ENCLOSURE 2

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket No.:	50-397
License No.:	NPF-21
Report No.:	50-397/97-04
Licensee:	Washington Public Power Supply System
Facility:	Washington Nuclear Project-2
Location:	3000 George Washington Way Richland, Washington
Dates:	February 10-14, 1997
Inspectors:	G. W. Johnston, Senior Project Inspector D. G. Acker, Senior Project Inspector
Approved By:	H. J. Wong, Chief, Reactor Projects Branch E

Attachment: Supplemental Information

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EXECUTIVE SUMMARY

Washington Nuclear Project-2
NRC Inspection Report 50-397/97-04

Engineering

- A nonconservative and erroneous plant modification record (PMR) resulted in a violation. Design personnel failed to consider, during initial design, the safety requirements associated with ensuring service water (SW) Pump 1A and the low pressure core spray (LPCS) pump would operate when required. The licensee did not act on available technical information which indicated that the associated instantaneous overcurrent (IOC) trips were set too low (Section E8.1).

- After issuing the PMR, engineering personnel twice noted conflicts with the UFSAR, but took no action to review the PMR for additional conflicts, until one was noted by the inspector (Section E8.1).

- The installation of replacement High Pressure Core Spray (HPCS) initiation drywell pressure switches without the required substitution evaluation was a violation of facility procedural requirements (Section E8.2).

- The licensee staff had several opportunities to identify the deficient conditions for both the overcurrent trip setpoints and the replacement HPCS initiation drywell pressure switches. These opportunities reflect on the ability of licensee staff to recognize potential problems prior to their occurrence (Sections E8.1 and E8.2).

- The licensee's immediate corrective actions for both issues were prompt (Sections E8.1 and E8.2).

Report Details

This inspection involved review of two events: (1) the tripping of Standby Service Water Pump 1A due to an incorrect overcurrent relay setting; and 2) the installation of drywell pressure instruments which were not properly vented and resulted in degraded performance.

III. Engineering

E8 Miscellaneous Engineering Issues (92902)

E8.1 (Closed) Licensee Event Report (LER) 50-397/96-009: miscalculation of instantaneous overcurrent relay settings resulting in inoperability of safety-related equipment.

The licensee identified that the supply circuit breaker to the motor for Standby Service Water (SW) Pump 1A tripped on December 20, 1996, during a routine attempt to start the pump. The licensee determined that the circuit breaker was tripped due to actuation of the circuit breaker's IOC relay.

The licensee determined that the setpoint for the IOC relay had been reset in November 1996 based on calculations using an inaccurate locked rotor current and nonconservative selection of a multiplication factor. Between November 1996, when the IOC was reset, and the December 20, 1996, failure, the pump had been successfully started seven times. Postmaintenance testing included bench testing of the relays and a successful pump start. The licensee reset the IOC relay trip setpoint and successfully started the pump.

The licensee identified the root cause as use of inappropriate design input for determining the IOC setpoint.

As a result of the trip of SW Pump 1A, the licensee requested and the NRC approved the use of enforcement discretion to discontinue repetitive testing of emergency diesel generators. This approval was documented in a letter to the licensee dated December 24, 1996.

a. Inspection Scope

The inspector reviewed the LER, the plant modification associated with the initial change in the IOC relay setpoint, associated calculations and circuit breaker coordination studies, industry standards for selection of IOC setpoints, the licensee's operability and root cause evaluations, and discussed this information with licensee employees.

b. Observations and Findings

The inspector noted that normal plant electrical protective device coordination requires IOC relays for tripping individual pump circuit breakers for pump and cable faults. Proper coordination requires that the IOC relays be set to trip the pump

circuit breaker before circuit breaker(s) supplying the entire bus trips. However, the IOC relays needed to be set high enough to ensure that they did not trip during starting of the pump. Starting current for pumps is normally estimated using vendor locked rotor test data, general motor design data, or actual starting current measurements.

Based on past licensee evaluations and NRC inspections, the licensee determined that the coordination of their plant circuit breakers could be improved. On January 30, 1996, the licensee approved PMR 85-0528-0, "Protective Relay Coordination Study and Installation," to reset or change a number of protective relays to improve overall plant protection from electrical faults. This PMR was based on calculations issued in 1993.

