CHAPTER 1

INTRODUCTION AND GENERAL DESCRIPTION OF INSTALLATION

1.0 INTRODUCTION AND GENERAL DESCRIPTION OF INSTALLATION

1.1 INTRODUCTION

Carolina Power & Light Company (CP&L) entered into an agreement with the U. S. Department of Energy (DOE) to conduct a licensed at-reactor dry storage demonstration program for spent nuclear fuel to be located at the H. B. Robinson Steam Electric Plant Unit No. 2 (HBR2). This document provides the safety analysis report (SAR) required as part of the license application under 10 CFR Part 72, "Licensing Requirements for the Storage of Spent Fuel in an Independent Spent Fuel Storage Installation (ISFSI)." This SAR is organized in accordance with the guidelines contained in Regulatory Guide 3.48. If information intended to be included in this SAR is redundant to information already included in the Updated Final Safety Analysis Report (UFSAR) for the HBR2 operating license, then such information will be included by reference to the UFSAR, Reference 1.4. Table 1.1-1 lists the acronyms and Table 1.1-2 lists the abbreviations used throughout this document.

The Nuclear Waste Policy Act of 1982 (NWPA) established 1998 as an operational date for a spent fuel/high level radioactive waste repository. To assist utilities in providing for spent fuel storage until a repository is operational, the Nuclear Waste Policy Act requires DOE to ". . . establish a demonstration program in cooperation with the private sector, for the dry storage of spent nuclear fuel at civilian nuclear power reactor sites, with the objective of establishing one or more technologies that the Commission [NRC] may by rule approve for use at the sites of civilian nuclear power reactors without, to the maximum extent practicable, the need for additional site-specific approvals by the Commission." Accordingly, on May 9, 1983, the DOE issued its Solicitation for Cooperation Agreement Proposal (#DE-SC06-83RL10432) for a Licensed, At-Reactor, Dry Storage Demonstration Program. Carolina Power & Light Company, in response to the DOE solicitation, submitted a proposal on August 23, 1983 to DOE to demonstrate the NUTECH Engineers, Inc. (NUTECH) Horizontal Modular Storage (NUHOMS) system at the site of the H. B. Robinson Steam Electric Plant Unit No. 2. DOE accepted CP&L's proposal in October 1983, and the contract was signed in March 1984 (Reference 1.1). The Electric Power Research Institute (EPRI) also entered into the program as a participant. EPRI, in particular, was involved in the research and development aspects of the program.

The NUHOMS system is the dry storage design used for the H. B. Robinson (HBR) ISFSI. In addition to this SAR, Revision 1 of the generic Topical Report for the NUHOMS system, submitted by NUTECH in November 1985 (Reference 1.2), provided the details of the system to be utilized at HBR2. Revision 2 of the NUHOMS Topical Report was issued in March 1990 (Reference 1.6). Figure 1.1-1 shows the primary components of the HBR ISFSI. The location of the ISFSI on the Robinson site is shown on Figure 1.2.2-1 of the UFSAR.

The NUHOMS system provides long-term interim storage for irradiated fuel assemblies. The fuel assemblies are confined in a helium atmosphere by a stainless steel canister. The canister is protected and shielded by a massive concrete module. Decay heat is removed by thermal radiation, conduction and convection from the canister to an air plenum inside the concrete module. Air flows through this internal plenum by natural draft convection.

The canister containing seven irradiated fuel assemblies is transferred from the reactor fuel pool to the concrete module in a transfer cask. The cask is precisely aligned and the canister is inserted into the module by means of a hydraulic ram.

The NUHOMS system is a totally passive installation that is designed by analysis to provide shielding and safe confinement of irradiated fuel. The dry shielded canister and horizontal storage module have been designed to function during and withstand certain accidents as described in this SAR.

The fuel assemblies stored in the ISFSI were previously located in the HBR2 spent fuel pool and were irradiated in the HBR2 reactor. Seven fuel assemblies are stored in each dry shielded canister. One dry shielded canister is stored in each concrete module. A total of eight modules have been constructed and filled with a total of 56 fuel assemblies.

TABLE 1.1-1

ACRONYMS

ACI	American Concrete Institute
A/E	architect/engineer
AIF	Atomic Industrial Forum
AISC	American Institute of Steel Construction
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASTM	American Society of Testing and Materials
CP&L	Carolina Power & Light Company
CQAD	Corporate Quality Assurance Department
CVCS	Chemical and Volume Control System
DBT	Design Basis Tornado
DOE	U. S. Department of Energy
DSC	dry shielded canister
E	East
EEI	Edison Electric Institute
ENE	East Northeast
EOC	Emergency Operations Center
EPRI	Electric Power Research Institute
FHB	Fuel Handling Building
FSAR	Final Safety Analysis Report
GE	General Electric Company
HBR	H. B. Robinson Steam Electric Plant
HBR2	H. B. Robinson Steam Electric Plant Unit No. 2
HSM	horizontal storage module
IC	internal combustion
IFA	irradiated fuel assembly
ISFSI	independent spent fuel storage installation
N	North
NC	North Carolina
NE	Northeast
NED	Nuclear Engineering Department
NFS	Nuclear Fuel Section
NNE	North Northeast
NNW	North Northwest
NRC	Nuclear Regulatory Commission
NUHOMS	NUTECH Horizontal Modular Storage
NUTECH	NUTECH Engineers, Inc.
NW	Northwest
NWPA	Nuclear Waste Policy Act of 1982
ONRR	Office of Nuclear Reactor Regulation
PWR	pressurized water reactor
QA	quality assurance
QC	quality control
RG	Regulatory Guide
SAR	Safety Analysis Report
SC	South Carolina
SE	Southeast
SSE	safe shutdown earthquake
SSE	South Southeast

TABLE 1.1-1 (Cont'd)

SSW	South Southwest
SW	Southwest
UFSAR	Updated Final Safety Analysis Report for HBR2 Operating License – Reference 1.4
US	United States
UTM	Universal Transverse Mercator
WDS	Waste Disposal System
WNW	West Northwest
10CFR	Code of Federal Regulations, Title 10

TABLE 1.1-2

ABBREVIATIONS

atm	atmosphere
bar	bar
cm	centimeter
ºC	degrees Centigrade
ºF	degrees Farenheit
fps	feet per second
ft/s	feet per second
ft	foot
ft-lb	foot pounds
He	helium
kg	kilogram
kw	kilowatt
k-in	kip inch
ksi	kips per square inch
Kr-85	Krypton 85
MWd/MT	megawatt days per metric ton
MWe	megawatts electric
MWt	megawatts thermal
Hg	Mercury
m	meter
FCi/cm^2	microcuries per square centimeter
mph	miles per hour
mm	millimeter
mrem/hr	millirem per hour
mR/hr	milliroentgen per hour
k_{eff}	neutron multiplication factor, effective
N	Newton
Pu-239	Plutonium-239
Pu-241	Plutonium-241
lb	pound
lb_f	pounds-force
psf	pounds per square foot
psi	pounds per square inch
psia	pounds per square inch, atmospheric
psig	pounds per square inch, guage
sec	second
sq. mi.	square mile
kips	thousand pounds
ton	ton
U-235	Uranium 235

1.2 GENERAL DESCRIPTION OF INSTALLATION

1.2.1 GENERAL DESCRIPTION

The ISFSI provides for the horizontal, dry storage of irradiated fuel assemblies (IFAs) in a concrete module. The principal components are a concrete horizontal storage module (HSM) and a steel dry shielded canister (DSC) with an internal basket which holds the IFAs.

Each HSM contains one DSC and each DSC contains seven fuel assemblies. The modules are constructed on a common foundation and are interconnected. The outer, exposed walls are 3 1/2 feet thick concrete to provide the necessary shielding. The initial phase of construction included three modules. A total of eight modules have been built and operated at the Robinson site. The second foundation for the additional five modules is constructed nearby, but separate from the initial three. It was determined that construction of the additional five modules would not have any impact on continued operation of the initial three modules. Figure 1.2-1 shows the configuration of the HBR ISFSI.

