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NUCLEAR ROCKET TEST FACILITY DECOMMISSIONING INCLUDING CONTROLLED EXPLOSIVE DEMOLITION OF A NEUTRON-ACTIVATED SHIELD WALL

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ABSTRACT

Located in Area 25 of the Nevada Test Site, the Test Cell A Facility was used in the 1960s for the testing of nuclear rocket engines, as part of the Nuclear Rocket Development Program. The facility was decontaminated and decommissioned (D&D) in 2005 using the Streamlined Approach For Environmental Restoration (SAFER) process, under the *Federal Facilities Agreement and Consent Order* (FFACO). Utilities and process piping were verified void of contents, hazardous materials were removed, concrete with removable contamination decontaminated, large sections mechanically demolished, and the remaining five-foot, five-inch thick radiologically-activated reinforced concrete shield wall demolished using open-air controlled explosive demolition (CED). CED of the shield wall was closely monitored and resulted in no radiological exposure or atmospheric release.

INTRODUCTION

Since 1998 radiologically-contaminated facilities in the Decontamination and Decommissioning (D&D) program at the Nevada Test Site (NTS) have been systematically decommissioned using the Streamlined Approach for Environmental Restoration (SAFER) process. This paper presents the facility history, decontamination and decommissioning (D&D) strategy and approach, the details of the controlled explosive demolition (CED) of the shield wall at Test Cell A, and the selected lessons learned on the project.

FACILITY HISTORY

The U.S. Atomic Energy Commission (AEC), predecessor to the U.S. Department of Energy (DOE), began to develop nuclear rocket engines in 1955. The AEC and the National Aeronautics and Space Administration (NASA) organized the Space Nuclear Propulsion Office to administer the development of an operational nuclear rocket. In 1956 the AEC designated 127,200 hectares (318,000 acres) in Area 25 (then called Area 400) as Project Rover, hoping to advance nuclear reactor technology and develop a nuclear-powered rocket for use in space travel.

The Test Cell A (TCA) facility (Fig. 1) was one of 4 facilities were constructed in the late 1950s and early 1960s utilized for the Nuclear Rocket Development Station Program (NRDS). Beginning in 1955, NRDS was jointly administered by the AEC and NASA Space Nuclear Propulsion Office [1].

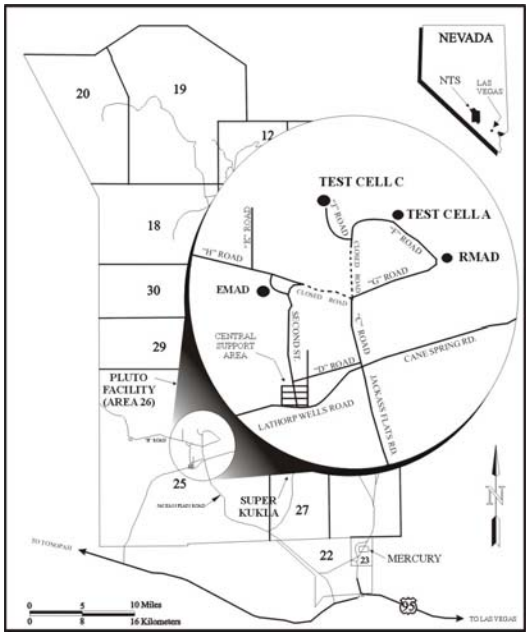

Figure 1. Location of Test Call A Facility

From 1959 to 1966, the Kiwi, Nerva, and Phoebus reactors were tested at Test Cell A (Fig. 2). These experimental reactors were operated by fission of highly enriched uranium 235 (^{235}U). The energy created by the fission of ^{235}U was absorbed by pumping liquid hydrogen gas through the reactor where it was heated to 2,400º Celsius (4,000º Fahrenheit). The heated hydrogen was then exhausted through a nozzle at very high velocities to produce thrust. After exiting the nozzle, the hydrogen gas was ignited, producing water vapor. The reactors were mounted on rail cars and fired upward. Sustained test runs ranged from several seconds to about fifteen minutes [5].

Figure 2. Nuclear Rocket Testing (Nerva Reactor) at Test Cell A Resulting in Activation of the Shield Wall.

