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U.S. NUCLEAR REGULATORY COMMISSION

Director, Nuclear Reactor Regulation
Att Mr Dennis M Crutchfield, Chief
Operating Reactors Branch No 5
US Nuclear Regulatory Commission
Washington, DC 20555

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PALISADES PLANT - SEP TOPIC IX-1, FUEL STORAGE

By letter dated January 29, 1981, the NRC requested additional information concerning SEP Topic IX-1 for the Palisades Plant. The Consumers Power Company responses to the staff questions are attached.

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PALISADES PLANT - SEP TOPIC IX-1

Response to NRC Letter of January 29, 1981

Question 1:

In reference to Regulatory Guide 1.13, Position C-6 and SRP Acceptance Criteria IIe(2) and (3), describe and discuss the measures taken at Palisades which provide assurance equivalent to current criteria in preventing the loss of spent fuel pool coolant inventory, and/or the spread of radioactivity when the following is considered:

(a) FSAR Appendix J, amendment dated August 9, 1974, and supplement dated March 1977, as well as FSAR Section 9.4.3.1 describes situations where a significant quantity of coolant could possibly be lost in an uncontrolled manner to the extent where the pool cooling system would become inoperative and pool boiling would occur.

Response to Question 1a:

There are several situations where some coolant can be lost from the pool. However, in no case is this loss uncontrolled.

Failure of the spent fuel pool cooling system inlet line could result in a loss of a small amount of coolant by siphoning action. However, the inlet line which is cut off approximately two feet below the normal pool level will act as a siphon breaker, terminating the siphoning action when the water level is about 18 feet above the top of the fuel. A failure of the outlet line will also result in the loss of a small amount of coolant down to the level of the bottom of the outlet pipe. This water level is more than 16 feet above the top of the fuel.

In the highly unlikely event that the spent fuel transfer cask is dropped in the cask loading area, the analysis presented in FSAR, Appendix J (Amendment 29) shows that the integrity of the pool will not be damaged. However, there is a remote possibility that the liner plate could lose its integrity. This possibility has been reduced by addition of a 1/2 inch thick base plate attached to the bottom of the cask anti-tip frame which will serve to dissipate the load over the cask loading area. In any event, seepage through the concrete will be limited to a few gpm, a flow rate which is well within the makeup system capacity.

For an inlet or outlet line failure, the cooling system will become inoperable. In this case, the pool will eventually heat up and boiling may occur. However, a backup makeup system (fire water system) is available to makeup the evaporative losses and maintain pool water level. Should the pool liner fail due to a cask drop in the cask handling area, the manual makeup system, which has a capacity of 1700 gpm for each of the two pumps, will be more than adequate to maintain pool water level. The backup fire water system is also available should the normal cooling and makeup system fail.

Question 1b:

The spent fuel pool cooling system is housed within a seismic Class I structure but it apparently is not seismic Class I. Section 9.4.3.1 of the FSAR indicates that the failure of the outlet pipe would result in the pool being drained to the level of the outlet pipe. Further, the August 9, 1974 letter states that the load drop analysis shows that the spent fuel pool cooling system lines, as well as fuel assemblies and racks, could be damaged.

Response to Question 1b:

In addition to the spent fuel pool structure being seismic Class I, the spent fuel pool cooling and cleanup system is a Class I system and has been designed accordingly. Class I structures, systems and equipment are those whose failure could cause uncontrolled release of radioactivity or those essential for immediate and long-term operation following a loss-of-coolant accident. They are designed to withstand the appropriate seismic loads simultaneously with other applicable loads without loss of function. Design bases for Class I Systems and Equipment Design are described in Appendix A to the Palisades FSAR.

A discussion of the load drop analysis on the spent fuel cooling system is discussed in response 1a. Cask handling in the spent fuel pool is controlled administratively, and is restricted to the cask loading area.

Question 1c:

Describe and discuss the modifications mentioned in paragraph 5.3 of Appendix J of the FSAR which have been made to prevent the spent fuel shipping cask from tipping and also identify all casks for which the anti-tipping modifications would be applicable.

Response to Question 1c:

The modification of the cask handling area is mentioned in paragraph Appendix J J.5.2 of the FSAR.

Subsequent to the fuel pool modification and safety analysis submittal of November, 1976, new racks were installed. The cask laydown area may (optionally) contain two 50 - element racks which will normally be used to store fuel during full-core off-loads. The area is presently occupied by a cask anti-tipping frame to allow placement of a spent fuel shipping cask or to allow the use of fuel inspection and repair equipment. The new rack system incorporating the anti-tipping frame is seismic Category I and each rack/frame is restrained to the pool wall at the top and bottom of each rack/frame to prevent excessive movement of the racks/frame under postulated seismic accelerations. Provisions are made in the design to accommodate thermal expansion.

