Long-Term Stewardship - Surveillance and Maintenance at Hanford - 15155

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ABSTRACT

In FY 2015, Hanford's Long-Term Stewardship (LTS) Program is tasked to complete the required entries into five cocooned plutonium production reactors (105-C, 105-D, 105-F, 105-H and 105-N), which sit adjacent to the Columbia River. The first reactor entered in October 2014, the cocooned plutonium production reactor, 105-F, signaled the LTS Program's entry into the Surveillance and Maintenance (S&M) era. Reactor entries at Hanford are conducted at 5-year intervals to assess the condition of the structures and evaluate potential deterioration of the reactor core, shield walls and roof. The cocooned structures are designed to protect the reactor core for up to 75 years while radioactive decay continues, ultimately making the structures safe for demolition and removal.

The 105-F entry demonstrates that the LTS program at Hanford is shifting from a program focused on transitioning cleaned up land and waste sites to a program focused primarily on S&M activities. The entry process is carefully planned, choreographed and monitored to ensure safety of the workers and minimize the time the reactor structure is opened. The process includes controlled opening of the reactor, air quality monitoring, structural safety inspections, and radiological clearance. Once the structure is cleared for entry, assessments of the structural integrity and radiologic conditions are completed. Evaluation of the interior temperature and flood monitoring equipment is conducted. Facility visits by regulators and DOE personnel close out the process prior to welding the door closed until the next assessment, five years later. This paper will document execution of the entry work package, identify challenges overcome, and provide video documentation as reference material for future workers and the public.

The current LTS program has responsibility for approximately 100,000 acres, over 200 waste sites and six cocooned reactors. Just over 5,600 documents have been identified, indexed and tagged for storage in the LTS document library. The program has successfully completed seven consecutive transitions since July 2011, with six more transitions planned in the next 18 months to support the U.S. Department of Energy Richland Operations Office's (DOE-RL) near-term cleanup objectives to significantly reduce the footprint of active cleanup operations for the River Corridor.

INTRODUCTION

FY14 marked a significant crossroad in the focus of Hanford's LTS program. The Hanford LTS Program now has nearly 100,000 acres, over 200 waste sites and six cocooned reactors. Those lands and facilities all require extensive S&M activities beginning in 2015 and beyond. This evolution in program requirements (transition to S&M execution, Figure 1) drives a similar transition in the LTS team skill mix. The mission support contractor who is responsible for managing these requirements must adjust the LTS team.

While the LTS initial team focused on building the program, preparing transition documents and gathering reference documentation while the cleanup contractor was still around, the transformation into S&M execution requires a more field-oriented skill mix. The S&M requirement for the cocooned reactors is one of the key drivers for the change in the program as it transitions into an operational and execution phase.