Built in 1958, the TCA facility (Fig. 3) was built in order to support Project Rover. Various types of nuclear reactors were tested at TCA from 1959 to 1969. Testing resulted in the facility being contaminated with fission products, neutron activation products, and fuel particles. Most of the contamination consisted of isotopes with relatively short half-lives that have since decayed away. The remaining isotopes of primary concern included cesium (^{137}Cs), strontium (^{90}Sr), cobalt (^{60}Co), europium (^{152}Eu, ^{154}Eu, ^{155}Eu), and fuel particles consisting of uranium (^{234}U, ^{235}U, ^{236}U, ^{238}U), and plutonium (^{239}Pu and ^{240}Pu). The facilities were shut down and/or partially deactivated in the mid- to late-1960s and placed into long-term mothball status in the early 1970s [2].

Figure 3. Test Cell A Facility

Facility Condition

TCA was a two-story structure constructed of reinforced concrete. The main building, 3113, was approximately 108 m^2 (1,200 ft^2) and consisted of an instrument room and mechanical room. The second level was approximately 57 m^2 (634 ft^2) which consisted of a penthouse room and a neutronics room [2]. Control rods, extending from the reactor, through the shield wall into the neutronics room, were used to control the power level that the reactor was operated at. Raw data from the reactor tests were collected in the penthouse room and transmitted via the cabling-access tunnel to be processed. The test reactor/rocket motor was controlled from the Reactor Control Point (RCP), approximately two miles away.

A 67.3 m^2 (748 ft^2) building addition was added in the early 1960s for data acquisition and transmittal to the RCP, test director, and staff. Reactor tests were conducted on a 277 m^2 (3,078 ft^2) concrete reactor pad, positioned behind the concrete reactor shield wall, shielding the remainder of the TCA facility. A movable shed sheltered the reactor from weather and satellite photography.

The TCA facility was constructed with a maze-like set of piping and systems necessary for the storage and transfer of cryogenic fluids for running the tests. The reactors were assembled and installed on rail-mounted test cars inside the assembly bays at the Reactor Maintenance, Assembly, and Disassembly (R-MAD) facility and transported via remote control on railroad to the test cells where the tests were run.

During the Kiwi-A test in 1962, leaks from high-pressure valves at the associated tank farm led to a surge of hydrogen gas through the reactor, causing an explosion. Approximately 7.2 hectares (18 acres) of land surrounding the test stand were contaminated with fission products. Ejected materials ranged in size from large and identifiable to microscopic pieces, and were located visually or by using radiation-survey instruments. Contaminated areas were decontaminated by sweeping, vacuuming, and mopping at the time. Approximately 780 m (2,600 ft) of hard-surface roads were decontaminated with high-pressure streams of water.

PLANNING

Test Cell A was designated as a Corrective Action Unit (CAU) 115 in the FFACO and was closed using the SAFER process. A SAFER closure combines elements of the Data Quality Objectives (DQO) process with the observational approach to help plan corrective actions. Use of the SAFER process allows technical decisions to be made by an experienced decision-maker within the conceptual site model established prior to conducting closure activities, based on a level of process knowledge and operational history. Any uncertainties are addressed by documented assumptions verified by sampling and analysis, data evaluation, and onsite observations of planned activities.

A SAFER plan was prepared, outlining the corrective (i.e., remedial) actions and D&D strategy required to close the facility. The SAFER plan identified the technical approach and the selected end state alternative and was approved by the National Nuclear Security Administration, Nevada Site Office (NNSA/NSO) and the Nevada Department of Environmental Protection (NDEP). Detailed work planning was initially performed using the Planning, Optimization, Waste, Estimating and Resourcing tool (POWERtool®). This assisted in organizing the facility into manageable sections, identifying the scope of work and resources for each task, waste estimating, and scheduling of each phase of the project, which provided the basis for the project documentation. As required, additional field investigation activities, including radiological surveys, core drilling, sampling, hazardous material identification, and other activities were performed to support development of the technical documentation.

