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PGE

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September 26, 1996

CPY-043-96

Mr. David Stewart-Smith
Oregon Department of Energy
625 Marion Street NE
Salem, OR 97310

Dear Mr. Stewart Smith

Supplemental Response to Request for Additional Information

On May 29, 1996, Mr. Adam Bless sent a Request for Additional Information to Trojan that contained questions about the Trojan Independent Spent Fuel Storage Installation Safety Analysis Report. PGE provided the Oregon Department of Energy responses to these questions on June 27, 1996 and July 31, 1996. Attachment I of this letter provides the response to question 25, which completes the PGE's response to the Request for Additional Information. The response does not contain proprietary information.

If you have any questions concerning this response, please contact M. H. Megehee of my staff at 503-556-7334.

Sincerely,

C P Yundt

C. P. Yundt
General Manager Plant
Support and Technical Functions

Attachment

c: A. Bless, ODOE
L. J. Callan, NRC, Region IV
L. E. Kokajko, NRC, NMSS
M. T. Masnik, NRC, NRR
R. A. Scarano, NRC, Region IV
J. Woessner, TAC

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Question 25

Section 3.3.7.1 states that the "ISFSI shall have a minimum design of 40 years." How is this supported by the vendor's SAR and supporting documents? Which components are limiting in terms of lifetime and how is it shown that they will last 40 years?

Response

The ability of ISFSI components to perform their required functions for the 40 year design life is inherent in the design that is reflected in the ISFSI SAR and supporting documents. For example, the stainless steel that was selected for the basket is corrosion resistant which helps the basket confine the spent fuel for the design life.

The ability of the ISFSI components to perform their required functions must consider degradation over design life. Radiation degradation, thermal degradation, and corrosion are degradation mechanisms that are required to be considered in the design by ANSI/ANS 57.9, "Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type)". In addition, fatigue is considered for the basket as required by the ASME Boiler and Pressure Vessel Code, weather effects are considered for components, such as the concrete cask, which are exposed to the elements outdoors, and creep is considered for the fuel cladding.

Table 1 lists the ISFSI components that are important to safety, the materials of which they are constructed, the primary function that the components perform, the mechanisms that could potentially degrade the component's ability to perform the primary function(s), and the reason why the degradation mechanism will not prevent the component from performing its primary function for the 40 year design life. The fuel debris can is not listed because the design has not been completed, but the justification for a 40 year life should be similar to other stainless steel components stored within the basket. Statements in Table 1 pertaining to coatings may change as a result of industry actions in response to NRC Bulletin 96-04, "Chemical, Galvanic, or other Reactions in Spent Fuel Storage and Transportation Casks."

Similar information is listed in Table 2 for the storage pad, which is an ISFSI component that is not classified as important to safety. Also, the fuel cladding is listed in Table 2 because it was not designed as part of the ISFSI, but its integrity needs to be maintained for the 40 year design life.

The design lifetime for each ISFSI component has not been calculated or estimated. Therefore, it is not possible to specify a limiting component. As shown in Tables 1 and 2, the ISFSI components are designed to perform their required functions for 40 years considering elements such as materials of construction, periodic inspection, and maintenance.

Table 1

Important to Safety ISFSI Components

Component	Material	Primary Function(s)	Effect of Potential Degradation Mechanisms on Component Function
Basket and Basket Overpack	Stainless Steel (Shell)	1. Containment 2. Heat Transfer	1. Radiation: The radiation flux to which the basket/basket overpack are exposed will not appreciable affect their material properties, i.e., strength and heat transfer properties. By comparison, material surveillance programs are required for reactor vessels, which are thick walled vessels operated at considerably higher pressures, only when the total neutron fluence ($E > 1$ meV) is 10^{17} n/cm^2 or higher. The neutron flux at the basket/basket overpack is about 10^5 n/cm^2-sec. At this neutron flux, over 30,000 years are required to accumulate a neutron fluence of 10^{17} n/cm^2. 2. Thermal: The basket and overpack are designed to the ASME Boiler and Pressure Vessel Code (except as specifically noted in ISFSI SAR Table 4.2-1a). The Code specifies allowable stresses for use in the design calculations that account for thermal degradation, i.e., lower allowable stresses at higher temperatures. 3. Corrosion: The stainless steel basket is minimally susceptible to corrosion from the Spent Fuel Pool borated water. The basket/basket overpack interior will minimally corrode in the dry, sealed, Helium atmosphere. If the epoxy coating on the exterior of the basket/basket overpack fails, the outside surface of the basket/basket overpack shell will still not experience significant oxidation. 4. Fatigue: A fatigue evaluation of the basket, provided in section 4.2.5.3.6 of the ISFSI Safety Analysis Report, shows that a fatigue analysis is not required.