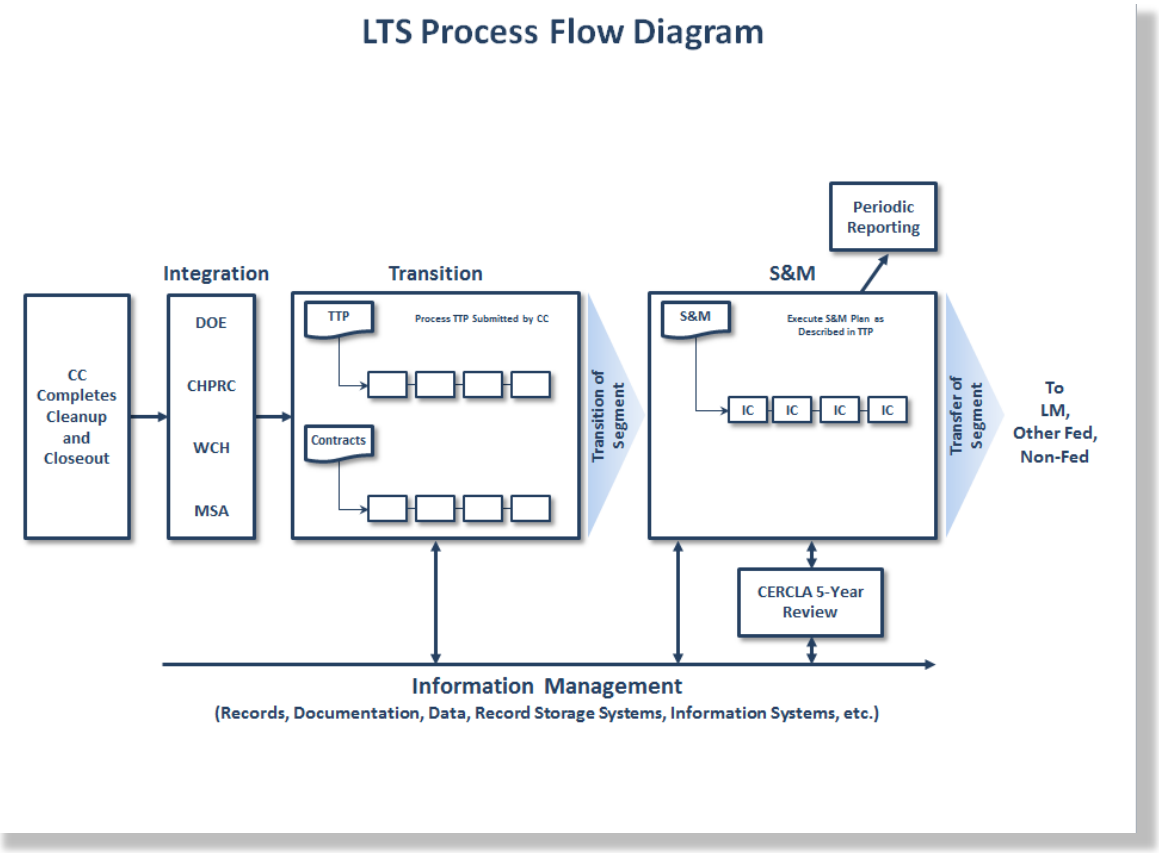

Figure 1 - LTS Process Flow Diagram

Reactor History

Between 1943 and 1963, nine graphite moderated plutonium production reactors were constructed along the Columbia River to support the production of weapons-grade plutonium. In the early 1960s, all nine reactors were operating. The first reactors to end operations were the

105-F and 105-H, which ceased operations in 1965. The last reactor, the 105-N Reactor, shut down in 1987. The reactors were then deactivated and decommissioned and the auxiliary buildings were demolished, in accordance with a CERCLA removal action. Since then, the 105 B Reactor, the world's first full-scale nuclear reactor, has been designated a National Historic Landmark (Figure 2).

Figure 2: B-Reactor National Historic Landmark - no cocoon

Construction of the 105-F reactor began in 1943 and was the third of Hanford's three original plutonium Production reactors constructed (see Photo below). After a 14-month construction schedule, the F reactor first went critical on February 25, 1945 just five months after the B reactor. F Reactor is located farthest downstream (Figure 3) and the production reactor closest to the city of Richland. It operated until 1965 and was the third reactor to undergo decommissioning and demolition. The construction of as safe storage enclosure began in January 1998 and was completed in September 2003.

Associated with the nine production reactors at Hanford are the 11 processing facilities, and 177 Underground Storage Tanks that hold approximately 53 million gallons of liquid waste. There are an approximately 685 acres of waste burial grounds that include 43 miles of disposal tranches. One might conclude that with the first full scale production reactors, associated processing plants and waste disposal areas, Hanford is ground zero for what we all now know as Waste Management Symposium. Or certainly the Manhattan Project can claim to be an initiator for Waste Management and environmental stewardship.

Figure 3: F Area Plutonium Production Reactor Complex

Reactor Cleanup and Alignment

Cleanup activities associated with the cocooned reactors have included partial demolition of ancillary structures and facilities to shrink the reactor building footprint back to the shield walls, followed by construction of a Safe Storage Enclosures (SSE) to prevent deterioration and release of contamination. This process resulted in an Interim Safe Storage (ISS) condition pending final disposition of the reactors in the future.

