INNOVATIVE ALARA TECHNIQUES AND WORK PRACTICES USED AT HANFORD FOR D&D

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ABSTRACT

The Department of Energy's Hanford Site has several nuclear facilities in the process of decontamination and decommissioning (D&D) with many more to follow. These facilities contain hazardous and highly radioactive materials in plant systems, gloveboxes, hot cells, rooms, collection tanks, ventilation ducts, fuel pools and outside these facilities. Some of the radioactive isotopes are fissile material and have to be closely guarded and require special handling. To safely work in this environment, workers had to learn new skills and develop innovative techniques to decontaminate, remove all equipment and demolish these radioactive work facilities without spreading contamination to the environment. Changing the workscope and worker attitudes involves a culture change for workers, managers, Department of Energy (DOE) and support organizations. D&D involves making different types of risk-based decisions than were made when the plants were operated or sitting dormant. Management involvement, use of the Integrated Safety Management System (ISMS), communications and sharing lessons learned are essential ingredients in developing a successful D&D strategy. New technologies have to be learned including the use of robotic devices and manipulative arms due to high dose rates and amount of radioactive contamination. Minimizing the amount of Transuranic and Mixed radioactive waste and learning how to ship the large quantities of waste are additional skills the Hanford workers have had to learn. D&D work at Hanford is in progress and Hanford Contractors have completed some very difficult and intense D&D work. This presentation will provide information on the best As Low As Reasonably Achievable (ALARA) protective measures, work practices, and the lesson learned to date.

BACKGROUND

The Hanford Site occupies about 568 square miles in the Southeast portion of the state of Washington. The Columbia River bisects the Site and was used to cool several reactor plants built near the shoreline in the 1940's. Other radiological facilities were built farther inland to process the nuclear weapons materials created by the reactor plants. In 1989, the last reactor plant was shutdown with the end of the Cold War and the mission at Hanford changed. We were left with 53 million gallons of radioactive liquid waste in underground tanks, Plutonium facilities that needed to be stabilized, spent fuel in fuel pools and a great deal of contaminated soil.

Work has been ongoing to place each facility in a safe condition and clean up the site. Some facilities have completed D&D and others are in progress. To make this change in workscope, the entire workforce had to undergo a culture change. D&D work is different and everyone had to learn new skills and management techniques.

WHAT'S CHANGING?

There is increased use of different kinds of tools and equipment. Some of these can be operated remotely. Specialized, hands-on training in mockups has increased and workers are making better use of lessons learned. An ALARA Center was opened to "showcase" new tools, equipment, work practices, and provide assistance in planning high-risk work. Information on the Hanford ALARA Center can be found at www.hanford.gov/alara/.

RISK-BASED DECISIONS

When doing D&D work many of the decisions are "risk based". If the decision is to decontaminate an area or a piece of equipment to near "free-release" levels and then demolish it, the work steps and risk levels will be much different than to accomplish D&D while it is still highly contaminated. Using a "graded approach", managers can select which path they intend to follow to complete D&D. Hanford has experienced recent success conducting D&D in facilities that are highly contaminated. New tools and equipment are working so well that managers have been able to select the less costly methods of D&D without first decontaminating the facility using a variety of tools, equipment and work practices:

Application of Fixatives - Aerosol fogging of a "Capture Coating" fixative into highly contaminated rooms, vaults and valve pits allows the fixative to be applied without entry by workers. All surfaces are left with a thin coating of material that is very "tacky" and this coating traps the contamination. See www.fogging.com

Polyurea coatings applied over the fixatives or directly on other surfaces seal any contamination or other hazardous products. The polyurea is similar to polyurethane products commonly sprayed in pickup truck beds. Vendors that have sprayed polyurea at Hanford include Master-Lee, Sherwin-Williams, and Specialty Products, Inc.

Other products can be painted onto surfaces to seal contamination. Some products are permanent and others can be stripped off to decontaminate the surface. Another product used recently to "fix" contamination inside a large rusty tank was "Rust Doctor". This product is used in the car restoration industry to convert rust to black magnetite. During the conversion process, the loose contamination on the rusty metal becomes fixed into the black magnetite. This allowed a large rusty tank located next to the Columbia River to be ripped apart with an excavator after the high levels of loose contamination inside the tank were "fixed" with the Rust Doctor. See www.therustdoctor.com.

Misting - Applying a water mist has long been used for dust suppression and it also works well to keep radioactive contamination from becoming airborne. A high-pressure pump forces the water through small holes in a nozzle forming a mist. The water droplets collect on the airborne particles and take them out of the air onto the surface. Very little volume of water is created. See www.AEEC.com.