Dimensional and structural restrictions of the anti-tipping frame arrangement presently limit it to accommoation of nominal 25-ton casks. At the present time, there is no intention of making spent-fuel shipments, but spent-fuel strategy planning will include re-evaluation of cask sizes required and their compatibility with the rack/frame installation.

Question 1d:

Considering the current Technical Specification prohibition on cask movements in the fuel building, describe the future course of action you intend to follow in order to satisfactorily address NRC concerns.

Response to Question 1d:

Reference is made to the Consumers Power Company letter of August 9, 1974 which transmitted Appendix J, "Evaluation of Postulated Cask Drop Accidents", to the Palisades Plant FSAR.

This letter describes the present plant procedures and equipment utilized to increase the margin of safety when handling the spent fuel cask.

The analysis for the amendment was based on the use of a 25 - ton spent fuel shipping cask even though the facilities provided for cask handling at the Palisades Plant were designed to handle a 100 - ton shipping cask. However, if CPCo determines that a cask larger than 25 tons should be used, the present design would be reevaluated. The reevaluation would address modifications to make the facilities single-failure proof and bring them into compliance with NUREG 0612.

Question 1e:

Section 9.4.3.1 indicates that the siphon breaker installed in the cooling water inlet line will prevent water from being siphoned from the pool. Assuming a spectrum of single system failures, describe the reasons why it is reasonable to assume the siphon breaker will not fail.

Response to Question 1e:

The siphon breaker is a passive device which consists of a small pipe extending from the high point in the inlet line to just below the water surface. The only possible failure modes are the crimping or blocking of the line. Blocking of the siphon breaker, however, is of no real consequence following a previous modification of the cooling water inlet line. The moficiation included the severence of the inlet line about two feet below normal pool level and removal of the remaining section of the line from the pool. The original siphon breaker is still present, but even if it were completely bocked, the pool level would still be maintained approximately 18 feet above the top of the fuel where a siphon would be broken at the elevation of the terminated inlet pipe.

Question 2:

In reference to Position C-8 in Regulatory Guide 1.13 demonstrate the capability to provide makeup water, at the maximum required makeup rate, from a seismic Category I system or its equivalent. Also describe all other redundant or backup makeup systems such as the unborated fire system.

Response to Question 2:

The Class 1 spent fuel pool cooling system has two 1700 gpm horizontal centrifugal pumps and can be reconfigured to provide fuel pool makeup water from the safety injection and refueling water storage tank, which is also part of a Class 1 system.

Backup for the spent fuel pool makeup system is provided by the fire protection system. Water for the fire system is supplied by three full capacity (1500 gpm each) fire pumps. One pump is electrically driven; the other two are diesel engine driven. Either pump will start automatically and can be manually started from the main control room. A jockey pump with local controls is provided to maintain the system full and pressurized.

The fire pumps are housed in the tornado-proof section of the intake structure. The backup supply header to the auxiliary feedwater pumps is buried underground for protection against tornadoes. A cross-connection provided with a hand-operatated valve connects the fire pump discharge header to the suction header of the auxiliary feedwater pump. One cross-connection provided with a hand-operated valve connects the fire pump discharge header to each of the critical service water lines. Both of the above cross-connections are protected from tornadoes. A header terminating in a blind flange is provided at the spent fuel pool for emergency filling.

The emergency fill for the spent fuel pool is taken off a branch line in the auxiliary building. To provide this source requires the use of a swing-elbow connection after removal of two blind flanges; one on a feeder line and the other on a spent fuel pool cooling recirculation line downstream of the spent fuel pool heater exchangers.

Question 3:

Section 7.1 of the November 1, 1976 submittal, relating to the increase in storage capacity, indicates that when spent fuel is stored in the tilt pit the two feet thick tilt pit wall is insufficient to achieve the radiation zoning criteria presented in the FSAR. Assuming, as stated that the older fuel is stored in the tilt pit, describe the measures taken to assure that the FSAR radiation zoning criteria has been met.

Response to Question 3:

To meet the FSAR radiation zoning criteria when older fuel is stored in the tilt pit, high density concrete shielding was added to the north tilt pit wall as shown in Figure 1.