In addition to these primary components, the HBR ISFSI also requires transfer equipment to move the DSCs from the irradiated fuel pool (where they are loaded with the IFAs) to the HSMs where they are stored. This transfer system consists of a transfer cask, a hydraulic ram, a tow vehicle, a trailer and a cask skid. This transfer system interfaces with the existing HBR2 irradiated fuel pool, the cask crane, the site layout (i.e., roads and topography) and other procedural requirements.

1.2.2 PRINCIPAL SITE CHARACTERISTICS

The ISFSI is located on the H. B. Robinson Steam Electric Plant site near Hartsville, South Carolina. Carolina Power & Light Company owns and operates a 2339 MWt nuclear generating unit (Unit 2) and a 185 MWe fossil-fueled generating unit (Unit 1) on the Robinson site. The ISFSI is located within the Unit 2 protected area approximately 600 ft. west of the Unit 2 containment building.

1.2.3 PRINCIPAL DESIGN CRITERIA

The principal design criteria and parameters for the HBR ISFSI are shown in Table 1.2-1. The radiation sources are for the maximum burnup fuel. For the fuel to be stored, the radiation sources shall be less than or equal to the sources described in Table 1.2-1.

1.2.3.1 Structural Features

The HSM is a low profile reinforced concrete structure designed to withstand normal operating loads, the abnormal loads created by seismic activity, tornados and other natural events and the postulated accidental loads which may occur during operation.

The structural features of the DSC are defined, to a large extent, by the cask drop accident. The operational procedures for the transfer of the cask from fuel pool to the module site are such that the maximum height at which a credible cask drop can occur is limited to 2.44 m (8 ft). The detail description of the cask handling procedure and the transfer operation is presented in Sections 1.3.1.7 and 8.2.4 of this report. The canister body, the double containment welds on each end, and the DSC internals are designed to provide their intended safety functions after a 2.44 m (8 ft) drop. In fact, the original design of the DSC and its internals, as presented in the NUHOMS topical report, has been modified to withstand decelerations associated with drop heights significantly higher than 2.44 m (8 ft) limit. However, the 2.44 m (8 ft) drop is the minimum requirement used as a design criteria, since it envelopes any actual drop accident that could occur at the Robinson site. The details of the cask drop accident are contained in Section 8.2.4 of this report.

1.2.3.2 Decay Heat Dissipation

The decay heat of the IFAs is removed from the DSC by natural draft convection. Air enters the lower part of the HSM, rises around the DSC and exits through the top shielding slab. The flow cross-sectional area is designed to provide adequate air flow from the draft height of the HSM and the inlet and outlet air temperature differences for the hottest day conditions (i.e., 51.7^{o}C (125^{o}F) inlet and 98.9^{o}C (210^{o}F) outlet).

1.2.4 OPERATING AND FUEL HANDLING SYSTEMS

The major operating systems of the ISFSI are those required for fuel handling and transport of the fuel from the spent fuel pool to the ISFSI. General operations are outlined in Table 1.2-2 and the primary design parameters of the required systems are listed in Table 1.2-3. The fuel handling operations involving the cask (i.e., fuel loading, drying, trailer loading, etc.) and the remaining operations (cask-HSM alignment and DSC transfer) are unique to the ISFSI. Procedures for these activities were developed using H. B. Robinson fuel shipment procedures and experience gained during testing of the ISFSI.

1.2.5 SAFETY FEATURES

The principal safety feature of the ISFSI is the containment provided by the DSC and the concrete shielding of the HSM. This shielding reduces the gamma and neutron flux emanating from the IFAs inside a DSC so that the average outside surface dose rate on the HSM is less than 20 mrem/hr. Additional ISFSI safety features include:

a) Filling the DSC and cask annulus with demineralized water and providing a seal prior to lowering them into the spent fuel pool **-** Minimizes contamination of the DSC exterior by pool water.

b) Internal shield blocks inside the HSM **-** Reduces scatter dose out of the air inlet.

c) External shield blocks on the HSM **-** Reduces scatter dose out of the air outlet.

d) Shield plugs on the DSC **-** Reduces dose during DSC drying, helium filling and seal welding.

e) Double containment closure welds on each end of the DSC - Prevent leakage of radioactive gases or particulates if the fuel rods should fail.

1.2.6 RADIOACTIVE WASTE AND AUXILIARY SYSTEMS

Because of the passive nature of the ISFSI, there are no radioactive waste or auxiliary systems required during normal storage operations. There are, however, some waste and auxiliary systems required during DSC loading, drying and transfer into the module. The HBR2 waste systems handle the fuel pool water and air and inert gas which are vented from the DSC and cask during drying. Auxiliary handling systems (such as hydraulic pressure control, alignment, crane, etc.) are also required during the loading and transfer operation.

TABLE 1.2-1

DESIGN PARAMETERS FOR THE HBR ISFSI

Category	Criterion or Parameter	Value
Fuel Acceptance Criteria	Fissile Content	3.5% Fissile (U-235 Equivalent)
	Radiation Source	
	Gamma	5.73×10^{15} photons/sec/assembly[1]
	Neutron	1.67×10^{8} neutron/sec/assembly
	Heat Load	1 KW/Assembly
Dry Shielded Canister	Capacity per Canister	7 PWR Fuel Assemblies
	Size	
	Length (typical)	4.56m (179.5 in)
	Diameter	0.94m (36.9 in)
	Temperature (max. fuel rod clad)	380°C (716°F)
	Cooling	Natural Convection
	Design Life	50 Years[2]
	Material	304 Stainless Steel with Lead End-Shields
	Internal Helium Pressure	0.0 psig " 0.5 psig
Horizontal Storage Module	Capacity	1 Dry Shielded Canister per Module
	Unit Size	3 modules per Unit
	Length	6.71m (22.00 ft)
	Height	3.81m (12.50 ft)
	Width	7.54m (24.75 ft)
	Unit Size	5 modules per Unit
	Length	6.71m (22.00 ft)
	Height	3.81m (12.50 ft)
	Width	11.86m (38.92 ft)
	Surface Radiation Dose Rate (average on contact)	20 mrem/hr
	Material	Reinforced Concrete
	Design Life	50 years[2]

1 Actual design limits are for seven assemblies in the DSC with source rates of 1.17×10^{9} neutrons/sec/DSC and 4.01×10^{16} photons/sec/DCS.

2 Expected life is much longer (hundreds of years); however, initial license application is for 20 years only. Future amendments may seek to extend the life.

TABLE 1.2-2

SUMMARY OF
ISFSI FUEL HANDLING OPERATIONS

1. Clean the DSC and load it into the transfer cask.
2. Fill the cask annulus and DSC with demineralized water.
3. Place the top lead plug on the DSC.
4. Lift the cask containing the DSC into the spent fuel pool.
5. Remove the top lead plug.
6. Load the fuel into the DSC.
7. Place the top lead plug on the DSC.
8. Install the cask collar lid.
9. Lift the cask containing the filled DSC out of the spent fuel pool and move it to the cask decontamination facility.
10. Drain water from the cask and DSC to a level approximately two inches below the top surface of the lead plug (approximately 15 gallons).
11. Seal weld the top lead plug onto the DSC body.
12. Perform liquid penetrant examination of top lead plug seal weld.
13. Drain the water from the cask annulus.
14. Drain, evacuate, and dry the DSC interior.
15. Backfill the DSC with helium.
16. Perform helium leak test.
17. Seal weld plugs in the drain and vent lines of the DSC.
18. Perform liquid penetrant examination of drain and vent line plug welds.
19. Perform helium leak test of drain and vent line plug welds.
20. Place and seal weld the top cover plate.
21. Perform liquid penetrant test on top cover plate weld.
22. Install the cask collar lid.
23. Lift the cask onto the trailer and lower it into the horizontal position.
24. Tow the trailer to the HSM.
25. Remove the HSM front access cover.
26. Remove the cask collar lid.
27. Align the cask and the HSM.
28. Insert the hydraulic ram.
29. Pull the DSC into the HSM.
30. Move the cask and the trailer away from the front of the HSM.
31. Replace and tack weld the HSM front access cover.
32. Disassemble the hydraulic ram from the rear of the HSM.
33. Install the seismic retainer and rear cover plate.

