SHIELDED RAILWAY TRANSPORTER SYSTEM EQUIPMENT DESIGN AND OPERATIONAL FEATURES

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ABSTRACT

The U.S. Department of Energy (DOE) Hanford Site at Richland, Washington requires a rail-mounted, shielded transfer system for on-site transfer of radioactively contaminated equipment in the T-Plant, U-Plant, B-Plant and PUREX canyon tunnel facilities. Some typical contaminated equipment are tanks (5-15 tons), reboiler bundles (7 tons), centrifuges (17 tons), moderators (13 tons), and pulse generators (5 tons). The Multipurpose Transfer Box (MTB) is designed and engineered to transport these pieces of equipment and meet specific design constraints for function, operation, and modified 10 CFR 71 normal and hypothetical accident conditions for transport.

INTRODUCTION

The MTB is a 300,000 lb stainless steel cladded box mounted on an eight axle rail flat car. The MTB main box structure is 14 feet wide, 26.5 feet long and has vertical height of 21.5 feet from the top of the rail. Also, there are 6 primary components or systems for MTB operation.

1. Hydraulic/Pneumatic power supply system
2. Washdown and sump drain system
3. Lid latching/locking and lift systems
4. Debris deflector system
5. Manual control system
6. HEPA filter system

The MTB is designed to operate within the applicable tunnel facilities by opening the lid via operator remote activation. The primary lid opening operation utilizes an air driven hydraulic system with a remote reserve capability of two full opening cycles. The manual lid opening mode requires the use of a 10-ton crane which utilizes a torsion bar assist system. The MTB is capable of safely handling a maximum cargo weight of 40,000 lbs .

The purpose of the Multipurpose Transfer Box (MTB) is to provide a safe means of rail transportation of radioactive contaminated equipment for on-site decontamination and repair. The MTB will permit safe transportation by providing secured transport and reduced radiation exposure to user personnel. The MTB is equipped wi'h several operator controlled systems which ensures hands on remote control. The MTB has been designed to interface with the facility 10 Ton overhead crane and connect to standard locomotive pneumatic hose connections.

DISCUSSION OF MTB SYSTEMS AND COMPONENTS

Box Enclosure

The main box structure consists of a composite steel cross-section. The main core is three (3) inch thick ASTM A-516, Grade 70, carbon steel with interior and exterior cladding of 3/4 inch and 1/4 inch SA-304L stainless steel, respectively. The four vertical corners of the box are wedged off and reinforced with exterior mounted angled doubler plates for accident impact resistance. The interior floor of the box is sloped toward the front wall to allow for liquid run off into the sump drain channel during wet-down or decontamination processes. The box has a lid which is hinged on one side and has a triangular face seal located around the entire periphery. The lid is provided with a torsion bar assist mechanism for lid lifting operations using the facility 10-Ton overhead crane.

LID LIFTING MECHANISM

The lid lifting system (Fig. 1), utilizing automatic mode, consists of two hydraulically operated main lift cylinders mounted one on each end of the box. The lift system is operated via a control console located at the front section of the railcar. Each opening and closing operation is considered one cycle and the hydraulic system has the remote reserve capability of two full cycles. In the event of hydraulic system failure, lid lifting can be accomplished by means of the manual lift mode.

The manual mode requires the lid to be lifted by utilizing the facility 10-Ton overhead crane. The lift bail is located on the front end of the box and is attached directly to the lid. The manual lift mode utilizes a torsion bar system to assist the overhead crane during lifting operations.

LID LATCHING MECHANISM

The lid latching mechanism (Fig. 2), consists of a series of latches that are interconnected via a main sliding arm. Attached to the lid are several tee's and attached to the box are several mating u-block clevises. The connection is made by insertion of the slide bolt into the tee/u-block connection. The main slide bolt is actuated by a linkage connected to a hydraulic cylinder located on the front of the box. The hydraulic unlock/lock mechanism has the remote reserve capability of two (2) complete cycles. In the event of a hydraulic system failure, lid latching/unlatching can be accomplished by means of the manual lift mode. Using the 10

