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DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards addl info re internally generated missiles, in response to SER Open Item 2.

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CP&L
Carolina Power & Light Company
OCT 25 1984

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Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NO. 1 - DOCKET NO. 50-400
INTERNALLY GENERATED MISSILES

Dear Mr. Denton:

Carolina Power & Light Company (CP&L) hereby submits additional information concerning Internally Generated Missiles at the Shearon Harris Nuclear Power Plant. This information is in response to Safety Evaluation Report Open Item No. 2 from the Auxiliary Systems Branch.

If you have any questions or require additional information on this subject, please contact me.

Yours very truly,

S. R. Zimmerman
Manager
Nuclear Licensing Section

JHE/cfr (592JHE)

Attachments

cc: Mr. B. C. Buckley (NRC)
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Mr. J. P. O'Reilly (NRC-RII)
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Shearon Harris Nuclear Power Plant
SER Open Item No. 2(a)
Internally Generated Missiles - Essential Services Chilled Water System

Open Item:

The SER noted that neither the ESCWS or the WPBCWS appears on the list of structures, systems, and components requiring protection against internally generated missiles (outside containment). In response, the applicant stated that the following had been considered as potential sources of missiles that could damage the ESCWS: high pressure systems, rotating machinery, gravitational missiles, and secondary missiles (resulting from the impact of primary missiles). However, the applicant concluded that these missiles were either not credible or would not affect safety-related equipment in the ESCWS area.

The staff finds this conclusion to be unacceptable. Missiles from these potential sources are considered credible unless some deliberate element in the design or extra precaution is provided to prevent their generation. Design of equipment to appropriate codes is not a satisfactory means for preventing missile generation. Therefore, to justify the conclusion that such missiles are not credible, the applicant must show, in detail, that the design specifically considered the problem of missile generation from these potential sources, or the applicant must show that the ESCWS is protected against such missiles. Either of these approaches will satisfy the staff's concern regarding protection of the ESCWS against internally generated missiles outside containment.

As for the WPBCWS, the applicant noted that no adverse safety or radiological impact results from failure of the non-nuclear WPBCWS and, therefore, the WPBCWS need not be protected against missiles. The staff finds this acceptable.

Response:

FSAR Table 3.5.1-1 will be revised in a future amendment to include the Essential Services Chilled Water System as a system required for safe shutdown or whose damage by internally or externally generated missiles could result in significant release of radioactivity.

A missile study was performed to evaluate the effects of internally generated missiles on the ESCWS outside containment. This study identifies the potential sources of missiles that could damage the ESCWS. Justification for the determination of non-credible missiles or recommendations to protect the ESCWS from credible missiles has been provided. The following highlights of the study are summarized below:

a. High Pressure Systems - FSAR Section 3.5.1.1 indicates that the only credible potential missiles generated from high energy systems outside of containment would be instrument wells. These potential missiles have been evaluated and the results are documented in FSAR Table 3.5.1-17.

(592JHE/cfr)

b. Rotating Machinery - A pump generated missile study which considered the possibility of rotating machinery as potential missile sources has been performed. This missile study has concluded that the ESCWS is protected from the possible effects of internally generated pump missiles.

c. Gravitational Missiles - SHNPP is designed to ensure that failure of non-safety related, non-seismically designed equipment and/or structures will not adversely affect the operation of safety-related equipment. The ESCWS has been reviewed in its entirety in order to ensure its continued availability. Equipment, systems, components and/or structures in the vicinity of the ESCWS are either seismically designed to ensure their continued structural integrity post-SSE or the postulated failure of non-seismically designed components has been assumed and it was determined that both trains of ESCWS would not be rendered inoperable.

d. Secondary Missiles - The effects of secondary missiles on safety-related systems including ESCWS, structures, and components is based on fragments generated from primary missiles. Our review has identified the existence of potential secondary missiles generated by primary missiles from high pressure systems and rotating machinery. In the event that secondary missiles are generated, we have determined that one of the following interactions would occur:

1. safety-related equipment would not be within the strike zone of the secondary missiles generated; or

2. the impact energy from secondary missiles on safety-related equipment is negligible and would not cause any significant damage; or

3. barriers and compartmentalization of safety-related equipment would confine secondary missiles to a finite area so that a single missile will be incapable of negating redundant safety trains.

