Section Four
ALARA Activities at DOE

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ALARA Activities at DOE

This section on ALARA activities is a vehicle to document successes and to point all DOE sites to those programs whose managers have confronted radiation protection issues and used innovative techniques to solve problems common to most DOE sites. DOE program and site offices and contractors who are interested in benchmarks of success and continuous improvement in the context of Integrated Safety Management and quality are encouraged to provide input to be included in future reports.

4.1. ALARA Activities at the Fermi National Accelerator Laboratory

At the Fermi National Accelerator Laboratory (Fermilab), a policy consistent with integrated safety management (ISM) and in accordance with 10 CFR Part 835 requirements is to conduct activities in such a manner that worker and public safety, and protection of the environment are given the highest priority. Fermilab is committed, in all its activities, to maintain any safety, health, or environmental risks associated with ionizing radiation or radioactive materials at levels that are As Low as Reasonably Achievable (ALARA). Likewise, Fermilab management supports related work planning and review activities in support of the Fermilab ALARA program.

During 2012, the primary activities at Fermilab that resulted in occupational radiation exposures were related to upgrade and repair activities of the Fermilab accelerator. Nearly all radiation doses to personnel were due to exposures to items activated by the accelerated beams. On May 1, 2012 Fermilab began a major maintenance and development (M&D) shutdown for approximately one year to prepare the accelerator and associated facilities for new experiments at much larger beam powers to support research at the Intensity Frontier. Upgrades were performed in Linac, Booster, Recycler, Main Injector, and Neutrinos at the Main Injector (NuMI) areas.

Such a shutdown was needed to improve the facility by replacing the 750 keV Cockcroft-Walton electrostatic accelerator at the beginning of the chain of accelerators with a modern radiofrequency quadrupole (RFQ). The shutdown also provided the opportunity to install many improvements in the entire chain of accelerators to achieve an increase in proton beam power at 120 GeV from 400 to 700 kilowatts, and to accommodate construction of the on-site near detector experimental hall for the very large NuMI Off-Axis Electron Neutrino Appearance (NOvA) experiment. Concurrently, Fermilab is working towards the completion of the far detector of the NOvA long baseline neutrino oscillation experiment in northern Minnesota. As part of the NOvA project, the accelerator complex infrastructure and the NuMI beamline are being upgraded to provide higher neutrino intensities than are possible in the current configuration. These upgrades focus mainly on converting the Recycler Ring from an antiproton storage machine to a pre-injector for the Main Injector.

The accelerator shutdown was also necessary to repair many accelerator components following the final years of operation of the Tevatron colliding beam program and the high intensity NuMI beamline. Many of the changes made in this shutdown are intended to improve operational reliability and hence, reduced maintenance needs in the future.

As with all recent maintenance and development shutdowns, it is clearly recognized that many of the tasks performed must be conducted in intense radiation fields dominated by gamma rays due to induced radioactivity from years of operations at high intensities. The Fermilab Accelerator Division (AD) established a task review process that requires all tasks performed in the accelerator to be entered into a database for review by all of its support departments. This initiative improves efficiency by preventing scheduling conflicts and also affords the AD Environment Safety and Health (ES&H) Department the opportunity to identify those radiological tasks that require special attention. A list of radiological tasks was developed prior to this shutdown.

Exhibit 4-1:
Total Collective Dose (person-mrem) as Function of Shutdown Week Number (through November 30, 2012)

