CHAPTER 3

PRINCIPAL DESIGN CRITERIA

3.0 PRINCIPAL DESIGN CRITERIA

3.1 PURPOSE OF THE INSTALLATION

The purpose of the H. B. Robinson (HBR) Independent Spent Fuel Storage Installation (ISFSI) is to provide the long-term storage of irradiated fuel assemblies (IFAs) in a dry environment. The HBR ISFSI is based on the NUTECH Horizontal Modular Storage (NUHOMS) System and is composed of a series of reinforced concrete horizontal storage modules (HSM). Each HSM will house a steel, helium filled, dry shielded canister (DSC) containing seven IFAs. The double weld sealed DSC serves as the confinement vessel for the IFAs while the HSM provides the biological shielding as well as a passive heat removal system for the decay heat of the IFAs.

3.1.1 MATERIAL TO BE STORED

Each modular unit of the ISFSI is capable of storing up to seven pressurized water reactor (PWR) fuel assemblies as specified in Section 3.1 of the NUHOMS Topical Report (Reference 3.1). The following subsections describe the physical, thermal, and radiological parameters of the fuel to be stored at the HBR ISFSI.

3.1.1.1 Physical Characteristics

The mechanical and structural design of the DSC is based on the physical characteristics of the PWR IFAs to be stored within the DSC. The physical characteristics of these IFAs are presented in Table 3.1-1. The overall length of the IFAs in Table 3.1-1 includes an allowance for 3/4 inch irradiation growth. Additional information on the physical characteristics of these fuel assemblies is contained in Section 4.2 of the Robinson Updated Final Safety Analysis Report (FSAR) (Reference 3.2).

3.1.1.2 Thermal Characteristics

The heat generation per fuel assembly is limited to one kilowatt per assembly. This results in a maximum of seven kilowatts per DSC. Fuel irradiated to less than 35,000 MWd/MT and cooled for five years will meet this criteria (based on ORIGEN2 (Reference 3.3) calculations). Other combinations of burnup and cooling time may also be acceptable upon further analysis.

3.1.1.3 Radiological Characteristics

The principal design criteria for acceptable radiological characteristics are shown in Table 3.1-2. The decay heat generation and the radiological characteristics described above bound fuel that has been irradiated to 35,000 MWd/MT and cooled for five years. This is considered to be the maximum radiation source fuel. The radiation source from the majority of the fuel to be stored will be less than or equal to that described in the NUHOMS Topical Report. ORIGEN2 calculations were used to determine this maximum burnup and minimum cooling time. Other combinations of decay time and burnup may also be acceptable if additional calculations are performed. However, for fuel which can be shown to have a burnup of less than or equal to 35,000 MWd/MT and been cooled for at least five years, no further fuel specific analysis is necessary.

3.1.2 GENERAL OPERATING FUNCTIONS

3.1.2.1 Overall Functions of the Facility

The ISFSI is designed to be totally passive, requiring no utilities or waste processing system and to utilize HBR2's existing cask handling, fuel handling and associated auxiliary equipment in preparing the IFAs for dry storage. The cask to be used for the onsite transfer operation is the GE IF-300 shipping cask which is fully documented in Reference 3.5.

The DSC will be placed into the cavity of the GE IF-300 shipping cask. The shipping cask will then be lowered into the existing HBR2 spent fuel pool where seven fuel assemblies will be placed into the DSC. Once the top lead shield plug is placed onto the loaded DSC, the cask containing the loaded DSC will be raised out of the pool and the water drained partially from the DSC cavity. At this juncture, the top lead shield plug is welded into place. The DSC cavity will then be drained and vacuum dried of all water and backfilled with helium through the vent and siphon tube penetrations. After backfilling the DSC with helium, the penetrations will be seal welded and the top cover plate will be welded into place. With the sealed DSC still within the confines of the shipping cask, the shipping cask will be transported to the HSM and aligned with the front access of the HSM. A hydraulic ram will then extend from the rear access of the HSM through the HSM and attach onto the DSC grappling plate. The hydraulic ram will be retracted through the HSM, pulling the DSC into the HSM. Once the DSC is properly positioned within the HSM, the front and rear accesses of the HSM will be closed.

The HSMs which house the DSCs are located on a level, reinforced concrete, load bearing slab. The slab is designed for normal and postulated accident conditions. The HSM is also designed to maintain its dimensional and structural integrity during postulated environmental and geological events.

