and
- Rinsewater from the laboratory.

Wastewater can be accumulated in 500,000 gallon holding tanks prior to treatment in on-site wastewater treatment systems. Separate holding tank and treatment systems are provided for the FWF and CWF landfills. The wastewater treatment systems will be comprised of the following:

- A mixing stage for any necessary pH adjustment, addition of precipitating chemicals, and addition of powder activated carbon if necessary;
- Microfiltration tubes; and
- One or more ion exchange steps if necessary.

Effluent from the wastewater treatment systems will either be discharged directly to an evaporation pond via double walled piping or first discharged to a tank upstream from the evaporation pond. Wastewater may also be trucked to the evaporation ponds.

The FWF and CWF wastewater evaporation ponds will be approximately 1.94 hectares and 0.73 hectares, respectively, in size and will be comprised of the following components:

- Berms having internal side slopes of 2H:1V and external side slopes of 3H:1V;
- A 60 mil HDPE geomembrane primary liner;
- A geonet leak detection layer underlying the primary liner;
- A secondary composite liner consisting of a 60 mil HDPE geomembrane over a 0.91 meter thick compacted clay liner with a permeability no greater than 1×10^{-7} cm/sec; and
- A leak detection sump with sidewall riser pipe.

Non-contact Storm Water Management

Non-contact storm water generated at the FWF facility will be collected and routed to the FWF sedimentation pond. Similarly, non-contact storm water generated at the CWF facility will be collected and routed to the CWF sedimentation pond. Storm water from both the FWF and CWF sedimentation ponds will then be pumped to a common non-contact storm water evaporation pond. This pond is approximately 6.9 hectares and is lined with 60 mil HDPE.

Modular Concrete Canister Design and Fabrication

Modular Concrete Canisters are required for disposal of most LLRW in both the CWF and FWF disposal cells. These canisters are constructed with an engineered 5000 psi, 0.30 cement to water ratio concrete for low permeability, reinforced with size #4 to #6 epoxy coated rebar, double-matted bottom and in all sides. WCS currently constructs two specific shapes to accommodate waste streams of 55 gal drums, 85 gal drums, various liners and B-25 boxes.

A cylindrical concrete canister was designed with an external dimension of 3.15M height x 1.17M outside radius with an internal volume of approximately 8.95M³, with this dimension the cylindrical canister can accommodate two different applications of metal drums, 14 55- gallon drum array of 7 on top of 7 or 10x85- gallon drum array of 5 on top of 5. In addition to the body, a base was designed to distribute weight evenly to the cell floor. The base and body were designed in a fashion so that the two will interlock, and topped off with an interlocking lid as well. With all three pieces the overall height of the cylindrical canister will be approximately 3.86M. The cylindrical body approximately weighs 10,700 Kg, with a payload of 14-55 gal drums weighing approximately 450 kilograms each, then encased in grout. The cylindrical canister has a potential to weigh approx 29,500 Kg, to assure the safety of the critical lifting task, a redesign to the anchoring system was put in place adding additional anchors.

A rectangular concrete canister was designed with an external dimension of 2.74M x 3.3M x 3.15M with an internal volume of approx 7.48 M3. With this dimension, the rectangular canister can accommodate 4- B-25's or (2) 7,500 liter liners. In addition to the rectangular body, a base and lid were similarly designed to the cylindrical canister as related to interlocking with base, lids, and other canisters. With all three pieces, the total height is the same as the cylindrical canister. The rectangular body weighs approx 23100 Kg, (2) 7.48 M3 liners weighing approximately 10,900 Kg each, and filling the remaining voids with grout, the rectangular canister has a potential of weighing approximately 53,000 Kg. Again, to assure the safety of the critical lifting task, additional anchors have been designed and installed.

At this early stage of LLRW disposal operations start up, Modular Concrete Canisters are being fabricated off site by a qualified vendor. Long term goals are to produce these canisters onsite.

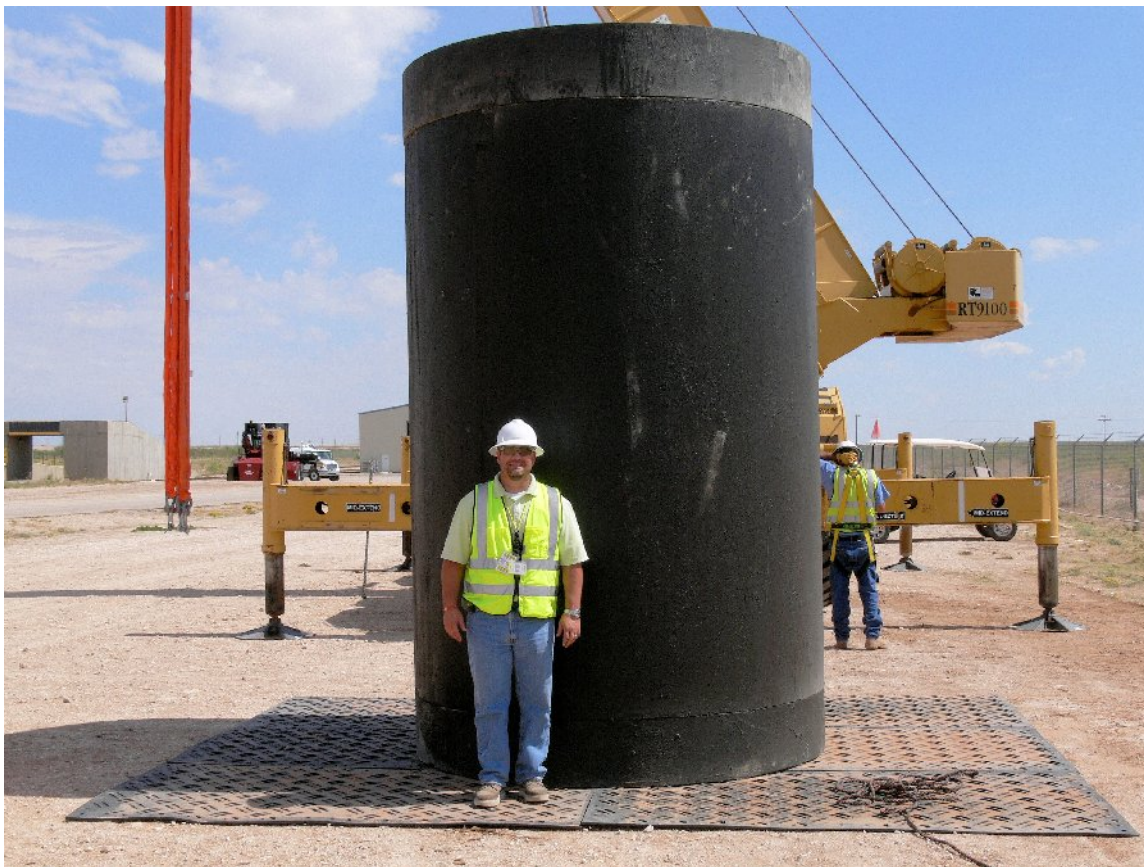


Fig 4. Modular Concrete Canister – In Cell Disposal Package.

RESULTS

Completion of Construction

Construction Certification

Grand Opening Ceremony

DISCUSSION