DESIGN, INSTALLATION, TESTING AND STARTUP OF A MATERIAL HANDLING SYSTEM AT THE WEST VALLEY DEMONSTRATION PROJECT

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ABSTRACT

West Valley Nuclear Services Company and the U. S. Department of Energy decided to install a Cement Solidification System (CSS) at the West Valley Demonstration Project to handle certain lower level radioactive wastes.

In August 1984, design was initiated on a 55 gallon Material Handling System (MHS) which would interface with and support the operation of the CSS.

This paper will describe and discuss the design and fabrication of equipment, installation of the system at the site, and startup and performance testing of the system.

INTRODUCTION

The Cement Solidification System (CSS) uses 55 gallon drums as waste containers and was designed for completely automatic or remote manual operation. The Material Handling System (MHS) features empty drum storage and staging conveyors, an air lock with hydraulically operated shield doors, a drum lid transfer mechanism, a drum capper, a swipe, weighing, and labeling station, an α, β, γ counter, a water spray and air dry decontamination station, a bridge crane with CCTV, drum rotator and grab and a complete control system with PLC.

There were two principle design objectives. One was that the drum handling system be capable of processing 8 drums per hour through all operations and second that the system was to be operated remotely from a control room with no direct operator contact.

EQUIPMENT ARRANGEMENT

Figure 1 is a layout of the Material Handling System. Basically there were four areas. One area was the control room for the CSS and MHS where both systems control panels were located. The MHS control panel included crane controls, CCTV monitors, and the PLC. This area was designed to have exposure limits less than 0.2 mR/hr. Empty drum storage conveyors, empty drum lifts and staging conveyors were located in the area east of the control room.

A 26 inch thick shield wall was located between the low radiation zone which included the control room and empty drum storage area and the high radiation area to the North which included the cement filling station and filled drum storage area.

Certain operations and functions were performed on either side of the shield wall. The swipe counting and drum label marking are performed on the low radiation side of the shield wall utilizing a hydraulically powered swipe passage drawer.

In the shield wall, two hydraulically operated shield doors formed an air lock and shield for transfer of empty drums, lids and clamping rings between the empty drum storage area and the cement fill station. Located in the high radiation area were the lid transfer mechanism, the drum capper, the swipe turntable, remote manipulator, drum contact dose meter, drum weighing station, drum decon station and the remotely operated bridge crane.

FUNCTIONAL SYSTEM DESCRIPTION

The Material Handling System begins with an empty drum storage station. Four gravity roller conveyors are manually loaded with 8 drums each. This is accomplished by setting 2 drums at a time on a scissors loading lift and raising the lift into alignment with an upper or lower set of storage conveyors. A local release switch is then operated which will retract a mechanical stop holding the drums on the scissors loading lift. Gravity will then carry the drums down the inclined storage rack to fill empty positions.

The operator will then select, using a selector switch on the Main Control Panel, which of the four storage racks is to be used for empty drum supply. The loading conveyor starts and an unloading lift positions itself in alignment with the selected storage rack. Once the unloading lift is in position, mechanical stops holding the drum in the storage conveyors will retract, allowing a drum to enter the unloading lift.

Automatic movement of a drum into the drum process room is accomplished as follows. The outer airlock door is opened and when the airlock outer door reaches its full open position, conveyors

