U.S. NUCLEAR REGULATORY COMMISSION

REGION V

Report No: 50-397/91-42

Docket No: 50-397

Licensee: Washington Public Power Supply System
P.O. Box 968
Richland, WA 99352

Facility Name: Washington Nuclear Project No. 2 (WNP-2)

Inspection Conducted: November 4 - December 6, 1991

Inspector: K. E. Johnston, Project Inspector

Approved by: P. H. Johnson, Chief — 1/2/92 Date Signed
Reactor Projects Section 3

Summary:

Inspection on November 4 - December 6, 1991 (Report No. 50-397/91-42)

Areas Inspected: The objective of the inspection was to perform an evaluation of the ability of the standby gas treatment system (SGTS) to perform its safety function. To support this evaluation, the inspector performed a system walkdown in accordance with inspection procedures 71710. Inspection procedures 36800, 61700, and 62700 were also used.

Safety Issues Management System (SIMS) Items: None.

Results:

General Conclusions and Specific Findings

Strengths: The inspector found the system condition and lineup acceptable, the system engineer knowledgeable of the system and its current condition, operators knowledgeable of system operations and following applicable operating procedures, and with minor exceptions, surveillance and operating procedures up to date and well written.

Weaknesses: The inspector noted in two instances that technical evaluations were not thorough. Paragraph 4.a of this report describes a Problem Evaluation Request (PER) which addressed a surveillance test of the SGTS heaters. This PER did not address the potential of heater damage which might have resulted from operation at higher voltages. Paragraph 4.b describes a design change to allow greater SGTS fan flow. The analysis supporting the design change did not thoroughly address the capability of the SGTS fan motors to support this change.

In both instances, the licensee was able to show that the equipment could continue to perform its design function. However, in each case, the design margins were considerably reduced.

Significant Safety Matters: none

Summary of Violations and Deviations: One violation was identified regarding the failure to follow the procedure implementing the requirements contained in 10 CFR 50.59 (paragraph 4.b).

Open Items Summary: One new enforcement item was opened and one previous enforcement item was closed.

DETAILS

1. Persons Contacted

Washington Public Power Supply System

*A. L. Oxen, Deputy Managing Director
*J. W. Baker, Plant Manager
*R. L. Webring, Plant Technical Manager
*A. G. Hosler, Licensing Manager
*W. S. Davison, Plant Quality Assurance Manager
*J. F. Peters, Plant Administrative Manager
*D. J. Pisarcik, Assistant Health Physics and Chemistry Manager
*C. L. Fies, Compliance Engineer
*B. E. Pesek, Plant Technical Supervisor, Balance of Plant
J. V. Hanson, Plant Technical Lead Engineer, Balance of Plant
*J. E. Bekhazi, Plant Technical Engineer, Balance of Plant
*L. D. Sharp, Plant Support Engineering, Principal Engineer
W. D. Bainard, Plant Support Engineering

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*P. L. Eng, Project Manager, NRR

The inspector also talked to other licensee employees during the course of the inspection.

*Attended the Exit Meeting on December 6, 1991.

2. Standby Gas Treatment System (SGTS) Walkdown

The objective of the inspection was to perform an evaluation of the ability of the SGTS to perform its safety function. To support this evaluation, the inspector did the following:

* system walkdown in accordance with NRC Manual Chapter 71710
* system walkdown with the Plant Technical system engineer
* observation of system operations and review of operating procedures
* review of surveillance procedures
* review of scheduled maintenance, selected maintenance procedures, and vendor manuals
* review of system description contained in the Final Safety Analysis Report (FSAR), training material, and other design basis documents

In summary, the inspector found:

* the system condition and lineup were acceptable,

* the system engineer was knowledgeable of the system and its current condition,

* operators were knowledgeable of system operations and were following applicable operating procedures,

* with minor exceptions discussed below, surveillance and operating procedures were up to date and well written.

During the review of the annunciator response procedures for the SGTS panels (4.827.K1), the inspector noted that one of the steps for an annunciator window did not make sense (Window 4-1, step 5 and 6). The inspector pointed this out to the licensee who acknowledged the error and committed to change the procedure.

The inspector found two instances wherein engineering work was less than rigorous. These examples, one regarding the review of an out-of-specification surveillance test and the other regarding a design change, are discussed in section 4 of this report. To support the discussion in section 4, it was necessary to provide the following brief system description.