TABLE 1.2-3

PRIMARY DESIGN PARAMETERS FOR THE
ISFSI OPERATING SYSTEMS

System	Parameters	Value
Cask	Cavity Diameter	0.953m (37.5 in.)
	Cavity Length	4.572m (180 in.)
	Payload Capacity	9524 kg (21,000 lb)
	Heat Rating	$\geq$ 7kw
	Shielding (Surface Dose)	200 mrem/hr
Cask Movement	Liftable by Crane	N/A
	Rotatable by Crane from Vertical to Horizontal	N/A
Cask Lid	Removable in Horizontal Position	N/A
Trailer and Skid	Truck Transportable	N/A
	Cask Lid Must Protrude Past End of Trailer and Skid	15.25cm (6 in.)
	Capacity (Trailer)	73,000kg (80 tons)
	(Skid)	100,000kg (110 tons)
	Positioning Capability	6 in. Vertically 5 in. Towards Module 3 in. Parallel to Module

1.3 GENERAL SYSTEMS DESCRIPTIONS

The major systems, subsystems, and components of the HBR ISFSI are shown in Table 1.3-1. The following subsections briefly describe the principal systems and components and their operation.

1.3.1 SYSTEMS DESCRIPTIONS

1.3.1.1 Canister Design

Figure 1.3-1 shows the dry shielded canister. The DSC is sized to hold seven irradiated pressurized water reactor (PWR) fuel assemblies. The main component of construction is a stainless steel cylinder with a 0.5 inch wall and 0.94m (36.9 in.) outside diameter. The overall length is 179.5 in. The general system description of the canister design is available in the NUTECH Topical Report.

1.3.1.2 Horizontal Storage Module

An isometric view of a unit of three HSMs is shown in Figure 1.2-1. The HSM provides a unitized modular storage location for irradiated fuel. The HSM is constructed from reinforced concrete and structural steel. The modules were constructed in place at the storage location. The thick concrete walls and roof of the HSM provide adequate neutron and gamma shielding. The general systems description of the HSM is provided in the NUTECH Topical Report.

The HSMs are placed in service on a load bearing foundation. Certain civil work was required to prepare the storage site for a level foundation and access area. This work included the relocation of any existing underground utilities, excavation, backfill, compaction and leveling. Also, a 4 inch mud slab was placed on the leveled subgrade to provide smooth working surface for the placement of the foundation.

1.3.1.3 Transfer Cask

The transfer cask used with the ISFSI provides shielding during the DSC drying operation and during the transfer to the HSM. For the HBR ISFSI, the IF-300 cask (which CP&L owns) licensed under 10CFR71 as a transportation cask was used (Reference 1.3). In order to meet the cask cavity minimum length requirement and the criteria for cask collar lid removal in the horizontal position, the IF-300 cask requires an addition. The addition includes an extension collar (12.5 inches long and approximately 6 inches thick) with the inside diameter the same as that of the cask, and a 1 inch thick cask collar lid. In this modified configuration the energy absorbing properties of the cask is significantly reduced. However, as described in detail in Section 8.2.4 of this report there is no credible condition during the cask handling and transfer operation in which the cask could be dropped on its head. Hence, the removal of the cask head with its radial impact limiting fins does not affect the safety features of the ISFSI transfer operation.

1.3.1.4 Transporter

The transporter consists of a trailer with a capacity of 80 tons. The trailer carries the cask skid and the loaded transfer cask. The trailer is designed to ride as low to the ground as possible to minimize the HSM height. Four hydraulic jacks are placed under the trailer to provide vertical movement for alignment of the cask and HSM. The trailer is pulled by a conventional tractor.

1.3.1.5 Skid

The cask positioning skid is a welded wideflange frame assembly, which houses the cask cradle support and the cask saddle assemblies. These components are welded to the skid frame. The cask cradle and its support provide the rotational capabilities required to orient the cask from vertical to horizontal position. Once in the horizontal position the cask will be seated on the saddle and will be prevented from further movement. The skid is seated on 75 ton (minimum) capacity guided Hilman Rollers at each corner. There are four hydraulic positioner cylinders mounted on the skid frame and the trailer bed. The rollers and the cylinders will be used for the final alignment of the cask and the HSM. The entire skid assembly is seated on the trailer bed. During towing of the trailer, the skid is secured to the trailer bed by means of tie down brackets.

The skid and its various components are designed to withstand the inertia forces associated with transportation shocks. The features of the skid described above are shown in Figure 1.3-3.

1.3.1.6 Horizontal Hydraulic Ram

The horizontal hydraulic ram is a telescopic, hydraulic boom with a minimum capacity of 22,000 lb_f and a reach of 25 ft. The ram will be mounted on the concrete foundation and wall of the HSM on the opposite side from the loading position. Figure 1.3-4 shows the hydraulic ram.

1.3.1.7 System Operation

The primary operations (in sequence of occurrence) for the HBR system are shown schematically in Figure 1.3-5 and are described below:

a) Cask Preparation - Cask preparation includes exterior washdown and interior decontamination. These operations are done in the HBR2 cask decontamination facility outside the spent fuel pool area. The operations are standard cask operations and have been previously performed by CP&L personnel. Detailed procedures for these operations are described in Chapter 5.

b) Canister Preparation - The canister exterior is wiped down with demineralized water. The interior is cleaned of any debris as required. This ensures that the newly fabricated canister will meet existing HBR2-specific criteria for placement in the spent fuel pool.

c) Cask-Canister Loading - The empty canister is inserted into the cask. Proper alignment is assured by visual inspection.

d) Cask Lifting and Placement in the Pool - The cask annulus and DSC inside the cask are filled with demineralized water. A seal is then installed. This prevents an inrush of pool water when the cask with the DSC is placed in the spent fuel pool. This will also reduce (if not prevent) contamination of the DSC outer surface by the pool water. The cask with the DSC inside is then lifted into the fuel pool.

e) Canister-Assembly Loading - Seven irradiated fuel assemblies are placed into the canister basket. This operation is performed using approved ISFSI procedures.

f) Cask Collar Lid Placement - The cask collar lid placement operation consists of placing the DSC upper end-shield plug inside the DSC using the overhead crane. The cask collar lid is then placed on the cask using temporary guide pins and it is raised to the surface where the cask collar lid bolts are installed. The cask collar lid firmly holds the DSC in place while in the cask.

g) Cask Lifting out of the Pool - The filled and closed cask is lifted out of the spent fuel pool and placed (in the vertical position) on the drying pad inside the decontamination area. This operation is performed using ISFSI procedures. During this operation the overhead crane is equipped with a redundant yoke and as such is operating in a single failure proof mode. The use of the redundant yoke eliminates the possibility of any drop accident at this stage of operation.

h) Canister Sealing - The seal is removed from the cask/DSC annulus. Using the cask drain valve, a sufficient amount of water is drained from the annulus so as to enable a contamination survey to be performed approximately 12 inches below the top of the DSC shell. Should the contamination values from the annulus survey be higher than acceptable, the annulus may be flushed using demineralized water to reduce the contamination levels in this area. Using a pump, the water level in the canister is reduced to approximately 2 inches below the bottom surface of the top lead shield plug. A seal weld is applied to the interface of the DSC shell and the lead shield plug. This provides the primary seal for the DSC. After completion of this weld, the remaining water is removed from the DSC interior in preparation of backfilling with helium to perform a helium leak test of the weld.

i) Cask-Canister Drying - Initial removal of water from the DSC is accomplished by connecting a hose from the instrument air supply to the DSC vent connection. A second hose is then connected to the DSC siphon connection and routed to the drain manifold at CD-7. The instrument air valve is opened and the air flow recalculated. When the DSC is drained, the instrument air valve is closed. Following evacuation of the water from the DSC using compressed air, the vacuum drying system is connected to the DSC and activated to facilitate DSC drying until the water content meets the design criteria.

j) Helium Filling - In order to ensure that no fuel and/or cladding oxidation occurs during storage, the canister is filled with helium (He). To accomplish this, a portable He gas bottle is connected to the piping/tubing of the vacuum drying system.