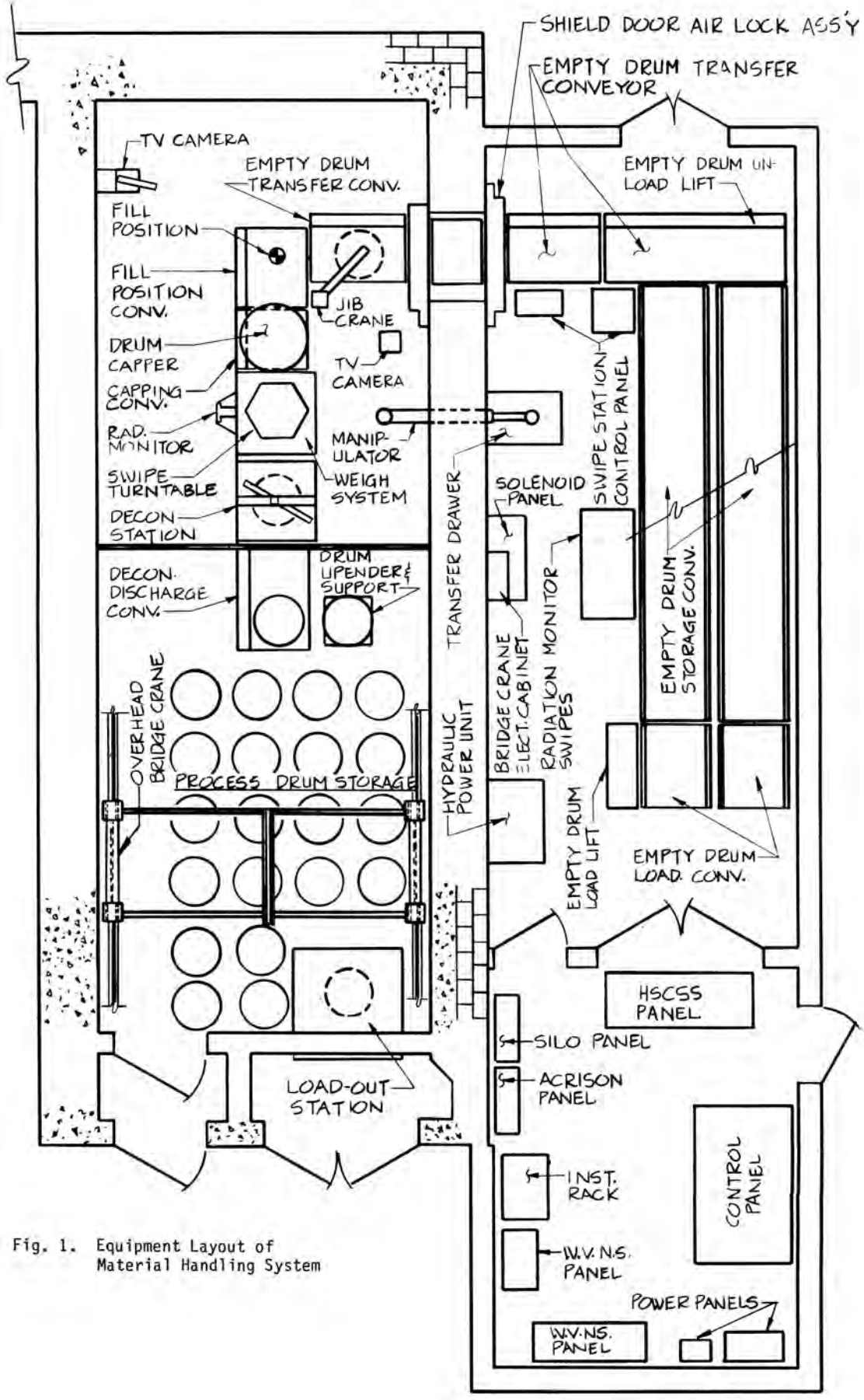

Fig. 1. Equipment Layout of Material Handling System

Fig. 2. Stainless Steel Conveyors

Fig. 3. Drum Handling System Control Panel

move the empty drum into the air lock; then the outer air lock door will be closed. With the outer air lock door closed, the inner air lock door opens. When the inner air lock door is fully open, conveyors move the drum into the process area. Once a drum reaches a position clear of the door, the conveyors stop and the inner air lock door shuts. Air lock doors are interlocked to prevent both being opened at the same time.

A drum is moved to the Filling Station as long as the drip tray is under the cement fill head. Once the drum is filled, it is then moved and lined up for capping. A drum lid jib crane will pick a lid off of the next empty drum and swing it over to a filled drum. With a lid on the filled drum, the lid jib crane moves back over an empty drum and the drum capper will lower onto the filled drum, crimp the lid, and raise off the drum. When all these actions have been completed, the drip tray can be swung in and the next empty drum filled.

