Providing an Integrated Waste Management Strategy and Operation Focused on Project End States at the Hanford Site - 9102

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ABSTRACT

CH2M HILL Plateau Remediation Company (CHPRC) is the U.S. Department of Energy's (DOE) contractor responsible for the safe, environmental cleanup of the Central Plateau of the Hanford Site.

The 586-square-mile Hanford Site is located along the Columbia River in southeastern Washington State. A plutonium production complex with nine nuclear reactors and associated processing facilities, Hanford played a pivotal role in the nation's defense for more than 40 years, beginning in the 1940s with the Manhattan Project. Today, under the direction of the DOE, Hanford is engaged in the world's largest environmental cleanup project.

The Plateau Remediation Contract (PRC) is a 10-year project paving the way for closure of the Hanford Site through demolition of the Plutonium Finishing Plant; remediation of six burial grounds and 11 groundwater systems; treatment of 43.8 meters of sludge; and disposition of 8,200 meters of transuranic waste, 800 spent nuclear material containers, 2,100 metric tons of spent nuclear fuel, and two reactors.

The $4.5 billion project, funded through the U.S. DOE Office of Environmental Management, focuses equally on reducing risks to workers, the public, and the environment and on protecting the Columbia River.

The DOE, which operates the Hanford Site, the U. S. Environmental Protection Agency (EPA), and the State of Washington Department of Ecology (Ecology) signed a comprehensive cleanup and compliance agreement on May 15, 1989. The Hanford Federal Facility Agreement and Consent Order, or Tri-Party Agreement (TPA), is an agreement for achieving compliance with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) remedial action provisions and with the Resource Conservation and Recovery Act (RCRA) treatment, storage, and disposal (TSD) unit regulations and corrective action provisions. More specifically, the Tri-Party Agreement does the following: 1) defines and ranks CERCLA and RCRA cleanup commitments; 2) establishes responsibilities; 3) provides a basis for budgeting; and 4) reflects a concerted goal of achieving full regulatory compliance and remediation (with enforceable milestones) in an aggressive manner.

CHPRC's approach to safely accelerate and accomplish solid waste stabilization and disposition provides an integrated waste management (WM) strategy and operation focused on project end states. CHPRC will present planned approaches for waste stabilization and disposition based on lessons learned at other DOE sites and discuss optimizing solutions to accelerating TPA milestone M-91 TRU waste retrieval activities through innovation and increased production, Point of Generation waste management, unique transport and packaging systems that are re-useable, and in-field waste handling and treatment processes that have generated cost saving and are generating early-completion cost savings of $66 million on the PRC that can be redirected to other pressing Hanford Plateau Remediation Contract (PRC) projects.

Current Issues and Problems in Waste Management

As one can imagine from the forgoing, regulatory oversight for a project the size of Hanford is complicated, at best. In addition to Ecology and EPA oversight, the Washington State Department of Health has some jurisdiction in addition to the self-oversight of the DOE. Each of these entities has specific interests and goals in the clean-up project that are not necessarily congruent. These are created because of laws and regulations that each party has to uphold and it does create a complicated matter for the DOE and its contractors in execution of work scopes. Further, plans developed as part of the TPA process nearly 25 years ago have been overcome by limitations in funding, technological hurdles, and regulatory limitations.

A specific case and point on the Hanford site can be evidenced in the management of contaminated soils created because of groundwater monitoring and treatment programs. Certain wells are managed under CERCLA and other under RCRA. Each has its own needs and requirements for sampling, characterization and, in some cases, treatment. As such, it has become practice on the Hanford site to take the soils and drum them for storage, treatment, and disposal. Some wells can generate as many as 1800 drums of waste soils that may result in a realized cost of nearly $255,000 for containers and handling alone.

Another particular case of interest at the Hanford site is the management and processing of remote handled (RH) waste forms (greater than 200 millirem/hour on contact) and large waste forms. Much of this waste has had only one avenue: storage at a licensed TSD until a facility specifically built or modified for use is brought on line. Due to funding constraints this project has never fully been executed since the expected costs are estimated to exceed $1.5 billion for the life cycle operation of the process. Since the waste stream volumes requiring this capability is not well understood yet, and is a fairly small volume of waste when compared to overall project projections (less than 20 percent), storage has been the choice since money can be better spent on the remaining clean up and associated waste forms. Of course, the down side to this is that storage costs remain high, and containers require monitoring and maintenance.

