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MASTER SLAVE MANIPULATOR MAINTENANCE AT THE DEFENSE WASTE PROCESSING FACILITY (U)

by

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DISCLAIMER

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ABSTRACT

Equipment has been developed and tested to provide transport, installation, removal, decontamination, and repair for the master slave manipulators that are required for thirty-five descrete work locations in the 221-S Vitrification Building of the Defense Waste Processing Facility at the Westinghouse Savannah River Company. This specialized equipment provides a standardized scheme for work locations at different elevations with two types of manipulators.

INTRODUCTION

The Defense Waste Processing Facility (DWPF) has been built at the Westinghouse Savannah River Company (WSRC) (Figure 1) to immobilize the high-level radioactive waste now stored at the Site, plus the waste to be generated from continued chemical reprocessing operations. WSRC is presently the nation's primary source of tritium, weapon's plutonium, heat source plutonium, deuterium, and several other radionuclides for defense, space, medical, and energy applications. The Site, which is located near Aiken, SC, comprises a large, remote land area with extensive support facilities and a single operating contractor.

The DWPF facility will produce canisters filled with radioactive waste immobilized in borosilicate glass. These canisters will be stored in interim storage and transferred to a federal repository. The long term solution to the nuclear waste problem at WSRC is to remove the waste from waste storage tanks and immobilize the waste in borosilicate glass. Immobilizing the waste in this manner is more cost effective than continued tank storage, and will permit safe transfer of the waste to a federal repository when available.

DESCRIPTION

The Defense Waste Processing Facility at the Westinghouse Savannah River Company has thirty-five work locations at shielded windows, where slave manipulators are utilized to perform sampling, analytical support, and process related tasks remotely (Figure 2). These locations are spaced throughout the Vitrification Building, at two floor levels (Figure 3). One floor level has work platforms at different elevations in the operating area, some of which are 4.6 to 7.6 m (15 to 25 ft) above floor level. Window locations were selected for viewing of process equipment and placed at elevations to facilitate performing tasks dictated by process needs. This paper describes how the manipulators are transported, installed, removed, decontaminated, and repaired using a standardized work scheme and two types of manipulators at all work locations.

