April 10, 1996 Public

MEMORANDUM TO: Joseph W. Shea, Project Manager
Project Directorate I-2
Division of Reactor Projects - I/II

FROM: Brenda L. Mozafari, Project Manager (Original Signed By)
Project Directorate II-1
Division of Reactor Projects - I/II

SUBJECT: H. B. ROBINSON, UNIT NO. 2, SPENT FUEL POOL SURVEY

This memorandum provides the information requested by the February 8, 1996, memorandum from John Stolz regarding a review of the spent fuel pool (SFP) practices and current licensing basis.

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The licensee has performed analyses on the entire cooling system for both the refueling case (1/3 core) and the full core unload case. The results of the two heat balances show the maximum SFP water temperature will be about 132°F for the normal refueling case and about 166°F for the full core unload case. The SPF temperature for both a normal and full core offload is limited by TS 3.8.3 to 150°F. The UFSAR section 9.1.3 indicates that the SFP cooling capacity design is based on a normal heat load case and a maximum heat load case. Procedures support the TS limit through increased temperature monitoring that begins when the SFP temperature exceeds 125°F. Fuel is returned to the reactor vessel if SFP temperature exceeds 150°F.

The UFSAR contains several inconsistencies in sections 9.1.2 and 9.1.3 where the true design basis for the SPF cooling system capability has not been captured in past revisions of the UFSAR. The licensee has created a CP&L Condition Report 95-02501 regarding these types of inconsistencies between the design documents, the UFSAR, and other related documents. In addition, consistency updates are being reviewed as part of HBR's current Improved Standardized Tech Spec Conversion project.

Attachment:
Robinson Spent Fuel Survey

Docket No. 50-261

cc: W. Orders, SRI (WTO)
C. Poslusny (CXP1)
M. Shymlock (MBS)

FILE G:\ROBINSON\ROB-SFP.SVY

OFFICE	LA:PDII-1	PM:PDII-1	D:PDII-1		
NAME	EDunnington ED	BMozafari BLM	EImbro EI		
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H. B. ROBINSON, UNIT NO. 2, FUEL POOL SURVEY

A. Spent Fuel Pool [Pit] System Design

The spent fuel pit (SFP) cooling loop consists of two 100 percent capacity pumps, heat exchanger, filter, demineralizer, piping and associated valves, and instrumentation. The pumps (one operating and the other as a backup) draw water from the pit, circulate it through the heat exchanger and return it to the pit. Another pump is used to circulate refueling water through the demineralizer and filter for purification. All wetted surfaces of the pumps are austenitic stainless steel, or equivalent. Component cooling water (CCW) cools the heat exchanger. The SFP heat exchanger is of the shell and U-tube type with the tubes welded to the tube sheet. Component cooling water circulates through the shell, and SFP water circulates through the tubes. The tubes are austenitic stainless steel and the shell is carbon steel. Redundancy of this loop is provided by the two cooling pumps.

The SFP cooling loop is in operation whenever spent fuel is in the SFP. The SFP cooling pump is started manually after CCW flow is established through the SFP heat exchanger. The SFP can also be filled from the refueling water storage tank (RWST). In the event of the failure of both SFP pumps or the heat exchanger, alternate cooling connections in the SFP cooling and CCW loop piping allows for connecting temporary piping to the CCW heat exchanger. Likewise, a temporary pump can be connected to the SFP cooling loop. In addition, in case of a leak into or out of the SFP, level can be maintained via the refueling water purification pump. SFP water can be used to heat the RWST water.

B. SUMMARY OF CLB REQUIREMENTS CONCERNING SPENT FUEL POOL DECAY HEAT REMOVAL/REFUELING OFFLOAD PRACTICES

1. Technical Specification limits are provided for:

TS 3.8.1.c - Radiation level shall be continuously monitored.

TS 3.8.1.h - Minimum 100-hour decay time before fuel movement.

TS 3.8.1.i - SFP ventilation shall be operable during fuel handling.

TS 3.8.2 - Spent Fuel Building filter system performance specifications.

TS 3.8.3 - During full core offloads, SFP temperature must be <150 °F. SFP temperature shall be recorded hourly if SFP temperature >125 °F. Fuel assemblies shall be transferred to the vessel if SPF temperature >150 °F.

