CHAPTER 5

OPERATION SYSTEMS

5.0 OPERATION SYSTEMS

5.1 OPERATION DESCRIPTION

The following sections describe the operating procedures, which are unique to the operations of the H. B. Robinson (HBR) Independent Spent Fuel Storage Installation (ISFSI) such as loading, unloading, and surveillance. Existing fuel and cask handling operations, which are currently being employed at fuel and cask handling operations, which are currently being employed at H.B. Robinson Steam Electric Plant Unit No. 2 (HBR2) will be incorporated with these procedures.

5.1.1 NARRATIVE DESCRIPTION

The following steps describe the operating procedures for the ISFSI.

5.1.1.1 Preparation of the Transfer Cask and Canister

a) Prior to the start of the operation, the fuel assemblies to be place in dry storage will be visually examined (e.g., by television cameras, binoculars, or other means, etc.) to insure that no visible defects exist and that the assembly structure is intact. The assemblies will also be checked (by analysis or by examination of appropriate records) to verify that they meet the physical, thermal and radiological criteria described in Chapter 3. Measures will be taken to ensure that no known failed fuel will be placed in dry storage. This process will be independently verified to ensure that fuel assemblies meeting the fuel specifications (see chapter 10) are selected for storage.

b) Place the cask in the vertical position in the decontamination facility.

c) Prior to the loading of fuel, the fuel basket used during the transportation operation will be removed from the GE IF-300 shipping cask and the cask cavity will be cleaned or decontaminated as necessary.

d) Using the spent fuel cask handling crane, lower the docking collar (Figure 5.1-1) onto the cask. Once the docking collar (cask extension) is properly oriented onto the transportation cask, bolt the docking collar into place and tighten.

e) Using the crane, lower the dry shielded canister (DSC) into the cask cavity.

f) Fill the DSC and the cask-canister annulus with clean, demineralized water.

g) Seal the top of the gap between the DSC exterior and cask interior.

h) Place the lid on the cask and lift the cask into the spent fuel pool.

5.1.1.2 Fuel Loading

a) Remove the cask lid and lead plug and place the irradiated fuel assemblies (IFAs) in the DSC (which is inside the shipping cask) using the existing HBR2 fuel handling equipment and procedures.

b) When all seven of the IFAs have been loaded into the DSC and the lead plug and cask lid have been secured, the cask will be moved to the decontamination facility.

5.1.1.3 Cask Drying Process

a) Place the cask in a vertical position in the decontamination stand.

b) Remove the cask lid.

c) Lower the water level about 2 in. in the cask canister annulus by removing water from the cask. Lower the water level in the DSC by removing approximately 15 gallons from the DSC.

d) Seal weld the upper steel cladding plates of the top lead plug to the canister body.

e) Connect a compressed air supply to the vent tube and another hose from the siphon connection to the decontamination facility's radioactive waste system. Activate the air supply forcing the remaining water out of the DSC cavity. (See figure 4.7-1 of the NUHOMS Topical Report (Reference 5.1) for a schematic of the piping system).

f) Once the water stops flowing from the DSC, remove the siphon hose from the DSC.

g) Connect the vent tube piping system to the intake of the vacuum pump. A hose should be connected from the discharge outlet of the vacuum system to the site radioactive waste system.

h) Start the vacuum system and draw a vacuum of 3 mm Hg within the DSC cavity.

i) Once a vacuum of 3mm Hg has developed in the DSC cavity, disengage the vacuum pump, connect the helium source, and backfill the DSC with 1.5 atm (22 psig) of helium. Verify with pressure gauge that pressure is holding and helium leak test the entire length of the primary end plug closure weld.

j) Seal weld the prefabricated plug over the vent and siphon tube connection.

k) Seal weld the prefabrication plug over the vent tube connection.

l) Perform helium leak test to ensure weld tightness.

5.1.1.4 DSC Sealing Operations

a) Place the top cover plant onto the DSC and weld the cover plate to the body of the DSC.

b) Perform dye penetrant test on seal weld.

c) Drain water from annulus and place the cask lid onto the cask and bolt the lid into place.

5.1.1.5 Transportation of the Cask to the Horizontal Storage Module (HSM)

a) Use redundant yoke to lift cask out of decontamination pit.

b) Disengage lower portion of redundant yoke and position cask in tilting cradle.

c) Lower cask to horizontal position on trailer and secure.

5.1.1.6 Loading of the Canister into the HSM

a) Inspect all air inlets and outlets on the HSM to ensure that they are clear of debris. Inspect all screens on the air inlets and outlets for damage. Replace screens if necessary. Leave the front access of the HSM open.

b) Using the optical alignment system, align the ram with the cask centerline.

c) Position the cask so that the docking collar is within 1 foot of the HSM.

d) Remove the cask collar lid.

e) Using an optical alignment system and targets on the cask, skid, and HSM as necessary, adjust the position of the cask until the cask us properly positioned with respect to the HSM.

f) Extend the hydraulic ram and activate the grapple to grab the canister.

g) Move the cask against the HSM, so that the docking collar is positioned in the HSM recess.

h) Retract the piston of the hydraulic ram. If the ram fails to retract when the load on the hydraulic system exceeds 6,200 lbs, stop the ram. Check the orientation of the cask with respect to the HSM and reorient the cask if necessary. Continue this step until the DSC contacts the stopping blocks mounted on the top of the DSC support rails at the rear end. These blocks will assure correct axial positioning of the DSC within the HSM.

i) Collapse the grapple arms and withdraw the hydraulic ram.

j) Pull the skid away from the HSM.

k) Install the plate over the front access of the HSM.

l) Insert through the rear access opening the seismic retainer assembly until it couples with the DSC grapple assembly. Bolt down the retainer assembly to the rear access cover plate. Bolt down the cover plate to the rear access embedded plate.