The high density concrete (minimum 195 lb/ft^3) is in the form of 6" x 8" x 16" masonry units which are staggered in both the horizontal and vertical directions to avoid radiation streaming through the mortar between the blocks. Calculations performed with the QAD computer code indicate that the FSAR radiation zoning criteria are met when 68 assemblies are stored in the tilt pit after a minimum decay time of 16 weeks. The QAD code calculates both uncollided and collided gamma (and neutron) dose rates, energy deposition and fluxes for a volumetric source represented by a number of point isotropic sources in a user specific shield configuration. For each dose point, the straight distance and attenuation in each shield material are calculated for each source point. The total dose is obtained by summing the contributions from each source point.

In order to simulate the fuel rack as a source, the 225 fuel pins in the 15 x 15 assembly array were homogenized with the racks and water to give a composition called "fuel rack". The source strengths were appropriately diluted over this homogenized source by multiplying by the volume fraction of the "source" occupied by the fuel.

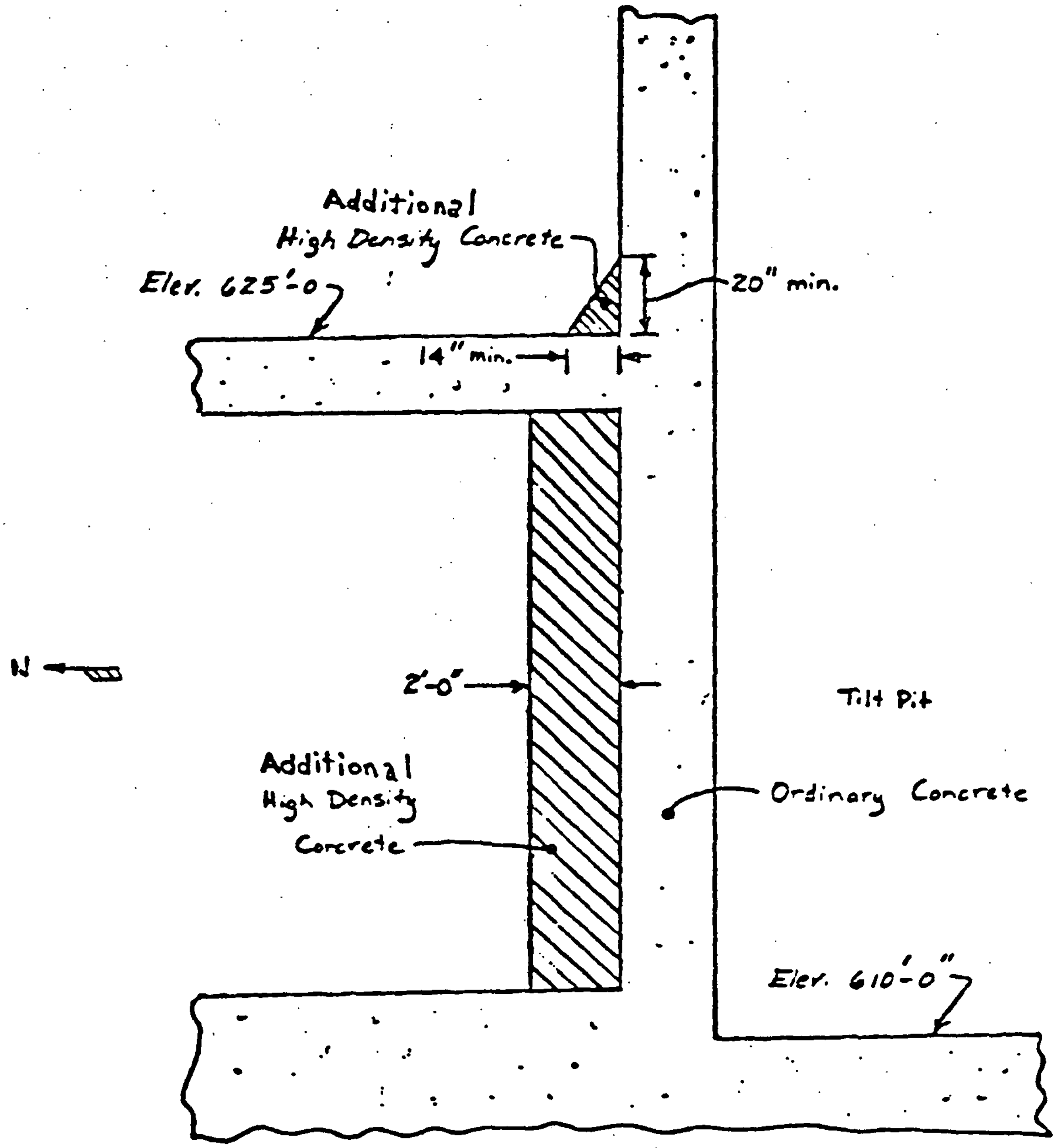

Figure 1 Additional Tilt Pit Shielding

Question 4:

The FSAR indicates that it is possible to temporarily tie-in the shutdown cooling system to the spent fuel pool. Identify, describe and discuss the spectrum of adverse situations insofar as the reactor core or stored spent fuel where the temporary tie-in would be employed. The discussion should demonstrate the adequacy of this operation.