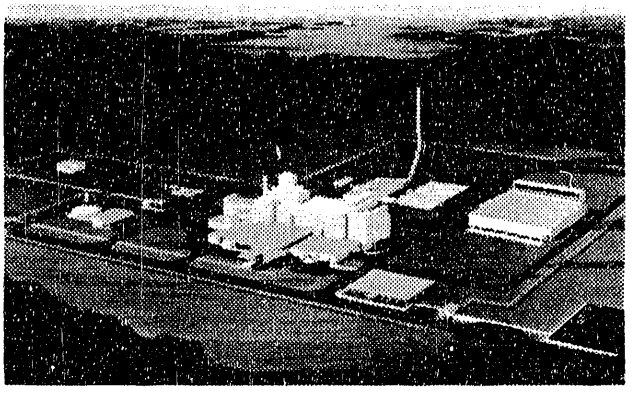

Figure 1. Defense Waste Processing Facility

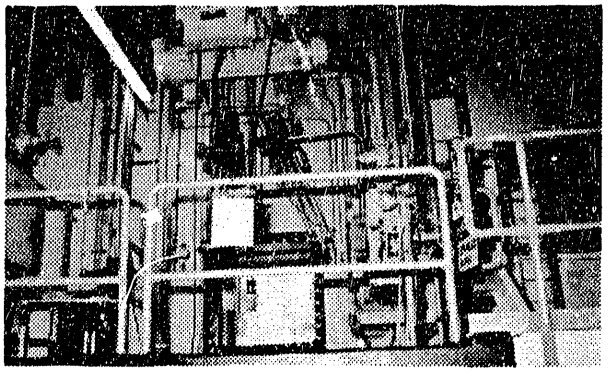

Figure 2. Platform Manipulator Work Station

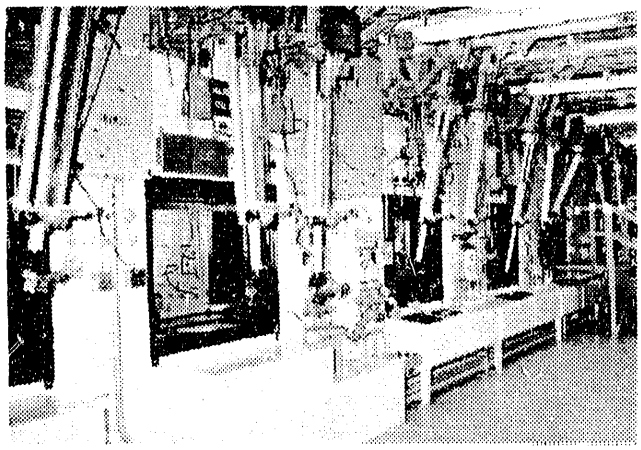

Figure 3. Analytical Facility Manipulators

TRANSPORT

Model E Central Research (REG) manipulators for two wall sizes are transported on a specially designed lightweight aluminum cart (Figure 4). The cart has full 360-degree mobility throughout the facility and is balanced so that it will not tip. The manipulators are securely locked in a carriage assembly that fits on the cart (Figure 5). This carriage assembly is also a part of an inverse hoist that lifts the Master Slave Manipulator (MSM) to a monorail and trolley installed at ceiling height over each opening. A lifting yoke is provided to lift the cart and the MSM to the workstation platforms (Figure 6). The cart then transports the manipulator on the platform to the installation location.