The TCA facility closure involved a seven-phased strategy: 1) Initial facility radiological and hazardous material investigation and characterization, 2) site setup and mobilization, 3) removal of hazardous materials and equipment, 4) decontamination of removable contamination, 5) structure demolition – conventional and controlled explosives, 6) final radiological release surveys, and 7) waste management [3].

Facility Characterization

Preliminary characterization activities were performed in order to plan demolition activities, radiological controls, and waste disposal. Radiological assessment included review of historical NTS documents and survey data, field radiological surveys, and sampling and analysis.

During characterization of the facility liquids, all systems were breached and voided of contents prior to demolition. This helped meet waste disposal criteria and ensure safety of workers. During system breaches, contamination, radiation, and airborne radioactivity surveys were performed.

Radiological Conditions and Controls

Field surveys included direct frisk of surfaces and materials to determine total contamination levels (fixed and removable), and swipe surveys to determine removable contamination levels. Little exposed removable contamination was found during the initial planning surveys, due to previous extensively decontamination; however, the potential for removable contamination in certain areas remained, primarily inaccessible areas such as in floor drains, underneath cabinets, and in surface cracks. These areas could not be surveyed until they were exposed during demolition.

Initial air samples provided a baseline, which was necessary because of the uncertainty of background airborne radioactivity levels from the resuspension of residual surface contamination at TCA. The facility and surrounding land contrained residual contamination from reactor testing and accidents. Over the years since testing, most of this contamination was covered by windblown soil or driven deeper in the soil by the weather and decontamination activities on the concrete pads. By disturbing these deposition areas during D&D activities, there was the potential to create airborne radioactivity and re-deposit radioactive particulates around the facility [6]. This concern was addressed in the air sampling program for TCA.

To help assess initial radiological conditions, scaling factors, based on historical data for Area 25, were used to determine ^{90}Sr and uranium and transuranic radioactivity levels based on ^{137}Cs. Scaling factors were also developed for this project to determine bulk concrete activation levels based on surface exposure rate measurements, frisker readings, and the Canberra In-Situ Object Counting System (ISOCS®) measurements. The concrete activation levels were needed to determine the mass average radioactivity of the concrete in order to calculate radioactive waste volumes, determine if the waste met the low-level landfill radioactivity limits, and provide input into the air dispersion calculation for the controlled explosive demolition (CED) blast.

Radiological Conditions

Actual radiological conditions varied according to the location and material. Fixed beta/gamma contamination levels ranged up to 2M dpm/100 cm^2 beta/gamma. Removable beta/gamma contamination levels seldom exceeded 1,000 dpm/100 cm^2, but were as high as 2M dpm/100 cm^2 in some locations. A third type of contamination, transferable contamination, and was defined for the project as contamination on small pieces of material that could be transferred easily, such as paint chips. This third type of contamination did not meet the definition for removable contamination per the NTS/Yucca Mountain Project (YMP) Radiological Control Manual [4]. Beta dose rates ranged up to 120 mrad/h. General area dose rates were less than 100 µrem/h. The higher levels of contamination and radiation were generally confined to the reactor pad, concrete shield wall, and some stainless steel piping; therefore, hot particles were monitored during work on the reactor concrete pad.

Initial planning conducted prior to starting field investigation activities, primarily based on historical documentation, did not recognize the source term from the neutron-activated concrete. Most of the historical documents accounted for activation in the metal rebar than the actual concrete. After field investigation activities were initiated, it was quickly determined that activated concrete and metal piping were likely the majority of the radioactive material onsite; therefore, plans were put together to perform ISOCS analysis of the different materials located at the site including concrete cores of the reactor shield wall and pad.

Several factors were used in assessing the activated concrete. Concrete properties were used to estimate activation levels. Concrete naturally contains ^{151}Eu and ^{153}Eu in concentrations of approximately 0.01 ppm, and about 1 ppm ^{59}Co. Neutron cross sections for the three isotopes are approximately 3000 barns (b), 3000 b, and 20 b. Neutron activation creates ^{152}Eu, ^{154}Eu, ^{155}Eu, and ^{60}Co. Other activation products are present, but not at levels considered significant for the TCA project.