The licensee stated that they received locked rotor current test data from General Electric (GE) for a number of plant pumps. Some of this data was locked rotor current for a test at 20 percent of rated voltage, some of it was locked rotor current data at 80 percent voltage, and some of the data was GE's projected locked rotor current at full voltage based on tests and an unspecified multiplication factor.

For the SW Pump 1A, GE provided a locked rotor current (LRC) value at approximately 20 percent rated voltage. The licensee extrapolated the locked rotor current at 100 percent voltage by multiplying the current at 20 percent voltage by a linear factor and determined the LRC was 960 amps.

Motor starting current is dependent on the locked rotor current and additional variables such as direct current offset and line voltage. Therefore, IOC trips are set at some value above locked rotor current that will ensure that the IOC trips will not activate during pump starting. American National Standards Institute/Institute of Electrical and Electronics Engineers (IEEE) C37.96-1988, "IEEE Guide for AC [alternating current] Motor Protection," recommends that the IOC trips be set at locked rotor current multiplied by 1.65 to 1.875. Other technical guides recommend use of locked rotor current multiplied by 1.7 to 1.8. The licensee chose to use 1.65 times locked rotor current for their safety-related and balance-of-plant pumps. As noted above, SW Pump 1A tripped on IOC during a routine start attempt after its IOC relay trip value was lowered.

Data was available to the licensee which indicated that the setting chosen by the licensee could be too low including:

> IEEE Standard 112-1991, "IEEE Standard Test Procedure for Polyphase Induction Motors and Generators," states that locked rotor current taken at low voltage levels could not simply be multiplied by a linear factor to determine locked rotor current at 100 percent voltage due to changes in reactance.

The motor nameplate and design drawings provided for the SW Pump 1A motor indicated locked rotor current was 1330 amps or approximately 30 percent higher than the value calculated by the licensee.

The value of locked rotor current calculated by the licensee provided a ratio of locked rotor current to running current which was approximately 4.5, a very low value for this size and type of motor.

The licensee was operating the motors at 4160 volts nominal, while their calculated lock rotor current was based on 4000 volts. Since the starting current will increase with increased voltage, the calculated IOC trip point was based on a voltage which was approximately five percent low.

The licensee was using the lowest multiplication factor (1.65) recommended by industry.

The inspector reviewed the above information with the licensee. The licensee acknowledged that they had information which could have alerted them to the potential for improper setting of the SW Pump 1A IOC relay. However, licensee representatives stated that they believed the primary root cause of the problem was that in attempting to provide the best circuit breaker coordination, they lost sight of the fact that the important safety function of SW Pump 1A was to operate and that they should have set the IOC at a higher industry recommend value, which would also provide adequate circuit breaker coordination. The inspector agreed that this was an important contributor to the event.

The licensee subsequently measured the starting current for SW Pump 1A and determined that it was approximately 1350 amps.

The inspector determined that IOC trip setting was incorrectly set in that the setting would not always ensure that SW Pump 1A would start when required, and had caused the pump to fail and be declared inoperable on December 20, 1996. Failure to correctly set the IOC relay to ensure SW Pump 1A operability is a violation of 10 CFR Part 50, Appendix B, Criterion III, Design Control (Violation 50-397/97-04-01).

The inspector noted that the IOC for the LPCS Pump was set as low as SW Pump 1A and was potentially susceptible to tripping during pump starting. The licensee reset the IOCs. There were no other IOCs for safety-related pumps set as low as these two pumps, partly since no safety-related pump IOCs had been reset for Train B safety-related pumps. The inspector reviewed circuit breaker coordination associated with the SW 1A and LPCS pumps and concluded that the new IOC settings provided adequate circuit breaker coordination with bus supply circuit breakers.

After the trip, the licensee had reset the IOC for SW Pump 1A to 2100 amps, approximately 1.5 times the measured locked rotor current of 1350 amps. The inspector reviewed the UFSAR and determined that Section 8.3.1.1 stated that the IOCs were set to trip at approximately two times locked rotor current. The inspector considered that this was not the same as described in the UFSAR. The IOC for the LPCS Pump was also set lower than two times locked rotor current.