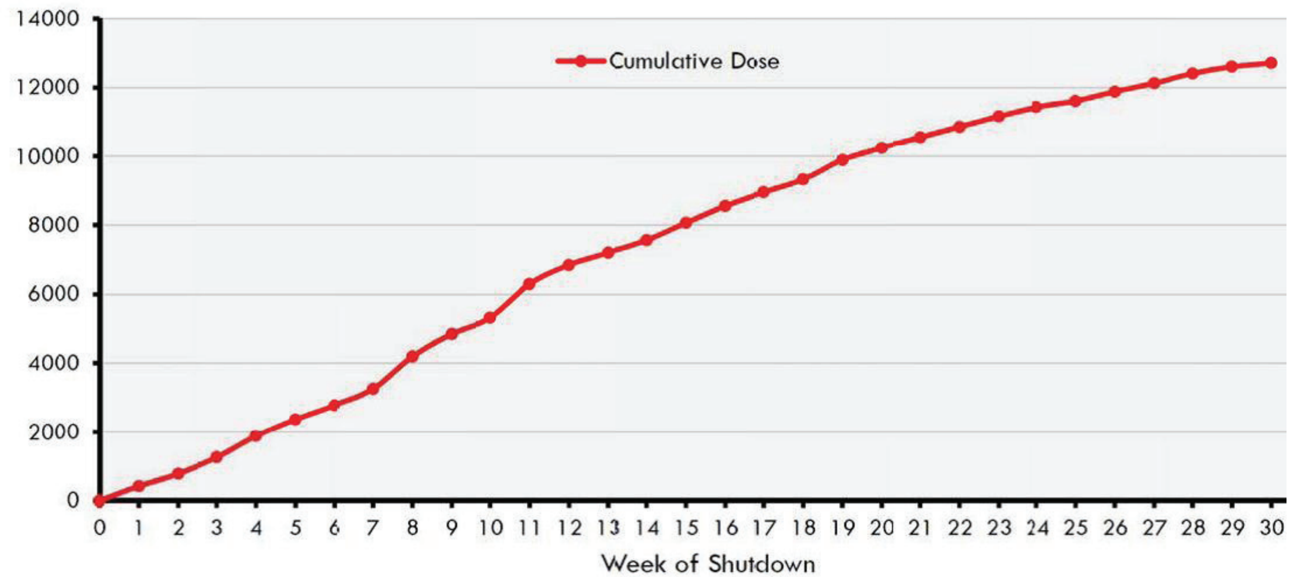


Exhibit 4-2:
Numerical Distribution of 239 Shutdown Workers in Terms of Dose Received in 2012 (through November 30, 2012)

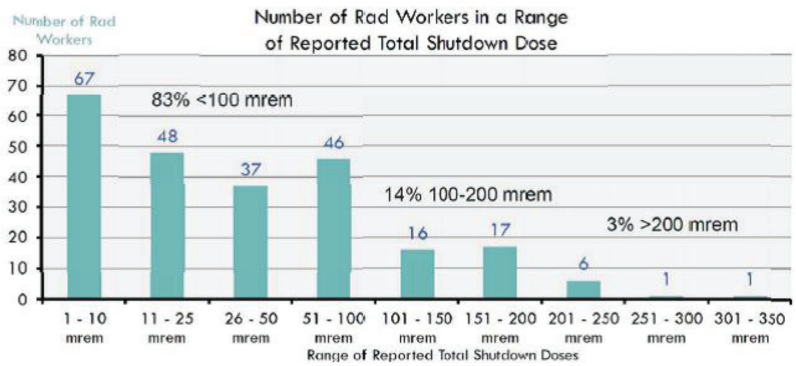
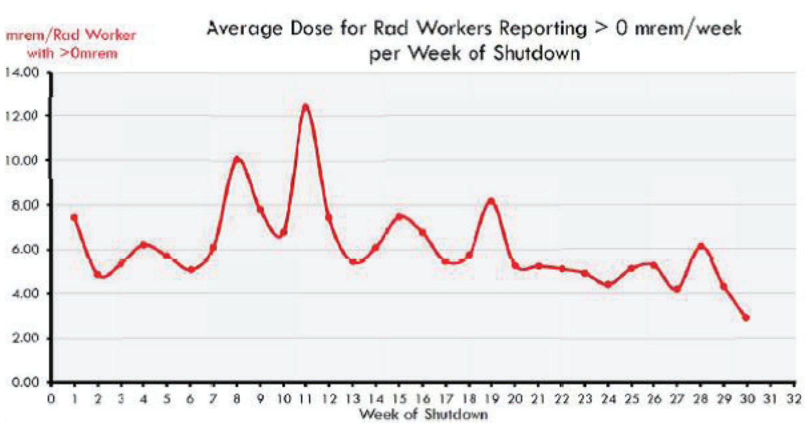


Exhibit 4-3:
Average Dose for Radiological Workers with Non-Zero Dose for Each Shutdown Week During 2012 (through November 30, 2012)



During this shutdown, the majority of tasks were successfully performed with lower collective dose than originally planned by implementing ALARA dose-saving measures such as careful planning, conducting dry runs for hot jobs, and managing ongoing input from task supervisors and individual workers regarding ALARA optimization as tasks proceed. For each task, an estimated collective dose was determined. Exhibits 4-1, 4-2, and 4-3 summarize the collective dose received during 2012.

The success in maintaining and controlling radiation doses to personnel was achieved due to the many commendable efforts of personnel lab-wide and AD management and personnel who work with AD ES&H Department staff to plan and coordinate shutdown work while implementing ALARA measures on a task-by-task basis. The following activities highlight the continued commitment to keeping exposures ALARA at Fermilab

4.1.1. Linac Beam Absorber Window Replacement

The Linac beam absorber window was replaced with lower collective doses than estimated. When the old window and the T piece were removed, dose rates measured 100 mR/hr out of the dump pipe and 10 mR/hr to the sides of the pipe where people worked. Tasks were completed faster than the ALARA plan estimated and installation of new components reduced the dose rates lower than anticipated. The collective dose estimate was 224 person-mrem and the actual dose received was 78 person-mrem.

