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Environmental Restoration and Waste Management Program

KERR HOLLOW QUARRY REMEDIATION PROJECT*

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ABSTRACT

The Kerr Hollow Quarry is a 3-acre flooded limestone quarry located near the Y-12 Facility on the Oak Ridge Reservation. A photograph of the quarry is shown in Fig. 1, and an aerial view is presented in Fig. 2. The quarry was used in the 1940s as a source of construction material for the Department of Energy in Oak Ridge, Tennessee. Its use was discontinued in the early 1950s, and it was allowed to flood with water. The quarry presently has a maximum water depth of approximately 55 ft.

During the period between the early 1950s until about 1988, the quarry was used for the treatment and disposal of a variety of materials including water-reactive, alkali metals, shock-sensitive chemicals, and compressed gas cylinders. For some of these materials, the treatment consisted of dropping the vessels containing the materials into the quarry from a high bluff located on one side of the quarry. The vessels were then punctured by gun shot, and the materials were allowed to react with the water and sink to the bottom of the quarry.

Very few disposal records exist for the period from 1952 to 1962. The records after that time, from 1962 until 1988, indicate some 50 t of hazardous and nonhazardous materials were disposed of in the quarry.

INTRODUCTION

In 1988, the Tennessee Department of Environment and Conservation (TDEC) issued a directive that the quarry was to be remediated. SONSUB Services, Inc., a Houston, Texas-based private contractor was hired to survey the quarry. This survey of the quarry bottom was performed in 1989 using a small submarine or remotely operated vehicle (ROV). Based on that survey, it was estimated that some 3000 to 5000 items or waste containers were in the quarry. SONSUB was then contracted to perform the remediation of the quarry starting in 1990.

Site mobilization by SONSUB was completed in September 1990, and waste removal operations began immediately afterwards. The remote remediation operation utilizes a remotely controlled pontoon barge, the ROV, and an underwater shredder. The barge, the ROV, and the shredder are shown in Figs. 3-5 respectively. A cross-sectional view of the quarry showing these three equipment items is presented in Fig. 6. The remote equipment is operated from a control van located approximately 200 ft from the edge of the quarry.

The pontoon barge is "H" shaped and is approximately 30 ft long and 21 ft wide. A large grapple is mounted in the center cross bar

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Fig. 1. Aerial view of the quarry and sediment basin.

Fig. 2. Aerial view of the quarry showing proximity to other facilities.

Fig. 3. Remotely driven pontoon barge.

Fig. 4. Remotely operated submersible with attached manipulator arm.

Fig. 5. Equipment used for underwater shredding of items.

Fig. 6. Pontoon barge, ROV, and underwater shredder.

of the configuration. The barge is remotely positioned over a pile of underwater debris and picks up the waste with the grapple. The ROV is used primarily to survey and retrieve small items. The barge and ROV then place the items into the shredder. The shredded debris are collected in a chip basket located on a trolley mounted directly under the shredder. When the chip basket is full, it is removed and dumped into waste containers. The waste is then stored in a Resources Conservation and Recovery Act storage area located near the edge of the quarry.

For removal of compressed gas cylinders, the waste grapple on the barge is replaced with a special cylinder breaching grapple. This grapple is a clam-shell configuration with a hydraulic punch located in the center. Each cylinder is picked up by the grapple and breached with the hydraulic punch. Although all of the cylinders are assumed to be unpressurized, the punching is performed as an added safety precaution.

REMEDIATION ACTIVITIES

Initial operations in the quarry identified a number of problems, primarily associated with oil leaks from the hydraulic systems on the barge and the ROV. These problems were solved by increasing the preventive maintenance measures on the hydraulic systems and by installing an environmentally safe hydraulic fluid (diethylene glycol).

After these start-up problems were solved, the remediation effort was anticipated to be a relatively simple and straightforward operation. Subsequent events, however, proved this to be an overly optimistic assumption.

In January 1991, low levels of unexpected, radiological contamination, in the form of depleted uranium, were found in some of the items removed from the quarry. Operations were temporarily suspended for additional personnel training, for the preparation and implementation of new safety procedures, and for more stringent waste control and disposal procedures.

In March 1991, gas cylinders that were still pressurized were encountered. The remediation of cylinders was temporarily suspended unless visual evidence from the ROV indicated conclusively that the cylinders had been breached before they were placed in the quarry. Also in March 1991, a reaction on the surface of the quarry occurred when a vessel containing unreacted alkali metal was processed in the shredder. This occurrence led to a re-design of the hopper used to feed materials into the shredder. The hopper was fitted with doors that could be remotely closed by the ROV prior to operation of the shredder and thereby prevent unreacted material from reaching the surface of the quarry.

In June 1991, small, unbroken glass vials were found in the shredded debris. Some of these vials were filled with a white powdery substance, while others contained unknown liquids. There was an initial concern that the powder could be a shock-sensitive, explosive material, specifically crystallized picric acid. A shielded glove box was subsequently constructed and provided for shredded debris inspection by operations personnel.

In January 1992, shredding operations were again temporarily terminated for fear of shredding gas cylinders containing toxic or poisonous gases. A Toxic Gas Evacuation Procedure, with local Civil Emergency Response Team involvement, was developed and implemented. Fluted cylinder punches and special cylinder grapples were designed and tested to allow the controlled release of pressurized gases at a rate where unreacted gases would not reach the surface of the quarry. Also, an underwater sorting table was designed, built, and installed to permit sorting of the waste and segregation of potentially pressurized gas cylinders.

The quarry also contains a number of closed vessels that are too large to be shredded by normal means. Starting in September 1992, explosive charges have been used to breach vent holes and surveillance windows into these vessels. The explosive charges are remotely placed onto the vessels by the ROV and detonated from the control van. Four 1/2-in.-

diam vent holes are shot into the top of each vessel to permit residual alkali metals to react with the water. An 18- by 18-in. surveillance window is then explosively breached into the vessel. A television camera is remotely inserted through the window by the ROV to verify that the vessel is empty prior to removal from the quarry.

Shallow water operations are scheduled to begin in January 1993 to remove waste material located in water too shallow to permit use of the barge or the ROV. Upon completion of the shallow water operations, a quarry bottom survey will be made by flying the ROV under the water in a grid pattern to verify the bottom is clean. The survey will be video taped and used to prove to TDEC that the quarry has been remediated in accordance with regulatory requirements.

The quarry cleanup has been a very challenging, expensive, and time-consuming project. Through September 1992, more than 17,000 items consisting of shreddable debris, open containers, gas cylinders, large vessels, and structures were safely removed from the quarry. The quarry remediation stands as an excellent example of how a hazardous clean-up operation can be completed in a safe manner with dedicated operations personnel using the proper remotely operated equipment.