Two cores were collected, one 2 feet in length and one 5 feet in length, both 4 inches in diameter, through the depth of the wall at biased locations–the locations of highest radioactivity as determined from earlier surveys. Activation attenuated to 'non-detect' after 20 inches in depth. Cores were drilled from opposite the reactor side of the shield wall to minimize worker exposure.

Figure 4. Shield Wall Characterization

Concrete core samples were taken of the concrete shield wall, reactor pad, and roof. The core samples were taken from the full thickness of the concrete at the sample location, five feet in the case of the shield wall. A four inch diameter coring bit was used for sampling. Sample locations were biased in order to get the most conservative sample with regards to radioactivity levels. The sample locations were determined from radiological surveys of the concrete surfaces. When possible, core sampling equipment was set up on the non-contaminated low dose side of the structure in keeping with As Low As Reasonably Achievable (ALARA).

The concrete core samples were counted in the laboratory using the ISOCS to assess the depth of neutron activation. This depth was found to be 20 inches. The core samples were also used to test the physical properties of the concrete for planning the CED. This included assessing the amount of explosives and the geometry for loading the explosives.

.Hazardous Material Removal

Toxic Substance Control Act (TSCA) waste (asbestos-containing materials [ACM] and polychlorinated biphenyls [PCBs]), Resource Conservation and Recovery Act (RCRA) waste (e.g., lead, cadmium containing foil), and Universal wastes (e.g., fluorescent lights and sodium lamps) were identified and inventoried in the facility. ACM was removed after preliminary radiological surveys and line draining activities but prior to all other D&D field activities to provide greater health and safety for personnel working inside the facility. ACM wrapping found throughout the facility covers conduit to protect lines from the intense heat generated from the reactor tests. ACM was also found in wall and roof penetration mastic, transite wall-board, and piping insulation. Heat reflecting foil surrounding electrical conduit was found to contain levels of cadmium (Cd) that exceed sanitary landfill limits. The Cd-containing silver-colored foil was removed by hand due to proximity to ACM and was either included with the ACM insulation, generating an ACM impacted hazardous waste, a mixed waste if radiologically impacted, or removed and packaged separately and disposed of as hazardous waste.

Lead was found in sections of the reactor shield wall to minimize neutron penetration. Lead bricks were backed by non-radiologically impacted sand used as a heat shield. Lead was also found encapsulated in steel doors throughout the exterior of the facility. In addition, lead bricks and wool were used as shielding in a number of penetrations in the neutronics room. Approximately 30 tons of lead bricks were removed from the facility. All of the lead generated at the TCA facility was disposed of as mixed waste at an offsite waste treatment and disposal facility in lieu of recycling due to schedule constraints and costs.

Paint covering the majority of the facility and reactor pad was found to contain PCBs and lead; however, neither was above landfill disposal levels according the NDEP lead statute and PCB Bulk-Waste rule; therefore, the paint was not removed from the concrete surfaces. Accumulations of windblown PCB lead-based paint containing high levels of radioactivity were removed prior to demolition using HEPA vacuums. This material was removed at this time to avoid spreading contamination during demolition activities. After sampling, it was determined that these paint chips met the same waste profile as the building debris and could be disposed in the same manner, PCB bulk-product low-level waste (LLW).

Thermostats and instrumentation were present throughout the facility; however, investigation found these materials did not contain mercury and were left inplace and disposed of with the building debris. All large circuit boards removed from the facility were disposed of as hazardous waste due to leachable levels of lead. Universal wastes (fluorescent lights and sodium lamps) were removed from the facility and sent to an offsite treatment and disposal facility as universal waste.

Pre-Demolition Decontamination

Prior to mechanical demolition and CED, removable radioactive surface contamination was decontaminated to the extent possible, and contaminated materials were removed from the facility when possible, using various techniques including wiping, debris/material removal, pressure washing, and vacuuming.

Radiologically-impacted mastic sealant located in the cracks and seams on the roof was removed during ACM remediation activities. HEPA vacuum cleaners were used in normal industry fashion to decontaminate surfaces and support other activities. Impacted soil and other debris were removed from railroad trenches and troughs built into the concrete reactor pad; troughs were grouted to avoid re-contamination during demolition activities. Masslin sheets were used to decontaminate removable contamination from smooth surfaces.

