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used during storage and transfer of spent fuel and GTCC waste. Figure 1.3-1 provides an overview of the basket and Concrete Cask.

1.3.1 STORAGE SYSTEM BASKETS

The Trojan ISFSI storage system utilizes two types of baskets, the PWR Basket and the GTCC Basket. The baskets are metal containers that are seal-welded closed. Both baskets serve as a confinement boundary for the materials stored within the baskets.

The PWR Basket is a fuel storage canister designed to provide safe storage of intact spent fuel, failed fuel and fuel debris. The PWR Basket consists of an internal sleeve assembly, an outer shell assembly, a shield lid and a structural lid. The internal sleeve assembly is fabricated from high strength steel plates formed into an array of 24 square storage sleeves, each holding one PWR spent fuel assembly. The cells are sized to accommodate storage of control components within the fuel assembly. The PWR Basket relies only on geometry for subcriticality during storage.

Assemblies containing damaged fuel, process can capsules containing fuel debris, fuel assembly hardware, process cans containing fuel assembly hardware, and a fuel rod storage container are placed in a failed fuel can in the PWR Basket. Fuel debris is placed in process cans, which are placed in a process can capsule, prior to placement in the failed fuel can in the PWR Basket. The four peripheral cells in each PWR Basket can accommodate failed fuel cans as well as spent fuel assemblies.

The GTCC Basket is designed to provide safe storage of GTCC waste. GTCC waste is placed in canisters and then placed into the GTCC Basket. The GTCC Basket does not contain an internal sleeve assembly. The GTCC Basket accommodates 28 individual canisters designed for GTCC waste.

A Basket Overpack is provided to be used in the unlikely event of a leaking basket.

1.3.2 STORAGE SYSTEM CONCRETE CASK

The Concrete Cask provides structural support, shielding, and natural circulation cooling for the basket. The basket is stored in the central steel lined cavity of the Concrete Cask. The Concrete

sheath. RCCAs consist of 24 absorber rods which can be inserted into the thimble guides. A total of 61 RCCAs will be stored in the ISFSI. BPRAs are similar to RCCAs but consist of fewer absorber rods (9 to 20). Thimble plugs were used to "plug" thimble guides which did not contain absorber rods or sources during reactor operation. Sources are similar in shape to absorber rods but a portion of the length contains a secondary neutron source. The primary design concern associated with these components is weight. Table 3.1-4 summarizes the physical characteristics of the inserts.

The main physical parameters of concern are the fuel assembly dimensions and weight, and envelope (cross-sectional dimension). These parameters establish the mechanical and structural design aspects of the Concrete Cask and basket. The thermal and radiological characteristics establish the shielding and thermal aspects of the design.

3.1.1.2 Failed and Partial Fuel Assemblies

Ten (10) partial fuel assemblies and one (1) fuel rod storage container, which contain intact, suspect, or failed fuel rods, will require storage.

3.1.1.3 Fuel Debris

Fuel debris consists of loose fuel pellets, fuel pellet fragments, and fuel assembly fragments (portions of fuel rods, portions of grid assemblies, etc.). The quantity of fissile material contained as fuel debris will not exceed 10 kg per basket. This limit is imposed to satisfy the license conditions of the TranStor™ Shipping Cask (Reference 1). An additional limit for fuel debris of no more than 20 curies of plutonium is imposed to meet the offsite transportation requirements of 10 CFR 71.63.

3.1.1.4 GTCC Waste

GTCC waste consists of activated core components consisting mainly of segmented reactor internals. GTCC waste characteristics such as weight and curie content are addressed in Table 3.1-2. GTCC waste is not stored in the same basket with spent fuel.

3.2.5.3 Load Combinations and Design Strength - Transfer Cask

The Transfer Cask is a special lifting device designed and fabricated to the requirements of ANSI 14.6 (1993) and NUREG 0612 (1980). The criteria for its load-bearing components are:

Maximum principal stress during the lift (with 10% dynamic load factor) will be less than $S_y/3$ or $S_u/5$.

Load bearing members of the Transfer Cask shall be subject to drop weight test (ASTM E208) or charpy impact test (ASTM A370) per ANSI 14.6 (1993) paragraph 4.2.6.

3.2.5.4 Load Combinations and Design Strength - Failed Fuel Can

The Failed Fuel Can is designed to be placed into one of the four corner storage locations of the PWR Basket. The Failed Fuel Can is designed to allow for water draining and vacuum drying during PWR Basket closure. Once placed into its storage location, the Failed Fuel Can is not subjected to external loadings applicable to ASME Service Level A (normal). Specific structural design criteria and load combinations are not applicable.

3.2.5.5 Load Combinations and Design Strengths - Fuel Debris Process Can Capsule

The Fuel Debris Process Can Capsule material and welds are selected based on ASME Section III, Division I, Subsection NG (1992). The Fuel Debris Process Can Capsule is structurally analyzed for external pressure, internal pressure, dead weight, thermal stresses, and drops. The stresses calculated by classical equations are less than the allowable stresses provided in ASME, Section III, Division I, Subsection NG (1992) for service levels A and D.

2. To provide adequate heat transfer so that the fuel clad temperature does not exceed allowables under design conditions.

The primary functions of the Concrete Cask are:

1. To protect the basket from weather and postulated environmental events such as earthquakes and tornado missiles,
2. To provide adequate heat transfer for the PWR Basket and GTCC Basket, and
3. To provide adequate shielding (together with a PWR Basket or GTCC Basket) to meet 10 CFR 72 requirements.

The primary functions of the Transfer Cask are:

1. To serve as a special lifting device meeting the requirements of NUREG-0612 (1980)/ANSI 14.6 (1993) for movement of a PWR Basket or GTCC Basket, and
2. To provide radiation shielding to minimize exposure rates during transfer operations.