5.1.1.7 Monitoring Operations

On a daily basis, site personnel will walk around the perimeter of the HSMs to visually inspect the air inlets and outlets to ensure that they remain unblocked and the integrity of the screens remains intact. Any debris present will be removed. If damage is evident, appropriate remedial action will be taken. The level of action will be responsive to the observation and will be sufficient to ensure safe operation of the facility.

Response to any finding potentially affecting the safe operation of the facility will be appropriate to the finding. If a generic problem is indicated, the remaining modules will be inspected and appropriate remedial action taken. It is anticipated that the many conservatisms and safeguards inherent in this design will ensure safe spent fuel storage over the lifetime of the facility.

5.1.1.8 Unloading the DSC from the HSM

a) Using the optical alignment system, align the cask and ram with respect to the HSM.

b) Remove front access cover and rear cover plate and seismic retainer of the HSM and install the ram and grapple.

c) Align the ram with the cask centerline. Extend the ram through the rear access of the HSM until it contacts the DSC.

d) Activate the grapple of the ram.

e) Activate the ram and push the DSC into the cask.

f) Retract the ram piston out of the cask and HSM.

g) Slowly pull the cask forward 1 foot away from the HSM.

h) Place the cask lid onto the cask and bolt the lid into place.

i) Close the front and rear accesses to the HSM.

The fuel is in a safe configuration in the DSC within the IF-300 shipping cask.

5.1.2 FLOW SHEET

A flow sheet for the handling operations is presented in Figure 5.1-3.

5.1.3 IDENTIFICATION OF SUBJECTS FOR SAFETY ANALYSIS

5.1.3.1 Criticality Prevention

Criticality is prevented by geometrical separation of the guide sleeves and by boron poison contained in the boral guide sleeves of the canister basket. All DSC baskets will include seven boral guide sleeves.

5.1.3.2 Chemical Safety

There are no chemicals used during the operation of the ISFSI that require special precautions.

5.1.3.3 Operation Shutdown Modes

The ISFSI is a totally passive system and therefore this section is not applicable.

5.1.3.4 Instrumentation

The ISFSI is a totally passive system requiring no instrumentation. However, some of the units were temporarily instrumented for experimental purposes only. The description of the instrumentation is provided in section 4 of this report.

5.1.3.5 Maintenance Techniques

The ISFSI is a totally passive system and therefore will not require maintenance. However, to insure that the airflow is not interrupted, the module will be periodically inspected to insure that no debris is in the airflow inlet or outlet. This inspection will be performed daily (see chapter 10).

5.2 FUEL HANDLING SYSTEMS

5.2.1 SPENT FUEL HANDLING AND TRANSFER

The ISFSI is a modular storage system which provides for the dry storage of irradiated fuel in a horizontal position with natural draft cooling of the dry storage canister. The ISFSI is located within the HBR2 protected area and utilizes HBR2's existing system for handling the irradiated fuel and irradiated fuel cask. The DSC is designed to be used for transporting the spent fuel to a federal repository and can be removed from the HSM as described in Section 5.1.1.8.

5.2.1.1 Functional Description

Figure 5.1-3 presents the flow diagrams for the transfer, loading and retrieval operations. The transfer system is composed of the HBR2 fuel handling system, the GE IF-300 irradiated fuel cask, a transport skid, an optical alignment system, the hydraulic ram, and the HSM T-section guides. Table 5.2-l lists these major systems and their important subsystems.

a) HBR2 Fuel Handling System - The ISFSI is designed to utilize the existing HBR2 fuel handling system. The major components of this system that will be employed during the cask loading operation are the spent fuel pit bridge, the spent fuel cask handling crane, and the spent fuel cask lifting yoke. A description of these components is provided in Section 9.1.4 of the HBR2 Updated FSAR (Reference 5.2).

b) HBR2 Decontamination Facility - The HBR2 cask decontamination facility will be used to decontaminate the irradiated fuel cask. It also provides the location for preparing the DSC.

c) Irradiated Fuel Cask - The General Electric IF-300 Shipping Cask is used to transfer the loaded DSC to and from the HSM. The cask provides shielding along the axial length of the fuel during the transfer, loading, and retrieval operations. A description of the cask's cooling and shielding capabilities is provided in the IF-300 Shipping Cask Safety Analysis Report (Reference 5.3).

   The DSC surfaces will be treated with a lubricant that is compatible with the spent fuel pool chemistry. The cask docking collar is a circular ring of steel which is bolted to the top of the cask. The top six inches of the cask docking collar are seated inside of the HSM walls. The cask, HSM, and docking collar serve as the shield for radiation during the transfer operation.

   The cask auxiliary components described above aid in the horizontal transfer of the DSC and were previously described in sections of this document and the NUHOMS Topical Report (Reference 5.1).

d) Cask Positioning Skid - The purpose of the skid is to transport the cask in a horizontal position to the HSM and to maintain the cask in the properly aligned position during the loading and retrieval operations.

e) Optical Alignment System - Once the loaded skid has been positioned at the HSM front access, the cask will be aligned with the HSM. The alignment system consists of a precision transit and targets installed on the cask, skid, and HSM as required. Once the cask is aligned with the HSM, the jack system and cask clamping system will insure that the alignment is maintained throughout the transfer or retrieval operation.