Transferring a drum from the Capping Station to the Swipe Station is the next step. Swiping, weighing, labeling, and contact radiation measurements are all performed on a drum by an operator at the swipe station. The operator will read and record a drum's weight and contact radiation level directly off of the local control panel. These two measurements are automatically displayed when a drum moves into position. Swiping is performed by placing a swipe pad onto a manipulator attachment arm and extending it through the shield wall via the transfer drawer. To do this, the operator opens the transfer drawer access cover and places the swipe in a container on the door. The operator then must simultaneously press two separate control buttons, spaced approximately 36" apart, to start the drawer moving into the handling area. An

Fig. 4. Hydraulically Operated Air Lock Shield Door

electro-mechanical manipulator arm with piston grip hand controls is used to pick up the swipe applicator and move it into contact with the drum. Holding the swipe in contact with a drum, the operator then presses a button to rotate the swipe turntable 360°. After swiping 360°, the swipe is withdrawn by using the manipulator to place the applicator in the transfer drawer and after retracting the drawer, the swipe is removed from the drawer with tweezers for counting. A label is then filled out with all necessary information and placed on a label wheel in the transfer drawer. Using the manipulator, the wheel is picked up after being passed through the shield wall and held in contact with a drum. The drum is rotated 360° again in the same manner as swiping, but in the opposite direction. The label will transfer to the drum. If a drum shows surface contamination, it is decontaminated before attaching a label.

Fig. 5. Swipe Transfer Drawer and Label Applicator

Decontamination of a drum can be accomplished if required. The Decon Station "IN" door opens, then a conveyor starts and moves the drum into the Decon Station. Once a drum is in position, conveyors stop and the Decon Station door closes. A *timed* water spray starts and when completed a timed air flow blows across the drum to dry it. Both the water spray and air blow is via both a 360 circumferential spray ring which travels vertically the entire depth of the drum and stationary jets on top and bottom of the Decon cabinet. When drying is completed, the Decon Station "IN" door opens, conveyors start in reverse and move the drum back to the swiping position. With a drum in this position, it is swiped again. The Decon procedure is repeated as necessary. Clean drums are then labeled and moved to the discharge conveyor.

The movement of drums from the Swipe Station to the Discharge Conveyor is initiated. Automatically the decon "IN" door opens, the conveyors start and the drum moves through the Decon Station to an unloading conveyor. From the final conveyor position, drums are lifted to their storage locations with the bridge crane.

The bridge crane is operated remotely from the Main Control Panel. A letter/number grid network showing every drum storage position, and every pickup point in the storage area is affixed to the ceiling of the storage area. The bridge crane has a permanently mounted fixed position camera on it pointed vertically at the ceiling and focused on the grid pattern. Cross-hair alignment is shown on a camera monitor in the control room for precise alignment of the bridge crane over a desired location. Control of bridge crane operations is by use of lever switches for East, West, North, and South movements. The hoist is also raised and lowered using a lever switch. The drum grab is actuated by pushbuttons, and the rotator is operated with a keylock selector switch.

To move a drum from the unloading conveyor to a storage position, the operator will manipulate control levers as necessary to align cross-hairs on the camera monitor with grid marks on the ceiling which correspond to the unloading position. The drum grab is then lowered onto a drum. Visual verification that the drum grab is properly on a drum is provided by a separate camera. Pressing the Drum Grab pushbutton closes the drum grab jaws onto a drum. Using a hoist, the drum grab is raised to its full up position before the bridge crane is moved. The operator uses the grid network markings, viewed by the ceiling camera, as guides to position the bridge crane over a desired storage location. After lowering the drum, release is accomplished and the drum grab can be raised back to its normal up position. The bridge crane cannot move unless the hoist is in the fully raised position.

Viewing of all remote operations is provided by a 4 camera, 2 monitor, closed circuit television system (CCTV). A fixed position, fixed focus camera is mounted on top of the bridge crane. This camera is focused on the ceiling for viewing location grid to provide precise positioning of the bridge crane. A camera with pan, tilt, and zoom capabilities is mounted on one end of the bridge crane trolley to view drum positioning and lifting. Being a mobile camera, it can also be used to view any position in the process area. Pan, tilt, and zoom capabilities are also installed in a camera which views swiping and labeling operations, and the transfer drawer. The fourth camera views drum filling and capping operations. It also has pan, tilt, and zoom capabilities and can be used to view other areas.

A monitor is located at the main control panel and at the swipe operator's panel. A switch is provided to select any of the four cameras to either monitor. This way any two operations can be viewed at one time. A "joystick" type controller with each monitor provides vertical and horizontal camera movements.

