Contract No. and Disclaimer:

Heavy Water Components Test Reactor Decommissioning – Major Component Removal

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INTRODUCTION

The Heavy Water Components Test Reactor (HWCTR) facility (Figure 1) was built in 1961, operated from 1962 to 1964, and is located in the northwest quadrant of the Savannah River Site (SRS) approximately three miles from the site boundary. The HWCTR facility is on high, well-drained ground, about 30 meters above the water table. The HWCTR was a pressurized heavy water test reactor used to develop candidate fuel designs for heavy water power reactors. It was not a defense-related facility like the materials production reactors at SRS. The reactor was moderated with heavy water and was rated at 50 megawatts thermal power. In December of 1964, operations were terminated and the facility was placed in a standby condition as a result of the decision by the U.S. Atomic Energy Commission to redirect research and development work on heavy water power reactors to reactors cooled with organic materials. For about one year, site personnel maintained the facility in a standby status, and then retired the reactor in place.

In 1965, fuel assemblies were removed, systems that contained heavy water were drained, fluid piping systems were drained, de-energized and disconnected and the spent fuel basin was drained and dried. The doors of the reactor facility were shut and it wasn't until 10 years later that decommissioning plans were considered and ultimately postponed due to budget constraints.

In the early 1990s, DOE began planning to decommission HWCTR again. Yet, in the face of new budget constraints, DOE deferred dismantlement and placed HWCTR in an extended surveillance and maintenance mode. The doors of the reactor facility were welded shut to protect workers and discourage intruders. The $1.6 billion allocation from the American Recovery and Reinvestment Act to SRS for site clean up at SRS has opened the doors to the HWCTR again – this time for final decommissioning.

During the lifetime of HWCTR, 36 different fuel assemblies were tested in the facility. Ten of these experienced cladding failures as operational capabilities of the different designs were being established. In addition, numerous spills of heavy water occurred within the facility. Currently, radiation and radioactive contamination levels are low within HWCTR with most of the radioactivity contained within the reactor vessel. There are no known insults to the environment, however with the increasing deterioration of the facility, the possibility exists that contamination could spread outside the facility if it is not decommissioned.

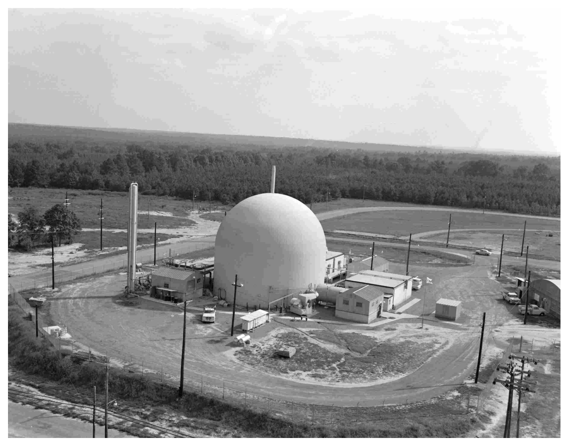

Figure 1 – HWCTR circ 1960

An interior panoramic view of the ground floor elevation taken in August 2009 is shown in Figure 2. The foreground shows the transfer coffin followed by the reactor vessel and control rod drive platform in the center. Behind the reactor vessel is the fuel pool. Above the ground level are the polar crane and the emergency deluge tank at the top of the dome. Note the considerable rust and degradation of the components and the interior of the containment building.

Figure 2 – Interior panoramic view at ground level

Alternative studies have concluded that the most environmentally safe, cost effective option for final decommissioning is to remove the reactor vessel, steam generators, and all equipment above grade including the dome. Characterization studies along with transport models have concluded that the remaining below grade equipment that is left in place including the transfer coffin will not contribute any significant contamination to the environment in the future. The below grade space will be grouted in place. A concrete cover will be placed over the remaining footprint and the groundwater will be monitored for an indefinite period to ensure compliance with environmental regulations. The schedule for completion of decommissioning is late FY2011.

This paper describes the concepts planned in order to remove the major components including the dome, the reactor vessel (RV), the two steam generators (SG), and relocating the transfer coffin (TC).