The primary function of the Transfer Station is to prevent the Transfer Cask from falling or overturning during Basket transfer operations.

The primary function of the Failed Fuel Can is to provide a containment boundary for failed fuel such that the failed fuel will be constrained within its PWR Basket storage location. The primary function of the Fuel Debris Process Can Capsule is to provide a containment boundary for fuel debris. Constraining failed fuel and fuel debris to fixed storage locations is required to maintain the assumptions in the criticality analysis and heat transfer modeling.

As discussed in the following sub-sections, the ISFSI design incorporates features addressing each of the above design considerations to assure safe operation during fuel loading, storage system handling, and storage.

3.3.2 PROTECTION BY MULTIPLE CONFINEMENT BARRIERS AND SYSTEMS

3.3.2.1 Confinement Barriers and Systems

Oregon Administrative Rule (OAR) 345-26-0390 prohibits the storage of spent nuclear fuel or radioactive materials other than that generated or used in the operation of the Trojan Nuclear Plant. Spent nuclear fuel and fuel related material will be confined within PWR Baskets. GTCC waste will be confined within GTCC Baskets.

The PWR Basket and GTCC Basket are designed to provide a confinement barrier for spent nuclear fuel and GTCC waste in accordance with the general design criteria requirements of 10 CFR 72, Subpart F. Each basket is a stainless steel seal welded enclosure. The basket shield lid and structural lid closures are accomplished by multi-pass welding. The PWR Basket and GTCC Basket confinement barriers are designed in accordance with ASME, Section III, Subsection NC (1992).

The PWR Basket internals, which are used to constrain fuel assemblies and Failed Fuel Cans during storage, are designed in accordance with ASME, Section III, Subsection NG (1992). The PWR Basket internals provide 24 storage locations. The four (4) corner locations are designed slightly larger to accommodate a Failed Fuel Can.

The Fuel Debris Process Can Capsule provides a containment boundary for fuel debris within the PWR Basket. It is designed using the guidance in ASME, Section III, Subsection NG (1992) (see Section 3.2.5.5).

The Failed Fuel Cans and GTCC Cans do not provide a confinement boundary and are considered to function as part of the basket internals. The Failed Fuel Can is designed in accordance with applicable portions of ASME, Section III, Subsection NG (1992). The GTCC Can is designed in accordance with applicable portions of ASME, Section III, Subsection NF (1992).

In the unlikely event of a PWR Basket or GTCC Basket confinement boundary failure, the affected basket may either be repaired or sealed within a Basket Overpack. The design criteria

for the Basket Overpack are the same as those specified for the PWR Basket and GTCC Basket confinement boundary.

The PWR Basket must be designed to withstand credible drop accidents without damaging the stored fuel (i.e., the storage cells do not deform such that they bind the fuel). The PWR Basket must also be designed to provide confinement in the event of a fuel clad failure.

3.3.2.2 Ventilation-Offgas

The ISFSI is designed to confine radioactive materials within a sealed enclosure for the life of the facility. There are no radioactive releases during normal operations or credible accidents. In the unlikely event a leaky basket must be placed in a Basket Overpack, evacuation of the Basket Overpack and backfilling with helium would be required. The operation is discussed in Chapter 5. A suitable filtration system such as a high efficiency particulate air (HEPA) filter would be used for the vacuum system vent path during this evolution.

3.3.3 PROTECTION BY EQUIPMENT AND INSTRUMENTATION SELECTION

3.3.3.1 Equipment

The equipment/components that have been identified as important to safety for the ISFSI are:

1. Concrete Cask,
2. PWR Basket,
3. GTCC Basket,
4. Basket Overpack,
5. Fuel Debris Process Can Capsule,
6. Failed Fuel Can,
7. Transfer Cask, and
8. Transfer Station

The design criteria for the PWR Basket, GTCC Basket, and Basket Overpack are summarized in Table 3.2-5. The design criteria for the Concrete Cask are summarized in Table 3.6-1.

3.3.3.2 Instrumentation

A temperature monitoring device is provided for each of the air outlet vents per storage cask (four per cask). The temperature monitoring devices are commercial grade. Additional discussion of temperature monitoring is provided in Section 5.1.3.4 and Section 5.4.1.

3.3.4 NUCLEAR CRITICALITY SAFETY

The storage system is designed to maintain subcritical conditions ($K_{eff} \leq 0.95$) under normal handling and storage conditions, off-normal handling and component functioning, and hypothetical accident conditions.

3.3.4.1 Control Methods for Prevention of Criticality

Subcritical conditions are to be maintained by PWR Basket internal geometry. The PWR Basket internals will establish fuel assembly spacing. The design will assume a fuel assembly enrichment equal to or greater than the maximum initial fuel assembly enrichment that will be stored (3.56 wt% U^{235}). No credit will be taken for burnup or fuel assembly control inserts. Although neutron absorbing material is incorporated into the PWR Basket internals design, it is not credited in the criticality analysis for dry storage conditions.

Table 3.1-1 lists the fuel characteristics. Loose pellets and fuel debris are placed in Fuel Debris Process Cans which are placed in a Fuel Debris Process Can Capsule. Administrative controls limit the amount of fuel debris which can be placed within a basket.

There are no criticality control requirements for the GTCC Baskets.

