THE DESIGN EVOLUTION OF A REMOTE CARTRIDGE FILTER HANDLING SYSTEM

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ABSTRACT

The need to safely handle and transfer spent primary coolant loop filter cartridge to the radwaste handling area, in a manner consistent with the As Low As Reasonably Achievable (ALARA) exposure principle, presented an equipment design problem at two overseas Pressurized Water Reactors (PWR's). The equipment had to be designed to handle filter cartridges with high radiation levels and limited access as well as function in a small work space. Hittman Nuclear & Development Corporation (HITTMAN) recently completed design, fabrication and testing of a remote cartridge filter handling system which has solved the plants' handling and transfer problems. The system, designed to remove the filter cartridges located in individual cubicles below floor level, augments the HITTMAN Radwaste Solidification System (Cement), RSS(C), provided to each of these plants. The remote cartridge filter handling system, however, provides a means of handling and transporting radioactive cartridge filter elements within a nuclear plant enviornment in accordance with sound ALARA principles, regardless of the utlimate system used to package the filters for disposal.

DESIGN REQUIREMENTS

The following operating and design requirements were identified for the filter handling system.

- Compactness: the system had to operate in a confined area with no modification to existing Plant facilities.
- Manpower: the system had to be capable of operation with a minimum of operators.
- Remote Viewing: the system had to provide a means of viewing the filter vessels cartridges during removal operations.
- Portability: the system had to be capable of servicing each of the 20 filter housing cubicles in the service building.
- Shielding: the system had to be capable of providing worker protection from spent filter cartridges having radiation levels as high as 500R per hour.
- Disassembly: the system had to be flexible enough to allow manipulation of tools required for disassembly of the filter cartridge housings.
- Extraction and Transfer: the system had to be capable of extracting filter cartridges of various sizes and weights from their housings, and of transferring them directly to a shielded carrier.
- Transfer to disposal area: the system had to be capable of furnishing sufficient shielding to allow for transport of the filter from their cubicles to the radwaste area for final packaging.

THE MODULAR SYSTEM APPROACH

To satisfy the specified operating and design requirements, several design approaches were considered. HITTMAN decided on a modular remote cartridge filter handling system (Fig. 1) consisting of

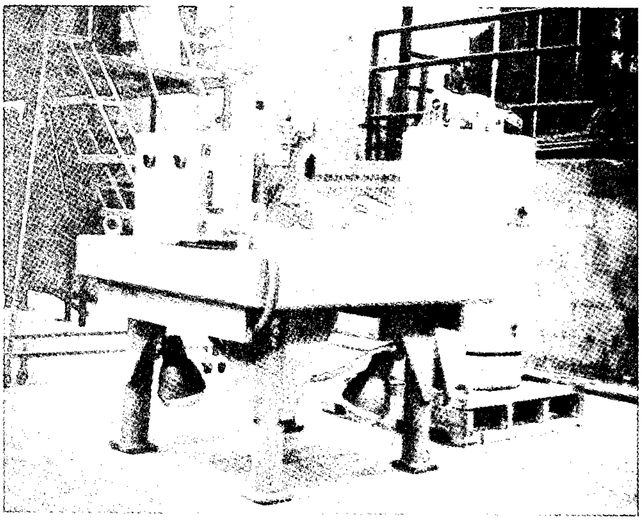

Fig. 1. The HITTMAN Remote Cartridge Filter Handling System

two major components, a working platform (Fig. 2) and a shielded transfer cask (Fig. 3). The modular design of this equipment allows the working platform and transfer cask to be operated together as well as perform independent functons in the removal and transfer process. Several long-handled tools supplement these major components.