Response to Question 4:

The spent fuel pool cooling system (SFPCS) is a closed loop system utilizing two half-capacity pumps and a full-capacity heat exchange unit consisting of two heat exchangers in series.

Table 6.1 of the November 1976, Spent Fuel Pool Modification Description and Safety Analysis defines the performance of the SFPCS under various single aotive failure conditions of the SFPCS and shutdown cooling system during normal refueling heat load and full core offload heat load.

The shutdown cooling system tie-in may be made when the reactor is on shutdown cooling offload conditions to supplement the SFPCS. Table 6.1 defines the consequences of various single active failure conditions when the tie-in is made during full core offload, for:

* Mechanical failure of a SFPCS pump.
* Mechanical failure of a shutdown cooling (LPSI) pump.
* Mechanical failure of a CCW pump.
* Loss of offsite power.
* Loss of offsite power and failure of one diesel generator.
* Air failure to valve on CCW inlet to SFPCS heat exchangers.
* Air failure to valve on inlet of shutdown heat exchangers.

These consequences are satisfactorily dispositioned in Table 6.1.

The tie-in may also be made when the reactor is on shutdown cooling if components of the SFPC have to be spared or repaired during either normal refueling heat load or full core offload heat load. The consequences of credible single active failures in other systems during a tie-in for this reason are defined and satisfactorily dispositioned in Table 6.1 for the most adverse situation of full core offload heat load.

During power operation, a single active failure of the SFPCS could occur with only a normal refueling heat load, after substantial decay heat removal, and the tie-in could be made. The only credible failures of the shutdown cooling system during such a tie-in are defined and satisfactorily dispositioned in Table 6.1 and (if safety injection were required) additionally in Section 6.1 of the FSAR. It must be noted, however, that this cross connection would render LPSI and one containment spray header inoperable. With existing technical specification limitations, therefore, cross connecting in this plant condition would only be acceptable in an emergency.

TABLE 6-1

PALISADES PLANT - SPENT FUEL POOL COOLING SYSTEM (SFPCS) SINGLE ACTIVE FAILURE ANALYSIS

Component	Failure Mode	Consequence: Normal Refueling Heat Load 16.9×10^6 BTU/hr	Consequence: Full Core Offload Heat Load 26.4×10^6 BTU/hr
Spent Fuel Cooling Pump	Mechanical Failure	Second pump is operational. Complete inventory of spares available for rapid pump repairs, if needed. However, maximum pool temperature will reach 118°F.	Second pump is operational. Shutdown cooling system is available and can be put into operation by manual connections between the two systems. Without the shutdown system, the pool temperature will reach 134°F. With the shutdown cooling system also in operation, pool temperature will be reduced to 103°F.
Low Pressure Safety Injection (LPSI) Pump (Shutdown Cooling Pump)	Mechanical Failure	Shutdown system is not required for normal cooling. No effect on SFPCS.	The second LPSI pump and two shutdown heat exchangers, and the SFPCS are available for cooling. Pool temperature will be less than in the case of ESP Bus 1o failure.
Component Cooling Water (CCW) Pump	Mechanical Failure	No effect on SFPCS, as two 2/3 capacity CCW pumps are available.	No effect on SFPCS or on shutdown cooling system, as two 2/3 capacity CCW pumps are available.
Offsite Power	Electrical Failure	Emergency Power is available. Manual starting of SFP and CCW pumps is possible. Hence, no effect on SFPCS performance.	Emergency power is available. Manual starting of SFP pumps, CCW pumps and LPSI pumps is possible. Hence, no effect on SFPCS and on shutdown cooling systems.
Offsite Power and Diesel Generator No. 1 (ESP Bus 1o)	Electrical and/or Mechanical	Diesel generator No.2 is available. Manual starting of one SFP pump and one CCW pump are possible. Second SFP pump may be started later, if tie-in breakers can be operated. Pool temperature will not exceed 118°F.	Diesel generator No. 2 is available. One LPSI pump, one CCW pump, and one SFPC pump are available for manual startup. Pool temperature will not exceed 109°F.
Air Operated Valve CV-0944 (On CCW inlet to SFPC heat exchangers)	Air Failure	Single failures in the air system other than rupture of air piping to valve cannot cause valve closure as redundant compressors, cross connects and air storage tanks are available for valve operation.	Both LPSI pumps and heat exchangers are available.
CV-3055 (At inlet to both shutdown heat exchangers on LPSI/shutdown system	Air Failure	No effect on SFPCS.	Single failures in the air system other than rupture of air piping to valve cannot cause valve closure as redundant compressors, cross connects, and air storage tanks, are available for valve operation.