Table 3.2-5

PWR Basket, GTCC Basket, and Basket Overpack Design Criteria

Component (Applicable Code or Criteria)	Criteria
PWR Basket, GTCC Basket, or Basket Overpack Normal Operation - Service Level A ASME Section III, Subsection NC (shell) ASME Section III, Subsection NG (internals)	$P_m < 1.0\ S_m$ $P_L + P_b < 1.5\ S_m$ $P + Q < 3.0\ S_m$
PWR Basket, GTCC Basket, or Basket Overpack Off-Normal Operation - Service Level C ASME III, Subsection NC (shell) ASME III, Subsection NG (internals)	$P_m < 1.2S_m$(shell), $< 1.5S_m$ (cells) $P_L + P_b < 1.8S_m$(shell), $< 2.25S_m$ (cells)
PWR Basket, GTCC Basket, or Basket Overpack Accident Condition - Service Level D ASME III, Subsection NC (shell) ASME III, Subsection NG (internals)	$P_m < 2.4\ S_m$ or $0.7\ S_u$ (whichever is less) $P_L + P_b < 3.6\ S_m$ or $1.0\ S_u$ (whichever is less)

4.2.1 STRUCTURAL SPECIFICATION

The design criteria of the storage structures and components account for both normal and off-normal conditions, including a range of credible and postulated accidents. The principal design criteria for the ISFSI is in accordance with Title 10, Code of Federal Regulations, Part 72 (10 CFR 72), and ANSI/ANS 57.9. The design criteria for the ISFSI is presented in Chapter 3. The design codes for the major ISFSI storage structures and components are summarized in the following table.

Component	Governing Code/Standard[1]
Storage Pad	ACI 318 (1983)
PWR Basket	Confinement boundary - ASME, Section III, Subsection NC
	Internal assembly - ASME, Section III, Subsection NG
GTCC Basket	Confinement boundary - ASME, Section III, Subsection NC
Basket Overpack	ASME, Section III, Subsection NC
Fuel Debris Process Can Capsule	ASME, Section III, Subsection NG (used as guidance - see Section 3.2.5.5)
Failed Fuel Can	ASME, Section III, Subsection NG
Concrete Cask	ACI 349 and ANSI 57.9

Section 3.4 provides the criteria used to classify structures, systems and components, important to safety.

The ISFSI Storage Pad meets the requirements of ACI 318 and is capable of supporting the loads associated with the array of Concrete Casks and transfer equipment. The ISFSI Storage Pad is not classified as important to safety. Its function is to provide a slab-on-grade supporting surface for the Concrete Casks, Transfer Station and shipping cask. It also provides a smooth level surface to allow operation of the air pad system.

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[1] Applicable revision of governing code/standard is provided in Chapter 3.

Basket Overpack. Section 3.3.2 discusses the design criteria applicable to these ISFSI components.

The cladding of intact fuel assemblies provides an additional confinement boundary. The Fuel Debris Process Can Capsule provides a containment boundary for fuel fragments and is stored within a PWR Basket. The Failed Fuel Cans provide a containment boundary for failed fuel assemblies to constrain these assemblies and associated components within its PWR Basket storage location. Constraining this material to fixed storage locations is required to maintain the assumptions in the criticality analysis and heat transfer modeling.

The design requirements for confinement barriers and systems are further discussed in Section 3.3.2.

4.2.4 INDIVIDUAL UNIT DESCRIPTION

The ISFSI is comprised of up to 36 individual storage systems. Each storage system consists of a Concrete Cask containing either a PWR Basket or GTCC Basket. In the unlikely event a PWR Basket or GTCC Basket fails to maintain a confinement boundary and can not be repaired, a Basket Overpack is available. The Concrete Casks are arranged on the Storage Pad as discussed in Section 4.2.2.1.

4.2.4.1 Functional Description

The primary functions of the ISFSI storage system components are discussed in Section 3.3.1.

4.2.4.2 Component Descriptions

4.2.4.2.1 Description of the PWR Basket

The PWR Basket is a transportable cylindrical container consisting of an outer shell assembly, a shield lid, a structural lid, and an internal basket assembly. The basket shell provides the confinement boundary and is designed to withstand credible accidents without loss of integrity.

The shell exterior is coated with a gloss epoxy coating for ease of decontamination following loading operations.

The PWR Basket internal assembly is fabricated from steel plates formed into an array of 24 square storage cells. Four (4) of the outer corner cells are slightly larger to allow accommodation of a Failed Fuel Can. Intact fuel assemblies, with or without inserts, may be stored in any of the storage locations. The internal assembly uses structural tubes to provide support for the storage cells during a postulated drop accident. Neutron absorbing poison sheets are also used in the construction of the PWR Basket internal assembly, however they are not credited in the criticality analysis for dry storage conditions.

Section 5.1.1 discusses the operations associated with basket loading and installation of the shield lid and structural lid. The steel shield lid contains two penetrations to allow for vacuum drying and helium backfilling of the basket internal atmosphere. Prior to lowering the shield lid onto the basket after loading is complete, a pipe is threaded into one of the two penetrations. When the shield lid is in place, the pipe length is such that it extends to the bottom of the basket to facilitate water removal. Upon completion of water removal, a pipe plug is threaded into the drain pipe penetration. The other penetration utilizes a quick disconnect fitting to allow connection to a vacuum drying and helium backfilling system. The shield lid is seal welded to the basket shell. The first and final shield lid weld passes are inspected by dye penetrant testing. The basket is then hydrostatically tested at approximately 7.3 psig.

Following completion of hydrostatic testing, a steel structural lid containing a penetration allowing access to the shield lid penetrations is placed on top of the shield lid and seal welded to the basket shell and to the shield lid (where exposed by the structural lid penetration). The first and final weld passes are dye penetrant checked.

Upon completion of the vacuum drying and helium inerting of the internal basket atmosphere, the shield lid and structural lid penetrations must be sealed. The quick disconnect fitting is relied upon to maintain the helium atmosphere until the penetration closure plates are installed. The shield lid penetrations are isolated by two steel plates inserted into the structural lid access penetration. The steel plates are inserted individually and seal welded to the sides of the structural lid penetration. The first and final weld passes for each of these closure plates are dye penetrant checked.