When a greater volume of mist was required, "Fog Cannons" were used to saturate areas with a dense cloud of mist. These work well when excavators are tearing down buildings that contain large amounts of fixed contamination. These Fog Cannons can be adjusted remotely to move the mist if the wind changes or the demolition equipment moves around the work area. See www.martin-eng.com. The Rocky Flats DOE Site modified snow-blowing machines to blow a mist instead of snow.

Foaming - Expandable foam works well at filling void spaces in waste boxes, ventilation ducts, and for cutting contaminated piping during D&D. A hole is drilled in the top of a vent duct or horizontal pipe and the foam injected. It expands and fills the duct or pipe at the cut location. How much is filled depends on how long the foam is injected. Piping can then be cut and the foam on the inside of the pipe traps any contaminates to keep them from spreading. Vent ducts can be completely filled with foam before removal. If vertical pipes are going to be cut, workers have had success by drilling holes a few inches beneath the cut and inserting bottle brushes to form a shelf for the foam to expand.

Cutting Tools - A variety of tools have been used at Hanford for size-reducing materials during D&D. Hydraulic shears and blade-plunging cutters can sever piping in seconds. Split-frame cutting machines mount on the outside of a pipe and rotating cutting bits can sever the pipe and bevel it, if necessary, so it is ready for welding.

Nibblers are used to size-reduce sheet metal and this makes them a good tool for cutting up gloveboxes and ventilation ducting. Hand-held nibblers are a "punch and die" tool that will bite their way through metal at a rate of up to 1 meter per minute. The chips exit the bottom of the tool and can be collected in a bag, which reduces contamination spread. At Hanford, we have cut carbon steel up to 3/8" (9.4mm) and stainless steel up to ¼" (6.2mm) thick with nibblers. Companies are building bigger nibblers for the future.

Saws-Alls and Porta-band tools are a popular choice with workers because they get instant feedback on how the tool is operating during cutting. Some units have special clamps that support the saw so workers only have to push or pull on the saw during cutting. We have worked with one tool manufacturer to improve their saws so they work better inside gloveboxes. We are also purchasing their lubricants which have doubled the amount of cuts we can make with each saw blade. See www.csunitec.com.

Guillotine saws are sophisticated pneumatic hacksaws that can cut piping or I-beams up to 34" (0.86m) in width. The saw mounts to piping on a heavy-duty bicycle chain and then can be hand-cranked through material at a rate of about 1" (2.54cm) per minute. Hanford Tank Farms uses a Guillotine saw to size-reduce long equipment removed from underground radioactive waste tanks. Their saw is purchased with an automatic clamping device that secures it to the component and a remote feed mechanism to allow the workers to remain at a distance from the highly radioactive item. See www.wachsco.com

Vacuum Cleaners and Shrouded Tooling - HEPA filtered vacuum cleaners are used to collect radioactive contamination, asbestos and lead. Often, a large amount of debris has to be collected so collection drums are installed in the suction hose to collect the debris before it gets to the vacuum cleaner. This keeps the vacuum cleaner from filling up and the collection drums can be exchanged when full. This allows a job to continue without shutting down to empty the vacuum cleaner and eliminates emptying the vacuum cleaner multiple times during a job.

If highly radioactive material is going to be collected that would result in the vacuum cleaner becoming a High Radiation Area, an in-line HEPA filter can be installed in the suction hose. This filter collects the highly radioactive particulate and the vacuum cleaner is protected. The in-line filter can be shielded during use and changed out as often as necessary. Shrouded tools are tools that have a shroud around their working area and a connection for a HEPA filtered vacuum cleaner. As the tool grinds, drills or cuts on contaminated surfaces, the debris, any radioactive

contamination, and sparks are drawn into the vacuum cleaner rather than being sprayed around the work area. See www.descomfg.com

Hot Taps - Hanford has hundreds of miles of contaminated piping located inside and outside radiological work facilities. "Hot Taps" are used to drain this piping or ensure it is drained before the piping is cut. Hot tap devices mount to piping and then a drill or spike is driven through the pipe wall. If liquid and/or pressure are present, it then drains out a valve on the hot tap housing. This provides a controlled method of ensuing the pipe is drained before other cuts are made. It also provides a place to install a HEPA filtered ventilation system to draw on the pipe so that if the pipe is cut at other locations, the flow will be into the pipe at the cut location. See www.expansionseal.com and look a "D-Series" Tapping Tools.