TS 3.8.4 - Limitations on spent fuel cask handling crane.

TS 5.4.2 - Criticality restrictions on the new and spent fuel storage areas.

TS 5.4.3 - Boron concentration in the SFP at or above 1500 ppm.

TS 5.4.4 - Capacity of the SFP is 544 fuel assemblies.

2. The maximum heat load under refueling outage conditions is limited to 26 x 10^6 Btu/hr for full core offload conditions. The licensee normally offloads a full core.[FSAR Table 9.1.3-1]

3. SFP temperature is limited to 132 °F with one-third core stored in the SFP and 150 °F for full core offload conditions. Single failure is considered for both of these limits. The licensee will vary the discharge time to ensure the SFP temperature will not exceed 150 °F (See TS 3.8.3). [FSAR 9.1.3.1.3 and 9.1.3.2.1.b]

   Under true emergency conditions, such as a complete loss of SFP cooling with a full core in the SFP, fuel temperature rise from 150 °F to boiling (6.8 hours) has been reviewed and found acceptable [FSAR Table 9.1.3-1]

4. Alternate cooling can be provided to the SFP cooling system to dissipate the heat from refuel activities should failures in the pumps or heat exchangers occur. The SFP cooling system provides a 100% capacity backup pump. In the event of a component cooling water failure, fire protection water can be connected to the shell side of the SFP cooling heat exchanger.

   The licensee should be able to show system operating procedures and analytical calculations that support the operation of the fire protection system in this mode. [FSAR 9.1.3.3.1 and rerack amendment dated 12/1/80 Section 8.4.1]

5. In-vessel decay time is controlled by TS.

6. No other implicit or explicit prohibitions exist within the CLB against performing a full core offload for any given refueling outage.

Discrepancies:

1. Robinson has no TS for SFP level. Level requirements are contained in FSAR section 9.1.3.1.5.

2. The licensee's requests to increase their fuel enrichment did not contain analyses of the impact that increased fuel enrichment has on the SFP cooling system. Although the impact should be small, the licensee should still address it.

3. The December 1, 1980, rerack amendment application defines the partial and full core offload analysis assumptions. The PM should check with the licensee why the "refueling conditions" heatload values are not consistent with the current values in the FSAR (12.0 versus 6.54 x 10^6 Btu/hr). See section 8.3 of the amendment and Table 9.1.3-1 of the FSAR.

4. Section 9.1.3.1.3 is not consistent with section 9.1.2.3.4 with respect to partial offload temperature. The PM should check with the licensee. The values in 9.1.2.3.4 are substantiated with the analysis provided in the 12/1/80 proposed rerack amendment.

C. Summary of Compliance with CLB Requirements or Commitments

(1) The design temperatures are implemented into the temperature setpoints for the SFP. Procedure APP-036 (Control Room Auxiliary Annunciator Panel) require actions if the temperature is outside the setpoint value and the indication is illuminated.

(2) The licensee performed an evaluation of the enrichment increase in the latest TS submittal (increase to 4.95 +/- 0.05 w/o) on the SFP cooling system. In the internal CP&L review of the Tech Spec submittal, per site procedure AP-029, the licensee evaluated the impact of increased enrichment on cooling capability as follows:

> ...though heat decay is not explicitly a function of enrichment, increased enrichment does generally allow higher burnups, of which decay heat is a weak function. However, the proposed ammendment does not increase the allowable assembly burnups specified in Chapters 4 and 15 of [the HBR UFSAR]. Thus there will be no effect on the Spent Fuel Pool heat load.

This discussion was also summarized in the Environmental Assessment and Determination of Significant Hazards for that TS package.

(3) The UFSAR appears inconsistent with the 1980 submittal for the SFP re-rack that shows values for the partial (1/3 core) discharge heat load as 6.54x10E6 and 12.0x10E6 btu/hr, respectively. The UFSAR Table 9.1.3-1 value of 6.54x10E6 btu/hr has not yet been traced to a reference document (as of 4/9/96). It may be an original FSAR value for the original number of fuel assembly locations prior to 1975. In 1975 the licensee added 36 rack locations, and showed a partial core discharge heat load of 7.96x10E6 btu/hr at 120°F.