An air flow path is formed by the openings at the bottom (air entrance), the air inlet ducts, the gap between the basket exterior and the Concrete Cask interior, and the air outlet ducts at the top. The air inlet and outlet vents are steel-lined penetrations that take non-planar paths to minimize radiation streaming. A shield ring is provided over the basket-liner annulus to reduce the dose rate at the top of the cask.

The cask lid is fabricated from a steel plate which provides additional shielding to reduce the skyshine radiation. The cask lid also provides a cover and seal to protect the basket from the environment and postulated tornado missiles. The lid is bolted in place and is provided with a locking wire with a lead seal.

The bottom of the Concrete Cask is covered with a steel plate which minimizes loss of cask concrete during a bottom drop accident. The Concrete Cask has reinforced chamfered corners at the top and bottom to minimize damage during handling.

The cask is constructed by pouring concrete between a re-usable form and the inner metal liner. The reinforcing bars and air flow embedments are installed and tied prior to pouring.

A summary of fabrication requirements is presented in Table 4.2-2. Figure 4.2-4 provides a description of the Concrete Cask.

4.2.4.2.5 Failed Fuel Can

The Failed Fuel Can is designed to contain partial or complete fuel assemblies with failed or suspect rods. The internal square opening accommodates a fuel assembly without inserts. The Failed Fuel Can will also be used to store a fuel rod storage container, Fuel Debris Process Can Capsules, fuel assembly hardware (non-fuel bearing components), and Fuel Debris Process Cans that contain fuel assembly hardware (non-fuel bearing components). The outside dimensions allow the Failed Fuel Can to fit in one of the four oversized storage locations within a PWR Basket.

The shell of the Failed Fuel Can is fabricated from carbon steel. Near the bottom of each side of the shell assembly are two screened vent holes. These vent holes enable vacuum drying of the canister. The vent holes also expose the contents of the Failed Fuel Can to the helium atmosphere of the PWR Basket.

The lid is bolted in place and is designed to be lifted using a fuel handling tool. The lid bottom also has vent holes to facilitate draining.

Carbon steel components of the Failed Fuel Can are coated with radiation resistant, high temperature, hard surface inorganic zinc coating. Figure 4.2-5 provides a description of the Failed Fuel Can.

4.2.4.2.6 Description of Fuel Debris Process Can and Capsule

The process can, shown in Figure 4.2-6a, is the container used to process the organic media and fuel debris located in the Spent Fuel Pool. The process can is constructed of 300 series stainless steel for corrosion resistance. The process can has 5 micron metallic filters in both the can bottom and lid. These filters allow removal of water and organic media by high temperature steam, while retaining the solid residue from the processed media and fuel debris inside the process can.

After high temperature steam processing, up to five (5) process cans are placed inside the process can capsule shown in Figure 4.2-6b. The process can capsule is constructed of 304 stainless steel for corrosion resistance and is inerted with helium. The process can capsule provides a sealed containment for the fuel debris. The process can capsule is designed to be lifted by normal fuel handling tools.

The process cans may also be used to store fuel assembly hardware (non-fuel bearing components). These process cans will be not placed in a process can capsule, but will be directly placed inside a failed fuel can. The process cans containing fuel assembly hardware (non-fuel bearing components) will not be processed by high temperature steam because there will be no organic media to remove. Water will be removed from the process can through the metallic filters during the basket vacuum drying process.

4.2.4.2.7 GTCC Can

The GTCC Can is designed to contain GTCC waste for placement within a GTCC Basket. Up to 29,000 lbs. contained within 28 GTCC Cans can be placed in a GTCC Basket.

The shell of the canister is fabricated from steel. Two vent holes are located near the bottom of each side of the shell assembly and on the bottom plate allowing draining and vacuum drying of the container.

4.2.6.8 Maximum Internal Pressure

The basket is backfilled with helium so that at the conditions present during normal operations the internal pressure is at approximately atmospheric pressure. The pressure calculated for different ambient conditions is presented in Table 4.2-9 and stresses are included in the structural analysis in Section 4.2.5. The worst case internal pressure occurs during a postulated accident where fuel rods inside the basket are breached and release their fission gases. This case and the resulting pressure and stresses are described in Section 8.2.6.

4.2.6.9 Evaluation of Cask Lifetime Performance under Normal Conditions of Storage

As shown in the preceding sections, the storage system operates within the thermal design limits. Therefore, no degradation due to temperature effects on materials or components is expected during the lifetime of the cask.

4.2.7 CRITICALITY EVALUATION

The criticality evaluation was performed using the KENO-Va module of the SCALE-4.1 code package (Reference 9). The model analysis was based on Westinghouse 17x17 standard fuel. The ISFSI storage system will also contain B&W 17x17 fuel which is considered to be bounded by the Westinghouse fuel. The only significant difference in these two types of fuel assemblies is the B&W assembly has a slightly smaller fuel pellet diameter. The smaller pellet size makes the B&W assembly slightly less reactive and should therefore be bounded by Westinghouse analysis.

The four corner cells of a PWR Basket may contain a Fuel Debris Process Can Capsule inside a failed fuel can. A fuel debris mass limit of 10 kg per PWR Basket will be administratively controlled. A limit of 10 kg of fuel debris is significantly less than the fuel mass of an intact fuel assembly (~460 kg uranium). The 10 kg of fuel mass will not be nearly as reactive as an intact fuel assembly no matter how the fuel debris is arranged within the Fuel Debris Process Can Capsule(s). The 10 kg of fuel mass will not cause thermal, structural or shielding problems no matter how it is distributed within the Fuel Debris Process Can Capsule(s).

