CHAPTER 4

INSTALLATION DESIGN

4.0 INSTALLATION DESIGN

4.1 SUMMARY DESCRIPTION

4.1.1 LOCATION AND LAYOUT OF INSTALLATION

The H. B. Robinson (HBR) Independent Spent Fuel Storage Installation (ISFSI) is located within the existing site boundary of the H. B. Robinson Steam Electric Plant, Unit No. 2 (HBR2). The design of the ISFSI is based on the NUTECH Horizontal Modular Storage (NUHOMS) System for irradiated nuclear fuel. The ISFSI is composed of a series of reinforced concrete horizontal storage modules (HSM). Each HSM contains one dry shielded canister (DSC) which serves as the confinement barrier for the irradiated fuel assemblies (IFAs). The following sections describe the ISFSI, its components and their interrelationship with HBR2's existing facilities. Figure 1.2.2-1 of the UFSAR shows the location of the ISFSI at HBR2.

4.1.2 PRINCIPLE FEATURES

4.1.2.1 Site Boundary

The site boundary is shown on Figure 2.1.1-4 of the UFSAR.

4.1.2.2 Controlled Area

The controlled area is shown on Figure 1.2.2-1 of the UFSAR.

4.1.2.3 Emergency Planning Zone

The exclusion zone is shown on Figure 2.1.1-4 of the UFSAR.

4.1.2.4 Site Utility Supplies and Systems

No utility supplies and systems are required for the ISFSI.

4.1.2.5 Storage Facilities

H. B. Robinson Unit 2 facilities are shown on Figure 1.2.2-1 of the UFSAR.

4.1.2.6 Stack

The ISFSI has no stack.

4.2 STORAGE STRUCTURES

4.2.1 STRUCTURAL SPECIFICATIONS

4.2.1.1 Design Basis

The ISFSI and all its components are designed in accordance with the requirements of 10CFR Part 72. The components are designed to maintain their dimensional and structural integrity and safely perform their intended functions under normal and off-normal operating conditions and during postulated geological or environmental events. The loading conditions associated with normal and accident events are specified in Section 3.2 and Chapter 8 of this report.

4.2.1.2 Construction, Fabrication, and Inspection

a) Horizontal Storage Module - The HSM is constructed of reinforced concrete. The HSM is designed in accordance with the requirements of the ACI 349-80. The applicable American Society of Testing and Material (ASTM) standards referenced in Section 3.8 of the ACI code was used as part of the fabrication and construction requirements of the HSM. Construction of the HSM is in accordance with ACI 301-84, Specification for Structural Concrete for Buildings.

The concrete materials used for construction of the HSM and the foundation consist of: Type II cement conforming to ASTM C150, fine and coarse aggregates conforming to ASTM C33, concrete air-entraining admixture conforming to ASTM C-260, and reinforcing bars conforming to ASTM A615 Grade 60. The concrete compressive strength specified is 4000 psi at 28 days. Minimum specified density of concrete is 145 pounds per cubic foot. The HSM walls are tied to the foundation by reinforcing dowels to prevent possible overturning or sliding during any accident condition specified in Section 8.2 of this report.

b) Dry Shielded Canister - The DSC is designed and fabricated in accordance with the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NB, 1983 Edition. Material selection, welding, and inspection of the DSC was per requirement of this code and the applicable ASTM, ANSI, and other codes and standards invoked by the ASME code.

Details of the material and construction of the DSC and its internals are contained in Section 4.2.3.1 of the NUHOMS Topical Report (Reference 4.1).

4.2.2 INSTALLATION LAYOUT

4.2.2.1 Building Plans

There is no building associated with the HBR2 ISFSI other than the horizontal storage module which is discussed in Section 1.3.1.2.

4.2.2.2 Confinement Features

The confinement features for each unit of the ISFSI are provided in Section 3.3.2.1.