Safe storage in the HSM is provided by: (1) a natural convection heat removal path, (2) the concrete radiation shielding, and (3) the double closure welds of the DSC. The operation of the HSMs and DSCs is totally passive. No active systems are required.

The first three units of the ISFSI facility were used as part of the demonstration program. Therefore, two of the HSMs and the DSCs were initially instrumented for the purpose of collecting data. The instrumentation was limited to placement of a number of thermocouples in these components. The placement of thermocouples inside the HSMs does not effect its structural and mechanical integrity. The instrumentation of the DSC, however, requires a feed through penetration at its bottom cover plate. This penetration is designed such that the confinement integrity of the DSC is not compromised under both normal operating and accident conditions. Furthermore the instrumentation of these components does not change the total passive nature of the system. Details of the instrument penetration analysis are provided in Chapter 8 of this report. The instrumentation is no longer in service.

A more detailed description of each component's functions is located in the following subsections.

3.1.2.2 Handling and Transfer Equipment

The ISFSI is designed to utilize the existing HBR2 fuel handling equipment and the GE IF-300 shipping cask. The function of the various HBR2 fuel handling equipment which are employed in loading and handling the IF-300 shipping cask are described in the plant's existing procedures and Section 9.1.4 of the HBR2 Updated FSAR (Reference 3.2).

The systems and equipment which are unique to the ISFSI for handling and transfer of IFAs are the DSC, the docking collar, the transfer trailer, the cask skid, the hydraulic ram, and the HSM. The function of each transfer and handling system or piece of equipment along with the waste processing system are briefly described in the following paragraphs.

a) DSC - The DSC will serve as the confinement vessel during transport of the IFAs to and from the HSM as well as during storage of the IFAs in the HSM. The shielded end plugs will provide biological shielding during transport of the fuel assemblies and also provide shielding for the front and rear accesses of the HSM.

b) Cask - The GE IF-300 shipping cask is used to transport the DSC to and from the HSM. The function of the shipping cask is to provide biological shielding along the axial length of the IFAs and a means for removing a sufficient quantity of decay heat so that the mechanical integrity of the DSC or IFAs is not jeopardized. The GE IF-300 is fully documented in Reference 3.5. As stated in Section 1.3.1.3 a new cask collar and lid are used on the IF-300 cask. This addition will provide the minimum cask cavity length requirement.

c) Cask Positioning Skid - The function of the cask positioning skid is to provide a means by which the final alignment of the cask with respect to the HSM can be achieved, and to restrain the shipping cask in the horizontal position during the transfer of the DSC to and from the HSM. The skid and the cask will be transported from the fuel building to the HSMs by a trailer. Both the skid and the DSC are designed to withstand the inertia forces associated with the transportation shock loads.

d) Hydraulic Ram - The hydraulic ram is used to move the DSC between the cask and the HSM. The hydraulic ram is a long hydraulic cylinder with a grapple device mounted at the cylinder's head. The hydraulic ram will be positioned at the rear access of the HSM. The ram will then be extended through the rear access and through the entire length of the HSM. Once the grapple is seated within the grappling plate of the DSC, the arms of the grapple will be extended so that it is securely in place between the DSC and the grapple plate. The ram will then be retracted, pulling the DSC out of the cask cavity and into the HSM.

e) Horizontal Storage Module- The function of the HSM is to provide protection for the DSC against geological and environmental events as specified in Section 3.2, and serve as the principle biological shield for irradiated fuel during storage. The HSM contains shielded air ducts near the bottom of the structure to admit ambient air around the DSC for cooling purposes. The air, warmed by the canister, is exhausted through shielded vents at the top of the HSM by natural draft convection. The HSM also provides support for the DSC. The DSC rests on a support rail assembly which is anchored to the walls of the HSM. The rear end of the DSC support rails are equipped with stopping blocks. The purpose of these stopping blocks is to establish the final axial position of the DSC inside the HSM. The final positioning is achieved when the DSC, being pulled into the HSM by the ram, makes contact with these stopping blocks. After the DSC insertion into the HSM is completed, a seismic retaining assembly will be attached to the grappling plate of the DSC top cover plate. This will prevent any possible axial movement of the DSC during any postulated accident such as an earthquake. The front access of the HSM is covered by a plate. The air inlets and outlets are covered with stainless steel wire bird screens to prevent foreign objects from entering the HSM.

f) Waste Processing - During the normal storage of IFA's in the ISFSI, no waste will be generated. However, contaminated water and possibly contaminated gases will be removed from the DSC cavity during the cask drying operation. The cask drying operation will take place in the HBR2 decontamination facility. The HBR2 utilities and radioactive waste processing system are described in Section 9.1.4. and Chapter 11.0 of the HBR2 Updated FSAR (Reference 3.2).