(4) UFSAR Section 9.1.3.1.3 states that:

> The original design basis was that, [with] 1/3 of a core is stored in the pool, the pumps and SFP heat exchanger will handle the load and maintain a pit water temperature of 120°F.

Table 9.1.3-1 shows the partial core offload temperature basis to be 132°F. Sections 9.1.2.3.4 and 9.1.3.3.1 also show 132°F as the partial core offload temperature. The 1980 submittal, in Section 8.3, also shows 132°F to be the partial core offload temperature. The Section 9.1.3.1.3 reference to the "original design basis" of 120°F should probably have been updated when the 1975 and the 1980 re-racks were implemented. Additionally, there are some <u>design</u> values for heat exchanger performance specified in UFSAR Table 9.1.3-1 that show values of SFP water inlet to the heat exchanger at 120°F and 150°F. These are intended to provide additional data points for heat exchanger performance as a function of inlet SFP water temperature.

(5) The licensee is reviewing Sections 9.1.2 and 9.1.3 and plans to correct numerous inconsistencies. In addition, Section 15.7.4.2 will be reviewed with respect to SFP water level. TS Sections 3.8.1, 3.8.3, and 5.4.3 also reference SFP conditions. These TS, as well as any others (such as Section 5.4 on Design Features) that require consistency updates are being reviewed as part of HBR's current Improved Standard Tech Spec Conversion project. At the time of this survey, the full scope of the licensee's response to C.R. 95-02501 has not been established.

(6) The 150-hour time interval is the design value used to assess the maximum amount of heat load following a full core discharge to the SFP. The 150-hour value indicates the time of completion of core off-load and, therefore, the time when the maximum heat load is assumed. The TS value of 100 hours to start fuel assembly movement was used for the Part 100 analysis for a Fuel Handling accident. There is no procedural reference to the 150 hours.

(7) The licensee has no SPF level TS requirements; however, level requirements are listed in the UFSAR. The SFP level alarm setpoints are set at 2 inches above and 7 inches below normal water level, which is 22'- 5" above the spent fuel. This translates to (Using UFSAR Table 4.1.2-1 and drawing HBR2-8948):

Normal level = 159.71"+ 8"+ 22'- 5" ≈36' 5"

(Hi Alarm ≈ 36'- 7" ; Lo Alarm ≈ 35'- 10")

However, UFSAR section 15.7.4.2 and the 1980 submittal on the thermal hydraulic analysis (section 8.5) indicates that normal level is 24 feet above the racks. This would translate to (Using drawing HBR2-8948 for high density rack height):

Normal level ≈ 14' 6" + 24' ≈ 38'- 6"

This is not likely because the SFP top edge is at 38'- 3". The resolution of the inconsistency must be addressed in the rewrite of the UFSAR sections.

H. B. ROBINSON UNIT NO. 2 SPENT FUEL PIT

Spent Fuel Storage Data Table		
Facility	**Name**: H. B. Robinson	Unit: 2
Licensee's SFP Contact	**Name**: Bill Ziegler	Phone: (803) 857-1705
SFP Related Tech Specs and UFSAR references	1.1: A steady state nuclear steam supply output (rated core thermal power) of 2300 Mwt.	1.1: 2300 Mwt rated thermal power
	3.8.1.f: During reactor vessel head removal and while loading and unloading fuel from the reactor, the minimum boron concentration of 1950 ppm shall be maintained ...	3.8.1.f: 1950 ppm Boron (Plant Procedure GP-010, "Refueling Operations")
	3.8.1.h: Movement of fuel within the core shall not be initiated prior to 100 hours after shutdown.	3.8.1.h: 100 hours cooldown (GP-010)
	3.8.3: During the discharge of a full core into the spent fuel pit, the temperature of the spent fuel pool water shall be maintained at or below 150°F...	3.8.3: 150°F max pool temperature (GP-010)
	5.4.3: The spent fuel storage pit is filled with borated water at a concentration of greater than or equal to 1500 ppm during refueling operations or new fuel movement in the spent fuel storage pit.	5.4.3: 1500 ppm Boron (GP-010)
	5.4.4: the spent fuel storage pit provides a storage location for 544 fuel assemblies.	5.4.4: 544 assembly storage limit (no procedure - physical limit)
	UFSAR Table 9.1.3-1: boron concentration	2000 - 2500 ppm
	No TS: SFP Level Hi/Lo Alarms (System Description SD-14, plant procedure APP-036)	Hi Alarm: 37' 0 5/8" +/- 1" Lo Alarm: 36' 2 1/2" +/- 1"
	UFSAR 9.1.3.1.5: SFP level is maintained at 22' 5" above the fuel. Alarm setpoints at 2" above and 7" below normal water level	Translates to (Using UFSAR Table 4.1.2-1 and drawing HBR2-8948): Normal level ≈159.71"+~8"+22'5" ≈36'- 4.75" Hi Alarm≈36'- 6" Lo Alarm≈35'- 10"
	UFSAR 15.7.4.2 and 1980 submittal on rack T/H analysis (Section 8.5): Normal level = 24 ft above racks	Translates to (Using drawing HBR2-8948 for H.D. rack height): Normal level ≈14'- 6" + 24' = ≈38'- 6" (Pool edge is at 38' 3")
SFP Structure	Location: Above grade, in fuel building	Seismic Classification of SFP Structure and Building: TS 5.4.1 states that "The new and spent fuel pit structures are designed to withstand the anticipated earthquake loadings as Class I structures."
	Volume of Spent Fuel Pool: 37000 ft^3 (UFSAR Table 9.1.3-1)	**SFP Temperature for Stress Analysis: (UNKNOWN AT THIS TIME)**