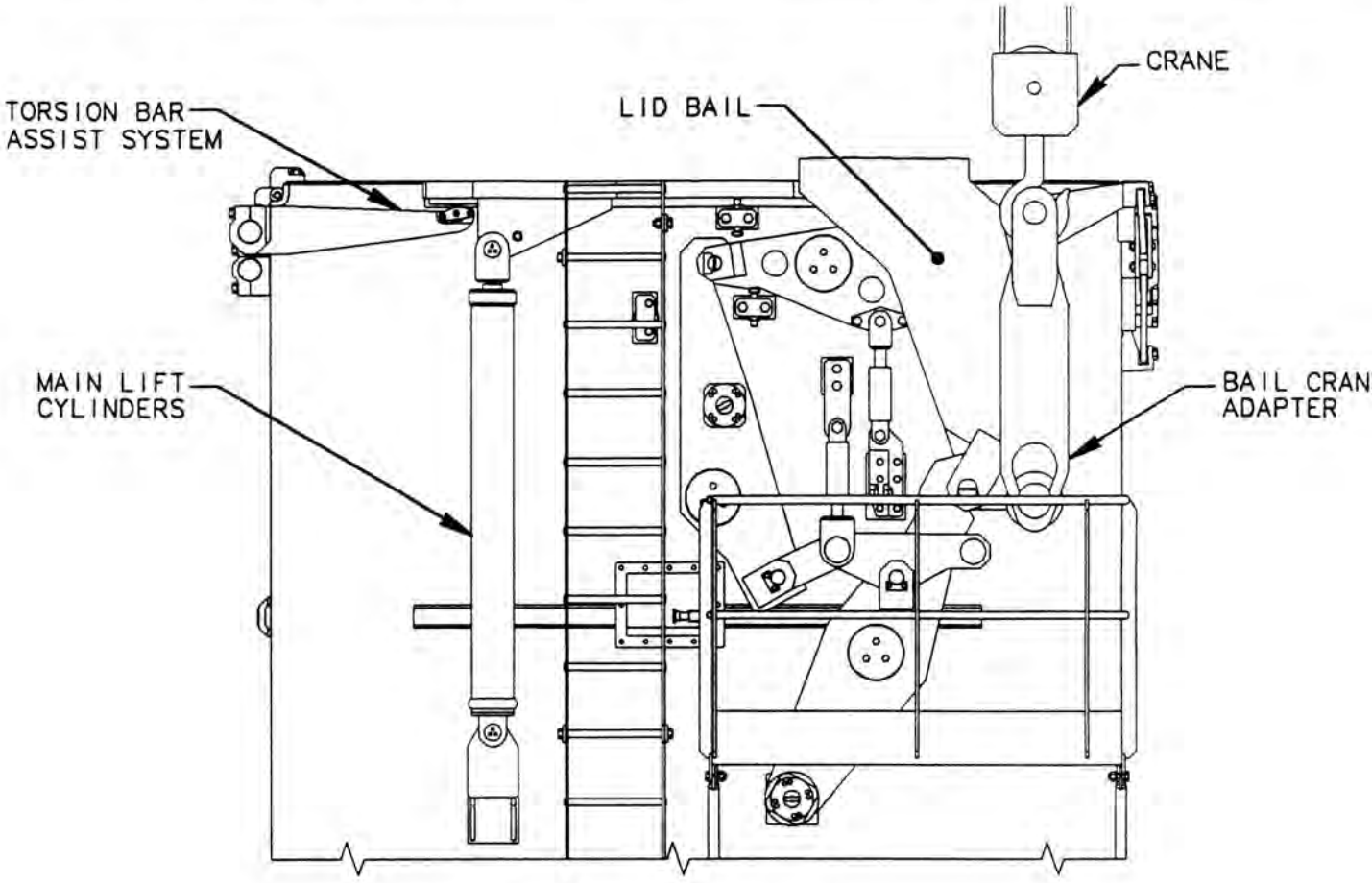

Fig. 1. Lid Lifting Mechanism.