4.2.3 INDIVIDUAL UNIT DESCRIPTION

Each unit of the ISFSI is composed of two components; a dry shielded canister and a horizontal storage module. The DSC is a weld-sealed stainless steel container that provides confinement of contaminants associated with the irradiated fuel assemblies, encloses the fuel basket in an inert atmosphere and provides biological shielding at the ends of the canister. The HSM is a reinforced concrete structure that serves as the primary biological shield for the irradiated fuel assemblies along with providing protection for the DSC against environmental and geological hazards. A detailed discussion and description of the function, design basis, and safety assurance considerations of each component are provided in Section 4.2.3.1 of the NUHOMS Topical Report (Reference 4.1). The engineering drawings of the DSC and the HSM, showing plan views, sections, and elevations of these components are provided in Figures 4.2-1 and 4.2-2.

Two DSCs and their corresponding HSMs were instrumented for the purpose of collecting data during the first year of storage. The instrumentation was limited to placement of thermocouples in the DSC and the HSM. The HSM thermocouples are cast in place or attached to the concrete surfaces, and as such, have no impact on the integrity of the structure. The DSC thermocouples were connected to an external cable by means of a specially designed feed-through. This feed-through penetration incorporates the same redundant seal philosophy used in the DSC containment design. After the penetration plug assembly has been 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 brazed thermocouple was sealed with an environmentally qualified resin.

4.3 AUXILIARY SYSTEMS

The design of the HBR ISFSI is based on the NUHOMS system for irradiated fuel. Each unit of this dry storage system is totally passive and self contained, requiring no auxiliary systems other than a transfer cask for transport operation.

4.3.1 VENTILATION AND OFFGAS SYSTEM

4.3.1.1 Ventilation System

The decay heat rejection system for each module is based on natural circulation convection cooling. The IFAs are confined within a double weld sealed DSC. The decay heat from the IFAs is transferred by radiation, conduction and convection to the surface of the canister. Air inlets near the bottom and air outlets at the top of each HSM allow air to circulate around the DSC. Decay heat is removed by convection and radiation from the surface of the DSC. The driving force for circulation of the air is thermal buoyancy. An analysis of the HSM ventilation system is described in Section 8.1.3 of the NUHOMS Topical Report (Reference 4.1). Since the IFAs are confined within the double weld sealed DSC and the contamination on the external surface of the DSC results in essentially no release of radioactive material, no filtration system for contamination is required.

4.3.1.2 Offgas System

The ventilation system used to process the offgassing during the DSC drying and backfilling operations is the same as that described in Chapter 9 of the UFSAR.

4.3.2 ELECTRICAL SYSTEM

The ISFSI is totally passive and requires no electrical system.

The HBR2 electrical system associated with the fuel handling area is utilized during DSC drying and backfill operations.

4.3.3 AIR SUPPLY SYSTEM

4.3.3.1 Compressed Air

The ISFSI requires no compressed air supply system. The HBR2 compressed air supply system will be utilized during the DSC drying operation.

4.3.3.2 Breathing Air

The ISFSI is located in an outside environment and requires no breathing air supply. Provisions for breathing air supply during an emergency situation exist at HBR2.

4.3.4 STEAM SUPPLY AND DISTRIBUTION SYSTEM

The ISFSI requires no steam supply.

4.3.5 WATER SUPPLY SYSTEM

The ISFSI requires no water supply system. The HBR2 water supply system associated with the fuel handling area will be used during cask preparation and decontamination operations.

4.3.5.1 Major Components and Operating Characteristics

The existing water supply system of HBR2 will be utilized during the cask preparation and decontamination operations and for fire protection purposes.

4.3.5.2 Safety Consideration and Controls

A loss of water supply would have no effect on the operation of the ISFSI. The water is used for removing contamination from the surface of the cask and DSC. Any loss of water during the cask wash down and loading operations would only extend the period of time which the DSC would be contained within the IF-300 shipping cask.

4.3.6 SEWAGE TREATMENT SYSTEM

4.3.6.1 Sanitary Sewage

The ISFSI requires no sanitary sewage system.

4.3.6.2 Chemical Sewage

The ISFSI requires no chemical sewage treatment system.