A final example of waste management issues driving costs can be pointed directly at how projects are planned. Most projects in clean up look at a very narrow band of scope: tear down a building or dig up some soil. Waste costs are simply calculated at an expected volume with some estimated cost for packaging, transport, and disposal. However, as in any risky project venture, wastes rarely get generated as expected, are different than originally planned, run into regulatory hurdles, and drive projects to move wastes inefficiently to storage to “meet the schedule.” This leads to multiple handling events for waste packages, exposure of personnel to multiple risks, and multiple processes to even make a waste ready for acceptance at a treatment facility. In the specific instance of the Hanford site waste retrieval operations a single 55 gallon drum may be handled as many eleven times and repackaged twice to simply meet transportation requirements. In this instance, that single 55-gallon drum may cost as much as $8000 just to be made ready for treatment or certification as TRU. When one considers we are talking about nearly 45,000 containers we are in the billions of dollars spent.

Taking advantage of a need for a clear end state

While the foregoing would tend to portend gloom and billions of dollars spent needlessly due to burdensome red tape and incongruent goals, it is apparent that all parties recognize the need to look at a cohesive strategy for end states that includes final waste disposition. It is not hard to see that goals and needs change over time and full cleanup activities at the Hanford site have been underway for less than twenty years. Considering what everybody had to learn over that time, understand, and develop new approaches for it is a wonder that the DOE and its contractors have accomplished so much over that short

time. Rocky Flats is complete, as are the Mound site and Fernald, just to name a few. In studying these successes, a common theme emerges that CH2M HILL is intending to bring to the Central Plateau contract: consensus.

Our first goals at the Hanford site are to work with the DOE and regulatory agencies to develop a common goal for site cleanup with defined goals for execution. A central key in that process is the integration of waste management as a central point for that vision. As we all know, the job is never truly done until the waste is buried not stored. A first goal in this area is to reduce the number of regulatory documents required to execute work. This, in turn, will reduce the number of zones, or work units that are created as part of clean up, and can allow wastes to be commonly characterized. In the case of the groundwater programs, this would allow for reduced analytical costs and would allow for bulk management of wastes across several zones at any one time.

If we take our previous example for management of drummed wastes at a drill site, 1800 drums will hold about 360 cubic meters of soil (about 59,000 kg). If we changed over to intermodal containers using bulk characterization processes we would then need only eight containers at a lease cost of $500/month. Assuming a very conservative estimate of one year to complete removal of the drill spoils the total cost for the containers alone would be $48,000: a saving in material costs alone to a project of about $177,000. When we consider this on a site the size of Hanford, many millions of dollars can be saved. Further, the waste would still be treated and disposed of in a manner that is no less safe or stringent than if it were done on a container-by-container basis.

Such lessons were gained through experience at the aforementioned sites where effective consensus was obtained and are proven methods for saving money and accelerating progress.

The big, hot, and nasty stuff

As previously mentioned, the Hanford site has a wide variety of large waste items: items that are packaged in containers, or in themselves, are larger than ten cubic meters (see figure 1). Hanford also generates a great many RH waste forms that for which a current processing facility does not exist on site. The wastes are both low-level and TRU wastes. The major hurdles with these waste forms over many years has been an assumption that they could only be treated on the Hanford site due to transportation limitations through dose control or compliant package configurations that were expensive and of limited use.

Fig. 1. Typical oversize waste container in storage.

Our experience was very similar in our work at the Hanford site tank farms. Tank waste contacted items routinely exceeded fifty feet in length, weighed nearly eight tons, and had dose rates in excess of 25 REM. Original plans for such waste forms were to store until a facility, or modification of an existing Hanford facility was completed to address such waste forms. Several projects have been through engineering review and design scoping over the last fifteen years, but each has run into a major hurdle: expense.

A specific regulatory milestone, under the Hanford Site Tri-Party Agreement, M-91 was developed to address these types of wastes and to drive obtaining the necessary capability to handle to waste forms. The project has encountered numerous delays due to funding constraints as estimates ranged between $400 to 750 million to build or modify and existing facility, with an operational life of approximately ten years at a cost of $30 million per year, and a clean close cost estimated at nearly $300 million. On the outside, we were talking nearly $1.5 billion for a waste stream that is less than twenty percent of the total volumes expected to be generated at the Hanford site. Through experience gained at the tank farms and other industry experience, the current plans are to significantly reduce the need for the M-91 facility. Several commercial companies have gained increasing experience at handling of RH and large item waste forms as the result of deactivation of nuclear facilities around the world and are actively participating with CH2M HILL to increase those capabilities without significant cost impacts.