The initial transition plan for the cocooned reactors from the cleanup contractor to the LTS program was cumbersome. The cocooned reactors were to transition over a three-year period, through five separate contract actions and transition plans. As the team looked forward, it was recognized that several efficiencies could be realized if the cocooned reactors were transitioned to the LTS Program in a single, smooth transition action.

The **ISS process** included demolition and removal of auxiliary buildings and adjacent structures leaving only the concrete core structure. Steel roof structures and siding were constructed above the concrete core for protection against the weather and deterioration of the facility. The ISS structure is monitored to ensure continued protectiveness. The ISS structures are designed to prevent deterioration and release of contamination from the reactors for up to 75 years.

The idea of a consolidated cocooned reactor transition was first proposed to DOE-RL in August 2012 in the LTS Baseline. The Baseline proposed an alignment of the 5-year recurring S&M activities required for the six cocooned reactors into a single year

(2020), thus gaining efficiencies and saving costs. Subsequent discussions in November 2012 accelerated that alignment to 2015, as shown in Figure 4 below. One key action that was needed to gain some of the potential efficiencies was getting the cocooned reactors into the LTS Program early in order to meet this 2015 alignment.

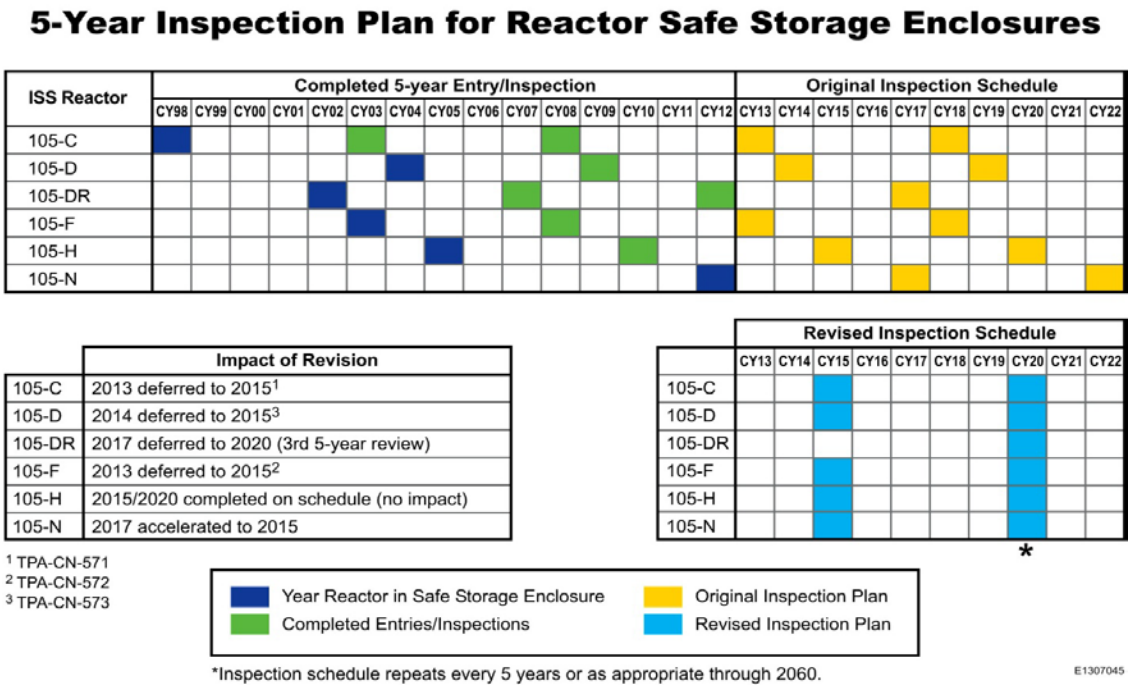

Figure 4- Re-Alignment of 5-Year Cocooned Reactor Inspections

In the spring of 2013, DOE obtained agreement on the change in the S&M schedule and published the Tri-Party Agreement change notices, documenting the regulatory approval of the realignment. The cleanup and mission support contractors quickly prepared the transition package, to enable the transfer less than two years after the initial concept was proposed and several years ahead of the original baseline.