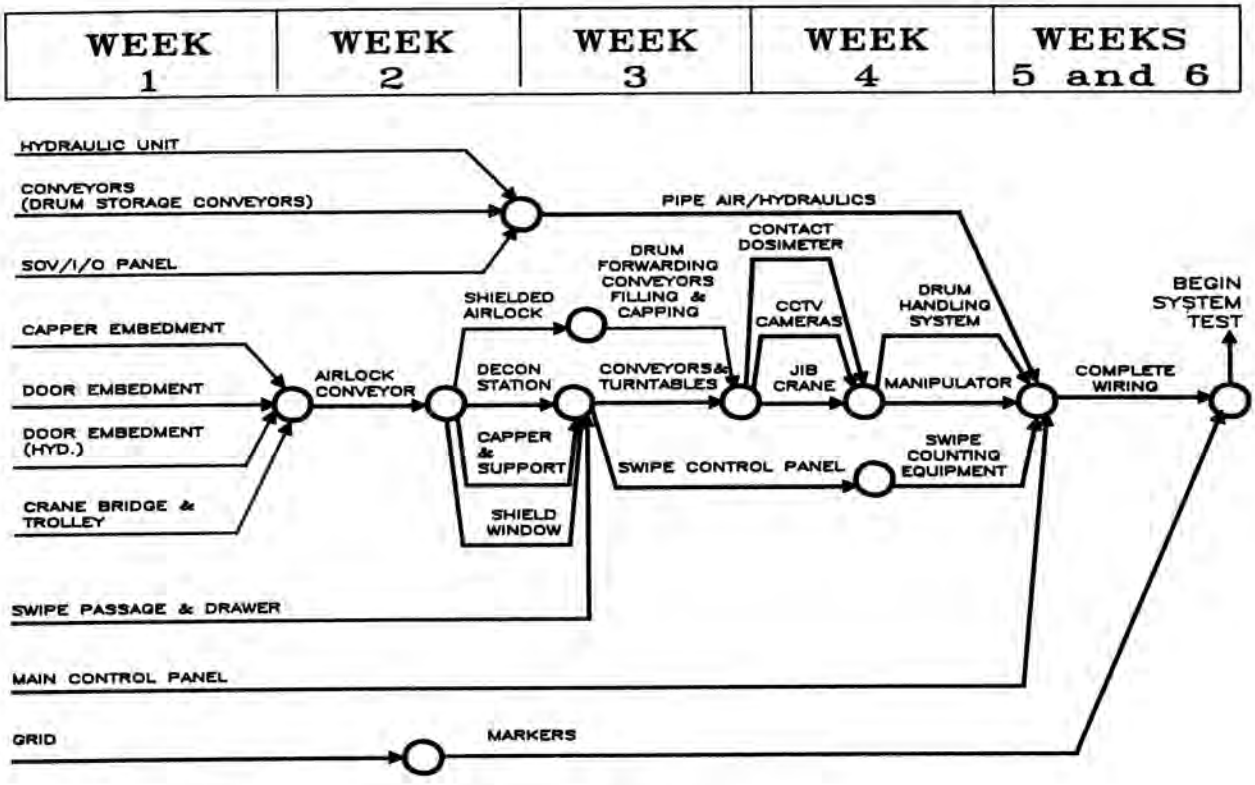

Fig. 6. Critical Path Method Schedule.

INSTALLATION

Figure 6 is a Critical Path Method (CPM) schedule that was used in the installation of all equipment, piping, wiring, and panels.

Basically, all equipment was preassembled and fabricated in the shop before shipment to the site. Basically, installation of equipment involved locating, anchoring, leveling and grouting the conveyors, lid transfer jib crane, drum capper, swipe transfer drawer, airlock shield doors, decon station and hydraulic power unit. Installation of the bridge crane and trolley was one of the first activities accomplished.

Final activities included installation of piping, tubing, fittings, and electrical conduit, wiring, and instruments.

TESTING

There were three phases of testing.

- Hydrostatic testing and an electrical wiring checkout
- Functional test of each piece of equipment
- Performance test of integrated system

After hydrostatic testing and electrical checkout, each piece of equipment was functionally tested to insure proper operation.

A performance test was completed on September 29, 1986 which demonstrated that the MHS could process eight drums per hour. The system was then turned over to WVNS Co. for cold functional and testing and hot operational use.