4.3.7 COMMUNICATIONS AND ALARM SYSTEM

The ISFSI is totally passive and requires no communication or alarm systems.

4.3.8 FIRE PROTECTION SYSTEM

No flammable or combustible substances are stored within the ISFSI or in its immediate vicinity. The ISFSI is constructed of noncombustible heat-resistant materials (concrete and steel). Since no combustible materials are stored within the ISFSI, the ISFSI requires no fire extinguishing system. In the unlikely event of a fire near the HSMs, the existing HBR2 fire extinguishing system will be utilized. This system and procedures for fire extinguishing are described in Section 9.5.1 of the HBR2 Updated FSAR (Reference 4.2).

4.3.9 MAINTENANCE SYSTEMS

The ISFSI is totally passive and requires no maintenance other than periodic inspection of the air inlets and outlets and possible removal of debris from the air inlets (see Chapter 10).

4.3.10 COLD CHEMICAL SYSTEMS

The ISFSI has no cold chemical system.

4.3.11 AIR SAMPLING SYSTEM

No air samples are required at any time during operation. Therefore, the ISFSI has no air sampling system.

4.4 DECONTAMINATION SYSTEMS

The ISFSI has no decontamination system; however, the existing HBR2 decontamination facility will be used to decontaminate the spent fuel cask.

The decontamination facility has been abandoned in place. Portable equipment is used to aid in the decontamination process.

4.5 SHIPPING CASK REPAIR AND MAINTENANCE

Existing HBR2 procedures are followed for maintenance and repair of CP&L's GE IF-300 shipping container and its auxiliary systems. Routine inspections of the cask system and components are accomplished in accordance with existing procedures. Where applicable, General Electric's recommended inspection intervals are followed. Corrective maintenance is planned and accomplished in a controlled manner as needed. Minor repairs can be accomplished onsite with the cask in the decontamination stand using existing HBR2 facilities (see Figure 4.5-1). However, if major repairs should be required on any large or heavy portion of the cask system, it may require offsite work. Such work can be accomplished for example at General Electric's Morris Operations facility located in Morris, Illinois.

During all phases of repair or maintenance on the cask, existing HBR2 health physics procedures are followed. These procedures address contamination control and emphasize occupational exposure reduction.

All necessary records generated during the maintenance, repair, or operation of the cask system will be retained in a controlled manner for the time period required by appropriate QA procedures.

4.6 CATHODIC PROTECTION

The ISFSI is dry and above ground so that cathodic protection in the form of impressed current is not required. The normal operating environment for all metallic components is well above ambient air temperatures so that there is no opportunity for condensation on those surfaces.

The austenitic canister body requires no corrosion protection for any forseeable event. The DSC support assembly components are Type A36 carbon steel. The top surface of the DSC rail is to be machined and plated with a high-phosphorus electroless nickel finish having a minimum thickness of .001 inch. The remaining surfaces of the rail and other components of the support assembly shall be painted with Carbo-Zinc 11 (Reference 4.3). Consequently, the A36 structural steel is protected against corrosion.

4.7 FUEL HANDLING OPERATION SYSTEM

The HBR ISFSI is based on the NUHOMS system for storage of irradiated nuclear fuel. The basis and engineering design for the various fuel handling systems used during the operation of the ISFSI are described in the following sections.

4.7.1 STRUCTURAL SPECIFICATIONS

The bases and engineering design of HBR2's fuel handling systems are described in Section 9.1.4 of the HBR2 Updated FSAR (Reference 4.2). Other handling and transport operation equipment (cask positioning skid, hydraulic ram, and trailer) are designed to meet the criteria established in Chapter 3 of the NUHOMS Topical Report (Reference 4.2). This equipment is designed to safely perform its intended functions under both normal and off-normal operating conditions. However, this equipment does not impact the safety features of the ISFSI facility and as such is not safety related.

4.7.2 INSTALLATION LAYOUT

4.7.2.1 Building Plans

Fuel handling operations will occur within the existing HBR2 Fuel Handling Building (see Figure 4.5-1).