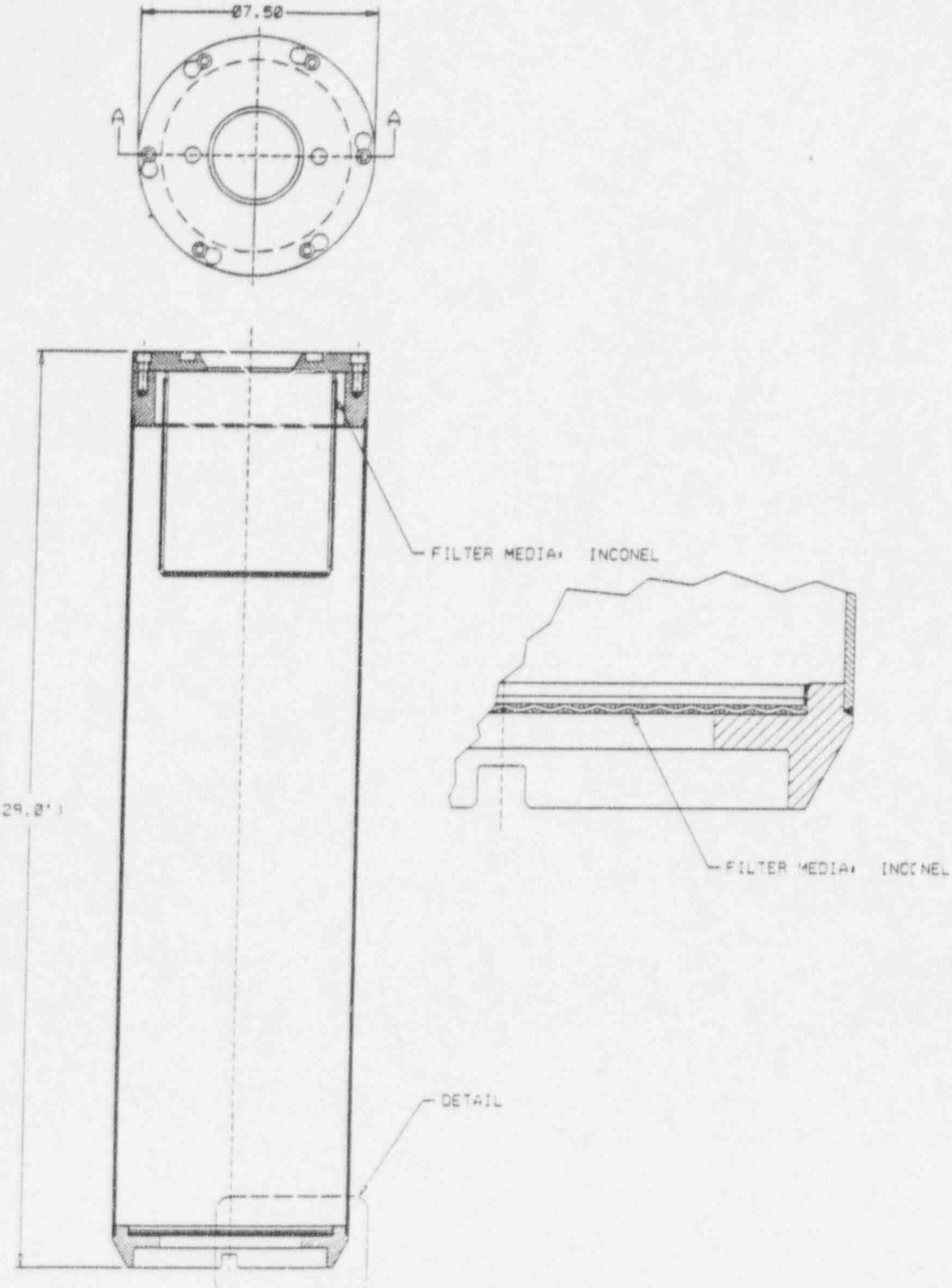
The parameters of concern for criticality evaluations are initial enrichment, burnup, moderation, poisons, and geometry. These parameters combined produce the reactivity of the system which

Table 4.2-1a
ASME Code Deviations
ASME Section III Subsection NC

Section	Requirement	Exception/Justification
3211.1	Establishes scope for vessel design	Requirement of NC-5250 (referenced in this subparagraph) to radiograph all Category C joints is not met for the basket closure welds. Radiographic examination of these field welds is not feasible; redundant leakage barriers used in lieu of this requirement. Lugs and corner support tubes are not attached to the shell with continuous welds (per NC-4267) due to lack of accessibility. Lugs are not loaded while the shell is serving as a pressure boundary. Detailed drop analysis includes the actual weld configuration and considers influence on the shell as applicable. Set of calculations, drawings, and specifications is used in lieu of the Design Report per Appendix C. However, the information is provided and the intent of the Code is met.
3223.2	Requires Design Report in Appendix C format	A set of calculations, drawings, and specifications is used in lieu of the Design Report per Appendix C. However, the information is provided and the intent of the Code is met.
3252	Describes permissible types of welded joints	As stated above, basket closure welds (Category C) can not be radiographed per NC-2553.
3254	Refers to NC-4267 for structural attachment welds.	Lugs and corner support tubes are not attached to the shell with continuous welds (per NC-4267) due to lack of accessibility. Lugs are not loaded while the shell is serving as a pressure boundary. Detailed drop analysis includes the actual weld configuration and considers influence on the shell as applicable.
4266	Requirements for category D weld joints in vessels designed to NC-3200	Valve covers (Cat. D welds) are fillet welds and do not meet Figure 4266. Small diameter and weld size provide large factors of safety. Lid reinforcement is provided and redundant valve covers are installed for the PWR basket [see NC-3252].
4267	Types of attachment welds allowed in vessels designed to NC-3200	Lugs and corner support tubes are not attached to the shell with continuous welds due to lack of accessibility. Lugs are not loaded while the shell is serving as a pressure boundary. Detailed drop analysis includes the actual weld configuration and considers influence on the shell as applicable [see NC-3211.1].
5253	Category C welded joints for vessels designed to NC-3200 require RT examination.	Structural lid welds are not radiographed due to limited accessibility and redundant PWR basket closure. Welds are tested using liquid penetrant or magnetic particle examination and helium leak testing. [See NC-3211.1]
6113	Requires pressure test in presence of inspector.	The inspection is performed but not by a Code certified inspector. Acceptable because the vessel is not N-stamped.
8100	References NCA-8000 for nameplate, stamping, and report requirements.	Code Stamping is not provided. The basket is not a part of a nuclear power system as defined by NCA-1110.