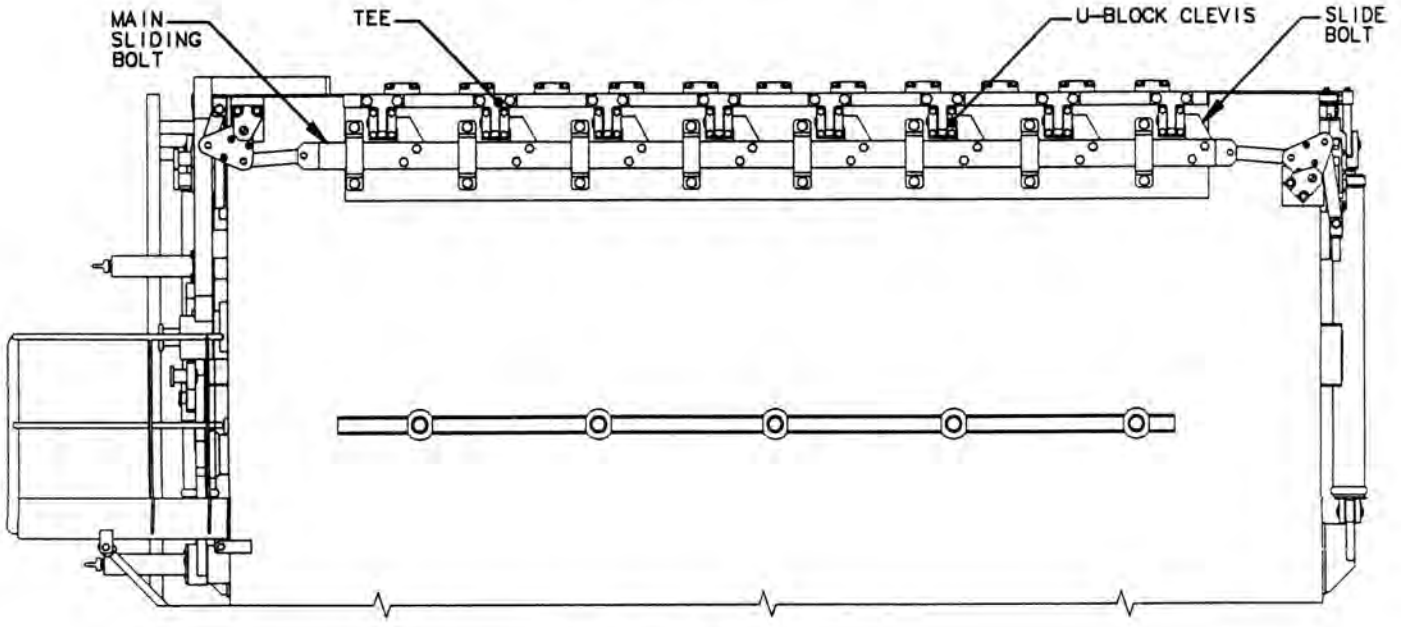

Fig. 2. Lid Latching Mechanism.

ton facility crane and crane adapter plates, the latch/unlatch link is lifted as required to actuate system (Fig. 3).

LID LOCKING MECHANISM

The lid locking mechanism (Fig. 3), consists of two locking systems. First, a manually activated positive lock pneumatic cylinder is located on both the upper and lower locking arms. The pneumatic lock cylinders are required to be released allowing operation of the manually activated hydraulic cylinders that actuate the upper and lower locking arms. The upper and lower locking arms lock/unlock the front latching arm and lid lift bail, respectfully. In the event of a hydraulic system failure, lid locking/unlocking procedures can be accomplished by means of the manual lift mode. The pneumatic lock cylinders will require manual release by means of a release rod prior to crane activation of locking system. To manually lock/unlock the MTB, attach the facility crane with adapter plate to the three (3) point link on the cylinder side for unlocking or on the lid lift bail side for locking.

DEFLECTOR MECHANISM

The MTB is equipped with a single-length, lightweight deflector plate to prevent radioactive waste and/or debris from falling outside of the loading cavity. The deflector has a lightweight honeycomb core with a bonded stainless steel cladded outer skin. The deflector is attached to the latch side of the MTB wall. Operation is automatic when the lid is raised by means of a connecting linkage. The deflector mechanism is shown in Fig. 4.

HYDRAULIC AND PNEUMATIC CONTROL PANELS

The pneumatic control panel is located within the control cabinet at the front right side of the flatbed railcar. The panel is equipped with four directional control valves, two ball valves, air pressure gauge, pressure regulator, and filter separator as shown in Fig. 5. The hydraulic control panel is located at the front left side of the flatbed railcar. The panel is equipped with four directional control valves, two needle