Both the work platform and the shielded transfer cask were designed and built in accordance with exacting operating requirements and HITTMAN's Quality Assurance program for engineered radioactive waste processing equipment. The platform and transfer cask consist of four and one-half inches of poured lead inside quarter inch steel shells. Both components were subjected to gamma scan testing following fabrication to ensure shielding integrity. Many of the design, fabrication and quality assurance requirements

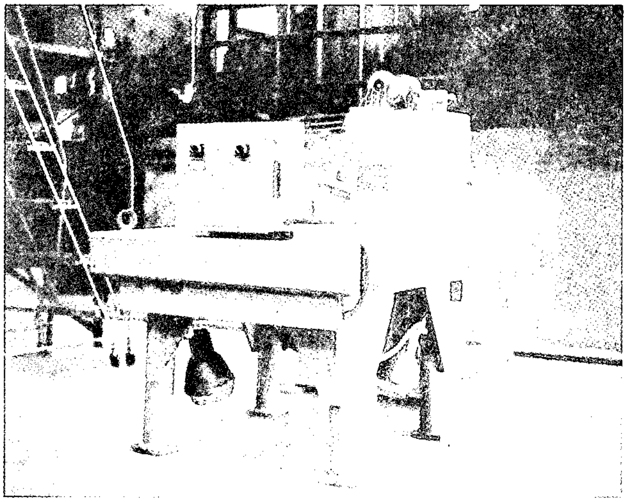

Fig. 2. Working Platform - Side View

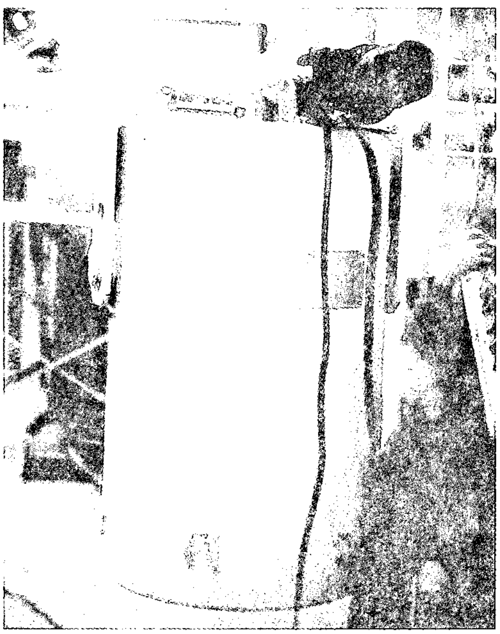

Fig. 3. Shielded Transfer Cask

were therefore identical to those normally applied to shielded shipping casks.

a. Working Platform

The working platform is designed to fit into the floor opening created by removal of the access plug of the filter housing cubicle, and to provide shielding equivalent to the 20" thick concrete plug. The filters are accessed through two small and one large port on the platform (Fig. 4). These ports are both vertical and angled to provide all required access. The large shield plug in the center of the platform can rotate on bearings within the cavity.

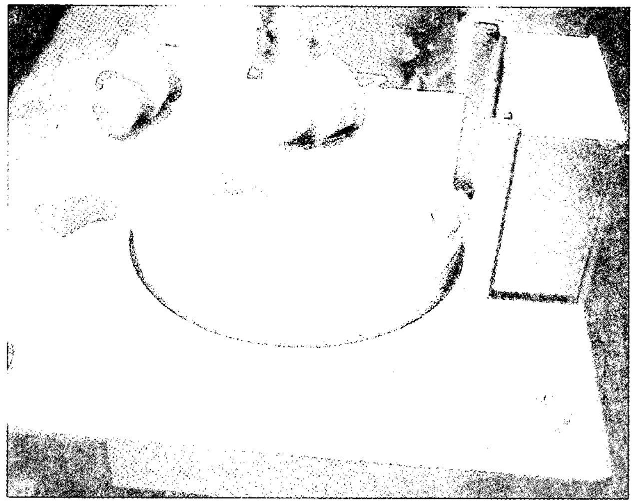

Fig. 4. Working Platform - Top View

To open the filter vessel, the small vertical shield plug is removed and a long-handled socket tool is used to loosen the filter lid hold-down bolts (Fig. 5). The large shield is rotated, as necessary, to line up the tool with the bolts.