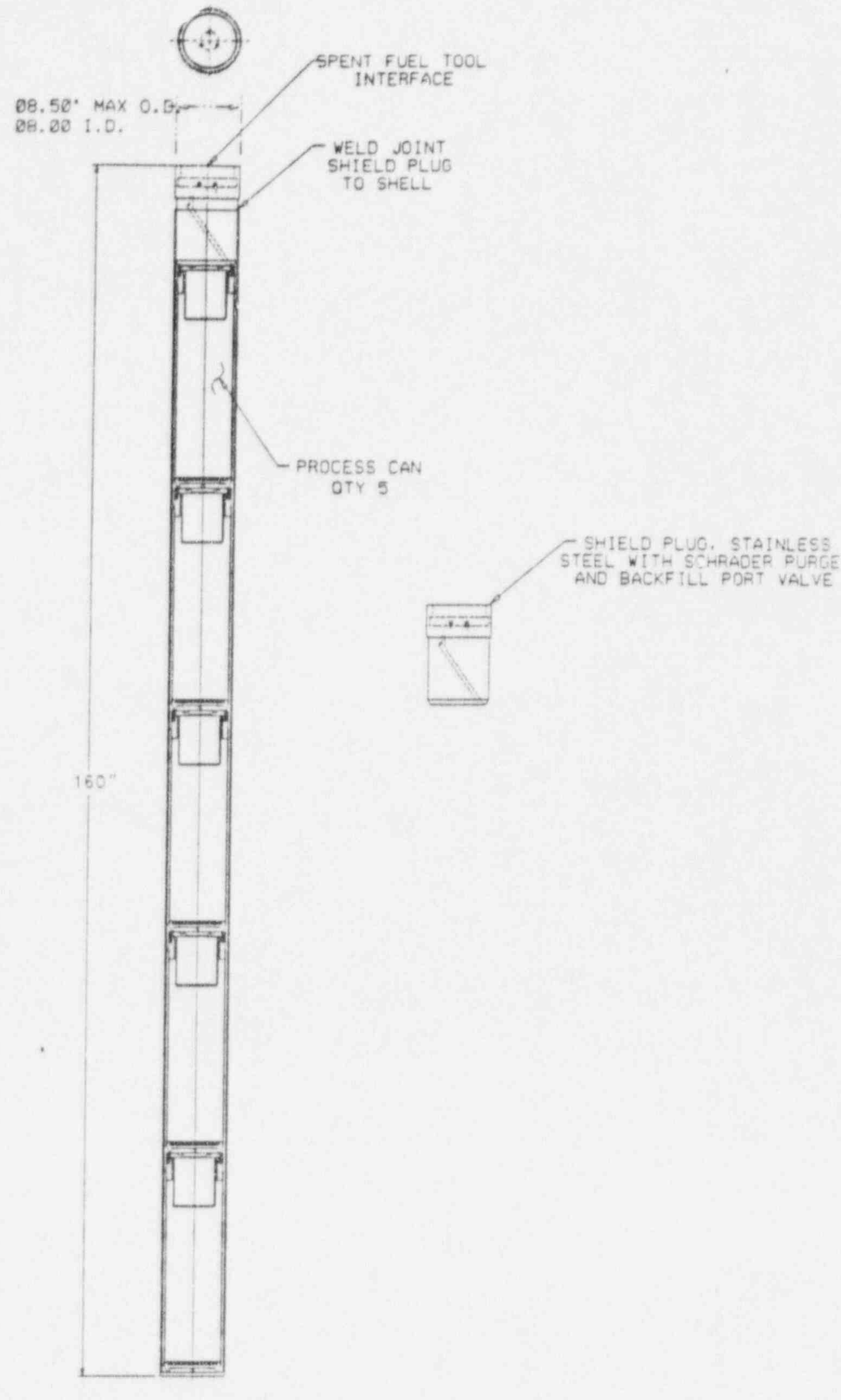
ASME Section III Subsection NG

Section	Requirement	Exception/Justification
2121	Requires use of ASME (SA) materials.	The basket internals and failed fuel can do not use SA materials. Materials used meet ASTM specifications that are identical to corresponding ASME specifications. All materials are supplied as important to safety, CMTRs are provided.
4110	General requirements specify use of materials per NG-2000.	NG-2000 is not entirely met (see NG-2121).
4121	Means of certification of materials.	ASTM materials are utilized for NG components (see NG-2121).
8100	References NCA-8000 for nameplate, stamping, and report requirements.	Code Stamping is not provided. The basket is not a part of a nuclear power system as defined by NCA-1110.