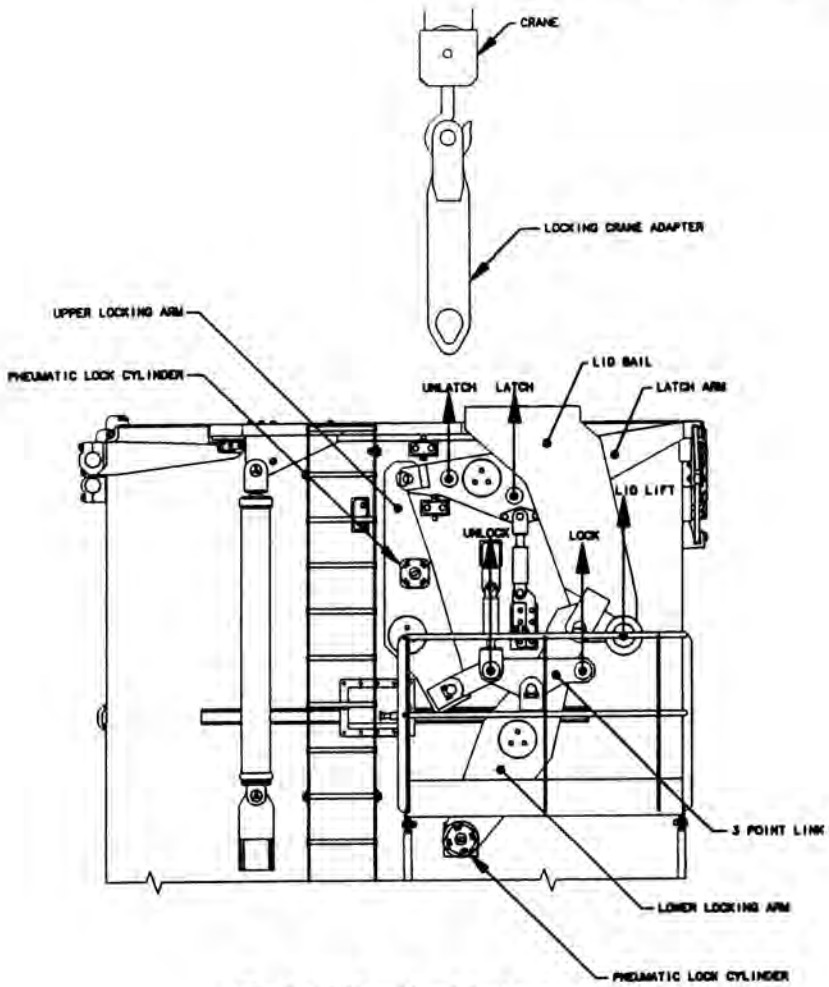

Fig. 3. Lid Locking Mechanism.

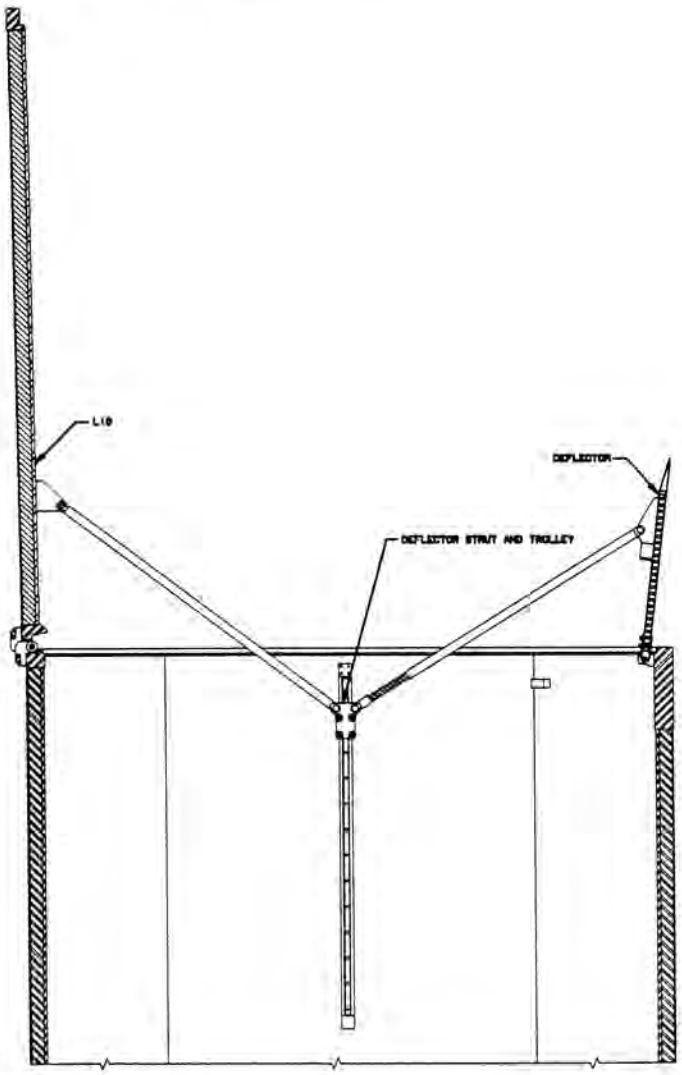

Fig. 4. Deflector Mechanism.

valves, four line pressure gauges, flow control valve, and a hand operated hydraulic pump as shown in Figure 5.