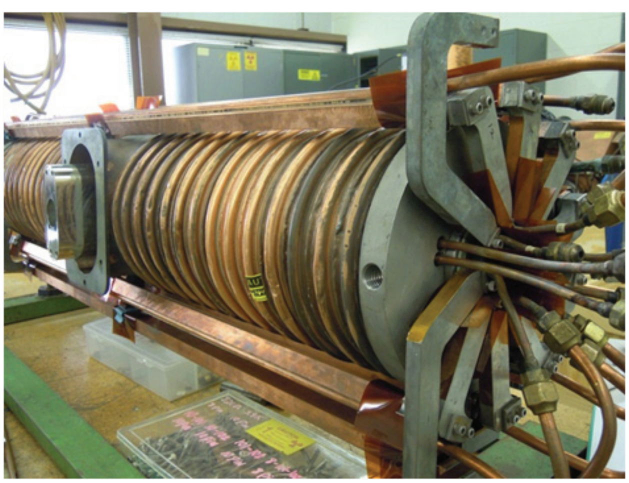
4.1.2. Booster Work

The Booster is the first circular accelerator, or synchrotron, in the chain of accelerators at Fermilab. It consists of a series of magnets arranged around a 75-meter radius circle. Shutdown upgrades to the Booster include repair of the Booster magnet, cabling, and conversion of Booster radio-frequency (RF) stations to solid state.

4.1.2.1. Removal of Booster Cavities to be reworked for Booster RF Upgrade

A practice dry-run of removal of a Booster cavity was conducted in preparation for the shutdown work. A “cool” Booster cavity was selected in October of 2011, so the component had several months to cool down before the work was finished in April of 2012 (See Exhibit 4-4). The estimated collective dose for this dry-run activity was 167 person-mrem. The actual collective dose received was 71 person-mrem. The reason for the reduced collective dose was due to the fact that the cavity cooled down considerably over the long period of time that the cavity was worked on.

Exhibit 4-4:
RF Cavity Tuner



4.1.2.2. Installation of a New Booster Notching Absorber at Long 13

A new booster notching absorber was installed in the Long 13 section of the Booster Ring as part of the accelerator upgrade (See Exhibit 4-5). Many beamline components were removed in June of 2012 in order to reduce the area dose rates. Shielding upstream and downstream areas further reduced dose rates to 5 mR/hr. Removal and capping of water lines was performed more quickly than planned which reduced the actual collective dose received. As new shielding material was installed, dose rates were reduced to 2 mR/hr. The collective dose estimate for this work was 630 person-mrem, but because the installation went so efficiently, the actual collective dose was only 373 person-mrem.

Exhibit 4-5:
Booster Notching Absorber

4.1.3. Recycler Ring Repurposing

By using the Recycler Ring as a pre-injector, the Main Injector cycle time can be reduced from 2.2 seconds to 1.33 seconds. This, along with other improvements, will yield an 80% increase in beam power, even though the number of protons per bunch is increased by only 10%. These upgrades require the construction of new transfer lines and additional radio-frequency power stations in the Recycler and Main Injector. In the Main Injector, all of the antiproton equipment has been removed. Keeping true to the Recycler name, 60% of the instrumentation and 90% of the vacuum components are reused. A new transfer line was installed into the Recycler and workers are in the process of installing a new transfer line from the Recycler to the Main Injector. Recycler Ring repurposing is 50% complete. Work in "hot" areas was delayed until later in the shutdown to allow for cool off. The collective dose estimate for the entire repurposing is 11,000 person-mrems. To date, an actual collective dose of approximately 2,000 person-mrems has been received for the removal phase, and it is estimated that an additional collective dose of between 2,000-3,000 person-mrems will be accrued during the installation phase. The shutdown coordinator, the attending radiological control technician, and the workers have spent much effort to modify work schedules and procedures to reduce dose.

4.1.4. Neutrinos at the Main Injector (NuMI) Work

The NuMI line must be upgraded to handle the higher proton beam powers. This involves construction of a new target, upgrades to the cooling systems, and improvements to the primary proton line.

4.1.4.1. NuMI Radioactive Water (RAW) Piping Upgrade

In May of 2012, NuMI radioactive water piping was upgraded for NOvA. This work involved cutting and reinstalling piping for water supplies for horn 2 hangers and spray lines. The piping was internally contaminated, so workers wore personal protective equipment (PPE) per Radiological Work Permit requirements and under the direction of the attending radiological control technician (See Exhibit 4-6).

The collective dose estimate was 147 person-mrem and the actual collective dose received was 105 person-mrem. The lower collective dose received was a result of workers finishing the job in a shorter amount of time than anticipated.

Exhibit 4-6:
NuMI Radioactive Water Piping

4.1.4.2. NuMI Beamline Air Duct Repositioning

Ductwork formerly identified as SR3 was detached, sealed off, and new ductwork was redirected to a chiller unit in the NuMI target hall during the summer of 2012. The old ductwork was contaminated, so all workers wore appropriate PPE. The collective dose estimate was 23 person-mrem and the actual collective dose received was 10 person-mrem. Doses received were lower than the estimated doses because the work was completed in less time than planned.