The inspector reviewed PMR 85-0528-0 and the licensee's design control procedures and determined that the design control procedures required a review of the UFSAR to determine if the design affected anything in the UFSAR; however, in January 1996 licensee personnel checked a step indicating that the UFSAR was not affected by the PMR. The inspector considered that since the licensee's objective on the setpoint change was to provide improved breaker coordination, lowering the IOC setpoint would be an expected result. At most, a more complete review of the UFSAR would have most likely resulted in only an updated UFSAR page and not a more accurate calculation of the IOC setpoint.

The inspector reviewed changes associated with the PMR and noted that two separate changes, issued in 1996, identified two other conflicts between the PMR and the UFSAR, which the licensee resolved. The inspector discussed review of the UFSAR with licensee personnel. The licensee issued a problem evaluation request (PER) to compare the PMR to the UFSAR and resolve any differences.

c. Conclusion

The inspector concluded that the present IOC setpoints for SW Pump 1A and the LPCS Pump were coordinated with upstream circuit breakers, but were nonconservative with respect to motor testing currents.

The inspector concluded that the original PMR was flawed in that licensee design personnel failed to consider, during initial design, the safety requirements associated with ensuring SW Pump 1A and LPCS pumps would operate when required and did not act on available technical information which indicated that the associated IOC trips were set too low. Failure to establish appropriate circuit breaker trip setpoints to ensure reliable operation of SW Pump 1A is a violation of 10 CFR Part 50, Appendix B, Criterion III, Design Control.

In addition, after initial issue of the PMR, engineering personnel twice noted conflicts with the UFSAR, but took no action to review the PMR for additional conflicts, until one was noted by the inspector.

In summary, the inspector concluded that engineering performance associated with this PMR was weak.

E8.2 (Closed) LER 50-397/96-008: failure to comply with a Technical Specification action requirement for the emergency core cooling system actuation instrumentation due to unidentified inoperability condition.

The licensee identified that drywell pressure switches, designed to initiate the High Pressure Core Spray (HPCS) on high drywell pressure, had exceeded their Technical Specification allowable values on several occasions during the period from June 10 through November 24, 1996.

The original pressure switches had been replaced by newer models in April 1996, during Refueling Outage R11. The switches that were installed had a loss-of-coolant accident (LOCA) seal and a vent plug installed on the instrument housing. The vent plug had not been removed as required for the installation. It was subsequently determined that the failure to remove the vent plug allowed temperature variations in the reactor building to affect the setpoint of the pressure switches.

The licensee determined the root cause of the event to be an administrative deficiency in the control on the issuance of the pressure switches for use. A PMR had been initiated in 1984 that would have initiated the engineering analysis of the replacement pressure switches; however, the PMR was cancelled in 1989. With no process tie between the PMR and the pressure switches, the installation in 1996 went forward without an engineering evaluation of the substitution.

a. Inspection Scope

The inspector reviewed the LER, the PMR associated with the installation of the drywell pressure switches, the substitution evaluations performed, design documents, work packages associated with the installation of the pressure switches, the licensee's operability and root cause evaluations, and discussed this information with licensee employees.

b. Observations and Findings

The licensee performed an evaluation of setpoint drift on December 5, 1996, related to drywell Pressure Switches MS-PS-47B and 47C (used for actuation of HPCS on high drywell pressure). The evaluation was prompted by several instances where the switches failed administrative calibration limits during surveillance tests and were required to be recalibrated. The evaluation was documented in PER 296-0829. The PER determined that the drywell pressure switches were installed with the instrument cover vent plugs left in place. The PER also determined that the switches were operable at the time of the evaluation. However, the PER indicated they had possibly been inoperative during several periods since their installation. Due to that evaluation, LER 50-397/96-008 was issued.

In 1984, PMR 84-1125-0 was written to replace a Static O-Ring (SOR) 12NAA5X10TT (referred to hereafter as TT) pressure switch installed as a drywell pressure switch for actuation of the HPCS System. The TT switch could not be procured as a Quality Class 1 component. However, SOR Pressure Switch 12N6BB4NXCIAJJTTX6 (referred to hereafter as X6) was available as a Quality Class 1 component. The primary difference between the switches was the provision for a loss-of-coolant accident seal or an air tight conduit connection and a vent plug installed on the instrument case for the X6 switch. In 1988, SOR Corporation issued a Part 21 notification for the X6 switch due to process permeation through the kapton diaphragm that affected setpoint drift. A revised version of SOR 12N6BB4NXCIAJJTX12 (hereafter referred to as X12) replaced the kapton diaphragm with a stainless steel diaphragm.