Based on the above analysis, the generation of secondary missiles cannot disable the necessary functioning of the redundant trains of the ESCWS.

Shearon Harris Nuclear Power Plant
SER Open Item No. 2(b)
Internally Generated Missiles - Missiles From Pumps

Open Item:

During the staff review, a concern arose regarding the possibility of internally generated missiles resulting from pump failure. The applicant was made aware of this concern, and, in response, the applicant noted that missiles from pumps within the nuclear steam supply system (NSSS) scope that are outside of containment have been designed so that their maximum no-load speed is equivalent to their operating speed. Thus, a sudden loss of load (resulting, for example, from a line break) will not result in the generation of missiles. Further, the FSAR states that the balance-of-plant (BOP) is designed so that missiles from internal sources will not damage engineered safety features in a way that would jeopardize the minimum required safety functions.

The staff finds this unacceptable. Although the pumps in the NSSS scope are prevented from overspeeding, the staff concern relates to the possibility of missile generation from well-designed pumps operating normally (see Item 3, above). In addition, the applicant must provide detailed information to explain how safety-related structures, systems, and components are protected against internally generated missiles generated from pumps within the BOP scope.

Response:

General Design Criteria 4, "Environmental and Missile Design Bases" of Appendix A, "General Design Criteria for Nuclear Power Plants", to 10CFR Part 50, Licensing of Production and Utilization Facilities", requires, in part, that structures, systems, and components important to safety be appropriately protected against the effects of missiles that might result from pump failures. A missile study was performed to evaluate the effects of internally generated pump missiles at SHNPP. Our assessment of internally generated pump missiles was conducted for high speed, reciprocating pumps. Small capacity support pumps associated with vendor packages were not evaluated in this study because of their small mass, low inertia, and integral incorporation within skid mounted packages.

The objective of this response is to provide assurance that redundant portions of safety-related structures, systems, and components are adequately protected from the effects of internally generated missiles from pumps.

In many cases, protection against pump generated missiles has been provided by the use of missile barriers. In other cases, protection of essential systems or structures against direct strikes by pump missiles was also provided by appropriate placement and orientation of the pump. The single failure criterion is used in the analysis. Therefore, if a safety related pump fails, the single failure criterion is met. If a non-safety related pump fails, an additional single failure is postulated.

Pumps were evaluated in accordance with the following criteria to ensure that missile damage is not credible:

1. Safety-related pumps which, because of their location, cannot affect multiple power or component trains by generating missiles shall not be considered as a potential danger to the safety of the plant.

2. Safety-related pumps which are isolated in cubicles and cannot damage other essential equipment by generating missiles shall not be considered a potential danger to the safety of the plant.

3. Non-safety related pumps which are located in non-safety related areas or which are isolated in cubicles and cannot damage essential equipment by generating missiles shall not be considered a potential danger to the safety of the plant.

4. Pumps for which vendor calculations or certifications are available stating that the pumps cannot generate missiles that penetrate the pump casing shall not be considered a potential danger to the safety of the plant.

5. Any pumps which are intended for use only during cold shutdown, shall not be considered a potential danger to the safety of the plant.

In order to assess the effects of pump generated missiles, the pumps listed in Table 1 were located and reviewed in terms of the evaluation criteria listed above. Evaluation Criteria 1, 2, and 3 eliminated most of the pumps (safety and non-safety related) from further analysis because of their location and the location of other essential components in the area of the pump.

Pumps which did not fall into categories 1, 2, or 3 were reviewed in terms of Evaluation Criteria #4. The pump vendor was contacted to determine whether the pump could actually generate a missile that could penetrate the pump casing. The vendor was requested to submit a letter of certification or a calculation showing that the pump could not generate a missile that would penetrate the pump casing. If such information was not available, the vendor was requested to supply pump data necessary to allow appropriate calculations to be performed.

Pumps which did not fall into any aformentioned categories were reviewed in terms of their mode of operation. If a pump was intended to operate only during cold shutdown conditions, evaluation criteria #5 was utilized.