Once all the assessments are completed in the spring of 2015, LTS will assemble a comprehensive report and provide recommendations for maintenance or repairs to the structures. Maintenance and repair activities for all structures will then be planed, sequenced, and executed in FY2016. This sequencing not only supports the regulatory requirements but also supports a more level funding scenario by splitting the assessments and repairs into two fiscal years avoiding a funding spike.

Based on the initial findings at 105-F, repairs will focus on minimizing biologic intrusions by sealing up exterior openings along seams and rooflines in the cocooned structure. The structural integrity of the cocoon (Figure 5), at least in 105-F, appears to be holding up to the elements well.

Figure 5: F Reactor after cocooning

Reactor Entry Planning

As this was the first cocooned reactor entry for the LTS program, a 7-month planning schedule was started in March 2014. Work planners, craft employees, professional engineers and Project Managers were brought together to discuss the scope and sequence of S&M activities at weekly planning meetings. The previous 2008 inspection report was used as a reference into the planning and entry process. On the surface, the activities appeared very simple; however, as it turned out, entering a 70-year old cocooned nuclear reactor is intricately complex and involves a host of people.

Using the previous contractors 2008 work planning package, we were able to identify the required craft and professional services. Additionally, because reactor entries happen at 5-year intervals, the team identified the need to capture video of the entry and assessment activities for future training, and documentary purposes. It was quickly realized that the previous assessment contractor had all of their field organizations mobilized as part of their ongoing closure contract requirements. The LTS program was starting from scratch. Simple things such as power, field trailers and porta-potties were all previously removed. Our team had to bring it all back, albeit temporarily. The weekly planning meetings allowed for not only detailed planning, but also discussions of potential scenarios that could be encountered during entry.

A varied workforce was needed to complete this seemingly “simple” entry safely. Just to name a few as examples:

- Radiation Control Technicians (RCTs) – established appropriate radiological conditions and boundaries. RCTs also established the appropriate Personnel Protective Equipment (PPE) for workers and visitors.
- Industrial Safety – identified physical safety hazards inside the structure.
- Industrial Hygiene – Identified other hazards including potential airborne dusts and initial oxygen levels.
- Biological Controls – identified areas of biological intrusion by bats, spiders and insects and provided direction on proper cleaning techniques as needed.
- Bat Monitoring – surveyed the cocooned structure for sensitive bat species and provided input on dealing with bat guano found in the structure.

Multiple craft services were engaged throughout the planning process as work scope was clarified and safety requirements identified. The craft services involved included:

- Work Planner – developed the overall work package for the entry.
- Scheduler – scheduled the specific labor resource categories as established in the work package.
- Welders – were used to re-seal the reactor doors when work was completed.
- Carpenters – were used to grind off the welded plate, sealing the door closed during the 2008 entry and assessment, also used as fire watch per the Hot Work permit.
- Electricians – were used to re-lamp interior lighting as needed and turn on power at the electrical panel.
- Sheet Metal Workers – opened exterior vents in the utility room allowing passive ventilation of the cocooned structure.
- D&D Workers - supported job site set up including construction zones and parking areas, as well as handled low level radioactive wastes (PPE) removed from the facility.
- Instrument Technicians – checked the operability of the remote monitoring equipment (temperature and moisture sensors).
- Teamsters – delivered and picked up equipment used at the job site and provided weed abatement and removal services at the job site.
- Construction Manager - provided oversight of the trailer delivery and set-up.
- Field Work Supervisor - provided overall coordination of craft services and ensured work package completion and compliance.

Finally, in addition to the personnel needed to accomplish the job safely, professional services were integrated into the planning to establish a safe and compliant operation:

- Facility Hazard Categorization (FHC) controls assessment – completed to ensure that assessment activities did not violate FHC controls.
- Waste Management Planning – completed by the Environmental Compliance Officer to ensure all potential waste streams were properly considered and addressed.
- Excavation Permit – obtained for the construction trailer and porta-potty tie downs.
- Occupancy Permit – Issued by the Hanford Fire Department for the construction trailer.
- Hot Work Permit – Issued by the Hanford Fire Department for grinding and welding activities.
- Waste Characterization and Disposal – completed for all waste streams for compliant disposal.
- Structural Engineering Assessment - provided engineering assessment of the integrity for the cocooned structure.
- Videographer/Photographer - completed video and still photography for future training and S&M documentary purposes.