TABLE 3.1-1

PHYSICAL CHARACTERISTICS OF PWR
FUEL ASSEMBLIES[1] BASED ON NOMINAL DESIGN

Array	15 x 15
Envelope (in)	8.426
Overall Length[2] (in)	162.05
Weight (lbs)	1466
Fuel Rod Number	204
Fuel Rod Length (in)	152.0
Active Fuel Length (in)	144.0
Maximum Distance Between Grid Straps (in)	26.19

1 See Reference 3.4.

2 Additional 3/4 inch added to overall length to allow for irradiation growth.

TABLE 3.1-2

ACCEPTABLE RADIOLOGICAL CRITERIA FOR
STORAGE OF MATERIAL IN THE HBR ISFSI

CRITERIA	VALUE
GAMMA SOURCE PER CANISTER (total)	1.48×10^{16} Mev/sec
Fractional Breakdown*	
Above 1.3 Mev	0.004
Between 1.3 Mev and 0.8 Mev	0.114
Between 0.8 Mev and 0.4 Mev	0.808
Below 0.4 Mev	0.074
NEUTRON SOURCE PER CANISTER (total)**	1.17×10^{9} n/sec
Fractional Breakdown	
Above 5 Mev	5.40×10^{7} n/sec = 5.41%
Between 2.5 and 5 Mev	2.43×10^{8} n/sec = 24.32%
Between 1 and 2.5 Mev	4.56×10^{8} n/sec = 45.67%
Below 1 Mev	2.45×10^{8} n/sec = 24.53%

* Fractional breakdown based on isotopic composition and resulting gamma spectrum calculated by ORIGEN2 analysis.

** Spectrum from U-235 fission, total number of neutrons per second from ORIGEN2 analysis.

3.2 STRUCTURAL AND MECHANICAL SAFETY CRITERIA

The H. B. Robinson Independent Spent Fuel Storage Installation is designed to perform its intended function under extreme environmental and geological hazards as specified in 10CFR, Part 72.122(a). The HSMs are installed on a monolithically placed, reinforced concrete mat foundation. The mat foundation is also designed to resist forces generated by extreme environmental and geological conditions. Specifics of the foundation design are reported in Section 8.3.

The environmental features at the ISFSI site, which are used to define the normal operating design basis for the DSCs and HSMs, are such that they are the same as or enveloped by those specified in Table 3.2-1 of the NUHOMS Topical Report (Reference 3.1). Specifically , the highest recorded ambient temperature of 107^{o}F, and the lowest recorded temperature of -5^{o}F, are well within the extreme ambient range of 125^{o}F to -40^{o}F specified in the NUHOMS Topical Report. The maximum diurnal temperature range for the ISFSI site is 25^{o}F. This range is also lower than the 45^{o}F diurnal temperature range specified in the above referenced report. The site area design basis solar radiation value of 188 Btu/hr-(ft^{2}) is the same as that reported in the above referenced report.

In general, the structural and mechanical safety criteria of the ISFSI are the same as or enveloped by the criteria specified in Section 3.2 of the NUHOMS Topical Report.

As stated earlier in this report, some design features of the H. B. Robinson ISFSI differ from those of the NUHOMS generic concept. In particular, the NUHOMS Topical Report addresses an eight module unit, whereas the H. B. Robinson ISFSI consists of a three-module unit and a five-module unit. Each unit will be a monolithically poured in place unit, with rear access penetrations for each HSM which allows for the hydraulic ram to be operated from the back of the modules. These unique features of the ISFSI reinforced concrete modules have no impact on the structural evaluation presented throughout chapter 8 of the NUHOMS Topical Report. This is due to the fact that the NUHOMS structural analysis of the HSM utilizes the frame action of the roof slab and the walls of only a single module in the transverse direction. This single module approach conservatively envelopes the structural response of any multi-module units including the three or five-module concept which is the subject of this report. The rear access penetration, however, require additional shielding evaluation which is presented in chapter 7 of this report.