HEPA FILTER ASSEMBLY

The interior of the MTB is vented through a High Efficiency Particulate Air (HEPA) filter (Fig. 6). The filter frame utilizes a fluid seal around the perimeter. The filter housing cover is attached to the exterior of the box for easy filter change out. Attached to the filter housing cover are two attachment points for DOP testing. An exhaust duct is provided and a upstream port necessary for sampling and differential pressure measurement.

WET-DOWN SPRAY SYSTEM AND SUMP DRAIN

The interior side walls of the MTB have a built-in spray mist system, for wetting of equipment being transported. The spray system provides sufficient coverage to all areas of the sidewalls, floor, and lid with the exception to the HEPA filter location. The wet-down system control valve is actuated by a pneumatic cylinder and activated by means of a control lever located in the pneumatic control cabinet at the front of the railcar.

The sump drain for the wet-down system is located on the interior floor of the box on the MTB centerline toward the front wall. The system is designed to drain all wet-down or decontamination fluid from the interior of the box. The sump drain valve is actuated by a pneumatic cylinder and activated by means of a control lever located in the pneumatic control cabinet at the front of the railcar. The spray/sump system schematic is shown in Fig. 7.

TIEDOWNS AND RAILCAR INTERFACE

The general configuration of the tiedowns (Fig. 8), is that the MTB rests flat on the railcar deck. The main box structure is restrained longitudinally and laterally by means of shear blocks welded to the railcar deck. All other move-