4.7.2.2 Confinement Features

The irradiated fuel assemblies will only be handled while in the spent fuel pool or in the confines of the DSC which is placed inside the cavity of the shipping cask or the HSM. The confinement features of the HBR2 spent fuel pool are provided in Section 9.1 of the HBR2 Updated FSAR (Reference 4.2) and the confinement features of the NUHOMS system are discussed in Section 3.3.2 of the NUHOMS Topical Report.

4.7.3 INDIVIDUAL UNIT DESCRIPTION

4.7.3.1 Shipping Cask Preparation

During the preparation, the DSC will be placed into the shipping cask cavity. This operation will take place in the HBR2 decontamination facility (see Figure 4.5-1). After loading, the cask annulus and the DSC will be filled with demineralized water and then lifted into the spent fuel pool.

The following components will be used for this operation:

a) Spent Fuel Cask Handling Crane **-** The spent fuel cask handling crane is used to place the DSC into the shipping cask cavity. The design basis and safety assurance features of the crane are discussed in Section 9.1.4 of the HBR2 Updated FSAR (Reference 4.2).

b) Spent Fuel Cask Lifting Yoke **-** The spent fuel cask lifting yoke is used in transporting and handling the shipping cask while in the plant and loading the shipping cask onto the transport skid. The design basis and safety features of the lifting yoke are provided in Section 9.1.4 of the HBR2 Updated FSAR (Reference 4.2).

4.7.3.2 Spent Fuel Loading

Loading of the IFAs into the DSC takes place in the existing spent fuel pool. The components which are used are described below.

a) Spent Fuel Cask Handling Crane **-** The spent fuel cask handling crane is used to transport the shipping cask to and from the spent fuel pool. The design basis and safety assurance features of the crane are discussed in Section 9.1.4 of the HBR2 Updated FSAR (Reference 4.2).

b) Spent Fuel Pit Bridge **-** The spent fuel pit bridge is used to move the fuel assemblies within the spent fuel pool. The design basis and safety features are described in Section 9.1.4 of the HBR2 Updated FSAR (Reference 4.2).

4.7.3.3 DSC Drying, Backfilling and Sealing

Once the IFAs have been placed into the DSC, the top lead shield plug is placed on the DSC. The cask collar cover plate is then installed. Using the spent fuel cask handling crane, the loaded DSC, sitting in the spent fuel cask cavity, will be removed from the spent fuel pool and moved to the decontamination facility where the cask will be drained. The DSC will be drained, vacuum dried, and backfilled with helium. The top lead shield plug and cover plates will be seal welded to the DSC body. After these operations, the cask will be placed onto the transport skid and taken to the ISFSI site where the DSC will be loaded into the HSM. Throughout all of the above operations, the fuel will be confined within the DSC and the DSC will be seated within the shipping cask. The design basis and safety assurance features of the DSC are discussed in Sections 3.2 and 3.3 of the NUHOMS Topical Report (Reference 4.1). More details on the drying and sealing operations are provided in Chapters 4 and 5 of Reference 4.1.

REFERENCES: CHAPTER 4

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

4.2 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.

4.3 Carboline Company, St. Louis, MO.

Figure Withheld Under 10 CFR 2.390

Amendment No. 5

H.B. ROBINSON INDEPENDENT SPENT FUEL STORAGE INSTALLATION SAFETY ANALYSIS REPORT
DRY SHIELDED CANISTER Figure 4.2-1 SHEET 1 OF 2

Figure Withheld Under 10 CFR 2.390

AMENDMENT 1

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STORAGE INSTALLATION
SAFETY ANALYSIS REPORT

DRY SHIELDED CANISTER
FIGURE 4.2 - 1
SHEET 2 OF 2

Figure Withheld Under 10 CFR 2.390

Amendment No. 1

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HORIZONTAL STORAGE MODULE
Figure 4.2-2

Figure Withheld Under 10 CFR 2.390

Figure 4.5-1
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Figure Withheld Under 10 CFR 2.390

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GENERAL ARRANGEMENT - HBR2 FUEL
HANDLING BUILDING
Figure 4.5-1
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