H. B. ROBINSON UNIT NO. 2 SPENT FUEL PIT

Spent Fuel Storage Data Table		
Leakage Collection	Liner Type: Stainless Steel	Leakage Monitoring: Leak collection chase, 2 leakage detection chase drain valves
Drainage Prevention	Location of Bottom Drain(s): At elevation 237' (bottom of pit is at elevation 236.75'); locked closed valve.	Elevation of Gate Bottom relative to Stored Fuel: Below top of fuel (gate bottom at 13' 1" above pool floor; top of fuel bundle is at about 13' 11")
Siphon Prevention	Location of Piping: Upper Suction 4 feet below normal water level. Lower Suction (Bottom Drain) near pool floor -- Locked closed. Discharge 20 ft above pool floor; at 6" below normal water level, there is a 1/2" siphon break hole	Anti-Siphon Devices: Locked closed valves, inboard and outboard (Lower Suction) Siphon Break Hole (Discharge)
Make Up Capability	Safety Related Source: Refueling Water Purification Pump (100 gpm) aligned to RWST (353,000 gal).	Seismic Classification: RWST was designed to meet the American Water Work Association Code AWWA D10 (1965) per Design Basis Document for the Safety Injection System. Refueling Water Purification Pump is Q-List.
	Normal Source: Same	Seismic Classification: Same
Reactivity	Limits on Keff, enrichment, and inclusion of integral burnable absorbers (T.S. 5.4.2.2). Controlled and verified acceptable through CP&L Reload Design Process, Nuclear Fuel Guideline NFG-14-17.	Keff ≤ 0.95 Enrichment ≤ 4.95 w/o If e ≤ 4.55 w/o, integral burnable absorber contents are required.
Reactivity Controls	Boraflex in High density racks Integral burnable absorbers in fuel ≤ 4.55 w/o enrichment	Boron Credit for accidents: yes (1500 ppm)
Shared or Split SFPs	No. of SFPs: 1	No. of SFPs receiving Discharge from a single Unit: 1
SFP Design Inventory Cases	<u>One-Third Core Discharge</u> 100 hours after shutdown, one-third core is discharged to fill the Spent Fuel Pool.(CP&L calc R-M/MECH-1590) <u>Full Core Discharge</u> This worst case analysis assumes a full core discharge at 100 hours, and after a recent third core discharge to fill up the pool (effectively a 4/3 core discharge).	<u>Emergency/Abnormal</u> The normal cases conservatively bound 'worst case' or abnormal situations.
SFP Design Heat Load (MBTU/Hr) and Temperature	Maximum = 26.0E+6 BTU/hr at 150°F SFP temperature (SD-14)	Emergency/Abnormal: Same
SFP Cooling System	Number of Trains: One	Licensed to withstand Single Active Component Failure: Licensed to withstand failure of one or both SFP cooling pumps through emergency pump hookup flange connections (NRC SE on CP&L 1980 submittal)