TROJAN ISFSI
SAFETY ANALYSIS REPORT

FIGURE 4.2-6a
FUEL DEBRIS PROCESS CAN



TROJAN ISFSI
SAFETY ANALYSIS REPORT

FIGURE 4.2-6b
FUEL DEBRIS PROCESS CAN CAPSULE

5.0 OPERATIONS

5.1 GENERAL DESCRIPTION

The methods and sequences described below define the operational controls which personnel performing spent fuel loading and storage activities will implement to assure that operations utilize the passive safety features of the Trojan ISFSI design described in Chapter 4. Fuel loading and basket sealing operations (including non-destructive examination and pressure testing) will be performed within the Fuel Building in order to utilize the existing systems and equipment for heavy lifts, radiation monitoring and controls, decontamination and any necessary auxiliary support (i.e., electrical, crane, service air, etc.). Fuel handling and cask loading operations in the Fuel Building will be performed in accordance with Portland General Electric Company's 10 CFR 50 license for the Trojan Plant. Storage at the ISFSI will be subject to the requirements of the ISFSI license issued in accordance with 10 CFR 72. Once the loaded storage cask is placed on air pallets in the Fuel Building Bay and moved to the ISFSI concrete slab area, operational activities are essentially limited to monitoring proper decay heat removal.

5.1.1 OPERATION DESCRIPTION

The following sections describe the spent fuel handling, basket sealing, and cask loading activities relevant to the operation of the Trojan ISFSI. As previously described in Chapter 3, the Trojan ISFSI will contain intact and failed spent nuclear fuel assemblies, fuel debris, and GTCC waste. The PWR Basket is vertically loaded with fuel assemblies and/or special canisters designed to hold failed fuel or fuel debris. The GTCC Basket is loaded with a special canister containing segmented GTCC waste. Section 5.1.1.1 describes the operational controls for loading the individual canisters. Section 5.1.1.2 describes operational controls for loading the individual basket.

Specific procedures will define and control classification criteria, loading sequence and individual basket/cask inventory. Fuel/debris/GTCC waste will be visually inspected as it is loaded to verify that each assembly/item conforms to the established classification criteria. As a minimum, item identification and/or serial numbers will be verified and recorded. Fuel loading operations will be videotaped to visually record fuel assembly serial numbers and to provide an independent record of loaded inventory. Fuel will be examined to verify that pellets are structurally contained within the cladding or it will be placed in a Failed Fuel Can. Additional

procedures will control placement and use of impact limiters, allowable travel path inside the Fuel Building, and limit lifting heights to assure compliance with bounding analysis.

5.1.1.1 Failed Fuel, GTCC Waste, and Fuel Debris Process Can Capsule Loading

Special containers are used to segregate failed fuel, fuel debris, and GTCC waste within the confines of the PWR Basket or GTCC Basket. The individualized containers provide containment properties by constraining the material to fixed storage locations which maintains the assumptions in the criticality analysis and heat transfer modeling.

Failed fuel is contained in special cans designed to fit in one of four oversized peripheral storage sleeves of the basket. Failed or suspect fuel that cannot structurally contain pellets within the cladding will be placed in a Failed Fuel Can. Because the cans are open to the internal basket atmosphere, they are vacuum dried and backfilled at the same time as other basket contents.

Fuel debris is contained within a specially designed and fabricated canister (process can capsule) which has been sealed as part of the fuel debris processing project before being loaded in a basket. The process can capsule is placed in a failed fuel can, which has been placed in any one of the four oversized storage cells in the basket.

The GTCC Can effectively contains GTCC waste currently stored at the Trojan Nuclear Plant. The cans are filled and placed in the GTCC Basket utilizing a 28 slot alignment grating which is removed after the GTCC Basket is filled. The cans are open to the GTCC Basket atmosphere to allow drying.

5.1.1.2 Basket Loading and Sealing Operations

This section describes the sequence of operations and controls necessary to load, seal, and test a PWR Basket or GTCC Basket in the Fuel Building and to control transfer operations to the ISFSI storage pad. The major components described in Chapter 4 are further defined with design and operating characteristics. Test and/or inspection methods demonstrate compliance with design requirements.

The basket and Transfer Cask are brought into the Fuel Building through the crane bay door. After examination and any needed cleaning, the Transfer Cask is moved by use of the Fuel Building overhead crane (independent dual hook design) and Transfer Cask Lifting Yoke to the cask wash pit area. There, a protective bottom cover (e.g., plastic sheeting, plexiglas, plywood, etc.) is installed on the Transfer Cask lower hydraulic door carrier rails, which will prevent possible contamination from the cask loading pit floor from being imbedded in the cask. The basket is then moved by the same crane and placed into the Transfer Cask. After installation of radiation shielding shims in the gap between the Transfer Cask and basket, a basket retaining ring is bolted to the Transfer Cask wall. The basket is then filled with borated water. The water is filtered, if necessary, to reduce the potential for contamination on the exterior of the basket. This filling may be done in the cask wash pit area or at the cask loading pit before submergence.

The Transfer Cask (with basket) is then moved by the Fuel Building overhead crane and suspended over the cask loading pit immediately adjacent to the spent fuel pool. Borated water is continuously flushed through the basket/Transfer Cask gap to minimize unnecessary contamination of the basket external surface while the Transfer Cask is in the cask loading pit. After the Transfer Cask is lowered to the pool bottom, the specified basket contents are loaded. Operations will be conducted in accordance with approved Trojan Nuclear Plant fuel handling procedures.

contents of the core baffle and baffle former plates are the most limiting. The GTCC waste gamma source activities are listed in Table 7.2-6.