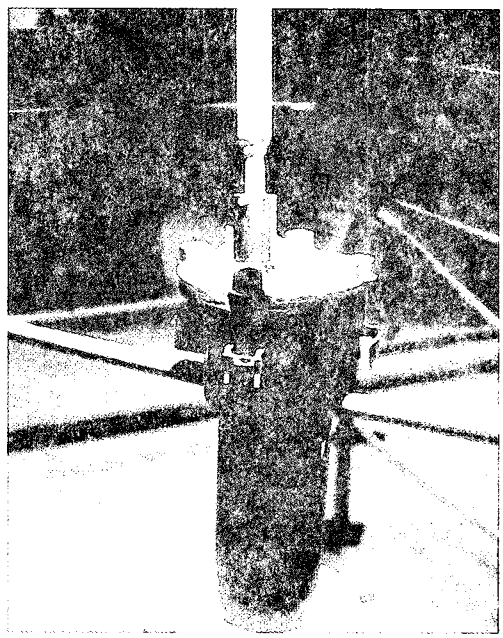

Fig. 5. Loosening of Filter Housing Lid Bolts

Once the bolts are loosened, a J-hook tool is inserted through the small angle plug opening to lift the vessel lid. A closed circuit television system is used to assist the operator during bolt loosening and filter removal. A remotely operated TV camera, with zoom capability, is attached to the underside of the platform. Spotlights, located near the camera, provide lighting (Fig. 6). A television monitor, situated beside the platform allows the operator to monitor operations at the filter housing.

from the vessel and draw it up into the transport cask. The cask is lifted slightly off the platform and plastic sheeting is used to cover the cask bottom (Fig. 8) in order to catch any drippings. The cask is

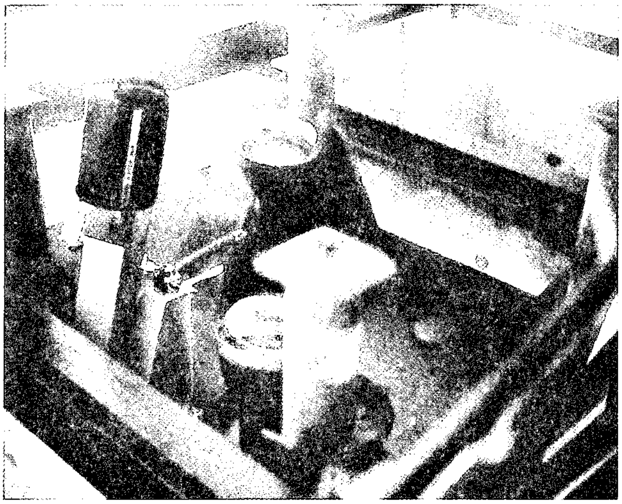

Fig. 6. Closed Circuit TV System on Underside of Working Platform

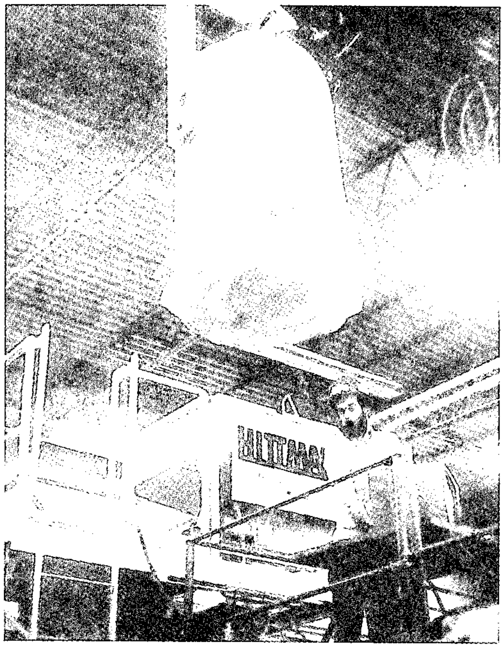

Fig. 8. Installation of Plastic Sheeting on Cask Bottom

then lowered onto its base plate, sealed, and transferred to the radwaste building (Fig. 9).

b. Transfer Cask

The transport cask is used to remove the filter from its housing. Following removal of the filter housing lid, the large rotating shield plug is removed from the work platform. The bottom of the transport cask is removed, and the cask is placed into the opening in the work platform created by removal of the large shield plug.