H. B. ROBINSON UNIT NO. 2 SPENT FUEL PIT

Spent Fuel Storage Data Table		
Electrical Supply to SFP Cooling Pumps	Qualification and independence of Power Supply: Non-safety Related Separate 480 Volt busses (SD-14)	Load shed initiators: 1) Safety Injection with concurrent undervoltage 2) bus overcurrent (electrical systems diagrams)
Backup SFP Cooling	System Name: None	Qualification: N/A
SFP Heat Exchanger Cooling Water	System name: Component Cooling Water (CCW)	Qualification: Seismic Class 1
Secondary Cooling Water Loop (if applicable)	System name: Fire water system can be hooked up as a once through cooling mechanism if CCW is lost	Qualification: Seismic Class 1
Ultimate Heat Sink	Type: Lake Robinson Impoundment	UHS Heat sink Design Temperature: (NOT DETERMINED)
SFP Cooling System Heat Exchanger performance (Highest Capability Heat Exchanger if not identical) (From System Description SD-14)	Design Heat Capacity: 26.0E6 BTU/hr	Type: Shell & Tube
	SFP Side Flow (lbm/hr or gpm): 1.1E6 lbm/hr	Cooling water Flow: 1.4E6 lbm/hr
	SFP Temperature: 120°F	Cooling Water Inlet Temp: 100°F
	SFP Cooling return Temp: 113°F	Cooling Water Outlet Temp: 106°F
SFP Related Control Room Alarms	Parameters (SD-14): SFP Level lo/hi SFP Temp lo/hi	Set points: SFP level: Lo - 36 ft 2-1/2 in +/- 1 in Hi - 37'ft 5/8 in +/- 1 in SFP Temp: Lo -- 74°F +/- 4°F Hi -- 121°F +/- 4°F
Location Of Indicators	SFP Level: Metal Plate on side of pool	SFP Temperature: Digital readout on stand at pool side
SFP Cooling System Automatic Pump Trips	Parameters: Overcurrent at breaker, and undervoltage on the bus (electrical system diagrams)	Independence: Pumps are on separate breakers and on separate busses (electrical system diagrams)
SFP Boiling	Staff Acceptance of non-seismic SFP Cooling System Based on Seismic Category 1 SFP Ventilation System: N/A	Off-site Consequences of SFP Boiling Evaluated: Yes (1980 Submittal, Section 8.6)
		If yes, Was Filtration Credited: No
SFP/Reactor System Separation	Separation of SFP Operating Floor from Portion of Aux or Reactor Building that contains Reactor safety Systems: SFP located in separate and independent fuel building that does not house reactor safety system components	Separation of Units at multi-Unit sites: N/A
Heavy Load Handling	SFP Crane Qualified to Single Failure Proof Standard IAW NUREG-0612 and/or NUREG-0554: Per Design Basis Reconstitution document "Hazards Analysis", GID/R87038/0007, the SFP crane is exempt because system capacity/load weight was less than the defined heavy load weight in NUREG-0612.	Routine Spent Fuel Assembly transfer to ISFSI or alternate wet storage: 56 assemblies in ISFSI, and routine shipments to other CP&L reactor site(s) for wet storage.

H. B. ROBINSON UNIT NO. 2 SPENT FUEL PIT

Spent Fuel Storage Data Table		
Operating Practices	Administrative Control Limits for SFP Temperature during refueling: If 140°F is exceeded, implement hourly augmented monitoring and recording of SFP temperature. If 150°F is exceeded, return bundles to reactor. (Procedure (GP-010, Refueling Operations)	Administrative controls for SFP Cooling System Redundancy and SFP Make-Up System Redundancy: Shutdown risk management techniques (PLP-055) used to evaluate impact of maintenance or other potential impacts on shutdown risk during refueling.
	Frequency of Full Core Off-loads: All prior outages	Administrative Controls on Fuel Decay: Tech Spec required 100-hr decay prior to moves
	Type of off-load performed during most recent refueling: Full core off-load	For Units with planned Refueling Outages Scheduled to begin Before April 30, 1996, Type of Off-Load Planned for next refueling and planned shutdown date: N/A Next refueling September 7, 1996.