All team members worked hand-in-hand to identify hazards and determine entry requirements. Radiological Controls determined the Radiological Work Permit requirements including that all entry teams would be escorted by Radiological control staff. Safety and the Fire Marshal

determined that due to the remote location and hazards, a maximum of nine people could enter at the same time.

One of the last planning elements conducted was a dry run of the entry process. Since the Historic B reactor and the F reactor were built from essentially the same plans, at the same time, it would be used as good training. B Reactor operators toured our team through the back rooms, hallways and stairwells to establish, as close as possible, the real world conditions that might be encountered. This activity proved to be quite valuable to all team members entering the reactor as it helped establish expectations and provided insight on how best to execute the required assessments in a safe manner.

Reactor Entry

With the planning activities completed, on Thursday, October 9, 2014, the welds were removed from the entrance door and it was opened for the first time since 2008. The Radiological Buffer Area (RBA) was established at the door and large volume air samplers were set up.

On Monday, October 13, 2014, the initial safety teams dressed out and entered the reactor. Safety assessments included radiological surveys of the planned entry routes, industrial hygiene to monitor air quality, industrial safety to evaluate physical hazards and biological safety to evaluate hazards from potential biological debris. Additionally, the entire reactor facility was evaluated for the presence of several special status species of bats that are found in the area. The safety teams found no unexpected conditions and allowed the assessment work to proceed as planned. Stop Work contingencies were in place if the safety teams identified any unexpected hazards or unsafe conditions.

With the facility deemed safe to enter, the Instrumentation Technician was escorted to the temperature and moisture sensors (Figure 6) in the facility to check operability and evaluate the need for any maintenance actions. Temperature and moisture monitoring inside the cocooned reactor was an item negotiated amongst the regulatory agencies during the closure process. The conditions have been monitored monthly since 2008 with no outlier results. All equipment was found to be in good working condition with no need for replacement or repair.

Figure 6: F Reactor Moisture Sensor

The structural assessment team reviewed the 2008 structural assessment report provided by WCH and confirmed all previous observations. Additionally, the entire structure was assessed, including the original construction concrete walls and stairs and the newer construction steel frame and siding. Photos were taken of items of interest and a full write up of the assessment was provided. In one location, the assessors identified a full penetration crack in the original concrete. This provided an opportunity to place a crack monitoring gauge for future empirical

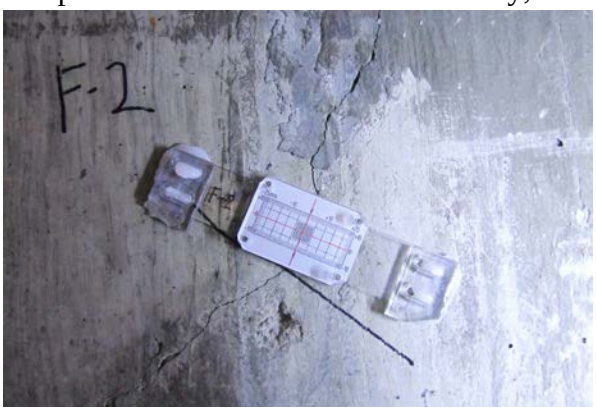

Figure 7: Crack Monitoring Gauge Installed at F Reactor

evaluation (Figure 7). The gauge allows for objective evaluation of any movement during the next monitoring cycle.

To complete the required assessments, a radiological survey was completed on October 13, 2014, of the easily accessible areas to evaluate any changed radiological conditions compared to the 2008 survey report. They found contamination and dose rates to be consistent with survey results documented in 2008. Removable contamination was found only in expected areas. Upon opening the structure door, the 105-F entrance was posted as a Contamination Area (CA) as expected. The posting remains a CA after closing the structure. No areas were re-posted as a result of radiological surveys. There were no observed radiation areas or high radiation area postings or any indication of a radiation area or high radiation area resulting from radiation surveys performed.

