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SAVANNAH RIVER SITE
TANK 5 SAMPLING
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Tank 5 at the Savannah River Site has been used to store high level waste and is currently undergoing waste removal processes in preparation for tank closure. Samples were taken from two locations to determine the contents in support of Documented Safety Analysis (DSA) development for chemical cleaning. These samples were obtained through the use of the Drop Core Sampler and the Snowbank Sampler developed by the Engineered Equipment & Systems (EES) group of the Savannah River National Laboratory (SRNL).

I. INTRODUCTION

Tank 5 is a Type 1 high level waste (HLW) tank at the Savannah River Site that has been selected for closure. Removal of residual material in the tank is necessary before grout may be introduced as a means of final closure. Characterization of the material currently inside the tank is necessary to assist development of the DSA for chemical cleaning, which is the next waste removal technique planned for Tank 5.

Two locations inside the tank were selected for sampling (See Fig. 1). The first location was directly below Riser 1 where sludge material was located. The second location was approximately five feet away from Riser 1 which was a large white heel in the corner of the tank nicknamed the “Snowbank”. The obvious difference in appearance of the two areas in the tank suggests a difference in composition. Analysis of samples from these two areas will assist in future processing of this waste.

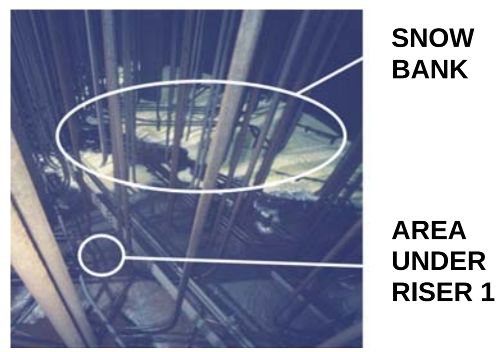

Fig. 1 - Sample Locations

Two separate sampling tools were used to sample each location at separate times. The sludge sample was obtained using the Drop Core Sampler which allowed a large weight with a sample cup located on the end to be lowered to the sample level, raised, and dropped to allow the sample cup to penetrate the sludge material. The snowbank sample was taken with the Snowbank Sampler which used an actuated arm with an extendable snapper tool that reached out and grabbed the sample with jaws.

With strong teamwork between operations, radiation control, and engineering, both tools successfully obtained the samples from the desired locations safely. In addition, the ability of these tools to be operated remotely meant than there was no need for an operator to remain over the riser to operate the equipment keeping radiation exposure time to a minimum.

II. DROP CORE SAMPLER

Historically, at SRS when core samples were desired, mast systems were used with hammers, manual slide hammers or pneumatic hammers as the drive mechanisms. One drawback to this type of system is that it requires an operator to stand over the open riser port to operate the drive mechanism where they will be exposed to radiation “shine” from waste in the tank interior. Another drawback is that the large mass of the mast requires that a crane be used to lower it into place. Breaking down the mast for disposal after sample retrieval also increases the time operators must stand near the riser opening. Liquid Waste Technology Development requested the assistance of the EES to aide with ALARA (As Low As Reasonably Achievable) practices by keeping the operators away from the riser port for as much of the duration of the sampling job as reasonable achievable. This was accomplished by automating the system to drive the sample cup into the material. The only time operators were exposed to high dose rates was when the sample was being packaged after being removed from the tank.

A hand winch was modified to be operated by a DC motor to drive the sample tool up and down. The system was able to remotely engage / disengage the winch from the motor so that at the desired time, the sample tool could be dropped, if necessary, to impact the waste material in the HLW tank with the sample cup.

The Drop Core Sampler was able to retrieve the desired sample size on the first attempt. Thanks to a very cohesive team the job was successfully & safely completed.

II.B. Drop Core Sampler Design

The Drop Core Sampling tool consisted of three main assemblies: the winch / drive system, drop core sampler, and the drop core frame (See Fig. 2).