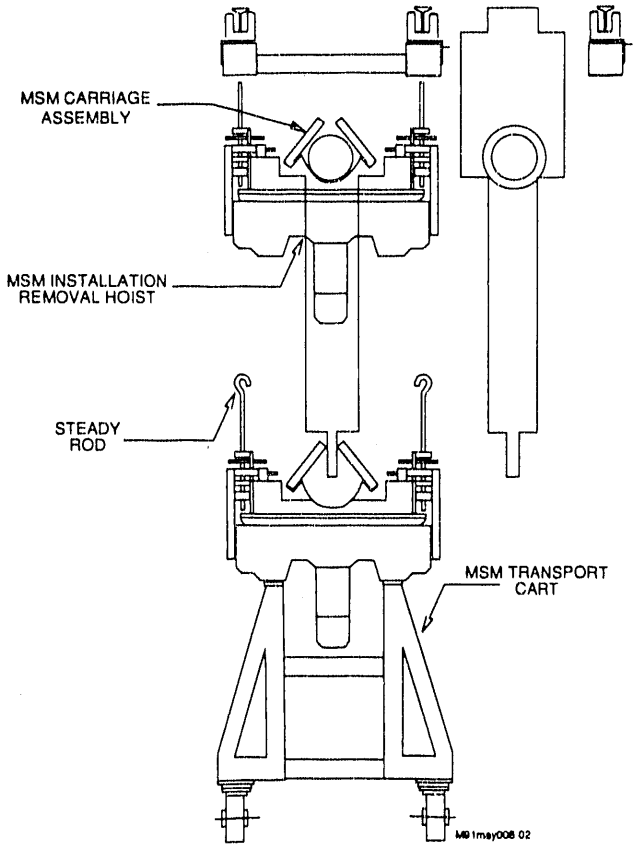

Figure 5. MSM Transport Cart

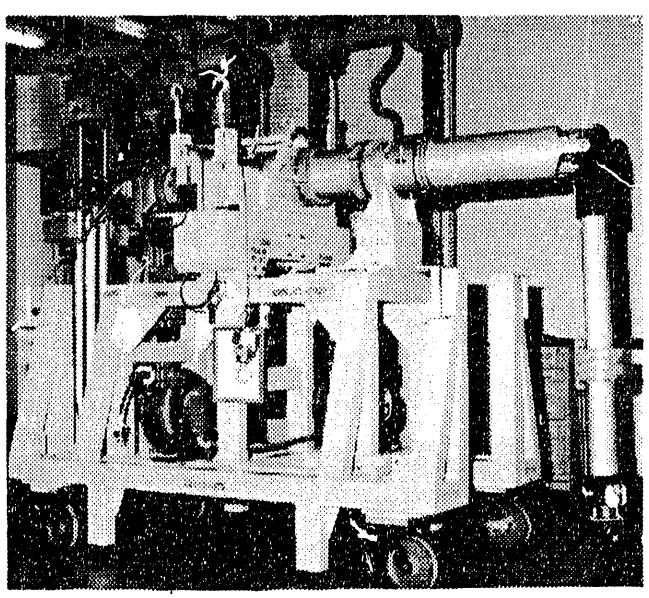

Figure 4. Manipulator Installation Cart

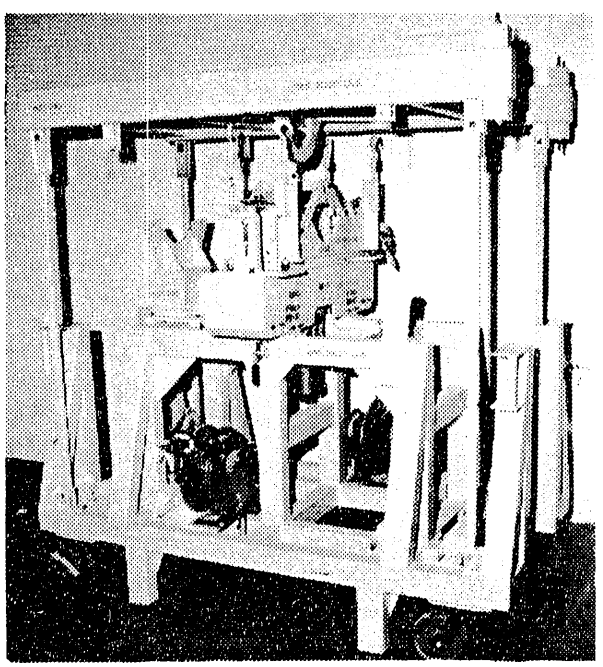

Figure 6. MSM Cart with Yoke

The transport cart can be used at floor elevation without the lifting yoke. It is designed to accommodate MSM's with 137–cm (54–in.) and 76–cm (30–in.)–thick wall tubes. All worksites have 25–cm (10–in.) diameter wall tubes at 3–m (10–ft.) center–line height from the operating floor. The cart has detent pins for all four wheels so that any two can remain stationary during transport. It also has a pressure foot brake for locking wheels when required. Electrical service is provided to the hoist and cart by retractable cord reels.

INSTALLATION/REMOVAL

Since the removal of a master slave manipulator involves the reverse steps of the installation procedure, except for removal into a plastic bag, only the installation sequence will be described. As a special safety feature, a locking device has been designed and incorporated into the equipment to both capture and physically secure the MSM throughout the entire procedure.

The installation procedure is as follows:

- Obtain a MSM for the proper location that has been checked for operability.
- Place on installation/removal cart and transport to area in which it is to be installed.
- If this area is on a platform, install lifting yoke. The yoke is not required for floor elevation.
- Position cart under monorail trolley such that the hot side may be raised to the horizontal position.
- Plug in electrical power cord.
- Raise inverted hoist to wall tube level.
- Install tie bar between trolleys.
- Attach tie securely to the MSM and hook the steady rods to the trolley lug plates.
- Push the manipulator slowly into the wall tube.
- Unhook the steady rods.
- Open the safety clamp.
- Lower the installation removal hoist to fit dowel pins on the transfer cart.
- Detach the hoist lifting hooks.

The removal of a manipulator is accomplished by reversing this procedure.

MANIPULATOR REPAIR SHOP

The Manipulator Repair Shop (Figure 7) is a standard construction building with 315 square meters (3500 square feet) of regulated floor space contiguous to the Vitrification Building. It includes a decontamination area with two large shielded gloveboxes, a repair area, a mockup facility for testing, a storage area, a clean spare parts area with work tables, and a regulated machine shop for maintenance support. The storage area features a monorail support system with trolleys so that the MSMs can be easily selected for transport. This conserves space and limits obstructions. The floor area has a smooth Cielcote® surface on concrete that can be easily decontaminated. A planned complement of spares for each type of MSM will be maintained in this repair facility.

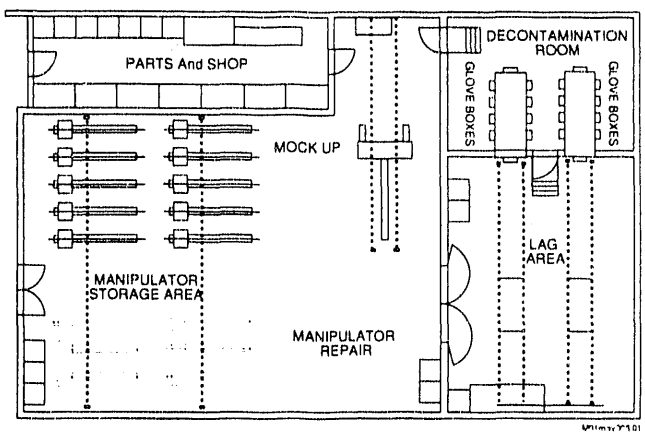

Figure 7. Manipulator Repair Shop

DECONTAMINATION

When a manipulator is removed for repair, it is transported to the decontamination section of the repair shop (Figure 8). The manipulator is placed in front of one of two decontamination gloveboxes, and the hot portion of the manipulator is placed into the gloved port opening.