Radiological Controls

Radiological controls were factored in during D&D planning activities, including evaluating various decontamination and demolition methods for accomplishing tasks. The best methods were selected based on several factors, including resources, schedule, industrial, and radiological safety. The most conservative approach was used for determining radiological controls; assuming the worse expected case and protecting to this level, as circumstances deemed necessary. This method is in contrast to the graded approach were minimal radiological controls are initially implemented then upgraded when radiological conditions are found exceeding initial assumptions. This method ensured maximum safety of the workers, the most important consideration of the job, while supporting an efficient demolition process. Each activity was assessed to determine radiological controls. Radiological work permits (RWP) were prepared to cover conditions specific for each specific activity.

If unexpected levels of radiation/contamination were detected, work would be halted and the radiological controls adjusted. Once the proper controls were in put in place and the identified task was determined radiologically safe, work would resume. An example of this occurred when high levels of radiation were encountered in soil at the bottom of railroad trenches on the reactor pad. The trenches had soil and wood bottoms which absorbed contaminants that were washed from the pad after testing and later covered with non-impacted soil.

Radiological survey plans provided specific direction beyond what was provided in health physics procedures to provide detailed guidance for the project RCTs. Plans included air survey plans, which accounted for wind direction; breathing zone air sampling; requirements for trending the data; and methods for assessing the results while properly accounting for radon daughters. Additional survey plans were written for performing the initial characterization survey, surveying demolition debris and previously inaccessible areas, performing radiological monitoring during the CED blast, performing the post-blast survey, and performed the final survey.

Other radiological controls included using engineering and administrative controls to minimize personnel exposure, including Radiological Protection (RP) and Environmental Restoration (ER) management oversight, daily pre-job briefings, and dust control, Routine and job-specific radiological surveys, evaluation of data, and trend identification provided the first line of defense in identifying trends and anomalies in radiological levels. The largest trend of increased radioactivity was identified by air sampling during concrete demolition and debris loading activities. Baseline bioassay samples were taken for personnel working in areas containing high levels of uranium and transuranic contamination; however, no uptakes occurred and therefore no additional samples were required. Radiological controls were sufficient to prevent worker intakes during all phases of the project.

Mechanical Demolition

Upon completion of decontamination, the remaining structures were ready for demolition. Both conventional and non-conventional demolition techniques were used. Buildings 3113, 3113A, 3113B, the exhaust stack, and moveable shed were removed using hydraulic hammers and shears, as the thickness of the concrete ranged from 1 to 3 feet thick (Fig. 5). Dust suppression was used throughout conventional demolition which was completed in two weeks.

Figure 5. Mechanical Demolition

A 100,000 gallon liquid hydrogen cryogenic tank (i.e. dewar) was removed as part of the TCA D&D activities. The dewar was composed of an outer steel shell surrounding an inner stainless steel chamber that held the liquid hydrogen. Between the two shells, a 3 foot void space filled with perlite insulation material. Initially holes were made on the sides of the dewar to vacuum the perlite out. The perlite, with consistency of talcum powder, proved very difficult to vacuum from small holes since moisture had penetrated the outer dewar over time solidifying the perlite it contacted. This problem was mitigated by removing the outer dewar shell from the top-down, vacuuming perlite as it was exposed. Any areas that had clumped were easily broken apart when exposed.

The vacuum system removed the Perlite from the dewar and discarded it into specially-designed plastic bags located inside roll-off containers. The stainless steel inner dewar was size reduced using burn rods since the hydraulic shears had difficulty cutting and size reducing the material.

Controlled Explosive Demolition Calculations

A formal ALARA review by the NTS ALARA Committee was performed on the controlled explosive demolition portion of the work. Several suggestions put forth from the ALARA Committee were implemented into the explosive demolition activity.

The U.S. Environmental Protection Agency (EPA) CAP-88PC model was used in the final calculations of the atmospheric dispersion modeling to determine the bounding airborne radioactivity concentrations that would be produced from the CED blast. The calculation, based on the ISOCS results from cores of the reactor shield wall, assumed 3 cubic feet of concrete dust was uniformly distributed in an arbitrarily selected volume of air–this value was provided by Controlled Demolition, Inc. (CDI), who would perform the CED blast.