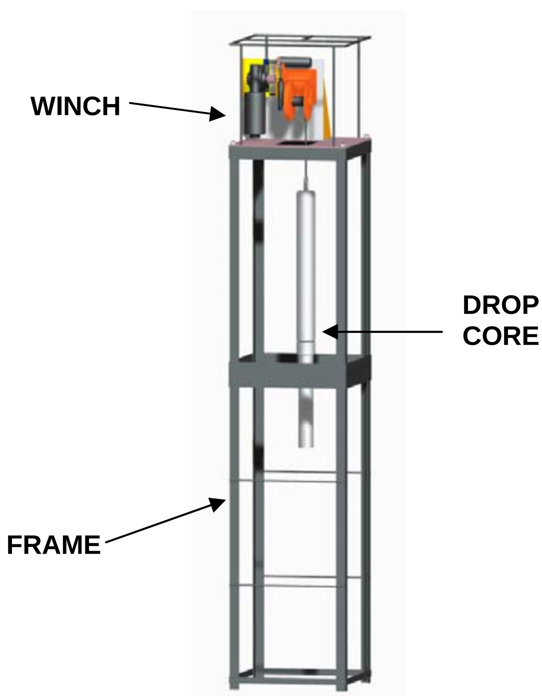

Fig. 2 - Drop Core Sampler Full Assembly

The winch drive assembly provided the mechanism to drive the drop core up and down inside the tank and also provided the capability to allow the drop core sampler to free fall. The main components of the system can be seen in Fig. 3 and include the drive motor, winch, and disengagement subassembly. A winch was modified so that a motor could be coupled to it to drive the system. The motor was selected with a gear ratio high enough that the weight of the sampler would not back drive the system. This provided a level of control over the drop weight and sampler and also of safety. The engagement piston worked with the linear slide and the engagement coupling to couple and decouple the motor drive shaft with the winch drum. Another air cylinder was used to engage and disengage the locking mechanism on the winch clutch as another added safety precaution.

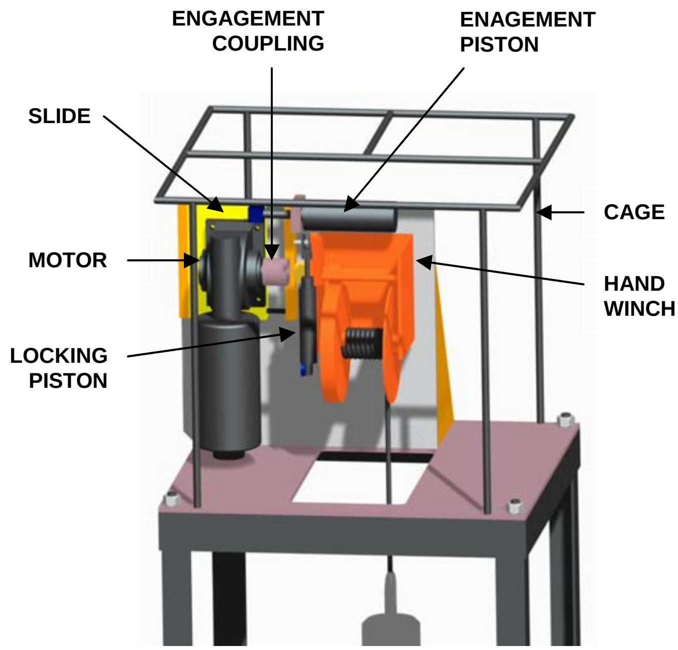

Fig. 3 - Winch Assembly

A contamination control measure used with the waste tanks is to keep the tanks at a negative pressure relative to the atmosphere. This insures that the flow of air goes from outside to inside preventing contamination from escaping the tank. The negative pressure pulls a vacuum on and collapses glovebags mounted an access riser. In order to address this concern, a cage was added to surround the winch assembly so that it could be contained on top of the riser without the collapsing effect. This prevented the glovebag from collapsing on the drop core drive components. The completed winch assembly can be seen in Fig. 4.