The cask position control system physically moves the cask into precise alignment with the HSM. It consists of a group of hydraulic jacks to adjust vertical position and a set of hydraulic cylinders to control horizontal position.

f) Ram and Grappling Apparatus - The ram is a telescopic hydraulic cylinder which extends from the back of the HSM through the length of the HSM. The grappling apparatus is mounted on the front of the piston. Figures 5.2-l and 5.2-2 show drawings of the hydraulic ram and the grappling apparatus, respectively. The hydraulics for the grappling apparatus are activated and the arms move out between the cover plate and grappling plate. Once the arms are extended, they are locked into position, the ram is retracted, pulling the DSC out of the cask and into the HSM. For retrieval of the DSC, the process is reversed.

g) HSM T-Section Guide - During the transfer operation, the DSC will slide out of the cask and onto the T-section guides, which are within the cavity of the HSM. The T-section guides serve as both the sliding surfaces during the transfer operation as well as supports during storage of the DSC.

5.2.1.2 Safety Features

Except for the transfer of the DSC from the cask to the HSM, the loaded DSC will always be seated inside the cask cavity until it is inside the HSM. The safety features of the HBR2 fuel handling systems are described in Section 9.1.4 of the HBR2 Updated FSAR (Reference 5.2). The safety features of the shipping cask are described in the GE IF-300 SAR (Reference 5.3).

To ensure that the minimum amount of force is applied to the DSC during the transfer operation, the surfaces of the DSC may be treated with a solid film lubricant. A low coefficient of friction will minimize the amount of force applied to the DSC, thus minimizing the possibility of damage to the DSC.

The maximum force which may be exerted by the ram is 22,000 lbs. All components of the DSC, ram, grappling assembly and DSC supports are designed to withstand this force. Materials and lubricants are specified so that an operating force of 6200 pounds should easily accelerate the DSC from rest and move it into the HSM. A pressure limitation device in the hydraulic pump will limit the ram force to less than 6200 pounds. The operator can increase the ram force to the 22,000 pound maximum design pressure only by stopping the ram and resetting the limit. Operating procedures will establish the methods for resetting or adjusting the ram speed during travel on extend and retract. It should be noted that it is not expected that a 22,000 pound force will ever be required. However, the system was designed to take such a force if it is ever needed.

5.2.2 SPENT FUEL STORAGE

A description of the operations involved in the transfer and retrieval of the DSC to and from the HSM are presented in Section 5.1. During storage, the ISFSI area will be patrolled and the HSM will be visually inspected once per day. The removal of the DSC from storage was described in Section 5.1.1.8 of this document and the NUHOMS Topical Report (Reference 5.1).

5.2.2.1 Safety Features

The features, systems and special techniques, which provide for the safe loading and retrieval operations are described in Section 5.2.1.2.

TABLE 5.2-l

TRANSFER SYSTEM COMPONENT LIST

HBR2 Fuel Handling System
HBR2 Cask Handling System
HBR2 Decontamination Facility
Irradiated Fuel Shipping Cask
  Cask Docking Collar
  Cask Lid
Cask Positioning Skid
  Tilting Cradle
  Skid Body (with rollers)
  Transport Trailer
Optical Alignment System
  Precision Transit
  Optical Targets
  Cask Position Control System
  Hydraulic Jacks
  Hydraulic Cylinders
  Control Unit
  Cask Clamping System
Hydraulic Ram
  Grappling Device
  Control Unit

5.3 OTHER OPERATING SYSTEMS

The ISFSI is a totally passive storage system, which requires no additional operating systems other than those systems associated with the loading and retrieval of the DSC.

5.3.1 OPERATING SYSTEM

No operating systems are required other than those used in transferring the DSC to and from the HSM.

5.3.2 COMPONENTS/EQUIPMENT SPARES

The only component postulated to be damaged during the life of the installation is the air outlet shielding block. As described in Section 8.2.1, a tornado induced missile could damage or knock off the shielding blocks. Consequently, two additional shielding blocks were precast during construction and are maintained as spares at the site. The screens on the air inlets and outlets will be inspected periodically for damage or blockage by debris. If the screens appear to be damaged they will be replaced. Additional or alternate responses to any event affecting the integrity of the screens will be appropriate to the level of damage or disturbance observed.

5.4 OPERATION SUPPORT SYSTEM

The ISFSI is a self-contained system and requires no instrumentation and control systems to monitor any of the safety-related variables. For research purposes, however, some of the DSCs and the HSMs to be installed at the H. B. Robinson facility were designed to accept instrumentation. Instrumentation was included as part of an agreement between CP&L, EPRI and the DOE to augment the U.S. data base on LWR fuel rods in dry storage.

The instrumentation of these components was limited to placement of the thermocouples. The DSC thermocouples were connected to an external cable by means of a specially designed feed-through. This feed-through incorporates the same redundant seal philosophy used in the DSC containment design. Details of the feed-through are shown in Figure 5.4-l. After the penetration plug assembly was welded to the bottom of the DSC cover plate, a sleeve was welded over the plug, forming a redundant seal. Thermocouple sheaths were brazed to the plug assembly at inner and outer surfaces of the penetrations. To ensure that possible leakage through the aluminum oxide insulation is precluded, each end of the sheathed thermocouple is sealed with an environmentally qualified resin.