The canister is filled with He gas (by activating valves) to a minimum pressure of 25 psig and a helium leak test is performed. The pressure is then reduced to 0.0 psig. After the canister is filled with the inert gas, the vent and drain lines are removed and the DSC vent and drain line connectors are plugged and welded closed. These welds are then checked for inert gas leakage. When the steel cover plate is then welded in place, the integrity of the penetrations is assured.

k) Final Canister Sealing **-** After the inert gas filling, the steel cover plate is positioned and seal welded. This provides a redundant seal at the upper end of the DSC. The lower end also has redundant seal welds, which were made and tested during fabrication. This operation provides the double seal integrity of the DSC.

l) Transporter-Skid Loading **-** The cask collar lid is positioned and bolted in place to close the cask for transport to the HSM. The cask is then lifted from the decontamination area by the overhead crane with its redundant yoke attached, and is placed on a concrete pad adjacent to the skid/trailer. Once the cask is on the concrete pad the lower half of the redundant yoke is removed to allow the cask to fit into the cask cradle. The maximum height required to raise the cask above the cradle is 2.44 m (8 ft). The cask is then raised just above the cradle atop the skid assembly which is held in the horizontal position. At this juncture the crane is operating without the redundant yoke. The cask is then lowered into the cradle until it is firmly seated. Next, the cask is tilted from the vertical to the horizontal position until the top region of the cask is firmly positioned on the saddle atop the skid. The lifting and tilting procedures used are identical to those used for loading the IF-300 shipping cask onto its rail car skid (Reference 1.5). The crane yoke is then removed and the cask is secured to the skid frame. At no time during the tilting operation is the bottom of the cask more than 2.44 m (8 ft) off the ground. Furthermore, since the cask is always lifted from the cask trunnions located on the upper region of the cask, the failure of the yoke will not cause the cask to drop on its head; hence, no possibility of a cask top end drop. If the yoke fails during tilting operation, the cask would land on its steel ring fins located near the top of the cask's outer shell. The cask drop accident analysis and further discussion on the postulated drop heights and orientations are presented in Section 8.2.4.

m) Transfer **-** Once loaded and secured, the transfer trailer is towed to the HSM. This movement is completely within the HBR2 plant site and protected area. The skid assembly is designed such that none of the cask redundant tie downs and support mechanism can fail due to the inertia forces associated with the transportation shocks and vibrations. Additionally, the skid is secured to the trailer bed by means of tie down brackets, designed to withstand the same forces. The possibility of cask dropping from the skid, or the cask/skid/trailer tipping or rolling over is extremely remote. The impact decelerations generated by such unlikely events are enveloped by the 2.44 m (8 ft) horizontal and vertical drop criteria due to the fact that the center of gravity of the cask is less than 2.44 m (8 ft) from the ground level during the transport operation.

n) Cask-Module Preparation **-** At the HSM storage area, the transfer trailer is backed into position and the HSM front access cover is raised and removed. Next, the cask collar lid is removed. The rear access cover plate is also removed. An alignment system and the hydraulic skid positioners are used for the final alignment of the canister and module.

o) Module Loading - After final alignment, the canister is pulled into the HSM by the hydraulic ram (located at the rear of the HSM).

p) Storage - After the DSC is inside the HSM, the hydraulic ram is released from the DSC. The transfer trailer is pulled away and the HSM front access cover plate is closed. The seismic retainer is installed in the rear opening. The rear access cover plate is also installed and secured in place. The DSC is now in storage within the HSM.

q) Retrieval- For retrieval, the cask is positioned as previously described and the hydraulic ram is used to push the DSC into the cask. All coupling, attachment, alignment, and closure operations are done in the same manner as previously described, but in reverse order. Once back in the cask, the DSC and its cargo of irradiated fuel assemblies are ready for shipment to a permanent repository or other storage location. Provisions have been made to return the canister to the HBR2 spent fuel pool if necessary.

TABLE 1.3-1

MAJOR SYSTEMS, SUBSYSTEMS AND COMPONENTS
OF THE H. B. ROBINSON ISFSI

Dry Shielded Canister

- Canister Basket
  - Square Cells
  - Spacer Disk
  - Support Rods
- Canister Body
- Shielded End Plugs
- Top Cover Steel Plate

Horizontal Storage Module

- Concrete Module
- Precast Outlet Shielding Blocks
- Dry Shielded Canister Support Assembly
- DSC Seismic Retaining Assembly
- Alignment System
- Front Access Cover Plate
- Rear Access Cover Plate
- Air Flow Penetrations

Trailer

- Cask Positioning Skid
- Skid Positioning System (Vertical and Horizontal)

Transfer Cask

- Cask Body
- Cask Lids
- Cask Drains
- Cask Extension Collar

See Figures 1.1-1, 1.2-1, and 1.3-1.

1.4 IDENTIFICATION OF AGENTS AND CONTRACTORS

The prime contractor for design and analysis of the HBR ISFSI was NUTECH, Inc. of San Jose, California. The construction was the responsibility of the CP&L onsite construction organization. Carolina Power & Light Company Nuclear Engineering Department, along with the Modification Implementation Section, were responsible for material procurement as well as contract administration.

1.5 MATERIAL INCORPORATED BY REFERENCE

The Topical Report for the NUTECH Horizontal Modular Storage (NUHOMS) System for Irradiated Nuclear Fuel (NUH-001) is hereby incorporated into this SAR by reference. The NUHOMS topical is referenced in Chapters 1, 3, 4, 5, 7, 8, 10, and 11. At the time of licensing of the Robinson ISFSI, NUH-001, Revision 1, ADV001.0100, as submitted to the Nuclear Regulatory Commission by NUTECH Engineers Inc. in November 1985, was the applicable revision. The current version is Revision 2 as submitted by Pacific Nuclear Fuel Services, Inc. in March 1990.

The General Electric Company Safety Analysis Report for the IF-300 Shipping Container is also incorporated by reference. The IF-300 SAR is referenced in Chapters 3, 5, and 8. At the time of licensing of the Robinson ISFSI, Revision 2 (NEDO-10084-2) was the applicable revision. The current version is Revision 5 (NEDO-10084-5) and was issued by Duratek.

REFERENCES: CHAPTER 1

1.1 CP&L/DOE Licensed At-Reactor Dry Storage Demonstration Program, Cooperative Agreement No. DE-FC06-84RL10532, Amendment No. M005, October 1988.