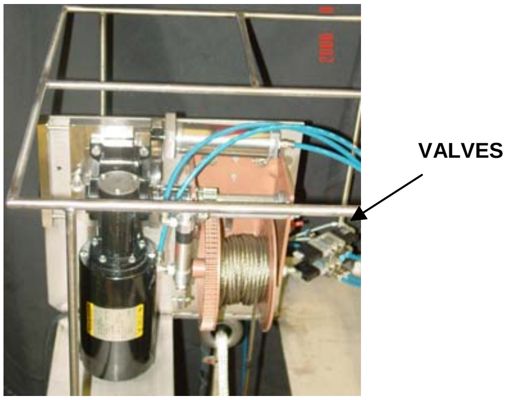

Fig. 4 - Completed Winch Assembly & Valves

The drop core sampler is composed of a removable sample cup attached to the bottom of a large drop weight (Fig. 5). The cup is designed so that fluid on top of the material being sampled is able to be pressed out of the cup through slits placed in the sides of the cup ensuring that the desired solids are obtained. The sample was coupled to the weight using a quick-release pin to allow the sample to be transferred to the lab without the sampler, allow reuse of the sampler with an unused cup, and to allow quick transfer of the cup to a transport package. After being pulled from the tank the sample was able to be separated from the drop core and placed into radiation shielding by pulling the quick-release pin where it would then be transported for analysis.

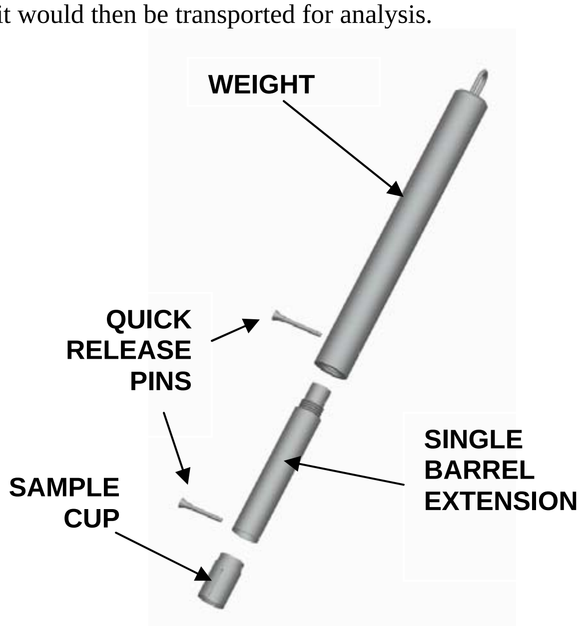

Fig. 5 - Drop Core Sampler Exploded Assembly

II.C. Drop Core Design Alternatives

The Drop Core was designed so that the Single Barrel Extension could be replaced with a Triple Barrel Extension (See Fig. 6) which would obtain three samples at a time. Disadvantages of the three-sample cup assembly led to it not being used in this sampling. Use of the three-cup assembly would increase exposure of the operator by the larger sample size of the samples. The assembly would also require longer to remove the cups due to the consecutive process of cup removal.

Fig. 6 - Three Barrel Core Sampler

Another sampling tool was developed to be used in the event that the material being sampled was too soft to stay in the sample cup. This system would be lowered to the surface of the material and utilize a snapper tool to extend into the material and grab the sample (See Fig. 7).

Fig. 7 - Driven Sampler

III. SNOWBANK SAMPLER

A short distance from directly below Riser 1 was a heel or bank of unknown white material. Due to its appearance it became nicknamed the Snowbank. Because of its location it was necessary to develop a sampling system to reach out from under the riser approximately five feet to obtain a sample. The system consisted of a sampling tool with a 'snapper' on the end of a piston on an elbowed arm. The arm allowed the sampler to be stowed in-line for entry into the tank through the riser. Once inside the tank the arm could be lifted up at the elbow and directed toward the desired sample area and the snapper jaws would then be opened. The snapper would then be pressed into the material using the forearm extension piston and the jaws then be closed. This is illustrated in Fig. 8.