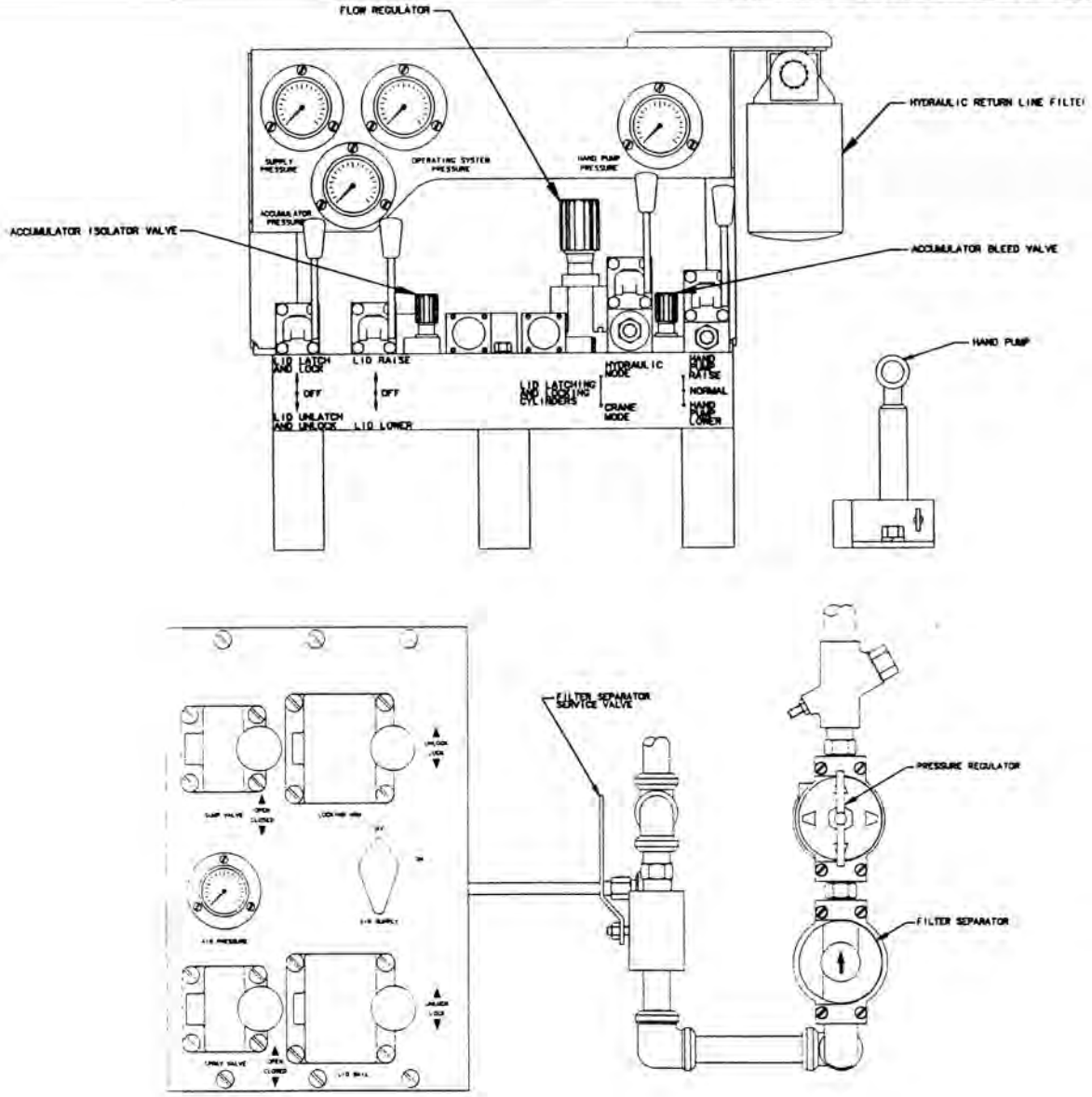

Fig. 5. Hydraulic and Pneumatic Control Panels.

ments are restrained by means of four trunnion blocks which are held in place by brackets attached to the tiedown tongues in the railcar deck.

The MTB railcar is an eight axle flat bed car which supports the MTB and its associated tiedown and support equipment. The railcar can be moved by use of conventional rail system locomotives. Located at the front end of the deck are two control consoles. Each console contains the necessary control valves to operate the pneumatic and hydraulic power systems.

SYSTEM OPERATION

The MTB has been designed for operation in an indoor or outdoor environment within an ambient temperature range of 0 °F to 120 °F. There are two possible loading/unloading operational sequences available depending on the type of lid lift mode utilized. The manual lift mode describes lid lifting and locking operations utilizing the facility 10 Ton overhead crane. The automatic lift mode describes lid lifting and locking operations utilizing the air driven hydraulic system. The automatic mode also describes lid lifting operations using the stored hydraulic power of the accumulators and hydraulic hand pump operations.

The manual mode for unlocking and lifting the lid is a five step process (Fig. 3). First the pneumatic lock cylinders require release by means of a pull rod. After manual release of both pneumatic lock cylinders the 10 Ton overhead crane is positioned over and attached to the unlock link and then raised until both the upper and lower locking arms reach the stop blocks. Next, the crane is positioned over and attached to the unlatch link. The crane is then raised until