March 9, 1989, Substitution Evaluation 567, Revision 0; was issued to evaluate the difference between the stock of X6 switches and the newer X12 model. The evaluation noted that a PMR was required to install the X12 version. No procedural requirement existed at that time to place a limitation on use in the Material Management System (MMS).

Subsequently, on August 3, 1989, PMR 02-84-1125-0 was voided. A note on the PMR states "SOR being revised to SS diaph. per RFTS 89-03-094" and "will address switch replacement as required." No reason was given for cancellation of the PMR. Later, on February 12, 1990, a purchase order was issued to return three X6 switches, have them modified to X12 versions, and acquire eight new X12 switches.

On June 15, 1991, Procedure SPES-1, Section 7.47, was issued, requiring that a limitation on use be placed on any item being procured as part of a PMR prior to a Basic Design Change being approved. This would place in the MMS a notation that the item required an engineering review prior to its use in the plant. This procedure change would, under current circumstances, require that any equipment procured for replacement stock that was not identical to the installed equipment be restricted with a limitation on use.

On December 8, 1995, four X12 switches were issued for replacement of installed drywell pressure switches under work orders (WO) YT4401 and WO YT4501. These WOs were generated on April 17, 1996, as routine replacement for environmental qualification requirements. The inspector examined the WO, identifying that the task required a replacement of flexible conduit for the installation of the new switch. This is because the TT model installed in the plant does not have a sealed electrical conduit connection. The inspector noted that the WOs requirement for extra work, specifically the conduit replacement, provided an opportunity for the preparer to identify the possible need for an engineering evaluation.

Two more opportunities occurred in June 1996 for identifying the need for engineering evaluations. June 4, 1996, Substitution Evaluation 2293, Revision 0, was issued to address the replacement of the now obsolete X12 pressure switch with an newer version. This substitution evaluation was released for review January 30, 1996. While recognizing that the preparer was not required to evaluate prior substitution evaluations or review previous limitations on use, had the preparer of this substitution evaluation noted that Substitution Evaluation 567 required a PMR for installation, the necessity for a limitation on use in the MMS may have become apparent. Further, a revision to setpoint Calculation E/I-02-92-1072 for the HPCS drywell pressure switches, was issued on June 6, 1996, that reflected changes due to the replacement of the pressure switches. The previous calculation (for the installed switches) stated that the switches were subjected to a walkdown to verify a vent path existed. The licensee noted that although the walkdown comment was included in the revision barred section of the calculation, no verification walkdown was conducted. Although the configuration of the original pressure switches included the vent plug, a walkdown may have noted the need for a vent path due to the inclusion of the LOCA seal in the replacement switches. Therefore a walkdown may have resulted in the identification of the need to vent the instrument housing.

WO YT4401 was signed off as completed for installation April 29, 1996, for Instruments MS-PS-47A and 47C. Final signoff occurred June 6, 1996. WO YT4501 for installation of Instruments MS-PS-47B and 47D signed as completed on April 26, 1996, and final sign off occurred July 7, 1996. The inspector examined the WOs and found them to be complete. Initial calibrations were done for both sets of switches with no notations of a problem in either case. There was no information supplied in either package of a substitution evaluation. Further, it appeared that no reliance was made of prior substitution evaluations.

The requirement to perform substitution evaluations is described in Plant Procedure Manual (PPM) 1.15.12, Section 8.4, Revision 0, "Substitution Evaluation," and a subtier Procedure SPES-1, Section 6.7, Revision 1, "Substitution Evaluations." PPM 1.15.12 states, in part, under 8.4.2, "Determination of Need," "Where desirable or necessary to procure or use substitute items, it is the responsibility of the user to request an evaluation by Material, Technical and Quality prior to procurement or use . . ." Further, Procedure SPES-1, Section 6.7.A, states, in part, that "Substitution evaluations are performed on safety-related and augmented quality class (other than Flag 1M) items per PPM 1.15.12 to assure the alternative replacement item is an acceptable substitute." Contrary to this, a substitution evaluation was not requested to be performed for the installation on April 26 and 29, 1996, of replacement HPCS drywell pressure Switches MS-PS-47A, 47B, 47C, and 47D. This is a violation of the requirements of Technical Specification 6.8.1a for failure to implement the requirements of PPM 1.15.12 (Violation 50-397/97-04-02).