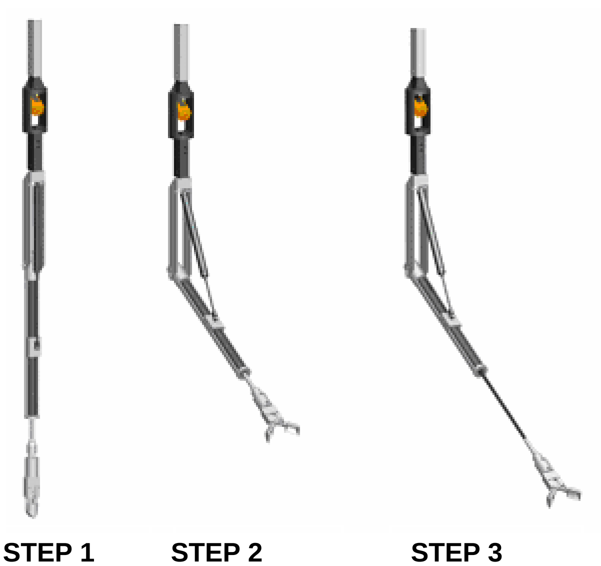

Fig. 8 - Snowbank sampler

The bending of the elbow and the extension of the arm were actuated with air cylinders. A control housing was placed at the joint between the sampler and the mast. The control housing contained the remote-controlled valves necessary to actuate the air cylinders and a camera to provide a close-up view of the sampler.

The Snowbank Sampler was designed so that the snapper tool used with the Driven Sampler could be placed on the end of a piston to reach out and grab material from the snow bank. A mast system was used to lower the sampler into position. A camera system was utilized to provide a close up view of the snapper jaws when it came into contact with the material. The sampler clamshell cups were removable and coupled to the sampler jaws by quick-release pins. The quick-release pins allowed for a quick transfer of the clamshells with the sample to a transport package. The quick transfer of radioactive waste samples reduces operator exposure.

IV. DEPLOYMENT

The Drop Core sampler provided a means of sampling remotely without large exposure to the operator. The sampler also eliminated the need to fabricate, deploy with a crane, disassemble, and dispose of a mast. The Snowbank sampler provided a reduced-cost, simplified system for reaching out from under risers than the large complex arms used previously in the DOE complex.

The Drop Core sampler was positioned on the riser deployed within the tank. The sampler was lowered into the waste material to test the mechanical properties of the solids and determine the required drop height. Upon contact with the waste surface, the sample cup sank into the surface due to the force of the drop weight. Upon lifting the sampler from the sludge, the sample cup was observed to have been filled with sludge. The sampler was retrieved without a need to use the drop feature of the sampling system.

The Snowbank sampler was assembled with a crane and then sleeved and lowered into the tank access riser. After lowering the sampler within the tank, the elbow was actuated lifting the forearm and the grab sampler. The sampler was lowered and rotated to align the sample jaws and sample clamshell cups with the desired sample location. The jaws were then opened and the forearm extension piston actuated pushing the sample cups into the waste mound. The jaws were then closed obtaining the sample. Finally, the mast was removed from the riser and the cups transferred to a shielded container for transport.

V. RESULTS

Both sampling tools were used successfully to obtain samples from their respective locations. The drop core sampling tool obtained the full sample on the first attempt allowing the job to be finished quicker and reducing the dose received. The sample can be seen from inside a shielded sell in SRNL in Fig. 9.

Fig. 9 - Tank 5 Sludge Sample

ACRONYMS

ALARA – As Low As Reasonably Achievable
DC – Direct Current
EES – Engineered Equipment & Systems
SRNL – Savannah River National Laboratory
SRS – Savannah River Site

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