HSM instrumentation will consist of thermocouples cast in place in the concrete and others attached to the surface and at various locations on the heat shield.

5.5 CONTROL ROOM AND/OR CONTROL AREAS

The ISFSI requires no control room or control area to safely operate under both normal and off-normal conditions.

5.6 ANALYTICAL SAMPLING

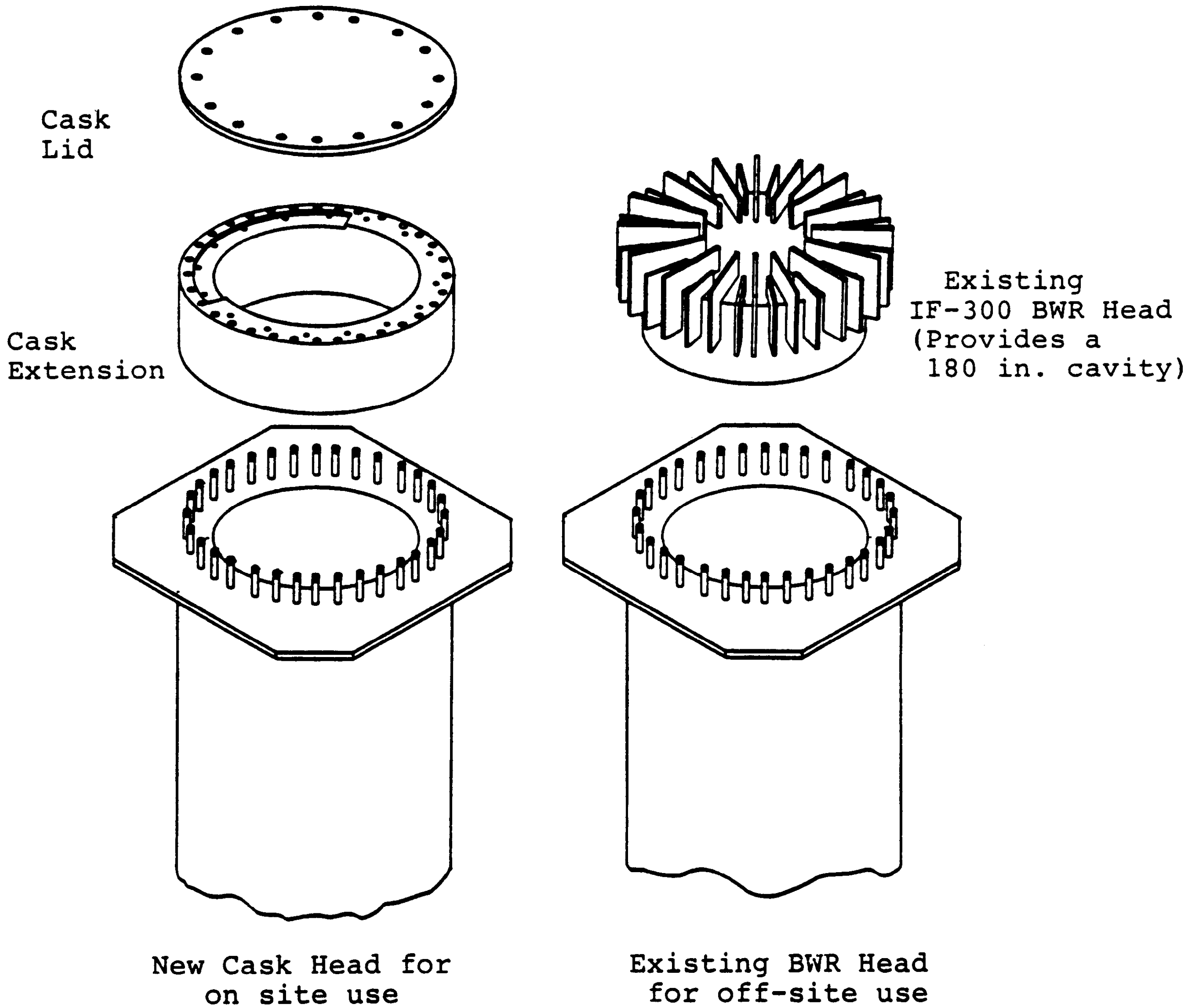
The ISFSI requires no analytical sampling. Any analytical sampling such as DSC surface contamination levels will utilize the existing HBR2 analytical equipment.

REFERENCES: CHAPTER 5

5.1 NUTECH Engineers, Inc., “Topical Report for the NUTECH Horizontal Modular Storage System For Irradiated Nuclear Fuel,” NUH-001, Revision 1, November 1985. (Note – currently NUH-001, Rev. 2)

5.2 Carolina Power and Light Company, “H. B. Robinson Steam Electric Plant Unit No. 2 Updated Final Safety Analysis Report,” Docket No. 50-261, License No. DPR-23.