Table 1

Important to Safety ISFSI Components

Component	Material	Primary Function(s)	Effect of Potential Degradation Mechanisms on Component Function
	Carbon Steel (Basket Internals)	1. Structural Support 2. Heat Transfer	1. Radiation: The radiation flux to which the basket internals are exposed will not appreciable affect their material properties, i.e., strength and heat transfer properties. The neutron flux inside the basket is about 10^5 n/cm^2-sec At this neutron flux, over 30,000 years are required to accumulate a neutron fluence of 10^{17} n/cm^2. 2. Thermal: The basket internals are designed to the ASME Boiler and Pressure Vessel Code (except as specifically noted in ISFSI SAR Table 4.2-1a). The Code specifies allowable stresses for use in the design calculations that account for thermal degradation, i.e., lower allowable stresses at higher temperatures. 3. Corrosion: The carbon steel basket internals have a coating that protects the carbon steel internals from corrosion for the short period of time while the basket internals are in contact with the borated Spent Fuel Pool water. Once the basket is drained, dried, and backfilled with Helium the basket internals will experience minimal corrosion.
	Boral - Aluminum and Boron Carbide (Basket Internals)	Criticality Control	1. Radiation: A fully loaded basket will emit about 10^{19} neutrons over a 40 year period which is considerably less than the 10^{27} boron atoms available for neutron absorption in the boral poison plates in each cask. 2. Thermal: The temperatures to which the Boral is exposed are below the vendor's recommended temperature limits. 3. Corrosion: The boral will not experience significant oxidation for the short period of time the basket is in contact with the pool water. Once the basket is drained, dried, and backfilled with Helium the boral will experience minimal corrosion.

Table 1

Important to Safety ISFSI Components

Component	Material	Primary Function(s)	Effect of Potential Degradation Mechanisms on Component Function
	Stainless Steel (Basket Internals)	Structural Support	1. Radiation: The radiation flux to which the basket internals are exposed will not appreciable affect their material properties, i.e., strength and heat transfer properties. The neutron fluence inside the basket is about 10^5 n/cm^2-sec. At this neutron flux, over 30,000 years are required to accumulate a neutron fluence of 10^{17} n/cm^2. 2. Thermal: The basket internals are designed to the ASME Boiler and Pressure Vessel Code (except as specifically noted in ISFSI SAR Table 4.2-1a). The Code specifies allowable stresses for use in the design calculations that account for thermal degradation, i.e., lower allowable stresses at higher temperatures. 3. Corrosion: The stainless steel is minimally susceptible to corrosion from the borated Spent Fuel Pool water and will minimally oxidize in the dry, Helium atmosphere of the sealed basket.
Failed Fuel Can	Carbon Steel	Containment	1. Radiation: The radiation flux to which the failed fuel can is exposed will not appreciable affect its material properties, i.e., strength and heat transfer properties. The neutron flux inside the basket is about 10^5 n/cm^2-sec. At this neutron flux, over 30,000 years are required to accumulate a neutron fluence of 10^{17} n/cm^2. 2. Thermal: The failed fuel can is designed to the ASME Boiler and Pressure Vessel Code (except as specifically noted in ISFSI SAR Table 4.2-1a). The Code specifies allowable stresses for use in the design calculations that account for thermal degradation, i.e., lower allowable stresses at higher temperatures. 3. Corrosion: The carbon steel failed fuel can will have a coating that protects the carbon steel internals from corrosion for the short period of time that the basket internals are in contact with the borated Spent Fuel Pool water. Once the basket is drained, dried, and filled with Helium the failed fuel can will experience minimal corrosion.

Table 1

Important to Safety ISFSI Components

Component	Material	Primary Function(s)	Effect of Potential Degradation Mechanisms on Component Function
Storage Cask	Carbon Steel (liner)	Structural Support (maintain air channel for heat transfer)	1. Radiation: The radiation flux to which the carbon steel liner is exposed will not appreciable affect its strength. The neutron fluence is less than 10^5 n/cm^2-sec. At this neutron flux, over 30,000 years are required to accumulate a neutron fluence of 10^{17} n/cm^2. 2. Thermal: The temperatures to which the carbon steel liner is exposed (about 200°F) not appreciable affect its strength. In addition, the stresses in the liner are well below the stresses allowed by the ASME Boiler and Pressure Vessel Code. 3. Corrosion: The carbon steel liner is coated to protect it from corrosion. The coating has a service life that varies with the environment. If long term degradation of the steel liner by corrosion occurs during the storage period, it is not anticipated that the heat transfer capability of air gap between the basket and liner would be significantly affected. If the air flow in the air gap were significantly affected, then the air outlet temperature, which is surveilled every 12 hours, would be affected. The shielding capability of the steel liner is not a primary function of the liner but is credited in the dose calculations. The overall adequacy of Concrete Cask's shielding is confirmed by periodic radiation surveys during the storage period.
	Concrete	1. Physical Protection 2. Radiation Shielding	1. Thermal: The temperature range to which the Concrete Cask will be exposed will not appreciably affect its material properties, i.e., strength or shielding capability. The ISFSI SAR provides a detailed description of the thermal analysis that was performed to show that there is no degradation due to temperature effects during the lifetime of the cask. The overall adequacy of Concrete Cask's shielding is confirmed by periodic radiation surveys during the storage period. 2. Weather: The exterior of the Concrete Casks is accessible during the storage period and will be inspected annually for cracks and repaired with grout as necessary.