The primary key, and major hurdle, to managing these waste forms is transportation. It is also one of the major drivers as to why an “on site” facility was always thought to be the only way to manage and process these waste forms. However, recent developments in local capabilities within thirty miles of the Hanford site, as well as use of rail with re-usable transport packaging systems is changing view points and is now the focal point of processing these waste forms. Our use in the tank farms over the last three years of systems such as the sixty-foot re-usable transport system (the Superbox), and modified rail capability allowed us to complete remediation of waste forms with oversize and high activity/dose consequences for a saving of nearly $125,000 per single item with and infrastructure investment payback of only one to two years (see figure 2). More importantly, storage of these waste forms was eliminated.

Fig. 2. 60 foot Type A "Superbox" Transport System

It is now a matter of expanding the capabilities already in place to handle more dose and activity consequence through better re-usable transport processes to further reduce the impacts of the M-91 facility, if not eliminate the need altogether. Our goal is to obtain the latter and allow that money to be used elsewhere to increase productivity and progress on the site. Our conservative estimates indicate that we would invest approximately $10 million in additional re-usable packages, including a Type B oversized container, over the next two years as well as approximately $1.5 million in rail improvements over a similar time frame. With these capabilities in place, we would commence movement of large and RH waste forms to off-site treatment at a cost of approximately $10,500 per cubic meter; factoring in transport, treatment, packaging, and disposal or preparation for shipment to the Waste Isolation Pilot Plant (WIPP). With about 7,500 cubic meters of such waste projected to process, the total cost for the waste streams in processing would be about $125 to 150 million. Even if a reduced capacity M-91 facility were required on site for certain waste forms, it is believed that those wastes could be processed in mobile facilities nor requiring the extent of upgrades or construction previously envisioned at a cost of only twenty percent of the current estimates. The total projected cost avoidance over the next ten years of the PRC contract alone would be expected to be in the area of $60 to 75 million based on current design and construction schedules for the M-91 facility commencing in 2012. Additionally, these approaches would, in the long run, avoid approximately $1 billion in costs over the life cycle of these waste streams.

Minimize waste handling to stay safe and save money

Another area of major focus for the PRC contract is to reduce the amount of handling of wastes that occurs. Experience has taught us that this must begin at the very outset of planning. If we know what we have for a high level confidence idea of what will be generated during remediation, we can use a concept known as Point of Generation (POG) waste management. Remediation projects have become far more integrated with waste management functions over years of evolution. It is safe to say that the majority of projects recognize that management of waste as an afterthought is not only expensive, but increases risk in multiple handling evolutions and can also create waste forms that may require many years of storage.

This is not an unusual situation. In some cases, wastes generated during initial accelerated closure projects in the DOE remained at store or treatment facilities for many years awaiting permits or technologies to be deployed to handle them and Hanford has many such examples. It certainly cannot be argued that this investment was not worthwhile, but it does point out that more money was expended than necessary to handle these wastes. Our intentions are to avoid that interim step if at all possible and aide in accelerated remediation, including final disposition of all wastes as an integral part of that process.

One immediate case and point being deployed here on the PRC project involves debris waste from demolition of the Plutonium Finishing Plant. Original plans for packaging and processing of low-level wastes (LLW) incorporated significant size reduction activities to fit waste into standard DOT waste containers for processing and disposal. Such activities would generate several waste boxes that still would require the same processing for disposal in any case, but at a rate of nearly $5,000 per cubic meter. The alternative is to use larger size IP 1 and 2 containers that are readily available with top, side and/or end load capability. Wastes require less size reduction and each container holds approximately 35 cubic meters at a cost of $8,000 per container. Equivalent standard waste packaging would require six packages at a cost of $3,700 per package: nearly $22,000 for equivalent packaging volume. This does not factor in the additional labor costs to size reduce debris to fit each container as well as additional processing for each package at nearly $5,000 dollars per package to meet disposal criteria. Conversely, the process we will employ, demonstrated on the tank farms project, will use a "flood grout" process for in trench treatment at an estimated cost of $7,000 per container. In short, the modified process will avoid costs of nearly $1,000 per cubic meter. With the volume projected for a project the size of the PFP it is clearly imperative that integration for POG waste management will be necessary to meet goals and reduce cost by many millions of dollars.