Some of the design features of the H. B. Robinson DSCs also differ from those of the NUHOMS Topical Report. In particular, the bottom region of the DSC has been redesigned to fit into the IF-300 cask. Furthermore, both the top and bottom regions, the spacer disk and the support rods of the DSC have been redesigned to withstand the inertia forces associated with cask drop accidents in which the drop heights are significantly greater than the minimum 8 foot drop criteria established earlier in this report. This was done for compatibility with future shipping options. Another unique feature of the H. B. Robinson DSCs is the instrument penetration at the bottom region of two of the initial three DSC assemblies. The instrumentation of the DSC was for the purpose of collecting temperature data during the first year of storage.

The penetration assembly is designed to maintain the confinement integrity of the DSC during both normal operating and accident conditions. The structural evaluation of the instrument penetration under various normal operating and accident conditions is addressed in chapter 8 of this report.

3.2.1 TORNADO AND WIND LOADINGS

3.2.1.1 Applicable Design Parameters

The ISFSI is constructed within the existing boundaries of the H. B. Robinson Steam Electric Plant which is located within Region I of the NRC Regulatory Guide 1.76 regionalization, and as such, the intensity of the design basis tornado for this region is the same as that assumed in the NUHOMS Topical Report (Reference 3.1).

The design basis tornado (DBT) intensities were obtained from NRC Regulatory Guide 1.76. Region I intensities were considered since it has the most severe parameters. For this region, the maximum wind speed is 360 miles per hour, the rotational speed is 290 miles per hour, the maximum translational speed is 70 miles per hour, the radius or maximum rotational speed is 150 feet, the pressure drop across the tornado is 3.0 psi, and the rate of pressure drop is 2.0 psi per second. The maximum transit time based on the specified 5 miles per hour minimum translational speed was not used since the transit time is conservatively assumed to be infinite.

3.2.1.2 Determination of Forces on the Structures

The forces due to the design basis tornado and tornado generated missiles are enveloped by those reported in the NUHOMS Topical Report.

The method of analysis for overall and local damage prediction due to a design basis tornado and tornado generated missiles is discussed in Section 3.2.1 of the NUHOMS Topical Report, and is fully applicable to the Robinson site specific analysis.

3.2.1.3 Ability of Structures to Perform

The ISFSI is designed to withstand the design basis tornado wind loads. Furthermore, all components of the ISFSI with the exception of the air outlet shielding block are designed to withstand the tornado generated missile forces. The loss of an air outlet shielding block is addressed in Section 8.2.1 of this report.

Since the ISFSI is not housed in any storage building, there is no possibility of any roof collapse on the facility. However, the possibility of total air inlet and outlet blockage by foreign objects or burial under debris during a tornado event is considered. The effect of facility burial under debris is presented in Section 8.2.

3.2.2 WATER LEVEL (FLOOD) DESIGN

The maximum flood water level at the Robinson site is 222 ft. elevation (see Section 2.4 of the UFSAR). The grade level of the ISFSI foundation is at the 234 ft. elevation. Therefore, there is no possibility of flooding within the ISFSI.

3.2.3 SEISMIC DESIGN

3.2.3.1 Input Criteria

The maximum horizontal ground acceleration specified for HBR2 is 0.20g for safe shutdown earthquake (SSE) (see Section 2.6.2.3 and Reference 3.2). The maximum vertical ground acceleration is specified at two thirds of the horizontal component, or 0.133g. These horizontal and vertical component values are less than the values of 0.25g and 0.17g, respectively, specified in the NUHOMS Topical Report (reference 3.1). Hence, the seismic evaluation contained in Section 8.2.3 of the referenced report is fully applicable to those components of the H. B. Robinson ISFSI which have design features similar to those of the NUHOMS generic concept. It is also applicable to those that can be conservatively enveloped by the NUHOMS generic assumptions, such as the single module approach to HSM evaluation discussed earlier in this section. In this manner, the seismic response of the HSM and the DSC support assemblies of the H. B. Robinson ISFSI are enveloped by the responses reported in the NUHOMS Topical Report for these components. The DSC, however, which has some unique features, is analyzed for the site specific seismic event, utililizing the methodology and the analytical approach of the NUHOMS Topical Report. The seismic evaluation of the DSC is contained in Section 8.2 of this SAR.