4.1.4.3. NuMI Horn 2 Repositioning

IIn June of 2012, the NuMI horn 2 was repositioned to the middle energy (ME) position downstream in support of the NOvA upgrade (See Exhibit 4-7). Shield blocks were removed, the chase area was opened, and new supports were welded in the new ME position. Because this work had not been performed before, mock-ups were used in planning. As the job progressed, workers were able to complete many

Exhibit 4-7:
NuMI Horn 2 Move in Target Hall

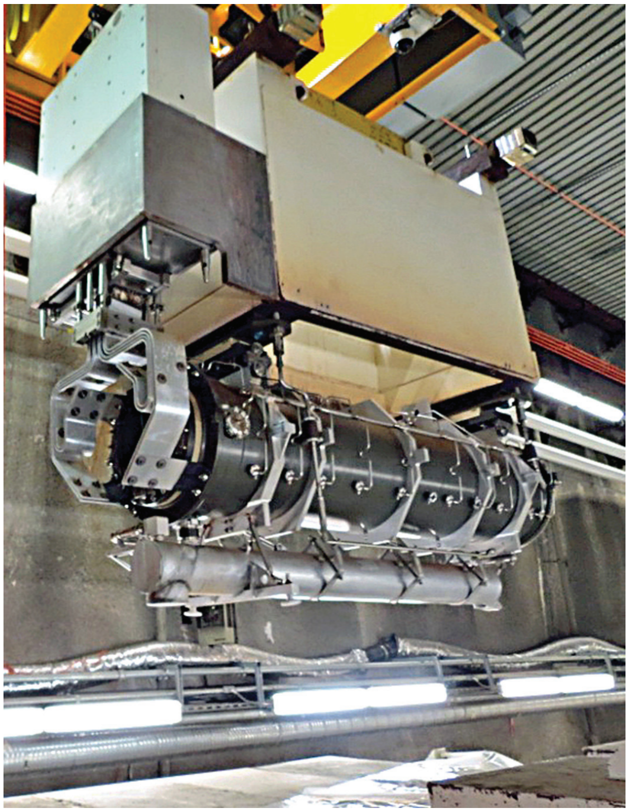


Exhibit 4-8:
NuMI Dehumidification Units

tasks in less time than the ALARA plan had allotted. Extra movable shielding was utilized during prolonged work in the chase area which reduced the collective dose considerably. Removable contamination was measured during opening up surveys, so workers wore personal protective equipment per Radiological Work Permit requirements and under the direction of the attending radiological control technician. The collective dose estimate for this work was 2,431 person-mrems and the actual collective dose received was 1,538 person-mrems.

4.1.4.4. Removal of Dehumidifier Condenser Coils

As one of the shutdown tasks for NuMI, dehumidifier condenser coils were removed and replaced (See Exhibit 4-8). The equipment had removable contamination, so personnel were required to wear PPE as specified in the Radiological Work Permit and under the direction of the attending radiological control technician. Old piping was removed, new piping was installed, and new dehumidifier units were installed. There was no contamination on any personnel or tools upon completion of the work. The estimated collective dose was 82 person-mrem and the actual collective dose received was 45 person-mrem. The doses received were lower than anticipated because the work took less time than expected and dose rates were somewhat lower than estimated.

4.1.4.5. Beryllium Window Vacuum Pipe Removal from NuMI Target Chase Wall

In November of 2012, the Beryllium window vacuum pipe was removed from the target chase wall to determine the leak point (See Exhibit 4-9). The Beryllium window measured 100 mR/hr directly in the dead-center of the window. Areas located off-center and downstream of the pipe measured between 5 mR/hr and 10 mR/hr. The pipe was removed from the wall and encased in a long plastic bag to prevent potential contamination. All workers handling the pipe wore coveralls, booties, and gloves per the requirements of the Radiological Work Permit and under the direction

Exhibit 4-9:
NuMI Beryllium Window Vacuum Pipe Removal

of the attending radiological control technician. The floor underneath the pipe and the transport box was covered with a strong industrial fabric that is abrasion resistant and waterproof. The estimated collective dose for this work was 14 person-mrem and the actual collective dose received was 5 person-mrem.

4.1.4.6. NuMI Target Hall Ventilation Unit Pre-filter Removal

In May of 2012, Pre-filters were removed from the NuMI target hall ventilation unit in order to reduce area radiation levels for shutdown work (See Exhibit 4-10). Workers followed a bag-in/bag-out procedure. Personnel wore full-face respirators with personal air monitors (PAM) attached to the outside of their protective clothing. The target hall pre-filters measured between 100 mR/hr and 120 mR/hr on contact.

Exhibit 4-10:
NuMI Target Hall Ventilation Bank

No local contamination was measured in the area or on worker's protective clothing upon completion of the task. The collective dose estimate was 40 person-mrem and the actual collective dose for this job was 27 person-mrem.