Air samples were taken when 105-F was initially opened and during subsequent entries on October 13 and 14, 2014. Radiological air quality was good and within acceptable breathing air standards.

Because of the historic nature of the reactors, and the fact that the reactors are only opened every five years, the decision was made to allow for key site personnel and regulatory agencies to enter and see the reactor. Once the actual assessment work was completed, we were able to offer visits to DOE-RL and Office of River Protection, US EPA and Washington State Regulatory agencies, DNFSB, other Hanford site contractors and LTS team members.

While all workers entering the reactor had PPE requirements that included Tyvek coveralls, booties, gloves, hard hats and safety glasses, none of the visitors conducted any “work” in the cocooned reactor and thus were afforded the choice of reduced PPE consisting of booties, gloves, hard hats and safety glasses.

Reactor Entry Results

After seven months of planning… how did we do?

- We mobilized on the planned date,
- We opened the reactor door on the planned date
- We finished the assessment activities four days ahead of schedule
- We conducted seven separate tours with no safety incidences, and
- We closed and buttoned up the reactor three days ahead of the original plan.

Preliminary results indicate that the structure is performing as designed (Figure 8). There was no evidence of structural deterioration in the original concrete or the newer cocooning structure. No unexpected contamination or radiological conditions were identified. No hazardous materials were identified and all remote monitoring sensors were working as intended. Minimal evidence of biological intrusion including bats, spiders and insects were found, so the program will engage in discussions with DOE-RL on ways to minimize future intrusions. Any maintenance tasks identified for 105-F will be combined with maintenance actions identified during the next four reactor entries and scheduled for repair in FY 2016.

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F Reactor passes 5-year inspection

ANNETTE CARY
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F Reactor has passed its five-year check-up, with Hanford workers finding nothing amiss after unsealing and entering what remains of the reactor.

Hanford workers have torn down six of the nuclear reservation's plutonium-production reactors to little more than their radioactive core, sealed up all openings and reroofed them.

The plan is to leave them in a state of temporary storage, or cocooned, for 75 years to allow radioactivity to decay to more manageable levels.

This was the second time Hanford workers have ground away the welds from around the steel door of F Reactor to go inside since the reactor was cocooned in 2003.

"This inspection gives us an opportunity to conduct radiological surveys, make any repairs to the roof and remove any hazardous substances," said Rick Moren, director of long-term stewardship for Mission Support Alliance. "During the inspection, workers found the reactor to be in good shape and almost identical to the last time it was inspected."

The workers who entered saw no wild creatures, but they did find a small amount of bat guano and a few spider webs, Moren said. There was no moisture, despite the recent rains.

The door to the reactor was unsealed a few days before the first entry, to allow it to air out and for air samples to be collected to make sure it is clear of contaminants. Radon is of particular concern in the closed-up

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Hanford's cocooned F Reactor is seen behind officials touring the area around the reactor.

Herald file

Figure 8: Tri-City Herald Front Page Article - October 23, 2014 - Successful F Reactor Entry

CONCLUSION

The Hanford LTS Program has entered into a new phase of Surveillance and Maintenance with the successful completion of the first cocooned reactor assessment. The planning efforts and a motivated, solution-oriented team combined to complete this task on time and with no safety incidences.

The 105-F reactor entry and assessment was an exciting project that brought together elements of world history, waste management and unique project execution requirements for LTS. Few people will ever get to see the inside workings of a Manhattan era plutonium production reactor. However, as stewards of the first three full scale production reactors, it is our honor to share the S&M activities at the cocooned reactors and also encourage folks that might stopover in the Richland Washington area to visit the Historic Landmark B Reactor.

All activities were video and photo documented for future training and documentary purposes. A short video of the 105-F reactor entry and S&M activities will be presented during the Waste Management conference as part of the oral presentation.

REFERENCES

1. http://www.b-reactor.org/
2. http://www.hanford.gov/page.cfm/LongTermStewardship