3.2.3.2 Seismic-System Analysis

The stresses in the HSM and the DSC support assembly due to the 0.20g horizontal and 0.133g vertical acceleration are enveloped by the results of the generic seismic analysis reported in the NUHOMS Topical Report. The stresses in the DSC due to the horizontal and vertical seismic acceleration specified above are evaluated and reported along with the DSC rollover evaluation in Section 8.2 of this report.

The ISFSI foundation and the HSMs tie down system are also designed to withstand the forces generated by the SSE. The details of the foundation design are provided in Section 8.3 of this report.

3.2.4 SNOW AND ICE LOADS

The NUHOMS Topical Report specified a postulated live load of 200 pounds per square foot which conservatively envelopes the maximum snow loads for the Robinson site (see Section 2.3 of the UFSAR for meteorology of the site area).

3.2.5 COMBINED LOAD CRITERIA

Load combination criteria established in the NUHOMS Topical Report (Reference 3.1) for the HSM, DSC and DSC support assembly are also applicable to the HBR ISFSI. The specific load combination evaluation of the DSC, utilizing the NUHOMS criteria, are reported in Section 8.2 of this report.

The facility's mat foundation is designed to meet the requirements of ACI 349-80 (3.6). The ultimate strength method of analysis was utilized with appropriate strength reduction factors. The load combination procedure of Section 9.2.1 of the ACI 349.80 was used in combining normal operating loads (i.e. dead loads and live loads) with severe and extreme loads (i.e., seismic and tornado loads). The details of the load combination procedure are described in the NUHOMS Topical Report. Specific foundation analyses including load combination and anchorage analysis are presented in Section 8.3 of this report.

3.3 SAFETY PROTECTION SYSTEM

3.3.1 GENERAL

The HBR Independent Spent Fuel Storage Installation is designed for safe and secure, long-term containment and storage of IFAs. The equipment which must be designed to assure that the safety objectives are met are shown in Table 3.3-1.

The major features which require special design consideration are:

a) Double Closure Seal Welds on DSC Upper End

b) Radiation Exposure During DSC Drying and Closure

c) Design of DSC Body and Internals for a Cask Drop Event During the Transfer Operation

d) Minimization of Contamination of the DSC Exterior by the Spent Fuel Pool Water

e) Minimization of Radiation Shine During Transfer of the DSC from the Cask to the HSM

These items are addressed in the following subsections.

3.3.2 PROTECTION BY MULTIPLE CONFINEMENT BARRIERS AND SYSTEMS

3.3.2.1 Confinement Barriers and Systems

The ISFSI relies on a system of multiple confinement barriers during all handling and storage operations. Table 3.3-2 from the NUHOMS Topical Report (Reference 3.1) has been included and summarizes the radioactive confinement barriers and systems employed in the design of the ISFSI.

During transport and storage operations, the IFAs are confined within the DSC. The DSC consists of a cylindrical shell and multiple end plates. Each end plate will be seal welded to the canister in order to provide redundant seals for the DSC. These redundant seals minimize the likelihood of an uncontrollable release of radioactivity. Detailed discussion of the DSC confinement integrity, including the discussion on helium confinement, is presented in Section 3.3.2.1 of the NUHOMS Topical Report and is fully applicable here.

The criteria for protection against any postulated internal or external natural phenomena are discussed in Section 3.2 and Chapter 8 of this report.

3.3.2.2 Ventilation - Offgas

During the normal storage operations of the ISFSI, there will be essentially no release of radioactive material. Additionally, as discussed in Chapter 8 of the NUHOMS Topical Report (Reference 3.1), there are no credible accidents which could cause a release of radioactivity. Therefore, the HBR ISFSI does not require an offgas system.

During the cask drying operation, water and gas will be removed from the cavity of the DSC. This operation will take place in the HBR2 decontamination facility and the water and gas will be routed through Unit 2's existing radioactive waste processing system.

3.3.3 PROTECTION BY EQUIPMENT AND INSTRUMENTATION SELECTION

3.3.3.1 Equipment

The DSC and the GE IF-300 shipping cask are the only equipment that specifically provide protection during normal and off-normal operations of the ISFSI. The design criteria for the DSC are provided in Section 3.2 of this SAR. The design criteria for the cask are listed in the GE IF-300 Safety Analysis Report (Reference 3.5).

3.3.3.2 Instrumentation

The HBR ISFSI is designed to be totally passive and therefore, no safety related instrumentation is required for operation of the facility. However, two of the DSCs and HSMs were instrumented for experimental purposes only for a one year test period (Agreements with DOE and EPRI).