5.3 General Electric Co., “IF-300 Shipping Cask Consolidated Safety Analysis Report, "NEDO-10048-2, Nuclear Fuel and Special Products Division, March 1983. (Note – currently NEDO-10084-5 issued by Duratek)



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CASK EXTENSION FOR THE
GE IF-300 CASK
Figure 5.1-1

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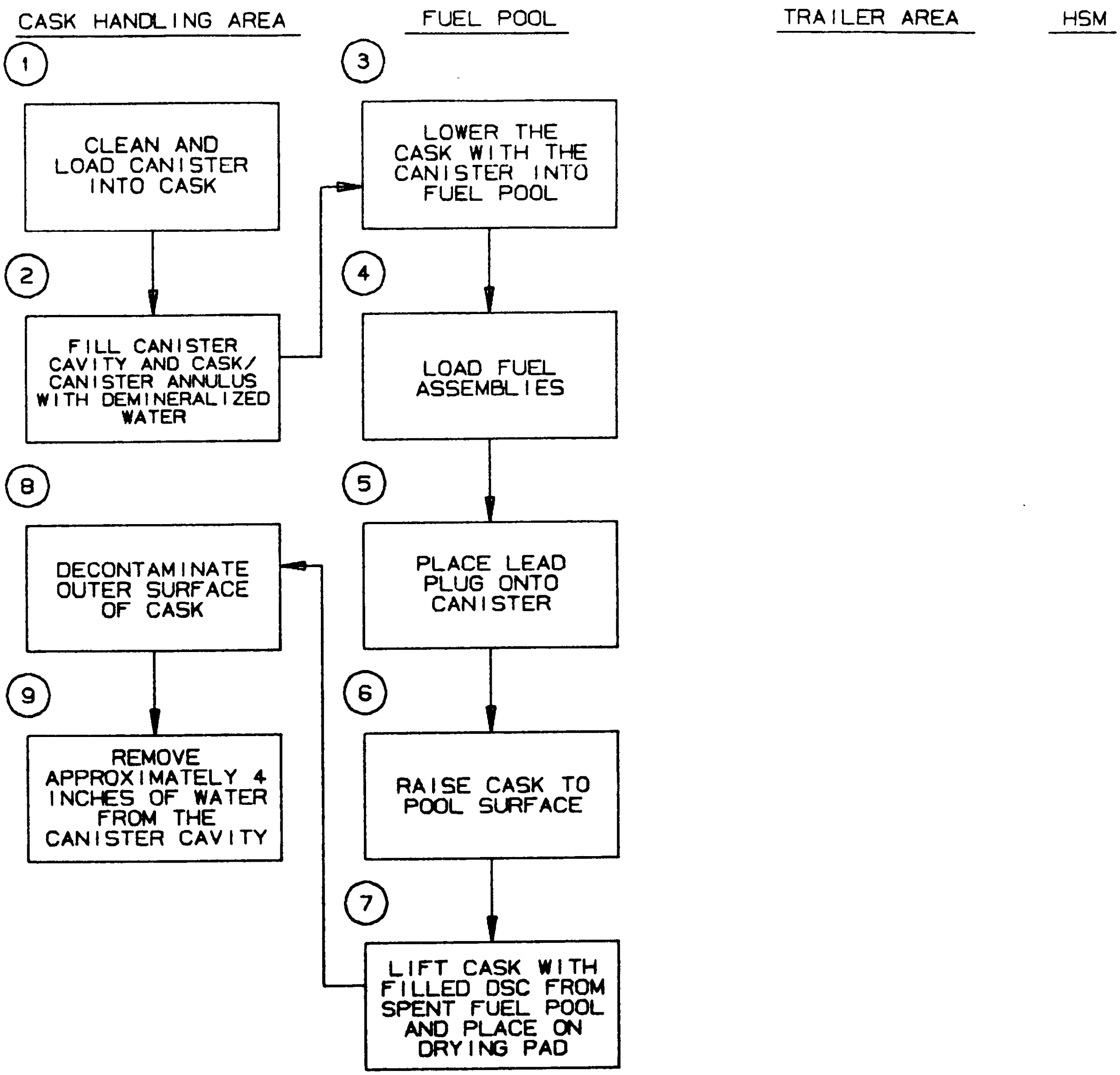
CASK LINER FOR THE
GE IF-300 CASK
Figure 5.1-2



