NUCLEAR ROCKET FACILITY DECOMMISSIONING PROJECT: CONTROLLED EXPLOSIVE DEMOLITION OF NEUTRON-ACTIVATED SHIELD WALL

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SUMMARY

Located in Area 25 of the Nevada Test Site (NTS), the Test Cell A (TCA) Facility (Figure 1) was used in the early to mid-1960s for testing of nuclear rocket engines, as part of the Nuclear Rocket Development Program, to further space travel. Nuclear rocket testing resulted in the activation of materials around the reactors and the release of fission products and fuel particles.

Figure 1. Test Cell A Facility

The TCA facility, known as Corrective Action Unit 115, was decontaminated and decommissioned (D&D) from December 2004 to July 2005 using the Streamlined Approach for Environmental Restoration (SAFER) process, under the *Federal Facility Agreement and Consent Order*. The SAFER process allows environmental remediation and facility closure activities (i.e., decommissioning) to occur simultaneously, provided technical decisions are made by an experienced decision maker within the site conceptual site model. Facility closure involved a seven-step decommissioning strategy.

First, preliminary investigation activities were performed, including review of process knowledge documentation, targeted facility radiological and hazardous material surveys, concrete core drilling and analysis, shield wall radiological characterization, and discrete sampling, which proved to be very useful and cost-effective in subsequent decommissioning planning and execution and worker safety.

Second, site setup and mobilization of equipment and personnel were completed.

Third, early removal of hazardous materials, including asbestos, lead, cadmium, and oil, was performed ensuring worker safety during more invasive demolition activities. Process piping was to be verified void of contents. Electrical systems were de-energized and other systems were rendered free of residual energy.

Fourth, areas of high radiological contamination were decontaminated using multiple methods. Contamination levels varied across the facility. Fixed beta/gamma contamination levels ranged up to 2 million disintegrations per minute (dpm)/100 centimeters squared (cm^2) beta/gamma. Removable beta/gamma contamination levels seldom exceeded 1,000 dpm/100 cm^2, but, in railroad trenches on the reactor pad containing soil on the concrete pad in front of the shield wall, the beta dose rates ranged up to 120 milli-roentgens per hour from radioactivity entrained in the soil. General area dose rates were less than 100 micro-roentgens per hour. Prior to demolition of the reactor shield wall, removable and fixed contaminated surfaces were decontaminated to the best extent possible, using traditional decontamination methods.

Fifth, large sections of the remaining structures were demolished by mechanical and open-air controlled explosive demolition (CED). Mechanical demolition methods included the use of conventional demolition equipment for removal of three main buildings, an exhaust stack, and a mobile shed. The 5-foot (ft), 5-inch (in.) thick, neutron-activated reinforced concrete shield was demolished by CED, which had never been performed at the NTS.

The shield wall was contaminated with significant levels of ^{60}Co, ^{152}Eu, ^{154}Eu, and ^{155}Eu.

Concrete core sample analysis showed induced radioactivity to a depth of 20 in. (Figure 2). The highest level of activated concrete was at the center point of the exposed surface of the shield wall in front of where the reactors were operated. Radioactivity levels diminished laterally and horizontally with distance from that point. The major radiological hazard in CED was the release of airborne dust with high levels of radioactivity.

Figure 2. Shield Wall Characterization

Conventional explosives (i.e., C-4) were loaded into over 400 pre-drilled holes, to a minimum depth of 36 in. approximately 2.5 ft apart, so the explosives generating the fine dust were pulverizing clean concrete instead of radiologically-impacted concrete on the outer 20 in. The U.S. Environmental Protection Agency CAP-88C program (i.e., Gaussian plume model) was used for atmospheric dispersion modeling to determine the bounding airborne radioactivity concentrations that could be expected from CED. The CED was closely monitored and resulted in no radiological exposure or atmospheric release; resulting radiological analysis of the sticky pads, placed radially around the shield wall, revealed levels less than 1,000 dpm/100 cm^2 for all sticky pads immediately after the blast.

The shield wall was covered with a layer of geotextile material, secured by tying chain-link fence to the wall (Figure 3) to minimize the velocity of ejected materials, control the area where the materials would spread, and minimize dust. Successful CED of the shield wall, performed by Controlled Demolition, Inc., demonstrated that this technique is cost efficient, and can contribute to accelerated D&D timelines. More importantly, this method increased safety by removing personnel from repeated exposure to heights, noise, radiation, and other hazardous working conditions.

Figure 3. CED of Shield Wall

Sixth, final radiological release surveys were performed to document the final status and radiological conditions of the remaining concrete pads and surrounding soil. The seventh phase, waste management, included disposition of over 1,800 cubic yards of remaining radiologically impacted building debris. This material was containerized into 140 bags and disposed of as low-level waste.

Key lessons learned from the project included the following: (1) Targeted preliminary investigation activities provided a more solid technical approach, reduced surprises and scope creep, and made the working environment safer. (2) Early identification of risks and uncertainties provided opportunities for risk management and mitigation planning. (3) Team reviews provided an excellent mechanism to consider all aspects of the task, integrated safety into activity performance, increased team unity and “buy-in” and promoted innovative and time saving ideas. (4) Development of CED protocols ensured safety and control. (5) The same proven D&D strategy is now being employed on the larger “sister” facility, Test Cell C.

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