The instrumentation was limited to placement of a number of thermocouples within these components. Instrumentation of the HSM does not effect its structural and mechanical properties. The placement of thermocouples in the DSC, however, requires a feed-through penetration at the DSC bottom region. This feed-through incorporates the same redundant seal philosophy used in the DSC design. The penetration is also designed such that confinement integrity of the DSC is not compromised under both normal operating and accident conditions. The instrument penetration analysis is provided in Section 8.4 of this report.

3.3.4 NUCLEAR CRITICALITY SAFETY

The DSC internals are designed to provide nuclear criticality safety during wet loading operations. A combination of administrative procedures, materials properties, geometry, and neutron poisons are used to assure that subcritical conditions exist at all times.

The DSC internals were analyzed for criticality safety using the KENO-IV Monte Carlo criticality code. The calculational procedures, cross-section sets, biasing techniques, and computer hardware used to perform the criticality analyses were identical to the methods used in the NUHOMS generic design (refer to the NUHOMS Topical Report - Reference 3.1).

Since the DSC for the HBR ISFSI design uses a different boron content in the aluminum boron alloy material on the fuel guide sleeves, additional calculations were performed to assure criticality safety. The 70E H_2O case

(Case No. 1, Table 3.3-4 of the NUHOMS Topical Report) was executed using the minimum specified boron content (4.5%). Twenty-one thousand neutron histories were executed to obtain the maximum k_{eff}.

$$\text{Max } K_{eff} = K_{eff} + 2 \text{ sigma} + K_{bias}$$
$$= 0.91960 + 2(0.00537) + 0.0174$$
$$= 0.94774$$

For details of the analysis methodology, and a discussion of the computational bias, see Section 3.3.4 of the NUHOMS Topical Report (Reference 3.1).

3.3.5 RADIOLOGICAL PROTECTION

3.3.5.1 Access Control

A fence with a locked gate is installed partially around the ISFSI for the purpose of designating the area a radiation control area. The key is controlled by the HBR2 Radiation Control unit. Access to the ISFSI is on an as needed basis.

3.3.5.2 Shielding

An estimate of collective onsite and offsite doses during operations and around the ISFSI are presented in Chapter 7.

3.3.5.3 Radiological Alarm System

There are no radiological alarms required.

3.3.6 FIRE AND EXPLOSION PROTECTION

3.3.6.1 Fire Protection

The degree of fire protection a structure requires is based on a number of factors: type and location of combustible materials and their proximity to or location within the ISFSI, type of construction and its fire resistance characteristics, fire barriers, and the ability of the plant's fire brigade to reach and effectively extinguish a credible fire.

No combustible materials are stored within the ISFSI or within the ISFSI's boundaries. There is no fixed fire suppression system within the boundaries of the ISFSI. The facility is, however, located outside the confines of any building and is directly accessible to HBR2's fire brigade. The fire brigade has access to HBR2's existing portable fire suppression equipment or the site's water fire protection system, as described in Section 9.5.1 of the HBR2 FSAR (Reference 3.2).

3.3.6.2 Explosion Protection

The DSC and HSM contain no volatile materials and therefore, no credible internal explosion is possible. Internal explosions are not considered as part of the design criteria. The design basis for explosions away from the HSM is bounded by the design basis tornado missile described in Section 3.2 of this report and of the NUHOMS Topical Report (Reference 3.1).

3.3.7 MATERIALS HANDLING AND STORAGE

3.3.7.1 Irradiated Fuel Handling and Storage

The fuel handling systems used in loading the IFAs into the DSC are presented in Section 9.1.4 of the HBR2 UFSAR (Reference 3.2). Irradiated fuel handling outside the spent fuel storage pool will be done with the fuel assemblies enclosed in the canister. Criticality safety during handling and storage is discussed in Section 3.3.4. The criterion for safe configuration is an effective mean plus two-sigma neutron multiplication factor (k_{eff}) of 0.95. Calculations have shown that the expected k_{eff} value is well below this limit.

The basic criterion for the cooling of irradiated fuel during storage is a maximum cladding temperature of 380^{o}C (716^{o}F). Higher temperatures may be sustained for brief periods without endangering cladding integrity. During canister drying and other normal and abnormal transients, the criterion is a cladding temperature of 570^{o}C for 48 hours. For further details, see Section 3.3.7.1 of the NUHOMS Topical Report (Reference 3.1).