The manipulator is decontaminated with decontamination solutions and water. The parts to be replaced are removed. The manipulator is smeared for contamination and when clean is removed from the glovebox.

The decontamination gloveboxes are stainless steel, lined with lead, and the faces are shielded glass. Lead–lined gloves mounted in Central Research Lab glove ports are mounted on both sides of the glovebox to provide access to the entire arm. The glovebox is equipped for waste removal and introduction of tools and decontamination supplies. The drain from the glovebox empties to a sump that transports contaminated liquid waste back to the processing cells.

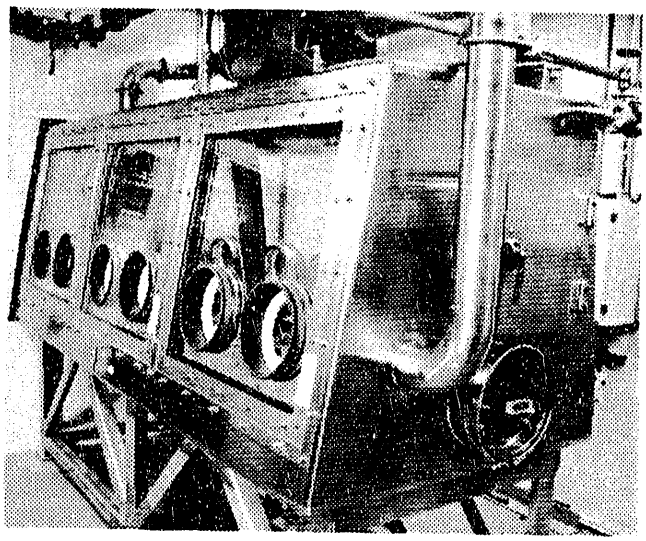

Figure 8. Decontamination Glovebox

REPAIR

Once the manipulator is decontaminated, it is then transported to the repair area. All spare parts and tape measuring tables are located in an adjacent clean room, and are placed at the repair station, which is a radiologically controlled area, on an as needed basis. The repair station uses chain operated hoists for ease of positioning during repair.

TESTING

Once the manipulator is repaired, it is transported to the mockup station for testing (Figure 9). A thorough checkout of the manipulator is performed using a sign-off checklist. The mockup frame can be adjusted to accommodate both wall spaces and different window sizes. It will be used to check out repaired manipulators and also to mock up analytical, sampling, and process related equipment prior to installation in the shielded cells. The MSM is then transported to the large storage area to await installation (Figure 10).

SUMMARY

A specially designed handling scheme for manipulators has been developed for different work locations at the Defense Waste Processing Facility. This procedure has been standardized for all MSMs to simplify operator training, and to minimize downtime and spare part inventories. This scheme is used throughout the operating areas and the repair facility. It is expected to be reliable, safe, and to facilitate operations, thus reducing installation and removal time. All segments that have been described have been checked out during the installation of manipulators in preparation for nonradioactive startup.

Figure 9. Manipulator Mockup Station

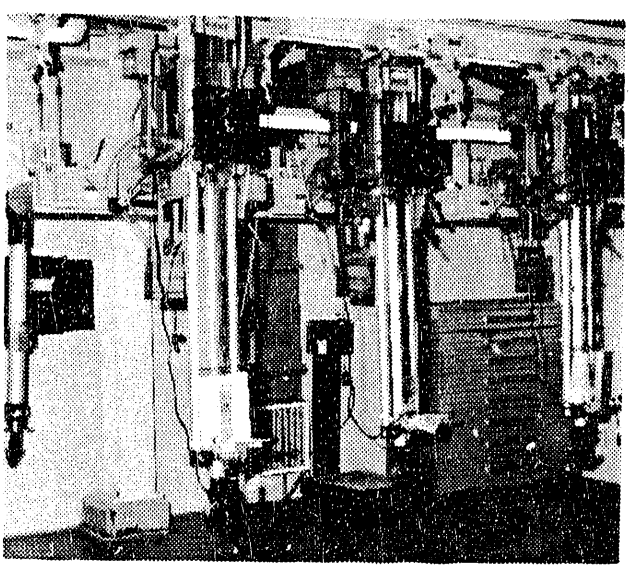

Figure 10. MSM Lag Storage Area

ACKNOWLEDGEMENT

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