7.2.1.5 Fuel Debris

The PGE fuel debris consists of individual fuel pellets and fragments from damaged fuel rods. For the shielding analysis, fuel debris source terms are conservatively assumed to be the same as for intact fuel. This assumption is conservative because the fuel debris will be stored in fuel debris process can capsules, separate from intact fuel, and the total quantity of fuel debris is only a few kilograms, as compared to an intact fuel assembly with several hundred kilograms of fuel material.

7.2.1.6 Non-Fuel Bearing Components

In addition to failed fuel, fuel assembly hardware, non-fuel bearing components, and one fuel skeleton will also be stored. These components are made of 304 stainless steel, zirconium IV, and Inconel. The source terms from these additional components were not independently considered in the shielding calculations, but the fuel source terms would bound this additional waste.

7.2.2 AIRBORNE RADIOACTIVE MATERIAL SOURCES

Loading of spent nuclear fuel and other wastes into the basket is carried out under water in the Spent Fuel Pool Cask Loading Pit which prevents the spread of contamination. The baskets are dried and sealed within the controlled environment of the Fuel Building. The gaseous waste from the baskets will be passed through a local HEPA filter.

Once the basket is dried and seal welded, there are no credible off normal events or accidents that will cause breaching of the basket and subsequent release of airborne radioactivity. Therefore, no airborne releases to the environment from the spent nuclear fuel assemblies or GTCC waste are expected to occur during loading and handling operations.

During normal operation of the ISFSI, the only potential source of airborne radioactivity is from surface contamination on the basket exterior, which would be deposited there from the Spent Fuel Pool water. As discussed in Chapter 5, filtered, borated water is injected into the

A basket internal assembly will be loaded with a dummy fuel assembly and a failed fuel can to check the fit up and satisfactory operation of associated handling tools and equipment. A GTCC loading grate will be checked for fit up with the GTCC basket and ability to load a GTCC can into the GTCC basket.

The hydrostatic test and dewatering equipment will be tested to ensure that the hydrostatic testing and dewatering can be accomplished in the amount of time necessary to prevent boiling of the borated water in the basket as described in Chapter 5. The vacuum drying and helium backfill equipment will be tested to ensure that the vacuum drying and helium backfill can be accomplished within the time limit described in Chapter 5.

9.2.3.1.2 Transfer Cask and Associated Equipment

Load testing of the transfer cask and trunnions will be performed at 300% of design load. The Lifting Yoke will be load test to 150% of design load. The crane(s) that lift the loaded transfer cask will also be load tested. Testing will also be performed prior to lifting a transfer cask if the load test has not been performed within the period of time specified in the test procedure, e.g., for loading a shipping cask several years after commencing ISFSI operation.

A test load equivalent to the heaviest fully loaded basket will be placed in the transfer cask to demonstrate the structural capability of the transfer cask bottom doors. The bottom doors will then be checked for proper operation after supporting the test load.

The system used to inject water into the annulus between the basket and the transfer cask will be tested to ensure that sufficient water is injected to minimize surface contamination of the basket external surface.

The load travel path at the site will be checked to ensure that the transfer cask can be safely moved from the Fuel Building bay to the Cask Wash Down pit. From the Cask Wash Down pit, the Transfer Cask will be moved to and lowered into the Cask Loading pit to verify the load

Table 9.2-1

Pre-Operational, Startup, and Other Tests

Component	Type	Test Purpose/Objective(s)
Basket lifting equipment (attaches to shield lid)	Other	1. Check fit up with shield lid and lifting cranes. 2. Load test demonstrates ability to safely lift a fully loaded basket.
Basket automated welding system and cutting equipment	Other	1. Check fit up of shield lid, structural lid, quick connect valves, and valve access port cover plates. 2. Demonstrate ability to install and remove the lids and valve access port cover plates.
Basket shield lid retainers	Other	1. Check fit up of retainers with shield lid. 2. Demonstrate ability to keep the shield lid on the basket during/after mishandling event or transfer cask tip over.
Fuel basket internal assembly	Other	1. Check fit up with fuel basket. 2. Load dummy fuel assembly into basket internal assembly.
GTCC basket 28-slot grating	Other	1. Check fit up with GTCC basket. 2. Load GTCC can into basket using the grating.
Basket hydrostatic test, dewatering, vacuum drying, and helium backfill systems	Other	1. Check fit up with basket quick connects. 2. Demonstrate ability to pressurize/evacuate basket to required test pressure/vacuum. 3. Demonstrate ability to dewater and evacuate basket in the time required to prevent boiling. 4. Demonstrate ability to vacuum dry and backfill the basket with helium within the required time.

Table 9.2-1

Pre-Operational, Startup, and Other Tests

Transfer cask lifting crane(s)	Other	Load test demonstrates ability to safely lift a fully loaded transfer cask.
Transfer cask and trunnions	Other	300% load test demonstrates ability to safely lift a loaded transfer cask.
Lifting Yoke	Other	1. Check fit up with transfer cask and crane. 2. 150% load test demonstrates ability to safely lift a loaded transfer cask.
Transfer cask bottom doors	Other	Demonstrate proper operation of bottom doors after supporting the weight equivalent to a fully loaded basket.
Transfer cask annulus water injection system	Other	Demonstrate the ability to inject sufficient water into the basket/ transfer cask to minimize contamination of basket external surfaces.
Concrete cask air pads	Other	Demonstrate ability to lift the weight equivalent of a fully loaded storage cask.
Concrete cask air outlet temperature monitoring system	Pre-op	Demonstrate proper operation of the temperature monitoring system prior to placing a loaded basket into the concrete cask.
Concrete cask shield ring and cask lid	Other	Check fit up.
Overpack automated welding system and cutting equipment	Other	Check fit up of overpack, structural lid, quick connect, and quick connect cover and demonstrate the ability to install and remove the lid and quick connect cover.
Overpack shield ring	Other	Check fit up.