Table 1

Important to Safety ISFSI Components

Component	Material	Primary Function(s)	Effect of Potential Degradation Mechanisms on Component Function
Transfer Cask	Carbon Steel	Structural Support	1. Radiation: The radiation flux to which the carbon steel components of the Transfer Cask is exposed will not appreciably affect their strength. The neutron flux is less than 10^5 n/cm^2-sec. At this neutron flux, over 30,000 years are required to accumulate a neutron fluence of 10^{17} n/cm^2. 2. Thermal: The carbon steel components of the Transfer Cask were analyzed using the ASME Boiler and Pressure Vessel Code allowable stresses which account for thermal degradation, i.e., lower allowable stresses at higher temperatures. 3. Corrosion: The carbon steel of the Transfer Cask will be coated for corrosion protection. The coatings are not required to last 40 years because the Transfer Cask is only used for short periods of time during the life of the ISFSI. Also, the Transfer Cask is accessible for inspection and repair as necessary in between baskets during the loading process.
	RX 244	Radiation Shielding	1. Radiation: RX-244 has good radiation resistance. RX-244 will withstand a neutron fluence of 10^{17} n/cm^2. The neutron flux is less than 10^5 n/cm^2-sec. At this neutron flux, over 30,000 years are required to accumulate a neutron fluence of 10^{17} n/cm^2. 2. Thermal: The transfer cask will be used for short periods of time during loading of the ISFSI and off-loading of the ISFSI. These limited operations will result in short exposures of the RX-244 to elevated temperatures which are below the vendor's recommended temperature limit. In addition, the overall adequacy of the Transfer Cask's shielding is confirmed by radiation surveys during spent fuel loading and handling. 3. Corrosion: The RX-244 is sandwiched between the inner and outer Transfer Cask walls which protects it from exposure to the borated Spent Fuel Pool water.

Table 1

Important to Safety ISFSI Components

Component	Material	Primary Function(s)	Effect of Potential Degradation Mechanisms on Component Function
	Lead	Radiation Shielding	1. Radiation: The shielding capability of lead, which is a very stable elements, is not degraded by radiation. The overall adequacy of Transfer Cask's shielding is confirmed by radiation surveys during spent fuel loading and handling. 2. Thermal: The transfer cask will be used for short periods of time during the life of the ISFSI. These limited operations will result in short exposures of the lead to temperatures elevated temperatures that are well below its melting point. 3. Corrosion: The lead is sandwiched between the inner and outer Transfer Cask walls which protects it from exposure to the borated Spent Fuel Pool water and weather.
Transfer Station	Carbon Steel	Structural Support	1. Corrosion: The Transfer Station will be coated to minimize corrosion. The coatings do not need a 40 year service life because the Transfer Station is accessible for periodic inspection, maintenance, and repair as necessary, which assures its functionality.

Table 2

Other ISFSI Equipment and Components

Component	Material	Primary Function(s)	Evaluation of Potential Degradation Mechanisms
Fuel Clad	Ziracaloy	Containment	1. Corrosion: The fuel cladding will not oxidize in the dry, inert Helium atmosphere inside the basket. 2. Radiation: Pacific Northwest Laboratory (PNL-6364) determined that radiation embrittlement is not considered to be of concern during the dry storage period because the failure mechanism related to radiation embrittlement requires that the size of the crack that initiates failure of the cladding would need to be greater than the thickness of the cladding itself, and is therefore not credible. 3. Thermal: Creep (strain) is time and temperature dependent. A time limit has been established for the vacuum drying process to limit the fuel cladding temperature to minimize the amount of strain accumulated to less than 0.1% per PNL-6364 recommendations. A maximum initial storage temperature, which will not be exceeded by Trojan fuel, has been established to minimize the accumulated strain during the storage period to 1% per PNL-6364 recommendations.
Storage Pad	Concrete	Structural Support	1. Weather: The storage pad is constructed of reinforced Portland Cement in accordance with ACI-318 (1983). Adherence to ACI-318 assures optimum lifetime expectency. The storage pad is inspected annually for cracks and repaired with grout as necessary.