The canister external contamination limits are listed below:

Beta/Gamma Emitters	10^{-3} μCi/Cm^2 or 220,000 dis/min/100 cm^2
Alpha Emitters	10^{-5} μCi/Cm^2 or 2,200 dis/min/100 cm^2

The canister is sealed by double welds prior to storage so that any contamination of the canister interior or its contents will remain confined during transfer and storage.

3.3.7.2 Radioactive Waste Treatment

The contaminated water removed from the cask annulus and cavity of the loaded DSC will be handled by HBR2's radioactive waste treatment system. The site's radioactive waste treatment system is described in Chapter 11 of the UFSAR.

3.3.7.3 Waste Storage Facilities

No radioactive wastes will be generated during the life of the ISFSI. The contaminated water removed from the cask annulus and cavity of the loaded DSC will be handled by HBR2's radioactive waste treatment system. The waste storage facility associated with the HBR2 radioactive waste treatment system is described in Chapter 11 of the UFSAR.

3.3.8 INDUSTRIAL AND CHEMICAL SAFETY

No hazardous or volatile chemicals or chemical reactions are involved in the operation of the ISFSI and therefore, were not considered in any of the facility's design criteria.

TABLE 3.3-1

H. B. ROBINSON
ISFSI IMPORTANT TO SAFETY (SAFETY RELATED) FEATURES

I. Transfer Cask (IF-300) (Q-List)	Safety Related[1]
II. Dry Storage Canister (DSC) (Q-List)	Safety Related[2]
II.a. Basket	
II.b. Stiffener Plates	
II.c. Support Rods	
II.d. Lead Plug/Support	
II.e. Canister Body	
II.f. End Closure Plates	
III. Horizontal Storage Module (HSM)	Non-Safety Related[3]
III.a. Concrete Shielding	
III.b. DSC Support Assembly	
IV. Foundation	Non-Safety Related[3]
V. Transfer Components	Non-Safety Related
V.a. Transport Vehicle	
V.b. Hydraulic Ram	
VI. Instrumentation	Non-Safety Related

Notes:

1. As defined by 10CFR71 for a licensed transportation cask.

2. For the purposes of this license application, CP&L considers the Dry Storage Canister Safety Related as defined by 10CFR50-Appendix B.

3. CP&L applied a "Radwaste Related" QA program to these components for the procurement, construction and testing phases of the project. The 10 CFR 50 Appendix B program as described in RNP UFSAR Section 17.3 shall be applied to the operational phase of the project.

TABLE 3.3-2

RADIOACTIVITY CONFINEMENT BARRIERS
AND SYSTEMS OF THE ISFSI

Radioactivity	Confinement Barriers and Systems
Contaminated Spent Fuel Pool Water	1. Demineralized Water in Cask
	2. Cask/DSC Annulus Seal
Irradiated Fuel Assemblies	1. Fuel Cladding
	2. DSC Body
	3. Seal Welded Primary Closure
	4. Seal Welded Secondary Closure

3.4 CLASSIFICATION OF STRUCTURES, COMPONENTS, AND SYSTEMS

A classification of the ISFSI's various structures, components, and systems is listed in Table 3.3-1.

3.5 DECOMMISSIONING CONSIDERATIONS

The dry storage canisters are intended to be transferred to a federal repository when such a facility is operational. The concrete module is designed so that the canister can be safely returned to a shipping cask and transported offsite to the federal repository.

Shipping cask design and transportation requirements will depend on the regulations in effect at the time when the federal repository begins receiving spent fuel. In the absence of new regulations, it is likely that the existing GE IF-300 shipping cask owned by Carolina Power & Light Company would be used to transport the canisters.

Contamination on the canister exterior will be very small (see Section 3.3.7 of the NUHOMS Topical Report (Reference 3.1)). The resulting contamination of the module internals and air passages will also be minimal. This level of contamination may be removed by manual methods so that the reinforced concrete module can be broken-up and removed using conventional methods.

The canister itself may be contaminated internally by crud from the irradiated fuel and will be slightly activated by spontaneous neutron emissions from the irradiated fuel. The canister is designed to be used in the repository for final disposal; however, if the fuel is removed from the canister, the canister could be disposed of as low-level waste. The exact decommissioning plan to be applied will depend on the status of the U.S. waste repository program at the time of decommissioning.

REFERENCES: CHAPTER 3

3.1 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)

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