Subsequent to the application of Evaluation Criteria 1-5, four types of pumps could not be eliminated from further consideration. For three of these types, the Charging Pumps, the CVCS Chiller Pumps, and the RHR Pumps, the potential for missile generation has been evaluated on the basis of the projected missile strike zones. Missiles from these pumps will not result in the impact of redundant essential component trains. The remaining pump type, the Boron Injection Recirculation Pump, is a close-coupled pump whose missile expulsion potential is not considered a potential danger to the safety of the plant.

The results of the evaluation are summarized in Table 1 - Pump Generated Missile Study. This evaluation supports the conclusion that systems, structures and components whose failure could prevent safe shutdown of the plant or result in significant uncontrolled release of radioactivity have been protected from the possible effects of internally generated missiles.

(592JHE/cfr)

TABLE 1 - PUMP GENERATED MISSILES STUDY

Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
Charging Pump	RAB EL. 236' G-016 (J-6, 7, 8)						The potential for missile generation has been identified. Subsequent evaluation of the projected missile strike zone has resulted in the conclusion that missile generation from this pump can not result in the impact of redundant essential component trains.
SW Booster Pump	RAB EL. 236' G-016 (K-11)(K-16)				X		
Boric Acid Transfer	RAB EL. 236' G-016 (J-16)				X		
CVCS Chiller Pump	RAB EL. 236' G-016 (M-13)						The potential for missile generation has been identified. Subsequent evaluation of the projected missile strike zone has resulted in the conclusion that missile generation from this pump can not result in the impact of redundant essential component trains.
Reactor Make-Up Water Pump	Tank Area EL. 236' G-033 (H-8)			X			

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Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
Condensate Transfer Pump	Tank Area EL. 236' G-033 (H-8)			X	X		
Sec. Waste Sample Tank Pump	Tank Area EL. 236' G-033 (H-7)			X			
Tank Area Drain Pump	Tank Area EL. 236' G-033 (I-4)			X	X		
Reactor Coolant Drain Tank Pump	Cont. Bldg. EL. 221' G-011 (J-4)			X			
Reactor Coolant Pump	Cont. Bldg. EL. 236' G-011 (F-13)				X		
Fuel Pool Cooling Pump	FHB EL. 236' G-023 (H-8)				X		
Containment Spray Pump	RAB EL. 190' G-015 (I-12, 19)	X			X		
RHR Pump	RAB EL. 190' G-015 (I-13, 18)				X		The potential for missile generation has been identified. Subsequent evaluation of the projected missile strike zone has resulted in the conclusion that missile generation from this pump can not result in the impact of redundant essential component trains.

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Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
Floor Drain Transfer Pump	RAB EL. 190' G-015 (J-1)				X		
Boron Injection Recir. Pump	RAB EL. 216' G-015 (J-8)						Analysis of the potential for missile generation has identified a penetration constraint due to pump design. A potential missile would be required to impinge upon and penetrate either the casing flange or a portion of the pump driver. This pump, therefore, is not considered to be a potential danger to the safety of the plant.
HVAC Condensate Transfer Pump	RAB EL. 216' G-015 (K-5)				X		
SSE Fire Protection Booster Pump	RAB EL. 216' G-015 (J-1)			X	X		
Recycle Monitor Tank Pump	RAB EL. 261' G-017 (L-12, 16)				X		
HVAC Chilled Water Pump	RAB EL. 261' G-017 (L-8)				X		
Steam Generator Wet Lay-Up Recirc. Pump	RAB EL. 261' G-017 (J-5)					X	

(592JHE/cfr)

Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
Condenser Water Pump	RAB EL. 261' G-017 (L-1)(L-8)				X		
Component Cooling Water Pump	RAB EL. 236' G-016 (M-3, 9)				X		
Motor Driven Steam Gen. Aux. Feedwater Pump	RAB EL. 236' G-016 (M-6)				X		
Turbine Driven Steam Gen. Aux. Feedwater Pump	RAB EL. 236' G-016 (M-9)				X		
Decontamination Wash Pump	FHB EL. 261' G-022 (B-21)			X			
Decontamination Rinse Pump	FHB EL. 261' G-022 (B-21)			X			
Decontamination Transfer Pump	FHB EL. 236' G-023 (I-18)			X			
HVAC Cond. Receiver Transfer Pump	FHB EL. 216' G-023 (E-3)			X			
Fuel Pool Skimmer Pump	FHB EL. 236' G-023 (G-13)			X			