A winch, located on top of the transport cask, lowers a line down through the center of the transport cask. This line, with an "S" hook at the end, is extended down to the filter cartridge and engages a ring on the top of the cartridge. If needed, assistance in securing the ring is provided by a long handled J-hook tool which may be used through the small angled opening in the work platform.

The winch is used to extract the filter (Fig. 7)

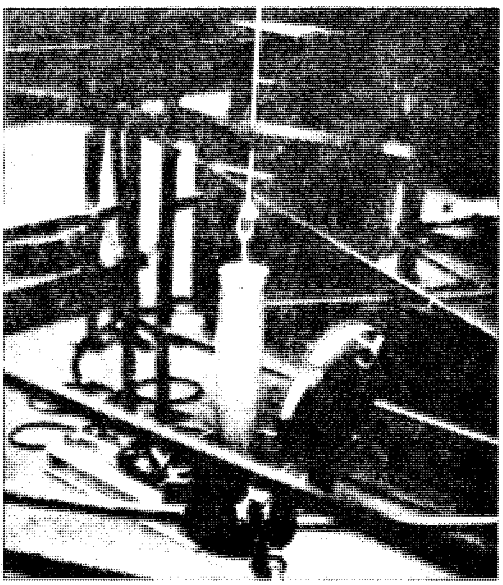

Fig. 7. Filter Removal Operation

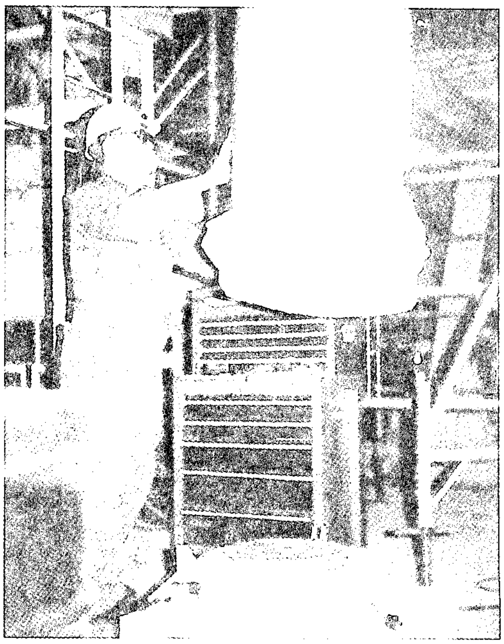

Fig. 9. Cask Transfer

At the radwaste building, the cask, with bottom removed, is suspended over the final filter disposal container. The winch line is cut at the top of the cask and the filter is allowed to fall into the disposal container. The disposal container is then backfilled with processed radwaste and cement from the HITTMAN RSS(C).

SYSTEM VERIFICATION

Prior to customer acceptance of the system, a demonstration test was performed at HITTMAN's facility in Columbia, Maryland. The demonstration test included a mockup of the filter cubicle and proper operation of all system components. The test proved the acceptabilty of the system under all required operating conditions and demonstrated that the system could be operated by 2 people. The two systems have been delivered to the respective plants.

ADVANTAGES OF MODULAR DESIGN APPROACH

The modular design of the system allows its application to both PWR's and Boiling Water Reactors (BWR's) and differing plant layouts and requirements. The system can be adapted to a plant's specific requirements as follows:

- Working Platforms, in different sizes and geometries, can be provided to fit a plant's cubicle opening configuration.
- A variety of lift mechanisms can be incorporated into the transfer cask design to accomodate heavier cartridge filters.
- If several working platforms are required, a portable TV system using fiber optics, can be provided in lieu of the permanently installed TV.
- A variety of counterweight designs can be provided to assist in the opening of filter housing lids.

CONCLUSION

The HITTMAN remote cartridge filter handling system represents an extremely flexible and efficient solution to the problem of in-plant removal, handling and transfer of spent filters.