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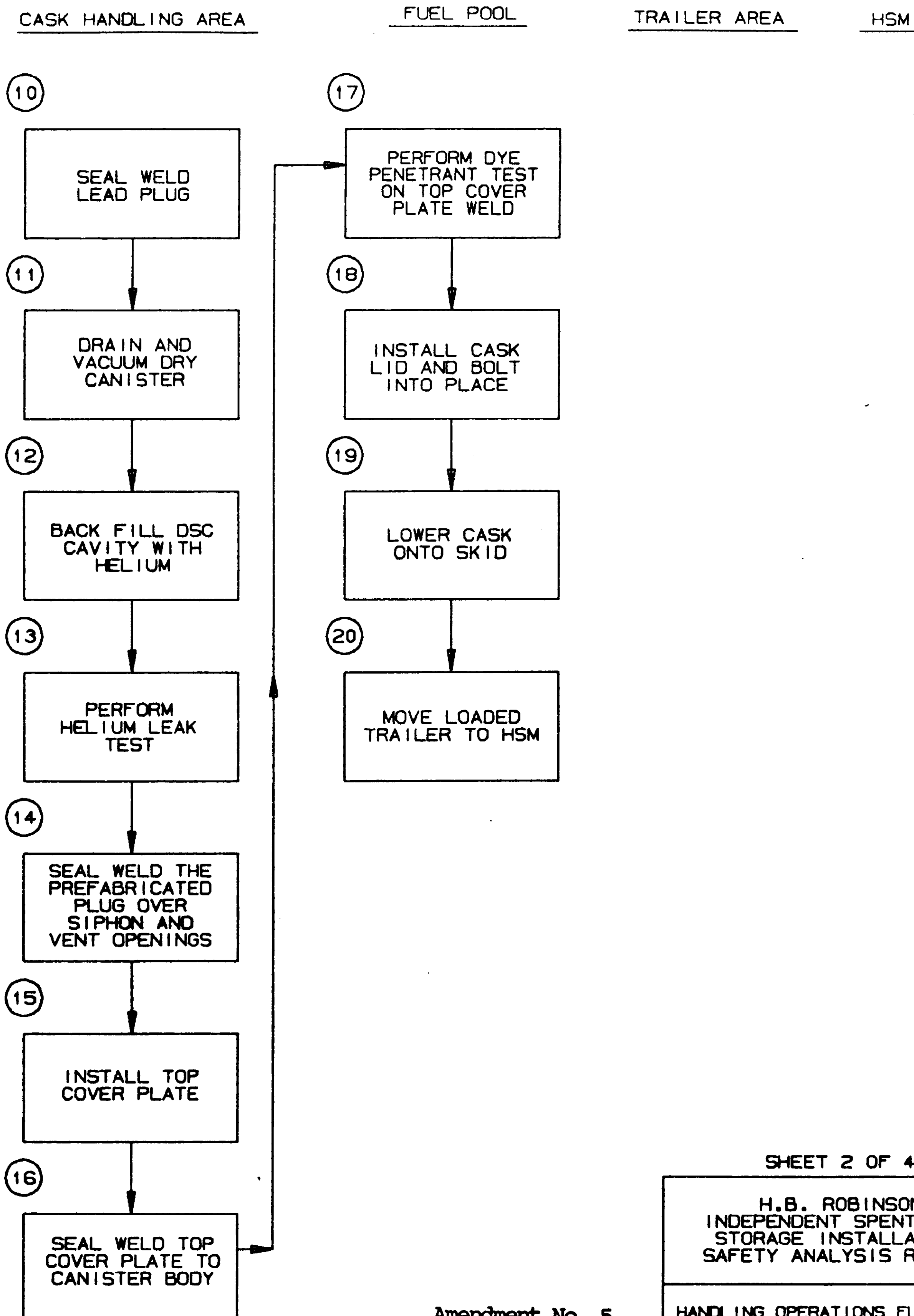
HANDLING OPERATIONS FLOW SHEET
FIGURE 5.1-3

Amendment No. 5



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HANDLING OPERATIONS FLOW SHEET
FIGURE 5.1-3

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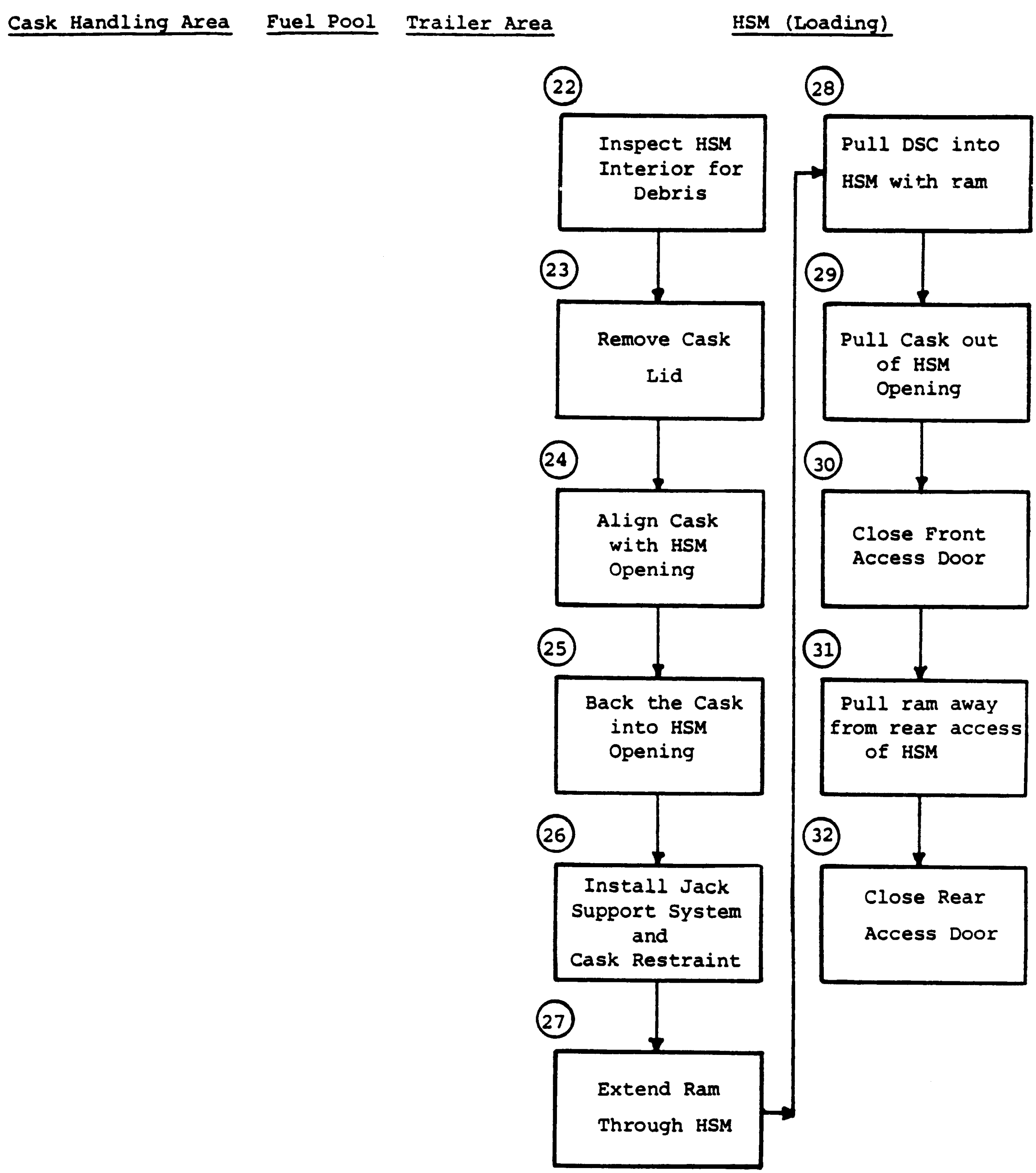