Another case to the point that is being deployed at the PRC is in-field processing of wastes to meet treatment facility requirements at the POG. This is another method to assure that wastes are prepared for immediate transport to processing facilities and reduce handling costs. Experience at the Hanford tank farms, now being applied at the PRC, shows that preparation for immediate transport in-field reduces handling evolutions on containers by at least three times, and as much as five times for items that were traditionally "removed from the project" as a point of completion, only to be processed again to meet a processing facilities acceptance criteria. Another aspect of this is use of re-usable containers again. Prices in containers have soared over the last five years and do not appear to be in a decline anytime soon. The vast majority of Contact Handled Mixed LLW is processed using macro-encapsulation technologies. As such, the containers are opened in any case and processed for disposal into disposal acceptable packaging. Previous processes used in-field packaging and transport containers one or two times. At costs for a B-25 steel container approaching $1,700 per container, one can clearly see how costs can quickly escalate.

By integrating waste management as an upfront part of the process, waste can be prepared for shipment into more standard waste containers that have useful lives up to ten times the previous containers. While slightly more expensive at $3,700 per container, less are used, hold twice the volume, and can be used for final disposal of non-mixed LLW when its lifecycle ends. One standard DOT Type A 5x5x9 box used ten times replaces twenty B-25 boxes at a material cost alone of $34,000. The method also reduces handling costs as well as transport costs by just the sheer volume reduction in the numbers of containers being managed by any project.

More challenges await our future

The next major target of opportunity facing the PRC mission revolves around retrieval of suspect transuranic wastes. The Hanford site placed nearly 40,000 containers of suspect transuranic waste in to below ground retrievable storage during the 1970's and 80's. A project to retrieve these wastes for characterization, processing, and shipment to WIPP or disposal, if LLW, has been on-going for nearly four years. To date, nearly half the inventory has been retrieved and placed into the Hanford site TRU certification project or the MLLW treatment projects. Containers have been removed mainly by removing overburden and manually handling the containers for over packaging and processing. However, time and the elements have taken their toll as we begin to move into the earlier generation containers (see figure 3).

Fig. 3. Typical container condition for early generation retrievably stored wastes

This was not an unexpected situation. Evidence was clear from many years ago that this might be the probable outcome for such a project and it was also very clear that risks to workers and the environment would increase as the older generation containers were exposed. Plans were already in place by CHPRC to modify retrieval approaches to meet these challenges while increasing safety and protection, as well as reducing costs. Experience and process changes at the Idaho site are being prepared for deployment here at Hanford by beginning to use bulk retrieval capabilities. Use of heavy retrieval equipment in controlled environments is expected to significantly reduce risks to workers and the environment, as well as increase retrieval speeds due to the severe degradation of containers. Our planned costs and schedule for completion of the work scope is estimated at around $45 million vice the original planned scope and cost of nearly $65 million under the previous contract. Challenges await in this area, but we remain confident that proven successes at other locations will translate into success at Hanford.

Another major area in the retrieval project is retrieval of RH TRU wastes located in caissons: underground vaults used to collect small volume waste containers from weapons production facilities. These units, while relatively small in size, represent the highest risk to workers and the environment, as well as planned costs. Our current plans in this area are to again use an approach that separates workers from the risk, increases production capability, and reduces waste handling to absolute minimums. In other words, produce packages at the POG that are ready to be certified for transport to WIPP and require no further processing. The technology of choice for our approach is a mobile hot cell system already in use in France for similar projects where waste are retrieved and processed in a central room and placed into compliant packages (see Figure 4). While we are in the early stages of planning for this project, we are confident that the processes and technologies can be deployed at a much reduced cost since much of the engineering is already done. We require only that we apply an adaptive approach in use that would place us into retrieval of this waste stream by mid fiscal year 2011, and have complete processing of the wastes by the end of fiscal year 2012: two years ahead of current plans at an estimated 50% of planned cost.

Fig. 4. Mobile hot cell processing area

SUMMARY

As we enter the new mission scope that is the PRC, we have much to learn. However, we are also confident that we can achieve real results with reduced cost, improved safety and environmental protection. Our mission with the DOE is an important one and one that we believe we can bring experience and tools to that will help meet these goals and show continued and improved progress in achieving. Funds from government sources are becoming more difficult to obtain every day, but the expectation for safe and efficient work performance has not diminished and, if anything, has become more strident.

Our plans for meeting that expectation are aggressive and will not be easy to achieve. But we do believe that we will become more creative, efficient and safe as a matter of course due to the constraints we will encounter and expect to encounter for some time to come. Funding levels for the PRC scope of work were expected to be at levels of nearly $650 million for some years to come. Current projects are more closely expected to be at around 75 percent of that number with little change in expectation for completion of work scopes covered under regulatory agreements. Our challenge remains to support those goals and to meet the cost reduction we have proposed while remaining compliant and safe.

We expect we can do this and believe that as we complete steps, more steps will be revealed that will allow us to further reduce costs, improve efficiency, and assure compliance.