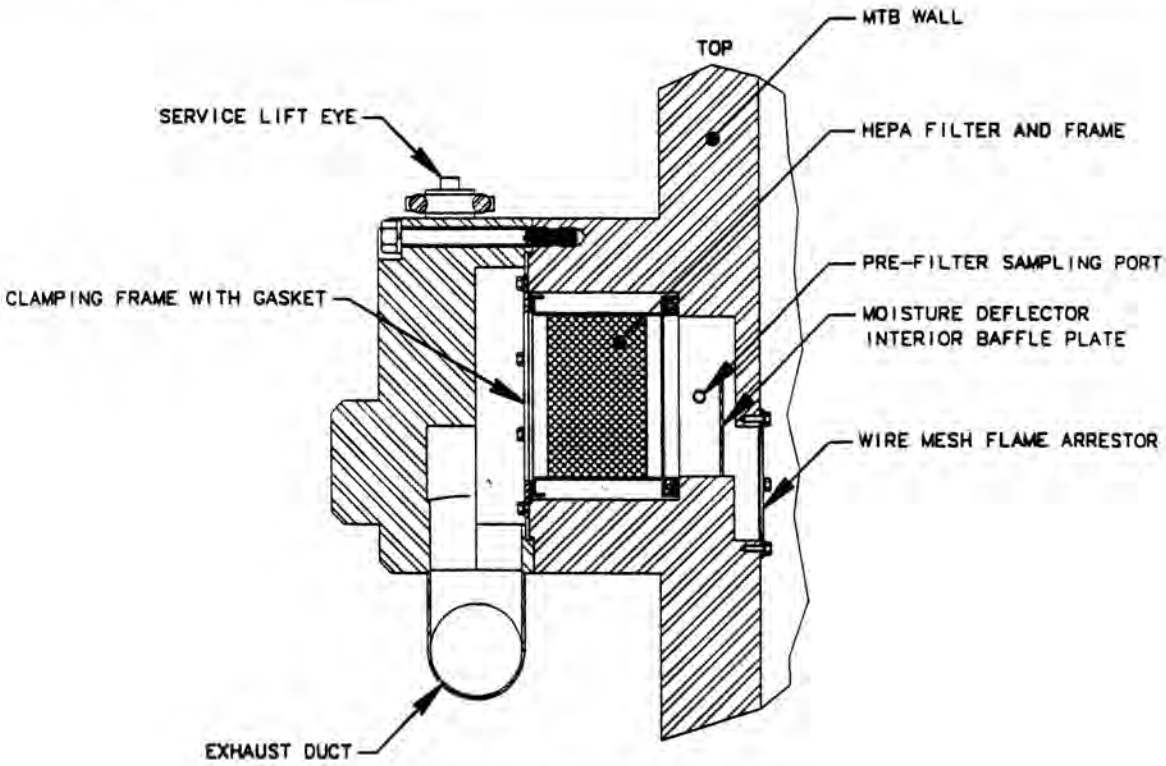

Fig. 6. HEPA Filter Assembly.

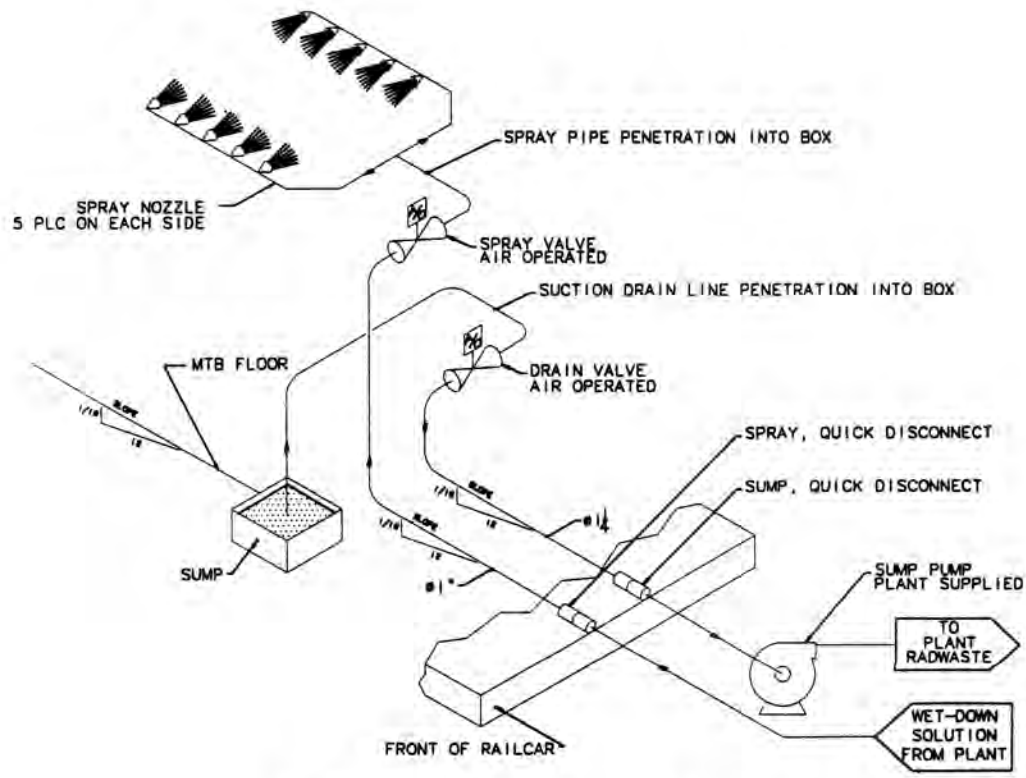

Fig. 7. Wet-Down Spray System and Sump Drain.