WORK DESCRIPTION

Dome Removal

The containment building is 21 meters in diameter. The structure rises 22 meters above ground, with 16 meters of the building below grade. The below-grade part was constructed of pre-stressed concrete. The hemispherical dome was fabricated from 1.9 centimeters thick carbon steel plate to a level of 9 meters above the ground. The remaining dome is 0.95 centimeters thick. The dome shell contains approximately 155,000 kilograms of steel. The demolition plan is to separate the upper portion of the dome from the cylindrical section and lift this portion free of the containment building allowing access to the major components inside HWCTR. Lifting lugs will be welded to the dome and with the use of a large crane, the dome will be removed and size reduced for disposal on site. Once the dome is removed the polar crane trolley and bridge will be removed allowing access to the reactor vessel and steam generators.

Reactor Vessel Removal

The reactor vessel, shown in Figure 3, has an overall height of 9 meters, a diameter of about 2 meters and weighs approximately 90,000 kilograms. The vessel is made of carbon steel, 8 to 13 centimeters thick, clad internally with 6.35 millimeters thick stainless steel.

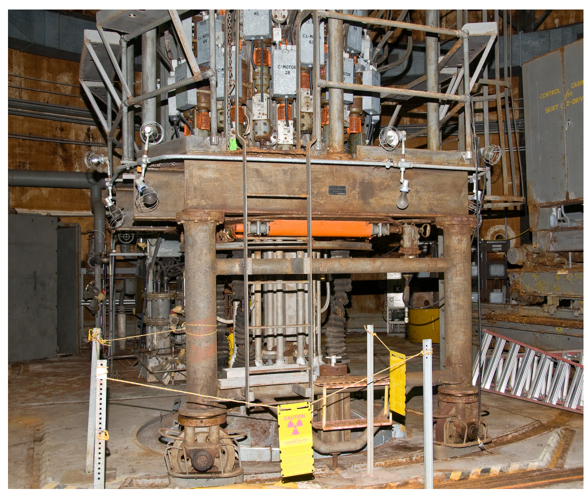

Figure 3 – Reactor Vessel with Control Rod Drive Mechanism

Basic steps to access the reactor and remove it from its cavity are:

1. Disconnect and remove the control rod platform and the control rod drive mechanisms. Cap the nozzles at the top of the RV.
2. Remove the concrete top plug allowing access to the RV annulus.
3. Remove 4680 shield blocks surrounding the RV.

4. Weld lifting attachments to RV.
5. Cut 44 pipes ranging from 4 cm to 41 cm in two places; install and weld blanks to allow for RV removal.
6. Remove incore instrumentation and piping in 44 places.
7. Cut incore instrumentation and install blanks on all incore instrumentation openings.
8. Remove shield plug halves from the lower RV shield plug penetrations.
9. Rig and lift the RV clear of the containment building.
10. Using a tailing crane, position the RV horizontal.
11. Secure the RV on a shipping skid.
12. Rig and transfer skid/RV to transport vehicle and transport to the waste disposal area.

Steam Generator Removal

There are two steam generators located below grade that are planned for removal. Each SG is about 7 meters high, weighs approximately 17,000 kilograms, and has 21 pipes that will be cut and capped. A five foot thick concrete plug will be removed allowing access to each generator. Using the existing lifting lugs on the steam generators each will be removed by lifting straight out of the containment building and using a tailing crane, the generator will be placed horizontal on a transport vehicle and transported to the SRS waste disposal area.

Transfer Coffin Relocation

The transfer coffin was used to transfer driver fuel and test fuel assemblies from the reactor vessel to the fuel pool. It will be relocated to the cavity left from removal of the RV. Basic steps for the disassembly and relocation of the transfer coffin are:

1. Remove electrical cabling, piping and mechanical equipment from the exterior of the TC.
2. Remove upper tank assembly.
3. Remove upper work platform and ladder.
4. Install new lifting lugs capable of lifting the TC as a unit.
5. Separate the containment portion (center section) of the TC from the trolley.
6. Rig the TC and lift clear of the trolley.
7. Lower the TC into the open RV cavity and land on a support platform previously installed in the cavity.

RESULTS

The work described in the paper is underway. Lift beams, rigging designs, fixtures and support equipment have been designed. Fabrication of the fixtures will occur in the spring and summer of 2010. Procedures have been written to implement these concepts. The current schedule shows dome removal to start late 2010.

CONCLUSIONS AND DISCUSSION

HWCTR has been shut down for almost 50 years. Decommissioning this facility presents many challenges due to the age of the facility, the lack of corporate knowledge and historical documentation, and the fact that the original facility design did not incorporate any decommissioning planning. The designs presented here recognize these problems and have incorporated contingency planning to deal with possible unknown situations. The final configuration of the HWCTR site will be an environmentally safe decommissioned facility.