4.2. ALARA Activities at the Savannah River Site

4.2.1. TRU Waste Remediation

The transuranic (TRU) waste mission statement is the remediation and repackaging of prohibited items into Waste Isolation Pilot Plant (WIPP) compliant containers for disposal.

The TRU waste remediation and repackaging project takes place on the cell covers and in the warm shop of H-Canyon. Several different types of waste packages are remediated for prohibited items and repackaged into Waste Isolation Pilot Plant (WIPP) compliant containers for final disposition. These waste packages contain a wide assortment of items including glove boxes, process tanks, piping, and various contaminated instrumentation. Most of the time process tanks and glove boxes are sealed and it is difficult or nearly impossible to confirm that no prohibited items are contained within. In this situation the waste item must be cut open and inspected for prohibited items. As a result, workers encounter high levels of contamination (4E8 dpm/100cm^2 α transferable), airborne radioactivity (38,000+ DAC-hr), and elevated dose rates (1,800 mrems/h whole body). Furthermore, the time and effort required to remediate a waste item is extensive and introduces several additional industrial hazards.

Exhibit 4-11:
Boroscope Camera

To limit the amount of intrusive work required for remediation, a boroscope camera was used to inspect the inside of several waste packages for prohibited items (See Exhibit 4-11). This method significantly reduced the amount of time and mitigated several hazards (industrial and radiological) associated with this project.

The radiological concerns are dose rates, airborne radioactivity, transferable contamination, and contaminated sharps. Time, effort, collective dose, airborne radioactivity generation, spread of contamination, and several industrial hazards were mitigated by the use of a boroscope camera.

The ALARA technique implemented was to cut or drill a small hole to insert the boroscope camera to inspect the inside of the container for prohibited items, instead of cutting a vessel in half with a reciprocating and/or circular saw. The average time to remediate box without the boroscope camera equals one 12-hour shift. The ALARA effort reduced this time by 50%, correlating to a 50% collective dose reduction. The actual collective dose for the project was 4,244 person-mrems.

The project staff included the Radiological Control Operator (RCO), and the operations, rigging, construction, & engineering staffs.

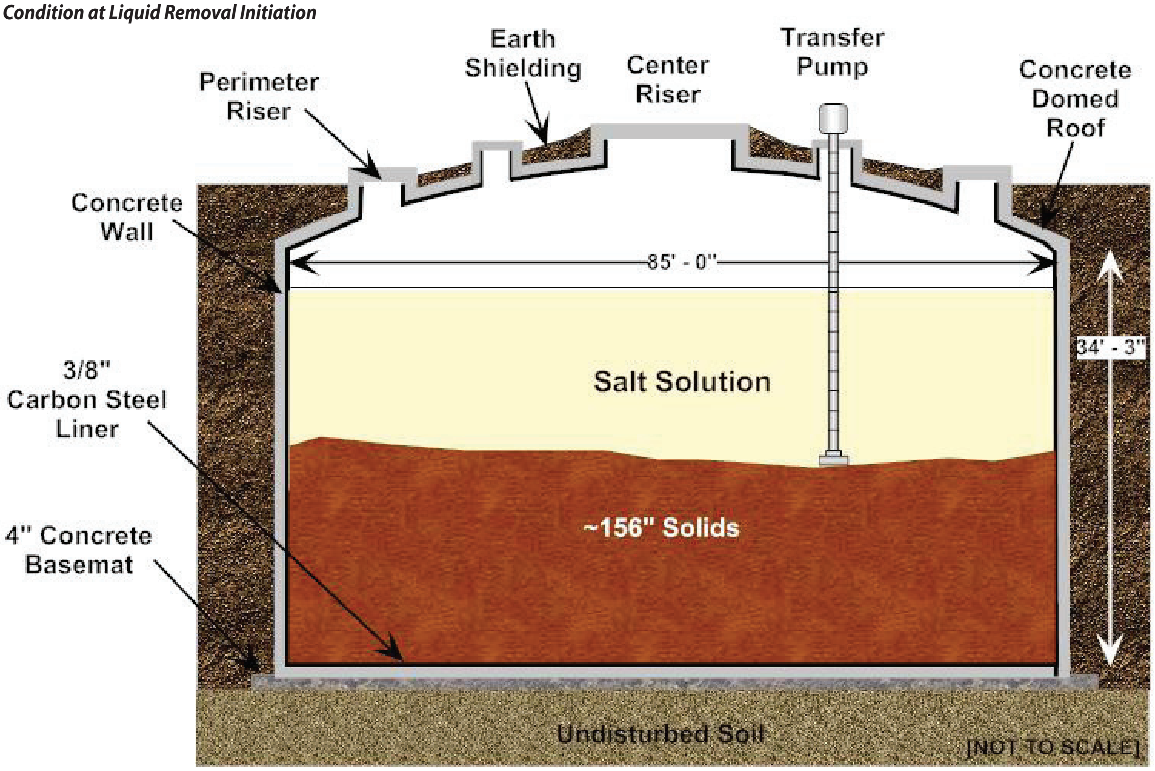
4.2.2. Waste Tanks 18 and 19 Closure

The waste tanks closure mission statement is to achieve tank closure through the disposition of SRS liquid waste in a safe, timely, and cost effective manner while exceeding stakeholder expectations.