Following installation of the X1.2 replacements, the switches were subjected periodic surveillance tests in accordance with Surveillance Procedures 7.4.3.3.1.53 "HPCS Initiation Drywell Pressure High A & C - Channel Function Test/Channel Check (CFT/CC)," and 7.4.3.3.1.54 "HPCS Initiation Drywell Pressure High B & D - CFT/CC." These procedures had administrative limits of 38.0 to 49.0 inches of water (1.37 psi and 1.77 psi respectively), with a nominal setpoint of 45.7 inches of water (1.65 psi). T. S. 3.3.3 specifies an allowable actuation setpoint of 1.85 psig. For the period from April 1996 through November 1996 there were six occasions when a switch failed to meet the administrative limits. In four of those occurrences, a switch failed to meet the administrative limit by being over the acceptance criteria. On two occasions the switches were below the acceptance criteria. Only one occurrence on June 30, 1996, involving Switch MS-PS-47C, was over the Technical Specification requirement of 1.85 psi, at 1.899 psi.

Corrective Actions - Following the determination on December 5, 1996, that the reliability of the HPCS drywell pressure switches was questionable, the licensee took immediate action to remove the vent plugs from the instrument cases and verify the setpoints in accordance with the Channel Functional Test Surveillance Procedures 7.4.3.3.1.53 and 7.4.3.3.1.54. The licensee's actions restored the instrument to their intended configuration. Other instruments in the facility were also inspected to assure the proper venting for similar instruments; none were deficient.

PER 296-0829 and the corrective action plans associated with the PER were reviewed by the inspector to determine the adequacy of the scope of the evaluation of the event and the long term corrective actions. The licensee indicated that all open or voided PMR's, which required procurement of component level materials to implement, will be reviewed to determine if there were materials requiring substitution evaluations that were not captured in the Material Management System with limitations on use. These actions appear to address the significant issues related to the installation of replacement components by ensuring that similar circumstances are not repeated.

c. Conclusion

The inspector concluded the licensee had several opportunities to capture the fact that replacement HPCS initiation drywell switches had not been subjected to engineering analysis for substitution. These opportunities reflect on the ability of licensee staff to recognize potential problems prior to their occurrence.

The installation of replacement HPCS initiation drywell pressure switches without the required substitution evaluation was a violation of procedure PPM 1.15.12.

The licensee's immediate corrective actions were prompt and effective. Long-term corrective actions appear to provide assurance that possible similar situations will be appropriately identified.

IV. Management Meetings

X1 Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management after the conclusion of the inspection on March 19, 1997. The licensee acknowledged the findings presented.

The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

ATTACHMENT

Supplemental Information

PARTIAL LIST OF PERSONS CONTACTED

Licensee

P. Bemis, Vice President for Nuclear Operations
R. Webring, Vice President Operations Support
L. Fernandez, Licensing Manager
B. Pfitzer, Licensing Engineer
G. Smith, Plant General Manager
J. Swailes, Engineering Director
D. Swank, Regulatory Affairs Manager

INSPECTION PROCEDURES USED

IP 92903	Followup - Engineering

ITEMS CLOSED

LER 50-397/96-008
LER 50-397/96-009

LIST OF ACRONYMS USED

CFT/CC	channel functional test/channel check
FSAR	Final Safety Analysis Report
GE	General Electric
HPCS	high pressure core spray
IOC	instantaneous overcurrent
LER	licensee event report
LPCS	low pressure core spray
MMS	material management system
NRC	U.S. Nuclear Regulatory Commission
PER	problem evaluation request
PMR	plant modification record
PPM	plant procedure manual
SW	service water
UFSAR	Updated Final Safety Analysis Report
WNP-2	Washington Nuclear Project-2
WO	work order