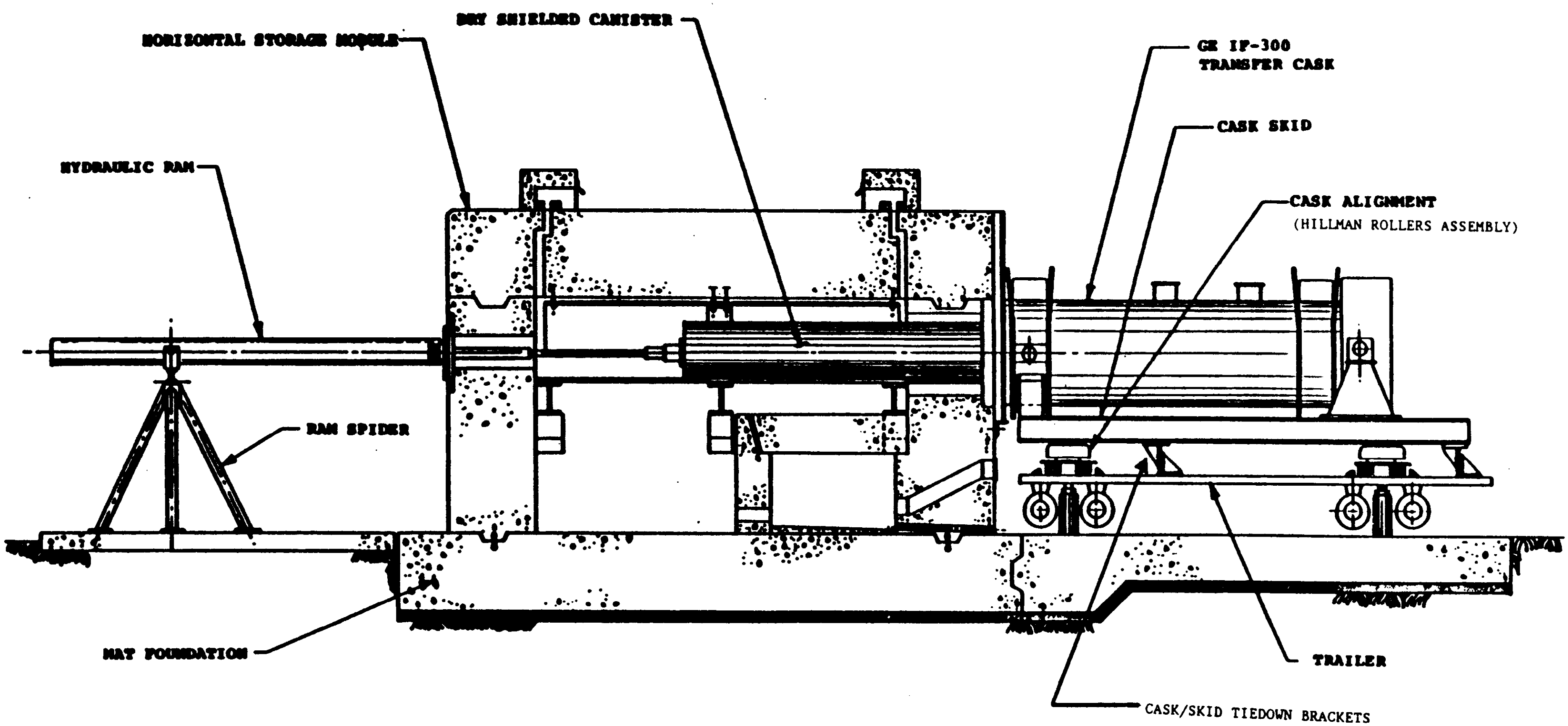
1.2 NUTECH Engineers, Inc., "Topical Report for the NUTECH Horizontal Modular Storage System for Irradiated Nuclear Fuel," NUH-001, Revision 1, November 1985.

1.3 Docket Number 71-9001, Certificate of Compliance Number 9001 for General Electric Model No. IF-300 Shipping Container, Package Identification No. USA/9001/B( )F.

1.4 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.

1.5 Carolina Power and Light Company, H. B. Robinson Steam Electric Plant, Plant Operating Manual, "Refueling Instruction Spent Fuel Cask Handling Instructions for Loading and Shipping of Power Fuel," FHP-034. Note – This was the applicable procedure at the time of loading of the ISFSI. This procedure has been deleted since the last loading in 1989.

1.6 Pacific Nuclear Fuel Services, Inc., “Topical Report for the NUTECH Horizontal Modular Storage System for Irradiated Nuclear Fuel,” NUH-001, Revision 2, March 1990.



AMENDMENT NO. 5

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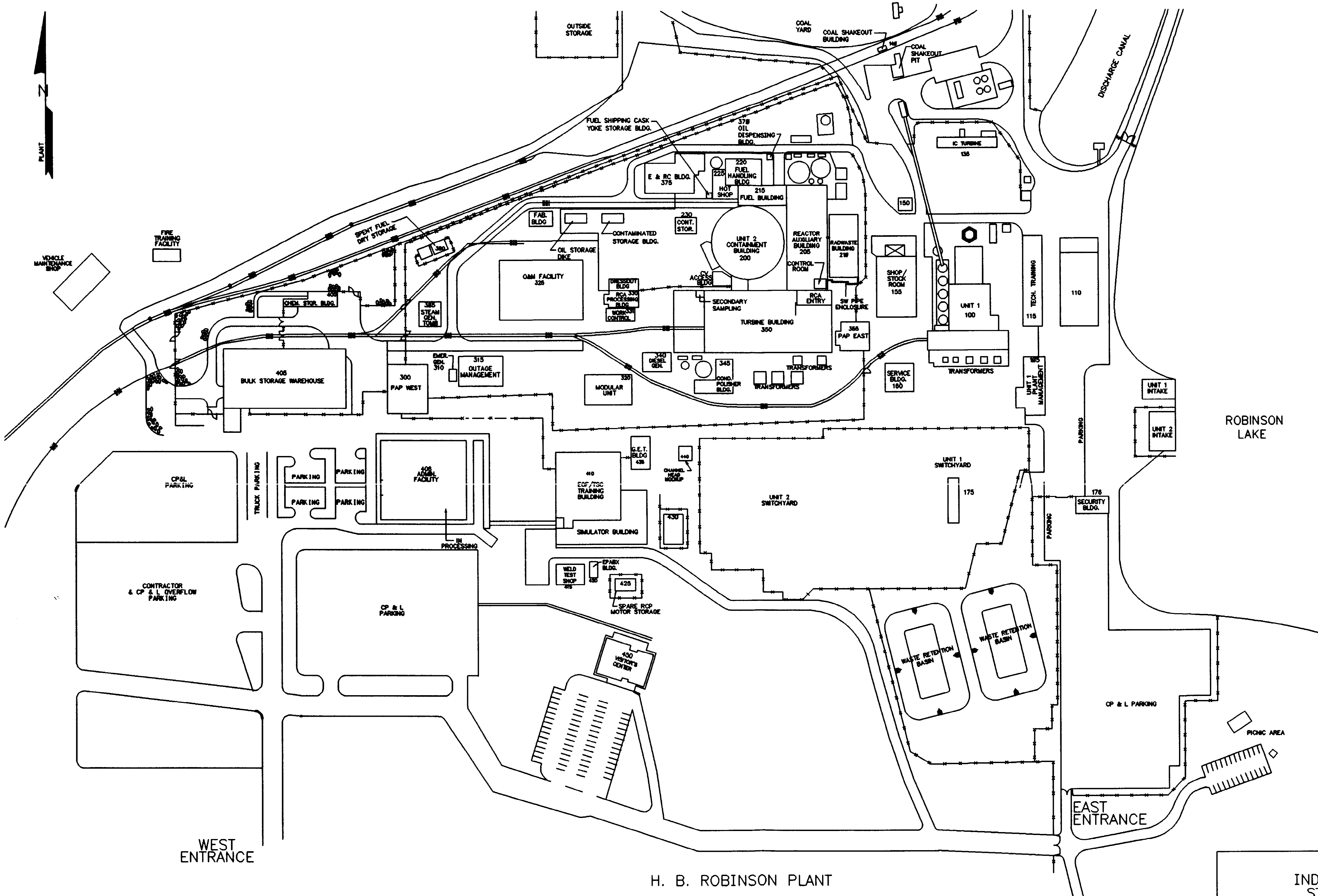
INDEPENDENT SPENT FUEL STORAGE INSTALLATION
SAFETY ANALYSIS REPORT