On September 21, 2012, F Tank Farm completed the grout fill of Tank 18 and Tank 19, capping each riser. These tanks were designed to hold 1.3 million gallons of radioactive waste. A total of 16,184 cubic yards of grout was used to fill the tanks. Savannah River Remediation (SRR) has declared these tanks officially closed (See Exhibit 4-12).

The radiation exposure was measured by dose rate working over the open hole, dose rate during sampling and waste removal activities, and dose rate during grouting activities. The spread of contamination was caused by the core drilling of the tank top, sampling activities and pouring the grout.

Exhibit 4-12:
Initial Condition at Liquid Removal Initiation



Mockups were performed to develop techniques and tools to reduce time over the open riser, during the sampling and grouting activities. Multiple planning meetings and reviews (e.g., Facility Radiological Action Team (FRAT), senior management, and pre-job ALARA reviews) were held prior to project start.

Engineering controls were implemented such as; certified huts installed (including a removable roof), tank ventilation as the primary unit and hut as a secondary, and supplemental ventilation during the final stages of the grout pour as the tank ventilation. In addition, the riser fill included localized units at the vent pipes, with airflow checks, shielding carbon steel plates and shield wall for personnel during core drill tank top and a polycarbonate resin thermoplastic box for crawler sampling and repairs (See Exhibit 4-13). Finally, a crane was used to lower the grout transfer line (e.g. tremmie) through a riser port opening into the tanks vapor space.

Exhibit 4-13:
Box for Crawler Sampling and Repairs

The estimated dose exposure for both Tank 18 and Tank 19 was 1.02 person-rem each and the actual dose received was 0.292 person-rem for each project.

DOE, the South Carolina Department of Health & Environmental Control (SCDHEC) and EPA made an agreement to suspend waste removal activities.

4.2.3. Old High Activity Waste Trailer Decommission

The old high activity waste trailer decommission mission statement was to obtain samples to be used for disposal of the trailer.

The old high activity residue trailer was parked on a pad at the lower end of Savannah River National Laboratory (SRNL) in 1975 after an axle on the trailer broke during transit to H Area. In the early 1990s it was covered with plastic due to contamination leaching out at the hatch on top of the tank. The trailer has been covered many times since then, due to deterioration of the tarps (See Exhibit 4-14).

Exhibit 4-14:
Tarps Covering the Trailer

The project description was to remove the tarps covering the trailer to obtain a sample of any residue remaining inside the tank and to analyze the tank's contents for development of a path forward for disposing of the tank, trailer, and shielding.

A job specific radiological work permit (JSRWP), ALARA review, work instructions and procedure were developed. Numerous planning meetings and reviews were held and a FRAT and Facility Operations Safety Committee (FOSC) review were held to verify that work was ready to proceed.

InSitu object counting system (ISOCS) readings were performed on the tank to tentatively identify the radioactive material remaining inside of the tank. Tools were fabricated for obtaining samples from the bottom of the tank. Mock-ups were performed to test and demonstrate use of extended tools for sampling and smearing of the inside of the tank for pulse height analysis (PHA).

Engineering and administrative controls were used to keep the exposure to the workers and work area ALARA. A certified glove bag was used to control contamination and airborne activities during sampling and smearing inside of the tank; a certified hut (60'x120'x14') was used as a backup to the glove bag to ensure contamination and airborne activity was not spread to outdoor environment. The large containment hut was built to cover the trailer and an HVAC system was installed on the containment hut to help reduce the temperature and humidity inside of the hut (See Exhibit 4-15). In addition, remote electronic personnel dosimetry was used for monitoring workers exposure during sampling activities. Other concerns to consider were the potential for insects such as wasps and small animals living between the tarp layers and the heat stress, as the work was being performed during the hottest months of the year.

Exhibit 4-15: Containment Hut with HVAC System

Electric scissors were obtained to reduce the time required to remove the numerous layers of tarps and wrappings on the trailer. The tarps/plastic coverings on the trailer were removed in small sections, layer by layer. Radiological protection department surveyed under each layer prior to its removal until the entire trailer was exposed. A glove bag was installed over the access hatch and the trailer was opened (See Exhibit 4-16).

The extended devices developed for sampling worked as designed. Workers were able to obtain samples of the residue remaining inside of the tank, and perform

Exhibit 4-16: Glove Bag

smears for waste analysis. Once all of the samples were obtained, the tank hatch was closed, the glove bag and hatch area decontaminated, and the glove bag was removed.