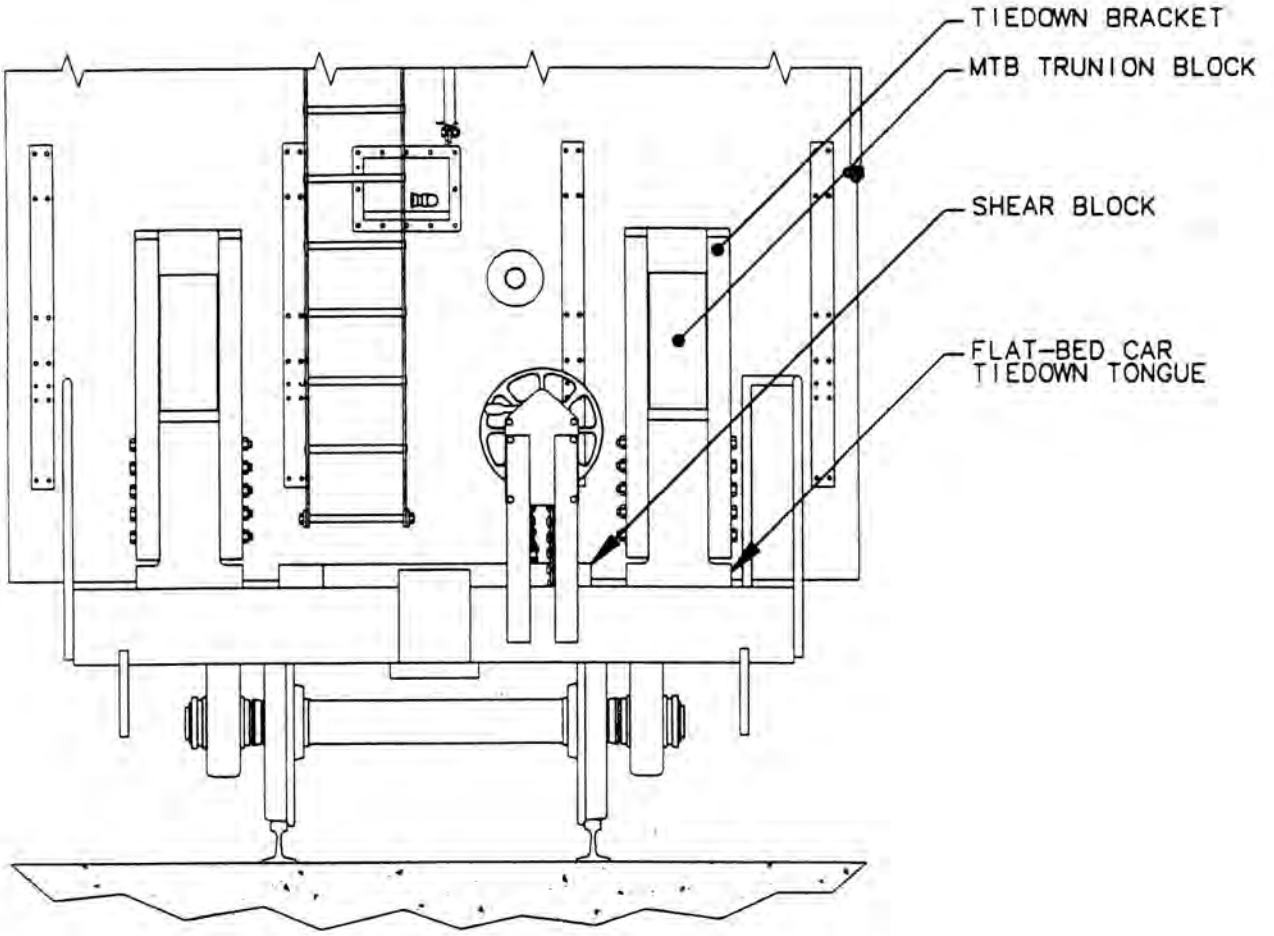

Fig. 8. Tiedowns and Railcar Interface.

the latching arm reaches the stop block. Finally the crane is positioned and attached to the lid lift bail for lid opening.

The automatic mode for unlocking and lifting the lid is remotely controlled at the front of the railcar. There are two control cabinets positioned on either side of the hand brake. The right side cabinet houses the pneumatic controls for the sump drain valve, spray system valve, and locking cylinders. The left side cabinet houses the hydraulic controls for operation of the unlock, unlatch, and lid lift cylinders. Also included in the hydraulic control cabinet is a hydraulic hand pump used for manual system pressurization. The accumulators hydraulic reserve capability can be activated by means of a accumulator isolator valve.

SUMMARY

The MTB system provides a safe means of transporting radioactively-contaminated equipment from the T-Plant, U-Plant, B-Plant, and Purex facilities for on-site decontamination and repair by providing secured transportation and reduced radiation exposure of user personnel.