Investigation has disclosed one case when the tie-in must not be made. A review of the validity of the projected consequences will be conducted and a revision to the pertinent plant SOP will be made if necessary, prohibiting the tie-in when:

* The reactor is on shut-down cooling, and
* The reactor, containing fuel, is under pressure.

During a tie-in under these conditions, the shutdown cooling (LPSI) pumps could take suction from both the SFP and the reactor vessel, and because of the pressure in the reactor vessel, would discharge preferentially to the SFP. Shutdown cooling water to the reactor may be limited and contaminated water discharged to the SFP.

Question 5:

Describe and discuss the reasons for concluding that the spent fuel pool cooling system piping, fittings and valves which meet the requirements of ASA B31.1 is acceptable considering the requirements presented in Table 1 in Regulatory Guide 1.26.

Response to Question 5:

NRC Regulatory Guide 1.26 specifies that the spent fuel pool cooling system be designed to Group C quality standards. Current practice, therefore, would specify that the cooling system piping, fittings and valves must meet the requirements of ASME Boiler and Pressure Vessel Code, Section III, "Nuclear Power Plant Components", Class 3. However, the design of the spent fuel cooling system to meet the requirement of ANSI B31.1 Power Piping is acceptable considering that the requirements of both the codes are essentially the same. Specifically:

- The allowable stress limits given in Tables 1-7.0 of the appendices of ASME Section III are identical to those given in Appendix A of ANSI B31.1.

- Pressure-temperature ratings for piping products: For piping products having specified ratings, the standards for ASME Section III Class 3 components given in Table ND-3132-1 are identical to the standards for ANSI B31.1 in Table 126.1. For piping products not having specific ratings, both the codes specify that the manufacturer's recommended pressure ratings should not be exceeded. The considerations for local conditions and transients addressed by the two codes are nearly the same. The differences are insignificant.

- Allowances for the effect of corrosion and erosion, threading and grooving, mechanical strength, longitudinal weld joint efficiency factors and the steel casting quality factors discussed in Article ND-3613 of the ASME B&PV Code and in Article 102.4 of the ANSI B31.1 are the same.

- Design Considerations:

  Article ND-3621, Design and Service Loadings of the ASME Code and the Article 101.4, Ambient Influences of ANSI B31.1 are identical.

  Article ND-3622, Dynamic Effects (which include impact, earthquake and vibration) of the ASME Code are approximately the same as the Article 101.5, Dynamic Effects of the ANSI B31.1. Although ANSI B31.1 does not address such items as exposed piping and relief and safety valve thrust, these items do not apply to the spent fuel cooling system.

  Article ND-3623, Weight Effects of the ASME Code is identical to Article 101.6, Weight Effects of ANSI B31.1.

- Pressure design of piping: The pressure design of piping components in the ASME Code is very similar to that in the ANSI B31.1. Minimum wall thickness of the pipe is determined by the same equation (ND-3641.1 of ASME and 104.1.2 of ANSI). The allowable working pressure of the pipe is determined from the same equation in both the codes. The requirements for curved pipes in the two codes are very nearly the same. The requirements for intersections, which include unreinforced and reinforced branch connections, extruded outlets, branch connections subjected to external pressure, mitres, attachments and closures in both ASME III, Class 3 and ANSI B31.1 are the same. The several equations used to determine the required reinforcement thickness are also identical.

- Design requirements that the various loads on the piping must meet are given in Article ND-3650 of the ASME Section III, Class 3 code and in Article 104.8.1 of the ANSI B31.1. These requirements, for sustained loads, occasional loads, thermal expansion stresses and sustained plus thermal expansion loads given in Equations 8, 9, 10 and 12 of ASME Section III, Class 3 are the same as Equations 11a, 12a, 13a and 14a of ANSI B31.1.