The expected dose for the work was estimated to be 190 person-mrem, but due to the ALARA techniques used the dose was reduced to 18 person-mrem. The use of engineering and administrative controls allowed contamination levels to be maintained to <200 dpm /100cm2 alpha and <100,000 dpm/100 cm2 beta-gamma inside of the hut, and <20 dpm/100 cm2 alpha and <200 dpm/100 cm2 beta-gamma to surrounding areas outside of the hut and contamination area boundaries. Airborne levels were maintained below 4 DAC-Hrs for fission products/ PU, inside of the hut and outside of the hut.

The samples were obtained and the trailer was deconned successfully. No spread of contamination occurred inside or outside of the hut. The workers exposures were maintained below the estimated goals. The samples obtained will allow a path forward to be developed to proceed with disposal plans for the trailer and lead shielding.

4.2.4. Tank 51 Telescoping Transfer Jet Repair

The mission statement for the repair Tank 51 telescoping transfer jet was to ensure a continued sludge feed for the defense waste processing facility.

The telescoping transfer jet developed a steam leak on the lower stuffing box on the steam supply leg of the jet. This steam leak rendered the jet inoperable. The management team determined that to repair the jet in place, by repacking the stuffing box, was the best option.

This activity was performed on a previous telescoping transfer jet in Tank 51 in 2003. During the repair activity, dose rates on the jet were 41 rem/hr extremity, 2.5 rem/hr skin and 250 mrem/hr whole body. Personnel exposures during the repair activity in 2003 for Tank 51 telescoping transfer jet totaled 183 mrem whole body. The highest individual whole body dose was 119 mrem, and the highest individual extremity dose was 3.7 rem.

Since 2003, the Tank 51 waste (feed for defense waste processing facility) has contained higher and higher concentrations of radioactivity. Currently, the Tank 51 Cs-137 concentration is 24 times higher and the Sr/Y-90 concentration is 5 times higher than in 2003. Also in 2011, a slurry pump was removed from the Tank 51 B4 riser and the dose rates reported through layers of plastic on the pump were 200 rem/hr extremity, 82 rem/hr skin and 1 rem/hr whole body.

Radiological engineering performed a dose analysis on the jet in the tank using dose rates from the 2003 jet repair, the dose rates from the 2011 slurry pump removal (considered bounding), and time and motion data from maintenance, construction, operations and radiological controls. These analyses generated estimated dose and stay times for hands on tasks. Since the estimated doses were high, the management team decided to limit extremity exposure to 16 rem and whole body to 200 mrem. Based on these dose targets and the analysis, it was determined that the jet could not be repaired with a direct hands on approach. The management team challenged maintenance to demonstrate that they could perform the work at 18” from the stuffing boxes. This would require extended tools, keeping the workers hands no closer than 18”. Based on expected dose rates, it was determined that personnel could work for 15 minutes at 18” before reaching the established dose target. Operations performed a series of internal and external flushes on the jet. Maintenance fabricated extended flush wands that would allow the operators to reach several feet below the stuffing boxes. The first external flush was with flush water only to remove residual salt material accumulated on and around the stuffing boxes. Several sequential external washes were performed by spraying (with a garden sprayer) a coat of caustic industrial cleaner that was allowed to soak for up to 30 minutes prior to being flushed off with water. This was done in an effort to remove or reduce the thin film of residual material adhered to the jet.

Shielding would be developed to include rubber gloves, tungsten gloves and leather gloves, coupled with a polycarbonate resin thermoplastic shield between the jet and the workers. This shielding plan would be tested when the jet was raised with an array of dosimetry placed inside and outside the shield and dosimetry with and without the gloves. The pre-job collective dose estimate was 200 person-mrem and the actual collective dose measured 102 person-mrem.

4.2.5. Disposition of Two Separation Equipment Development (SED) Legacy Boxes

Equipment used to process nuclear material had been stored inside wood and metal boxes in the Separation Equipment Development (SED) facility since the operating process was shut down in 1978. Reclaiming the materials would require opening the metal/wooden boxes, sampling and removing material inside of the equipment, and repackaging the accountable material and waste items for disposal.

In the planning preparation phase, X-rays were taken of the boxes in an attempt to identify the contents of the box. Numerous planning meetings and reviews were held and a JSRWP, ALARA review, work instructions and procedure were developed. FRAT and FOSC reviews were held to verify that work was ready to proceed.

In addition, tools were fabricated for tilting the box, allowing easier removal of items on the bottom of the box.

The airborne radioactivity risk was the spread of contamination, exposure to the workers, potential sharp objects identified through x-rays, weight of equipment hindering work in glove bag, the unknown condition of the items in the boxes, and disturbance of the materials inside of the equipment that could increase the possibility for the spread of contamination, and the creation of airborne activity.