Remotely Operated Tools - Contractors are using a BROKK Remote Controlled Demolition Machine to accomplish work in environments that are too hazardous to send workers. One unit dug out old fuel pools and occasionally had to handle highly radioactive fuel elements. These fuel elements were located by using a Gamma Camera hung from a crane. The GammaCam located the hot spots and then the BROKK dug up the spot to see what was causing the high radiation levels. When a fuel element was found, the manipulative arm on the BROKK picked up the fuel and deposited it in a shielded container. See www.brokk.com. Other manipulative arms were used in fuel pools to size reduce equipment underwater. One facility installed a manipulative arm on a backhoe for use in highly radioactive valve transfer pits. The backhoe can be positioned near the pit and its manipulative arm lowered into the highly contaminated environment to accomplish work. Several hand tools were modified to fit the end-effector on the arm so workers could operate the tool remotely from outside the pits.

LESSONS LEARNED

DOE Hanford contractors have had some recent success in mixing and matching technology to accomplish D&D work.

244-AR Canyon Building - The building had 19,000 gallons (~72,000 liters) of highly radioactive liquid in four tanks located in process cells below the canyon floor. Access to the tanks could have been made by lifting 5' (1.52m) thick cover blocks but the building crane was inoperable and there was no other method available. The floor and walls were highly contaminated with loose, removable contamination and HEPA filtered building ventilation was installed, but inoperable. The job was to remove the liquid so the building could be turned over to the D&D Contractor.

The ISMS Planning process was used to get workers, engineers and managers involved with the work planning. It was decided the liquid needed to be pumped from the tanks through holes in the cover blocks and piped outside the building to another nearby underground tank. The holes through the cover blocks could be core drilled inside a containment tent on the canyon floor. It was decided that if the high levels of contamination in the canyon were "fixed" there would be a significant reduction in the risk of contamination spread and uptakes and the job could be accomplished by only ventilating the containment.

The contamination was "fixed" by using aerosol fogging to apply a thin coat of fixative to every canyon surface. Polyurea coating was then sprayed on the floor and up the walls as far as workers could reach. After spraying, contamination levels on the floor of the canyon were very low compared to the high levels that existed prior to fogging.

Rather than installing one containment tent to cover the entire canyon floor it was decided to install a small containment over each of the four tanks and run a passageway between the containments. This allowed the small workforce to install the tent in steps rather than trying to install one large containment tent.

Instead of providing negative ventilation for the containment it was decided to make the containment "positive" to keep contamination outside the containment from migrating inside. In addition, instead of installing scaffolding and tying up the containment, it was decided to inflate each section of the containment and install the scaffolding inside. This worked very well and the inside of the containment stayed contamination-free during the entire job. Contact www.lancsindustries.com for information on containment fabrication.

233-S Plutonium Concentration Facility – The D&D of Building 233-S Plutonium Concentration Facility at Hanford has been well documented and presentations were made at the 2004 Waste Management Conference. The radiological controls used to demolish the building are worth discussing.

The plutonium concentration process in the building created piping and vessels with high internal contamination. In addition, a major fire in 1963 spread radioactive materials throughout the building. The building was one story except for the Process Hood Area that was four stories high and contained most of the residual contamination left in the building. Several layers of sealant covered the contamination. The gloveboxes, processing equipment, and internal structure had been removed and the inside sprayed with a sealant to fix any remaining loose contamination. A decision had to be made on how to demolish the concrete building. Meetings were conducted and options included putting the entire building in a containment tent or demolishing it in the open using various engineered controls. A search for better-engineered controls was conducted and it was learned that the Fernald Site had used a "Fog Cannon" to spray a mist on excavation sites and for D&D work. Based on their experience, it was decided that the building could be demolished without a large containment tent as long as Fog Cannons were used in conjunction with additional misting.

An excavator with a claw-like gripper was outfitted with a misting nozzle, high-pressure pump and a water tank. Two fog cannons were positioned on either side of the excavator to direct their stream of mist at the building as it was being ripped apart. The single story sections of the building were ripped apart by the excavator and no spread of contamination occurred outside the posted boundary located 40 meters from the building.

Removal of the process hood structure was accomplished by a sub-contractor using a large circular concrete saw. The saw was mounted to tracks on the outside of the building, which had 12" thick walls. Roof sections were removed first and then the walls were cut and rigged off. Each piece was bagged and transported to a disposal facility located on the Hanford Site. During work, contamination was found in areas where it wasn't expected and where it was expected, the levels were much higher than anticipated.

SUCCESS

D&D at Hanford is in full progress and we continue to look for better tools, equipment, and work practices to accomplish the work in a manner that is compliant, protects the environment and is safer for workers. Old methods are challenged to determine if they are appropriate for the kinds of work we now have to do. Well-trained workers are the key to success and we give them

support and tools they need so they can be successful. As the site closure accelerates, we understand there will be new challenges that need to be addressed. Based on our track record to date, the workers at Hanford will be ready to face these challenges.