PRIMARY COMPONENTS OF THE ISFSI
Figure 1.1-1



REVISION NO. 19

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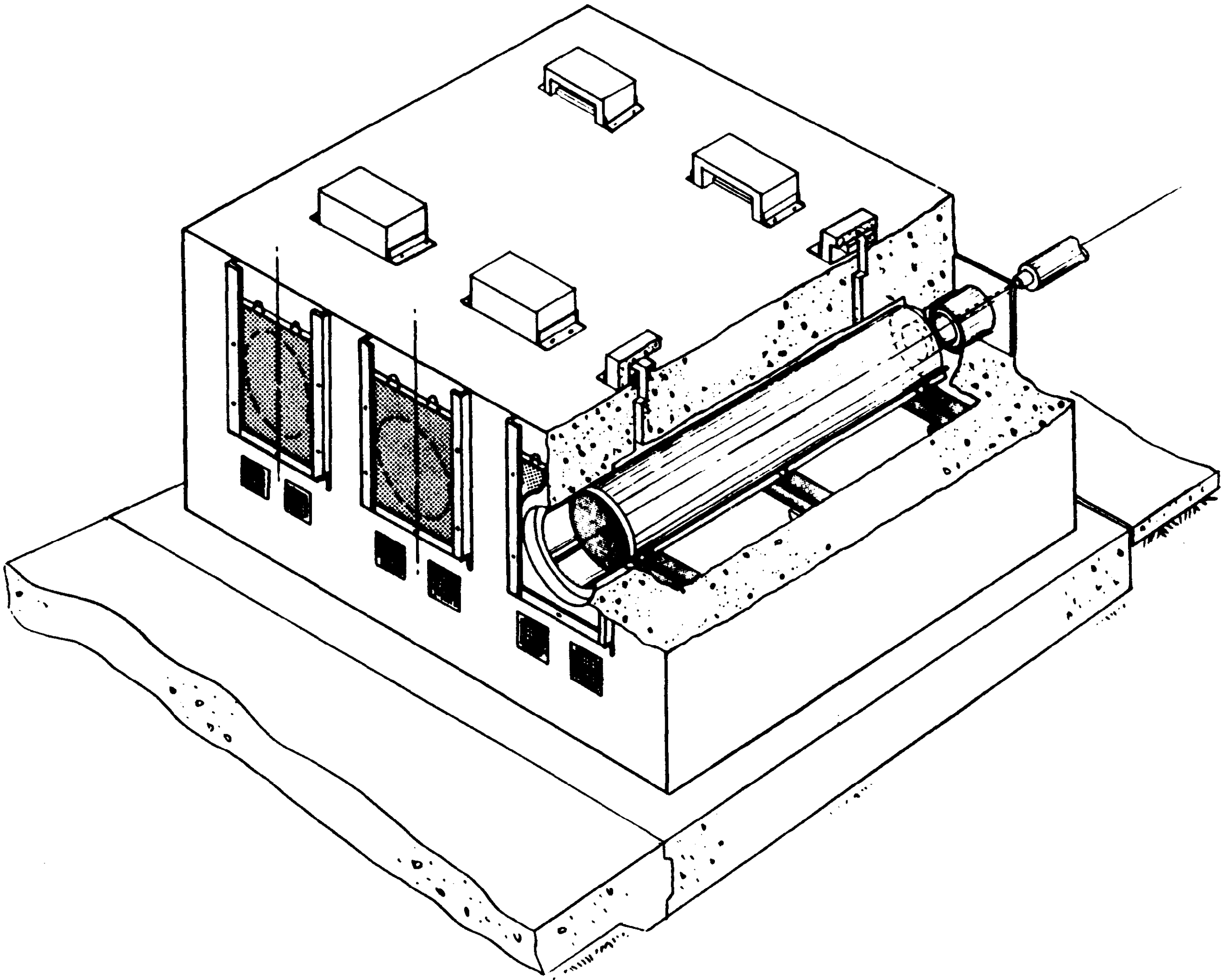
STORAGE INSTALLATION
SAFETY ANALYSIS REPORT

PLOT PLAN

FIGURE 1.1–2



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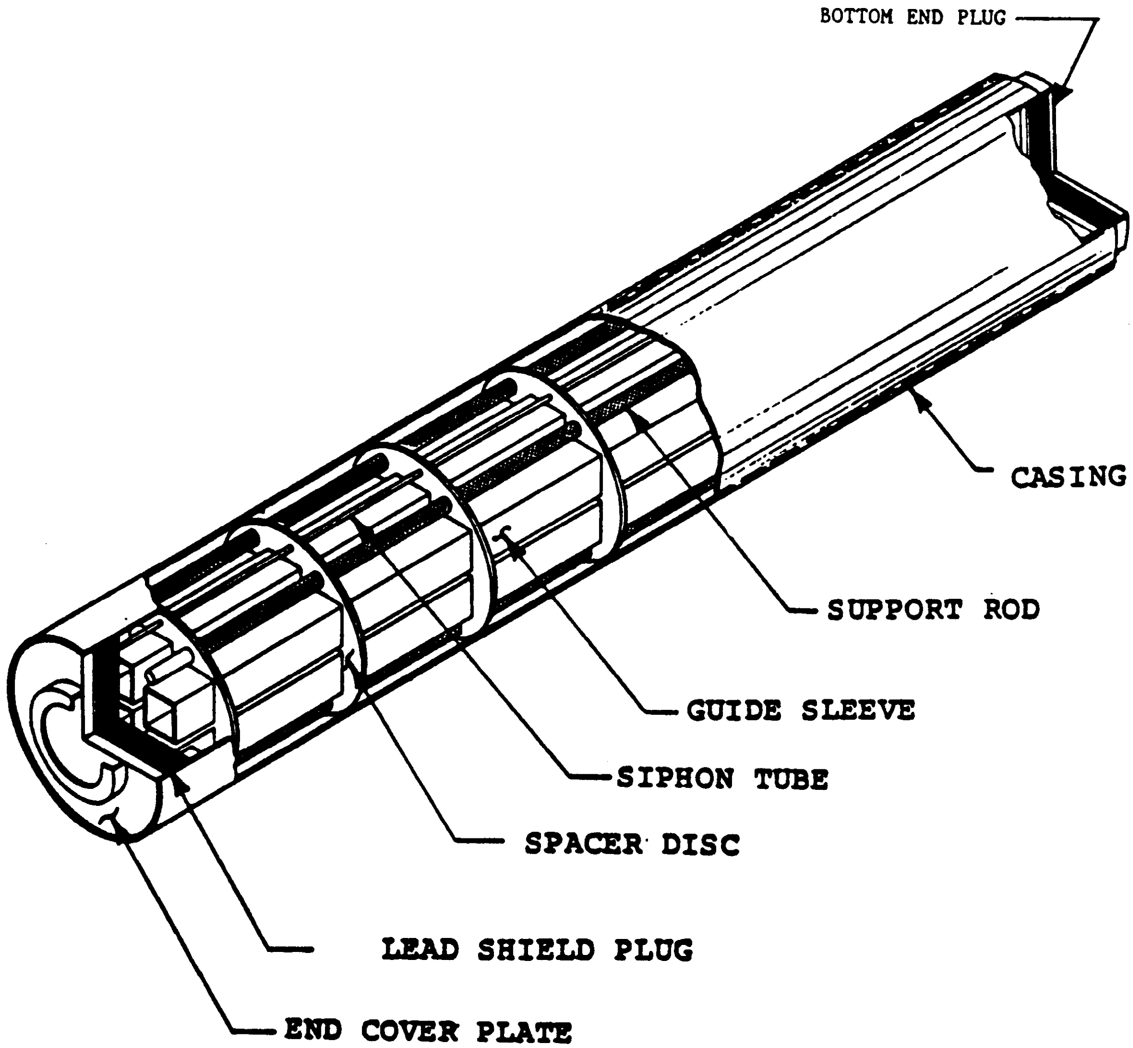
STORAGE INSTALLATION
SAFETY ANALYSIS REPORT