Engineering controls were used to keep the exposure to the workers and work area ALARA. Some of these were; a certified glove bag used to control contamination levels, a certified hut used as a backup to the glove bag to ensure contamination and airborne activity was not spread to the room, extended tools used to increase worker distance and reduce the chance of encountering sharp objects, tungsten sheeting used to wrap the sample bottles to reduce the dose to the workers from the materials as they were collected, two mock-ups of the evolution performed prior to the start of the work to demonstrate the effectiveness of the tools and equipment, and remote electronic personnel dosimetry was used to monitor the dose of workers as the work progressed.

Administrative controls were; a procedure and work instructions for performance of the work, the "reader worker" method was utilized to minimize time in the area, a JSRWP was developed for the work, over gloves fabricated for industrial protection were used for protection if the workers had to place their hands on a piece of equipment, fresh-air supplied hoods were worn for protection against airborne activity and for comfort due to the long duration of the work evolution, and lead aprons were worn to reduce the exposure to the worker.

The expected dose for the work was estimated to be 1.6 person-rems, but due to the ALARA techniques used the dose was reduce to 0.137 person-rem; a dose savings of 1.463 person-rems. Additionally, due to the use of the engineering and administrative control, contamination levels were maintained to <1000 dpm/100 cm2 beta-gamma and 500 dpm/100 cm2 alpha outside of the glove bag and airborne levels were maintained below 4 DAC-Hrs for fission products/PU inside of the hut.

The repackaging and disposal of the legacy nuclear materials also eliminated any future exposure that workers would have received when performing routine work in the SED area.

4.2.6. A Block In-Cell Crane Replacement

The in-cell cranes are vital to the shielded cells day-to-day operations. They are used to move heavy loads, replace protective windows, replace HEPA filters in the cells, and install equipment inside of the cells.

The A cell block crane had failed multiple times, requiring pulling the in-cell crane for repairs. The crane would not operate in a north to south direction. Because of the age of the crane and the inability to obtain replacement parts it was decided to replace the crane.

The planning phase included cell plugs or covers that had to be pulled numerous times to take measurements, and/or pictures of the old in-cell crane. Multiple planning and review meetings, included a FRAT, FOSC, and pre-job ALARA review, and a JSRWP, ALARA review, and work instructions were developed.

Radiation exposure risk involved dose rates over the open cell, dose rates during wrapping of the in-cell crane, and the spread of contamination. The crane could not be bagged until it was completely out of the cell, and relocated away from the cell opening.

Engineering controls and administrative controls were used to keep the exposure to the workers and work area ALARA. Some of these were; the airflow was verified going into the cell before the crane was removed, an industrial penetrating oil was sprayed on the in-cell crane as it was lifted out of the cell to control contamination and airborne activity, the remote electronic personnel dosimetry system was used to monitor the dose of the workers as the work progressed, and extended tools were used where possible.

Prior to the start of work, the replacement crane was set up in a clean area and performance tested to ensure that everything was working, then after being taken into the radiological area it was checked again, to ensure that it was working prior to installation. A low dose area was established by radiological protection for workers who were not actively performing a task. To prevent the spread of contamination and reduce the workers exposure, a containment bag was fabricated with flaps for wrapping the crane. The flaps allowed the bag to be held open using extended tools. This maximized the workers distance for the majority of the wrapping process with the exception of closing the bag.

The pre-job collective dose estimate was 1,240 person-mrems and the actual collective dose measured was 186 person-mrem.

4.3. ALARA Activities at the MOAB UMTRA Project

The mission of the Moab UMTRA project is to relocate mill tailings and other contaminated materials from a former uranium-ore processing facility (mill site) and from off-site properties known as vicinity properties in Moab, Utah, to an engineered disposal cell constructed near Crescent Junction, Utah. The scope also includes active remediation of ground water at the mill site (Moab site).

The Uranium Reduction Company constructed the Moab mill in 1956 and operated it until 1962 when the assets were sold to Atlas Minerals Corporation (See Exhibit 4-17). Uranium concentrate (called yellowcake), the milling product, was sold to the U.S. Atomic Energy Commission through December 1970 for use in national defense programs. After 1970, production was primarily for commercial sales to nuclear power plants. During its years of operation, the mill processed an average of about 1,400 tons of ore a day. The milling operations created process-related wastes and tailings, a radioactive sand-like material. The tailings were pumped to an unlined impoundment in the western portion of the property that accumulated over time, forming a pile more than 80 feet thick. The tailings, particularly in the center of the pile, have high water content. Excess water in the pile drains into underlying soils, contaminating the ground water.

Overall concerns are gamma doses, Radon related dose and inhalation of dust from the tailing resulting in minor uptakes.

Project curtailment (three months) along with non-operational time lowered the actual collective dose. Dose rates were only slightly above the estimates. Airborne levels for specific jobs were above 30% DAC and the surface contamination was unchanged.

The total pre-job dose estimate for the project was 2,000 person-rems and the actual collective dose measured was 1,056 person-rems.

Exhibit 4-17: Moab site.