The activity of this dust was assumed to be equal to the highest measured concrete activity determined from the core samples. It was also assumed that all radioactivity settled onto the ground at the bottom of this volume. This provided insight into the maximum expected airborne radioactivity levels and ground contamination levels down wind of the blast. Calculations produced a maximum downwind dose of 0.0058 mrem at 40 meters from the wall.

CED Site Preparation

Prior to the CED of the reactor shield wall, the debris generated from mechanical demolition was staged on pads prepared from non-impacted barrow pit soil, away from the shield wall. The pads provided a base that would allow the waste to easily be picked up and loaded into trucks without cross contaminating the underlying native soil.

A method for assessing the spread of contamination from the CED plume was developed and tested. One foot square sticky pads were placed in the approved down wind direction from the shield wall. Sticky pad placement was preplanned. The sticky pads were placed from 40 m to approximately 300 m radially out from the shield wall, approximately 50 m apart. Each of these rows were in directions 30 degrees apart from each other. Global Positioning Satellites (GPS) coordinates were taken at each sticky pad location. A set of control sticky pads were placed several day prior to the blast as controls. A new set of sticky pads were placed just prior to the blast and collected immediately after the blast.

The release of radioactivity from the CED was minimized by CDI wrapping a geotextile fabric cover around the shield wall, held inplace by a chain link fence, which also helped to curb the velocity of debris ejected. The intention of the cover was to contain large flying debris and minimize fragment dispersion. Dust-sized particles became airborne and were carried by the wind as expected; however, it was minimized to the extent possible. The covers provide some explanation of lower than expected downwind air sample results from those expected by CAP-88PC model calculation.

CED

The CED of the shield wall was the most challenging phase of the project and was the last remaining structure to be demolished. CED had not been performed on the NTS since the 1970s. No explosive demolition of radioactive structures, prior to TCA, had ever been performed at the NTS. The CED consisted of radiological characterization, airborne dispersion modeling, planning of controlled explosive demolition, and monitoring of dust plume generated from the CED.

World-renowned experts, CDI, were subcontracted to perform the CED of the shield wall, based on their experience with similar thickness and size of concrete at the H-Reactor demolition project at the Hanford Site in Washington. Approximately 125 kilograms (275 pounds) of explosives were loaded into holes drilled into the shield wall approximately 2½ feet apart and a minimum of 3 feet in depth. After conducting a test blast to ensure the correct amount of explosives would be used, the production CED blast was shot (Fig. 6).

Figure 6. CED of Shield Wall

During the CED blast, extra precautions were taken to minimize personnel and equipment exposure. Authorization to proceed with the CED activity was only granted by RP after the wind was orientated in the proper direction to carry the dust plume away from the site support facilities, heavy equipment, and other demolition support materials, which were staged upwind away from roads and parking areas.

Radiological survey data from the CED activity were within the bounds of predicted values. The airborne radioactivity levels were bounded by the plume modeling results, and contamination levels on the ground at the predetermined contamination survey locations (sticky pad locations) were less than detectable.

Building Debris Disposal

The primary form of contamination at the TCA facility was in the form of activation products caused by operation of nuclear reactors. It was determined after the first stages of traditional demolition activities that demolition of activated concrete was leading to elevated levels of transferable contamination on equipment and building debris. Since the construction debris landfill at the NTS cannot take any debris containing removable contamination exceeding levels of Table 4-2 of the NTS/YMP RCM. Based on this determination, all the building debris that exceeded this limit for transferable contamination was containerized disposed at the NTS Area 5 LLW landfill.

After explosive demolition all waste that was determined to exceed the sanitary landfill radioactivity limits was stockpiled on the soil pads for shipment. The project teamed with a specialty bag producing company to meet the shipping and disposal requirements of the LLW landfill. ER and a liner/bag manufacturing company devised a new system to produce a lifting frame that could be used to lift empty puncture resistant geotextile liners into end dumps in an open position.