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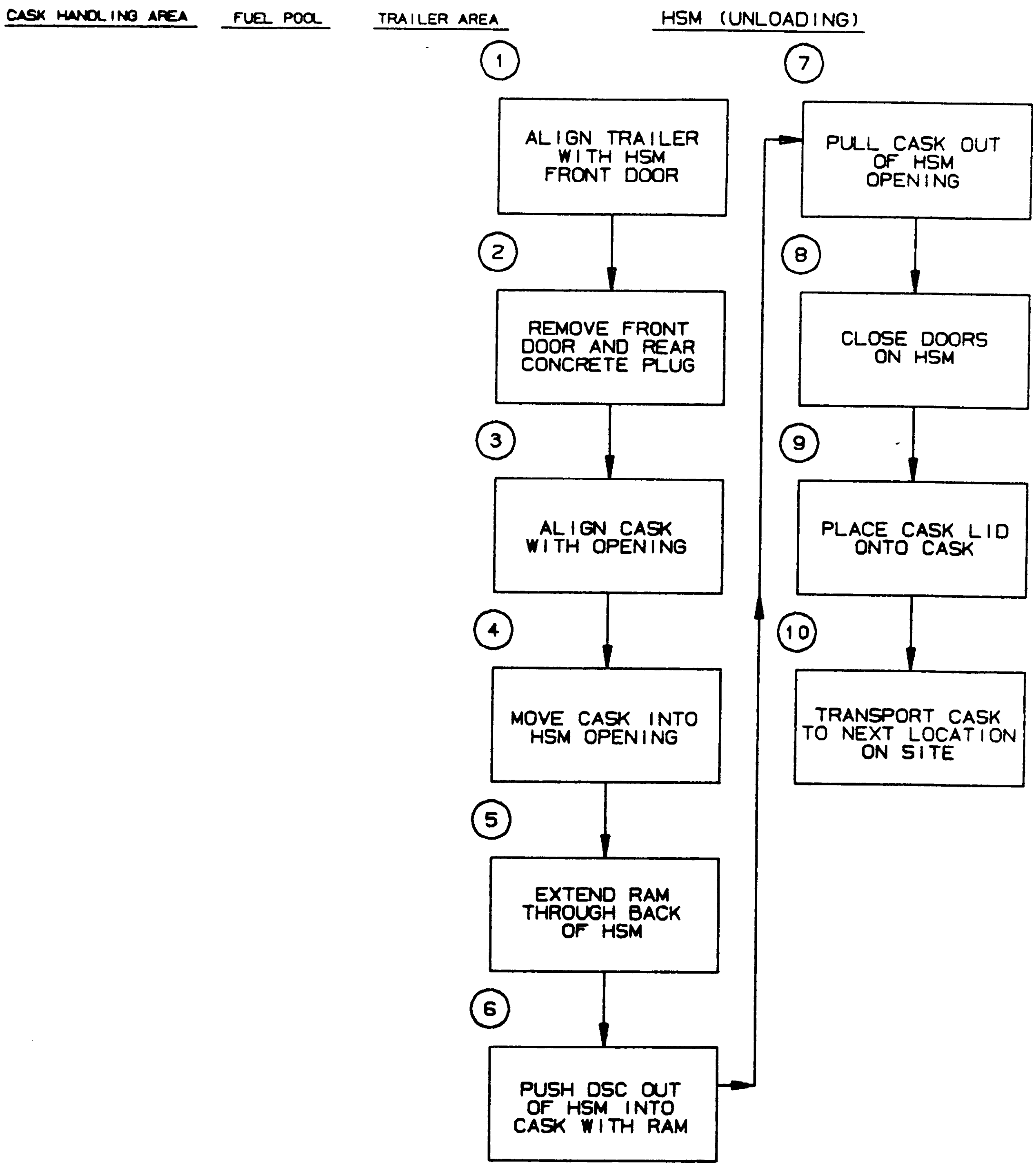
**HANDLING OPERATIONS FLOW SHEET
Figure 5.1-3**