HORIZONTAL STORAGE MODULE

Figure 1.2-1



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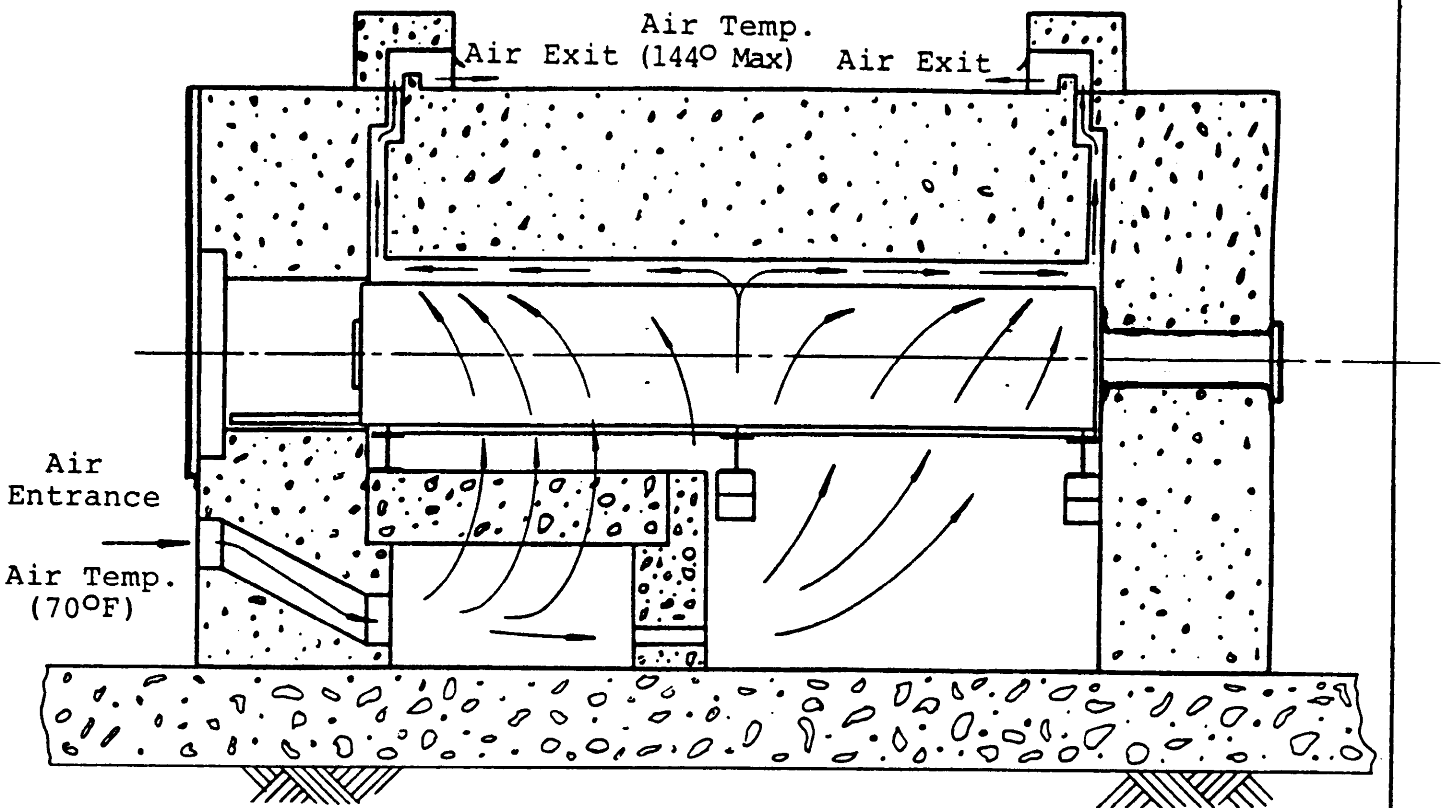
STORAGE INSTALLATION
SAFETY ANALYSIS REPORT

DRY SHIELDED CANISTER AND
INTERNAL BASKET
Figure 1.3-1



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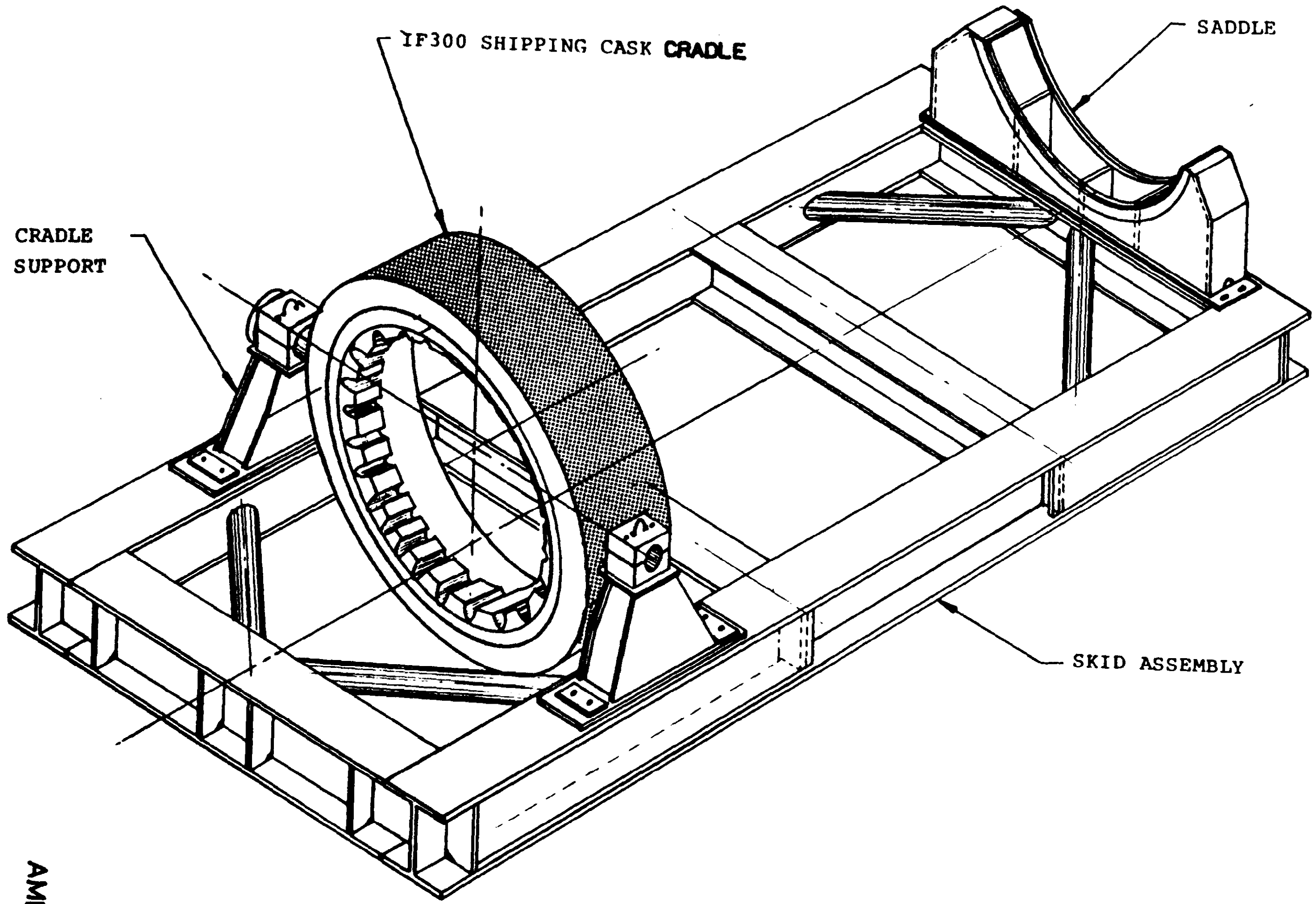
HSM AIR FLOW DIAGRAM
Figure 1.3-2