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Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
CCW Transfer Pump	FHB EL. 216' G-023 (D-18)			X			
Spent Fuel Pool Refueling Water Purification Pump	FHB EL. 216' G-023 (C-6)			X			
Equipment Drain Transfer Pump	RAB EL. 190' G-015 (J-16)			X			
Hydrotest Pump	RAB EL. 236' G-016 (I-3)			X			
Aux. Building Filter Backwash Transfer Pump	RAB EL. 236' G-016 (G-13)			X			
Recycle Evaporator Feed Pumps	RAB EL. 236' G-016 (G-10)		X				
FHB Filter Backwash Transfer Pump	FHB EL. 216' G-023 (C-4)			X			
Diesel Oil Transfer Pump	DOSTA G-214 (D-9, 13)	X					
Cooling Tower Makeup Pump	ESW Intake G-202 (E-5, 7)			X			

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Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
Normal Service Water Pump	NSW Intake G-201 (H-10)			X			
Circulating Water Pump	CT Intake G-203 (C-12)			X			
WPB Cooling Water Pump	WPB EL. 261' G-912 (I-13)			X			
Waste Monitor Tank Pump	Tank Area G-033 (L-4)			X			
Chlorine Booster Pump	NSW Intake G-201 (I-12)			X			
Caustic Metering Pump	CT Intake G-203 (D-9)			X			
Acid Metering Pump	CT Intake G-203 (E-8)			X			
Fire Service Screen Wash Pump	ESW Intake G-209 (F-5, 11)			X			
Economizer Recirc. Pump	Aux. Boiler Bldg. G-243(S1) (G-10)			X			

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Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
Rinse Recycle Pumps	Turb. El. 240 G-004 (D-5)			X			
Condensate Pumps	Turb. Bldg. G-004 (J-10)			X			
Steam Generator Feed Pumps	Turb. Bldg. G-005 (C-13)			X			
Heater Drain Pumps	Turb. Bldg. G-004 (E-14)			X			
Condenser Vacuum Pumps	Turb. Bldg. G-005 (G-9)			X			
Aux. Boiler Fuel Oil Unloading Pump	Yards G-210(S01) (E-14)			X			
Screen Wash Pump	ESW Intake G-205 (G-4, 6)	X					
Aux. Steam Condensate Pump	WPB G-910 (G-11)(J-11)			X			
Main Reservoir Make-Up Pump	Deleted (Unit 2 Cancellation)						

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Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
Fire Water Pump	ESW Intake Screen G-209 (E-14)(F-4)			X			
Jockey Pump	ESW Intake Screen G-209 (G-14)			X			
Condensate Booster Pump	Turb. G-005 (C-8)			X			
Emergency Service Water Pump	ESW Intake G-202 (C-13, 18)	X					
Floor Drain Tank Pump	WPB EL. 211' G-910 (K-3)			X			
Floor Drain Tank Mixing Pump	WPB EL. 211' G-910 (L-3)			X			
FD Polyelectrolyte Feed Tank Pump	WPB EL. 211' G-910 (L-4)			X			
Waste Evaporator Feed Pump	WPB EL. 211' G-910 (L-7)			X			
Waste Evaporator Conc. Tank Pump	WPB EL. 211' G-910 (L-8)			X			

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Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
Gas Decay Tank Drain Pump	WPB EL. 211' G-910 (N-7)			X			
WPB Filt. Part. Cond. Tank Pump	WPB EL. 211' G-910 (N-7)			X			
WPB Filter Backwash Storage Tank Pump	WPB EL. 211' G-910 (M-8, 9)			X			
Chemical Drain Tank Pump	WPB EL. 211' G-910 (J-5)			X			
Waste Evaporator CNDS Pump	WPB EL. 211' G-910 (J-7)			X			
RO Feed Pump	WPB EL. 211' G-910 (H-6)			X			
Spent Resin Transfer Pump	WPB EL. 211' G-910 (H-10)			X			
Sluice Pumps	Turb. EL. 240' G-004 (E-8)			X			
Lube Oil Transfer Pump	Turb. G-005 (J-16)			x			