RADIOACTIVE WASTE TRANSPORTATION DRILLS

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ABSTRACT

The Tennessee Valley Authority's (TVA) radwaste transportation drills involve staged transportation accidents which precipitate communications and emergency responses that would result in the event of a real accident. These exercises allow TVA to test several areas of the radwaste shipping program and transportation incident response procedures. The exercise calls for emergency response by local law enforcement, civil defense, and other State emergency personnel. In the developmental stages of the exercise, meetings are held with all of these organizations in the host State. At these meetings, a presentation on the transportation drill is made by TVA which includes general information on TVA radwaste shipments, what radwaste is, why the drill is being held, and what the value of the exercise is to all involved. The drill, therefore, serves as a learning tool for TVA and all other participating organizations.

BACKGROUND

TVA now has in operation or under construction four nuclear power plants comprised of nine units in the 1,100- to 1,300-MWe range. The two plants (five units) currently in operation generate a total of approximately 130,000 cubic feet of low-level radioactive waste annually. This consists of materials such as mops, cleaning rags, coveralls, contaminated tools, and dewatered resin. Until very recently, TVA utilized only the Chem-Nuclear Systems, Inc., site in Barnwell, South Carolina, for disposal of this material. Because of reductions in volume allocation at Barnwell, TVA began making radwaste shipments (trash packaged in drums and boxes only) to the U.S. Ecology disposal site near Richland, Washington. TVA submitted license applications to NRC for temporary onsite storage in engineered concrete modules in July 1980 and November 1980 for its Browns Ferry and Sequoyah Nuclear Plants. On September 17, 1982, NRC granted a license for use of the onsite storage modules at Sequoyah Nuclear Plant. These storage modules will only be used to accommodate waste which cannot be shipped offsite within a reasonable length of time because of plant generation rates or circumstances at the commercial disposal sites. TVA's philosophy is to minimize waste generation while considering the economic, environmental, and political aspects of low-level waste management. Offsite shipment is more environmentally acceptable than lengthy periods of onsite storage, so immediate shipment of TVA's low-level waste is accomplished to the extent possible.

TRANSPORTATION OF TVA'S RADWASTE

The safe transportation of material which travels to commercial disposal sites is of the utmost importance to TVA. Our safety record has been excellent to date with nearly one million miles logged by commercial carriers hauling TVA's radwaste. While it is hoped that no accident will occur, the possibility exists and we must be prepared. TVA has taken several steps to enhance its preparedness in this area. An emergency kit and emergency instructions accompany each shipment. All drivers are trained in use of the equipment in the kit and emergency instructions which include notification procedures. A portion of TVA's Radiological Emergency Plan (REP) is dedicated to incidents involving transportation of radioactive waste. TVA's Radwaste Management Group maintains updated shipment information and monitors a pager at all times to facilitate notification and quick transfer of information in case of an accident. TVA's transportation drills provide the opportunity for testing all of these measures.

TRANSPORTATION DRILLS

Planning the Exercise

TVA's transportation drills involve a simulated accident which assumes the wreck of a tractor-trailer carrying radioactive waste. These exercises are conducted somewhere along the usual route during an actual radwaste shipment. A drum of noncontaminated trash is used to simulate a breach of container integrity and release of radioactive material. These exercises require extensive planning and coordination on the part of TVA and have proven to be very worthwhile.

The first step in planning a transportation drill is development of a preliminary scenario outlining the basic exercise, the goals, and the expected response for each portion of the exercise. The scenario can then be used in the next step which involves choosing a host State for the exercise. Discussions are held with appropriate State officials to determine their willingness to be involved in the drill. Usually, State officials are receptive to the idea of a transportation drill and enthusiastically promote the concept among their local law enforcement and emergency response personnel.

Next, several possible site locations along the normal radwaste transportation route are evaluated using quadrangle maps and area descriptions from drivers. The drill site is then selected after physical inspection of these likely areas. Several factors must be considered when selecting a site. Some of these include the method by which the driver is to make required notifications (CB radio, telephone), whether the exercise can be executed without interrupting the