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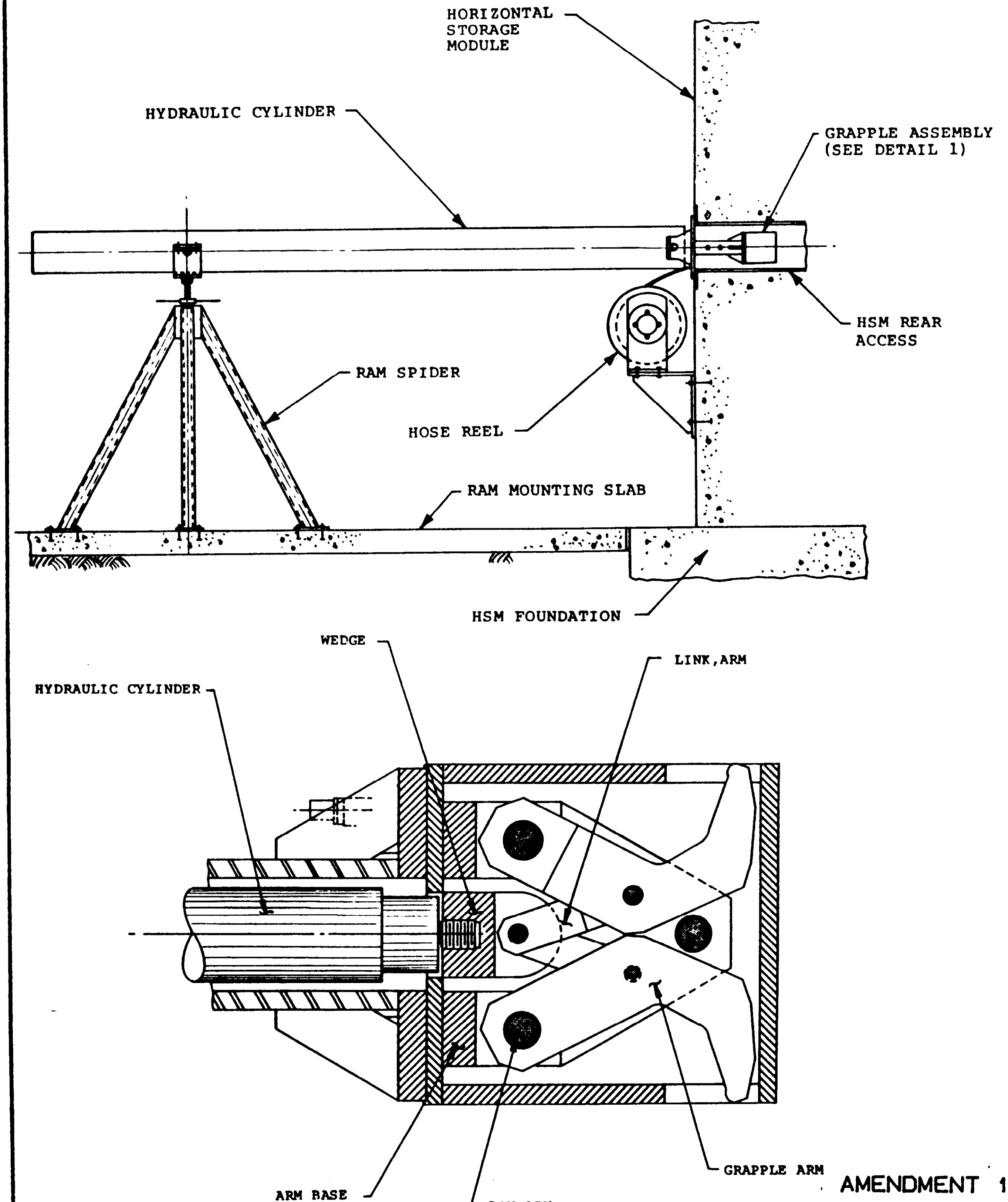
SKID FEATURES
Figure 1.3-3



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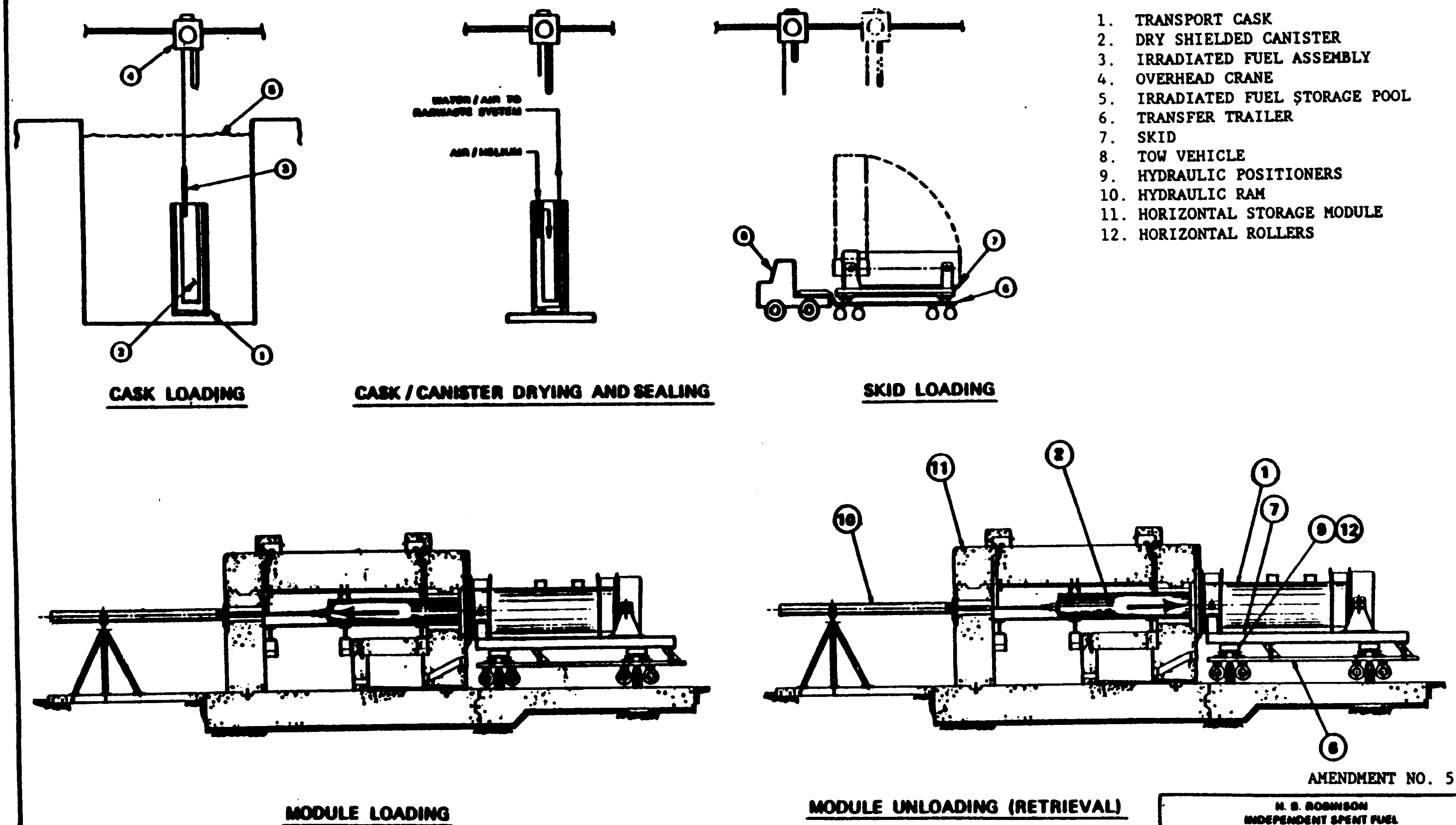
HYDRAULIC RAM
Figure 1.3-4



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PRIMARY CANISTER HANDLING OPERATIONS
Figure 1.3-5