The allowable stress range for expansion stresses given in Article ND-3611.2(e) of the ASME Section III Class 3 is identical to that given in Article 102.3.2(c) of the ANSI B31.1 Code.

The determination of moments and section modulus are the same according to both the codes.

The piping flexibility and the stress intensity factors according to ASME Section III Class 3 given in Article ND-3673.2 (associated with Figures ND-3673.2(b)-1 through ND-3673.2(b)-5) are identical to those according to ANSI B31.1 (Appendix D).

Question 6:

Identify and discuss where the Technical Specifications for Palisades are not in accord with the current Technical Specification as it relates to new and spent fuel storage and associated refueling operations. For each deviation demonstrate that when other plant features or procedures are taken into consideration your present Technical Specification provides an equivalent level of safety or describe and discuss what additional measures must be implemented to bring Palisades Technical Specifications up to current practices.

Response to Question 6:

The attached table provides a direct comparison between the Standard Technical Specifications for CE plants and the current Palisades Technical Specifications.

TECHNICAL SPECIFICATION COMPARISON

STANDARD T.S. FOR CE PLANTS		PALISADES T.S.	
Section	**Purpose/Remarks**	**Section**	**Purpose/Remarks**
3.9.7 -	Prohibits crane movement of loads in excess of ____ lbs over fuel assemblies	3.13.b -	Prohibits crane movement of any material past the SFP unless interlocks are operable or unless crane is under direct administrative control of a supervisor. NOTE: Interlocks prevent movement of a load over the SFP.
		3.21.1 -	Provides specific restrictions on movement of shielded shipping casks in the vicinity of the SFP.
		The entire issue of movement of heavy loads near safety-related equipment is being addressed in response to NRC Generic Letter 81-07 dated December 22, 1980. CPCo responses include letters of May 15, 1981; July 6, 1981; and September 23, 1981.	
4.9.7 -	Requires demonstration of crane interlock operability within 7 days prior to movement of loads in excess of ____ lbs over fuel assemblies and once per 7 days thereafter.	3.13.b and Table 3.17.4 -	Requires crane interlocks to be operable whenever material is moved past the SFP except when special administrative controls are imposed on crane operation. The interlocks are checked monthly as a preventive maintenance item. Tech. Specs. do not specify a test frequency, but do meet the intent of the STS.
3.9.11 -	Specifies minimum water level for SFP at 23' over fuel.	-	Equivalent T.S. does not exist for Palisades. Routine operator inspection tours which include an inspection of the spent fuel pool area are made on a shift frequency, however. In addition, an SFP low level alarm is provided which is actuated at a level approximately 18' above the top of the fuel (el. 646'). Operability of this alarm is periodically verified as a preventive maintenance item.
4.9.11 -	Requires verification of SFP water level each 7 days.		

Section	Purpose/Remarks	Section	Purpose/Remarks
3.9.12 -	Requires two SFP air cleanup systems to be operable or one cleanup system to be in operation (through HEPA filter and charcoal adsorber) whenever fuel is moved in the pool or when crane operations are performed with loads over the pool.	3.8.4 -	Requires the ventilating system, including the charcoal filter, to be in operation whenever irradiated fuel is being handled in the SFP or whenever refueling operations are being performed with the equipment door open. This is consistent with STS. As discussed above, movement of other heavy loads is being addressed in response to Generic Letter 81-07. Movement of loads over the pool is generally prohibited unless special administrative controls are in effect.
4.9.12 -	Specifies that SFP air cleanup system operability be verified each 31 days; and system cleanup efficiency be verified each 18 months, after structural maintenance, or following painting, fire or chemical release which could contaminate filters. Specified efficiency is 99% (Palisades calculations assume 90%). Also specifies system flow rate measurements and laboratory tests of charcoal after every 720 hours of operation.	Table 4.2.2, Item 11 -	Requires efficiency test of HEPA and charcoal filters during each refueling shutdown and whenever work on filters could alter their integrity. Specified efficiency is 99%.
5.6	Provides miscellaneous design information for fuel racks, pool water level and storage capacity.	5.4.2 -	Provides miscellaneous design and operating information for SFP. Differences from STS have no practical effect.

Section	Purpose/Remarks
-	Equivalent does not apparently exist in STS.

Section	Purpose/Remarks
Table 4.2.1, Item 6	Requires monthly test to verify minimum SFP boron concentration. Requires continuous monitoring of bulk water temperature when bundles which have decayed for less than one year are stored in tilt pit racks.