(592JHE/cfr)

Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
Spent Resin Sluice Pump	WPB EL. 211' G-910 (I-10)			X			
Aux. Steam Cond. Tank Pump	WPB EL. 211' G-910 (G-11)(J-11)			X			
Sec. Waste Evap. Cond. Tank Pump	WPB EL. 211' G-910 (G-13)(I-13)			X			
Sec. Waste Evap. Conc. Pump	WPB EL. 211' G-910 (H-14)			X			
Sec. Waste Evap. Recirc. Pump	WPB EL. 211' G-910 (G-14)			X			
SW Filter Backwash Transfer Tank Pump	WPB EL. 211' G-910 (H-15)			X			
High Conductivity Hold Tank Mixing Pump	WPB EL. 211' G-910 (J-14)			X			
High Conductivity Hold Tank Pump	WPB EL. 211' G-910 (J-14)			X			
Low Conductivity Hold Tank Pump	WPB EL. 211' G-910 (L-13)			X			

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Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
Chiller Pumps	WPB EL. 291' G-914 (G-10)			X			
Solidification System Pretreat. Tank Pump	WPB EL. 291' G-914 (L-4)			X			
WPB Feed Pumps	WPB EL. 291' G-914 (J-9)			X			
RO Conc. Evap. Cond. Pump	WPB EL. 236' G-911 (M-3)			X			
RO Conc. Evap. Recirc. Pump	WPB EL. 236' G-911 (K, L-3)			X			
RO Conc. Evap. Distill Pump	WPB EL. 236' G-911 (L-3)			X			
RO Conc. Evap. Conc. Pump	WPS EL. 236' G-911 (J-3)			X			
L&HS Tank Pump	WPB EL. 236' G-911 (H-3)			X			
L&HS Tank Mixing Pump	WPB EL. 236' G-911 (H-3)			X			

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Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
L&HS Polyelectrolyte Feed Pump	WPB EL. 236' G-911 (H-3)			X			
Treated Laundry & Hot Shower Tank Pump	WPB EL. 236' G-911 (E-3)			X			
Demineralized Water Storage Pump	Yard G-210 (S0) (L-5)			X			
Skimmed Oil Trans Pump	Yard G-210 (S03) (H-5)			X			
Burner Fuel Oil Pump	Yard G-210 (S01)(E-14)			X			
Effluent Water Transfer Pump	Yard G-210 (S03)(H-3)			X			
Neutralization Basin Recirc. Pump	Yard G-201 (S03)(E, H-12)			X			
Flash Mixer Feed Pump	Yard G-210 (S03)(E, I-16)			X			

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Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
Secondary Waste Evap. Distillate Pump	WPB EL. 236'			X			
Reverse Osmosis Concentrate Evaporator Feed Pump	WPB EL. 236'			X			
Laundry and Hot Showers Reverse Osmosis Feed Pump	WPB EL. 236'			X			
Settling Tank Drain Transfer Pump	Turb. Bldg. EL. 240'			X			
Ammonia Recycle Pump	Turb. Bldg. EL. 240'			X			
Lube Oil Conditioner Circulation Pumps	Turb. Bldg. EL. 261'			X			
Emergency and Bearing Oil Pumps in Oil Reservoir	Turb. Bldg. EL. 286'			X			
Ammonia Transfer Pumps	Yard			X			
Diesel Oil Unloading Pumps	Yard			X			
Evaporator Concentrates Pump	RAB. EL. 236' G-016		X				

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Type of Pump	Location	Eliminated per criteria: 1	2	3	4	5	Remarks
Distillate Pump	RAB. EL. 236' G-016		X				
ESCWS Lubricating System Oil Pump	RAB. EL. 261' G-017	X					

(592JHE/cfr)