Using the lifting frame and a crane to load the open bags into the truck beds this eliminated the need to place employees inside the end dumps, exposing them to dangerous situations and reducing the unfolding and setting time. Once loaded and closed, the bags presented a closed system, thus reducing the amount of radiological surveys required for release from the site and the landfill after dumping. Approximately 140 bags were shipped to the LLW landfill with an average content of 13 cubic yards of debris.

Final End State

Any remaining contamination above the established radioactive limits was removed from the reactor pad by aggressive scabbling. After demolition activities, a decontamination station was set up for decontaminating heavy equipment which consisted of a plastic lined basin where equipment could be moved to and washed down with a pressure washer. Resulting radiologically impacted decontamination material from all of these activities would be managed and disposed of as LLW.

When the demolition debris had been removed, and the concrete reactor pad surface had been decontaminated, final release surveys of the building foundations commenced.

Criteria existed for soil contamination, removable surface contamination, total contamination (primarily fixed), and dose rates. An understanding of the distribution of radioactivity on or in the medium was also factored in when performing release surveys. The SAFER Plan, which documented the closure strategies and final posting requirements of the TCA site, stated that after demolition the entire facility footprint area would be downgraded to a Controlled Area and the posting the building foundation drains as internal contamination. This reduction was reached on the main building foundation, which was shielded from neutron penetration by the reactor shield wall, but not on the reactor pad foundation.

Because of the elevated levels of fixed contamination from concrete activation of the reactor pad, not identified at the time of the SAFER Plan approval, portions of this reactor pad area were posted as a Radiological Materials Area (RMA) and some as an Underground RMA due to underground waste lines and underlying activated concrete and soil. The SAFER Plan process allows for site characterization as work proceeds; therefore, these postings were agreed upon with NNSA and NDEP after demolition and communicated in the Final Closure Report.

Figure 7. Final End State

LESSONS LEARNED

The Test Cell A D&D Project, proved the effectiveness of CED of radiologically-activated reinforced concrete, while maintaining contamination control and personnel safety. In addition, lessons learned applicable to other D&D and ER projects across the DOE complex and in the D&D community/industry were documented for future use for the upcoming CAU 116: Test Cell C (TCC) Facility D&D Project.

Faced with many challenges primarily associated with performing D&D remediation activities and first time evolutions under the SAFER Process where characterization is performed concurrently with D&D activities. The D&D project team met the challenges, coordinated with onsite and offsite organizations, engaged the regulators and stakeholders to meet all fee milestones, addressed issues immediately, and captured numerous lessons learned to apply to current and future D&D projects. Lessons learned include the following:

- Preliminary investigation activities, such as facility radiological surveys, early removal of hazardous materials, first-hand facility knowledge, extensive characterization sampling, and waste stream determination resulted in a more solid technical approach and safer working environment.

- Size-reducing work areas improved engineering and administrative controls during lead removal activities, leading to smaller areas being impacted with lead-dust and radionuclides.

- Implementing a demolition debris survey plan that contained specific direction on radiological survey requirements to provide consistent debris characterization and expedite debris loading and truck exit surveys.

- Inclusion of specific waste removal, sizing, handling, containerizing, and packaging requirements in the work package and waste management plans can reduce double and triple handling of highly contaminated soils and debris, reducing potential for employee exposure.

- Team reviews served as an excellent mechanism to integrate efficiency, safety, and sequence into the work packages. Incorporating the entire project team's input, lead to fewer revisions of work control documentation during the project, streamlined the approval process, integrated safety into planning, and ensured the proper equipment was onsite.

- Development of CED protocols and checklist prior to detonation to ensure the safety of personnel and equipment, and effective size-reduction of the shield wall.

CONCLUSION

D&D of the TCA Facility, with the CED of the shield wall, paved the road for the next NTS D&D project, Test Cell C, the next generation nuclear rocket test facility. With proven methods, baseline data, established protocols, and experienced personnel, the experience and lessons learned can be captured and applied to the Test Cell C project, a larger facility, with the same set of challenges.

The program, as a whole, now benefits from a more experienced technical and management team and more involved supporting organizations (e.g., Environment, Safety, and Health; Radiological Control; Construction, Waste Management), as well as a defined strategy and approach for TCA's sibling facility, TCC.

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DISCLAIMER

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