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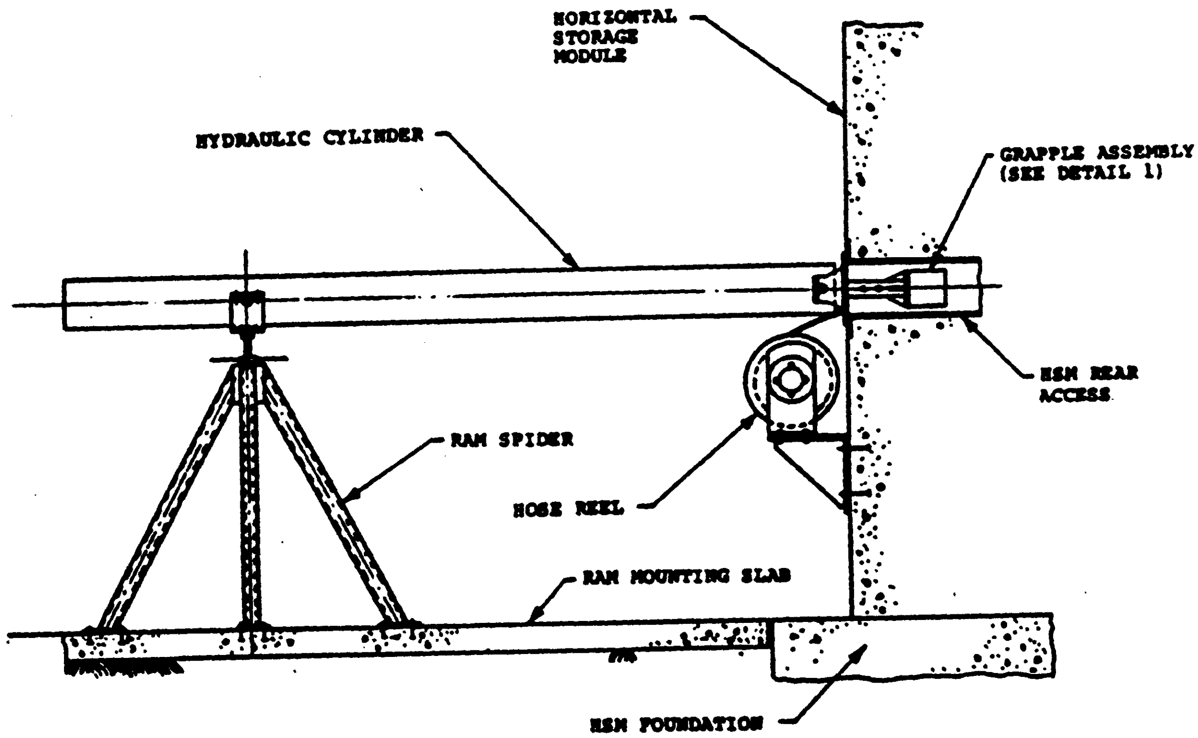
HANDLING OPERATIONS FLOW SHEET
FIGURE 5.1-3



AMENDMENT 1

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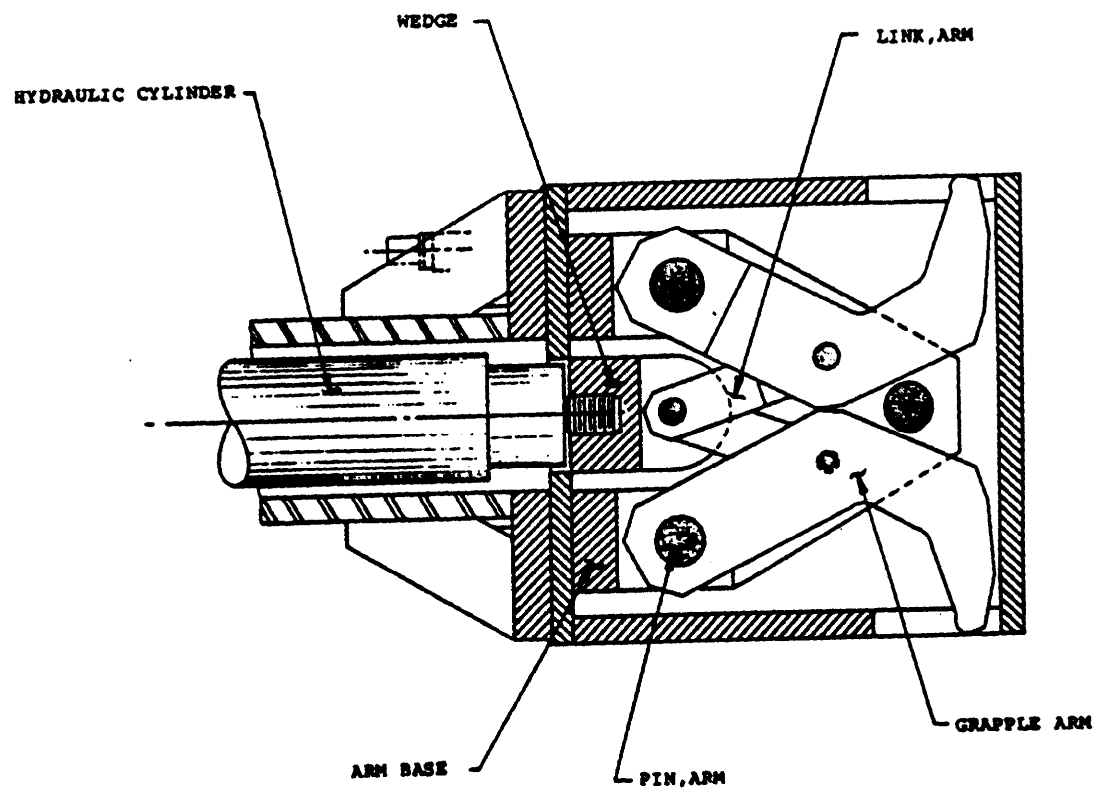
HYDRAULIC RAM SYSTEM

Figure 5.2-1



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DSC GRAPPELING SYSTEM

Figure 5.2-2

Figure Withheld Under 10 CFR 2.390

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Figure 8.4-1

DSC INSTRUMENT LOCATIONS