3. SGTS Description

The SGTS was designed to limit the release of airborne radioactive contaminants from the secondary containment (the reactor building) to atmosphere following a design basis accident. In addition, the system was designed to enable purging of the primary containment through the SGTS filters when airborne radiation levels inside the primary containment are too high to permit direct purging to atmosphere. The system is required by the Technical Specifications (TS) to be operable in Modes 1, 2, and 3 and during refueling operations. The system was designed to remove 99 percent of iodides and particulates.

The SGTS is composed of two full-capacity filter trains, originally sized to provide a reactor building pressure, under design basis conditions, 0.25 inches of water gage (w.g.) lower than atmospheric pressure. Each filter train consist of the following:

* a moisture separator, a prefilter, two high efficiency particulate air (HEPA) filters, and two 4" deep banks of impregnated charcoal adsorber filters,

* two banks of electric blast coil heaters, rated at 20.7 kW each at 460V, provided to limit the relative humidity of the incoming air to 70 percent, and

* two full-capacity centrifugal fans, powered from separate vital 480V buses.

The SGTS will automatically initiate on high drywell pressure, reactor vessel low water level, and high radiation level in the reactor building exhaust air plenum. With an automatic actuation, reactor building intake valves, fan intake valves, and SGTS discharge valves to the elevated

release duct will open and one of the electric heaters will energize. Following a 10-second delay, one fan on each train will start. If it does not operate successfully (achieve a flow of 500 cfm), the second fan and electric heater will start.

System flow is controlled to maintain building pressure negative with respect to atmosphere and is limited to a maximum flow. The differential pressure is measured on the four sides of the reactor building at the 572' level (the reactor building basement is at 422' and the refueling floor is at 606'). System flow is measured by annubars at the fan discharge.

It was recognized in 1989 that by controlling the reactor building to -0.25" w.g. with monitors on the 572' level, it would not be possible to maintain pressure negative with respect to atmosphere at all locations. To achieve -0.25" w.g. in all locations, the licensee determined through tests and calculations that building pressure needed to be controlled to -1.7" w.g. using the monitors on the 572' level. It was noted that the licensee has led the industry in the study of atmospheric effects on reactor building differential pressures.

To establish a more negative building pressure, the SGTS fans' upper flow limit was increased from 4457 cfm (as measured by a discharge flow annubar) to 5600 cfm. The issue was discussed by the licensee in a Justification for Continued Operation (JCO) and was the subject of Licensee Event Reports (LERs) 89-40 and 89-40, Revision 1 (dated June 19, 1990).

4. Findings

a. Electric Heaters Operated at High Voltage During Surveillance Testing

On April 15, 1991, shortly after plant shutdown for the a refueling outage, a surveillance test was performed on SGTS heaters to measure whether their heat generation was in compliance with the TS. On two heaters, heat generation was found to be higher than the TS limit. This was due to a high bus voltage condition. To evaluate the condition and initiate corrective action, a Problem Evaluation Request (PER) was initiated.

The inspector reviewed the PER (No. 291-250) and found the following weaknesses:

* The actions taken were poorly documented,

* The review did not adequately address whether the heaters had been damaged, and

* The review did not address whether the heaters could operate in all voltage conditions and still meet TS requirements.

Description of the Surveillance and PER

TS surveillance 4.6.5.3.d.4 requires that every 18 months the licensee verify that the SGTS heaters dissipate 20.7 ± 2.1 kW. TS surveillance procedure TSS 7.4.6.5.3.4 was performed on April 15, 1991 to meet this TS requirement.

The methodology of TSS 4.6.5.3.d.4 was to measure the line current and phase-to-phase voltage of each of the nine heater coils which make up each heating unit. The product of the current and voltage, corrected for the coil configuration (three sets of coils wired in delta) provided heat dissipated in watts.

The measured heat dissipation was as follows:

SGT-EHC-1A1	23.12 kW	(SGTS train A; Division 1 power supply)
SGT-EHC-1A2	22.21 kW	(SGTS train A; Division 2 power supply)
SGT-EHC-1B1	23.82 kW	(SGTS train B; Division 1 power supply)
SGT-EHC-1B2	22.79 kW	(SGTS train B; Division 2 power supply)

The heat dissipation on SGT-EHC-1A1 and 1B1 were above the TS limit of 22.8 kW. These results could have been anticipated. Bus voltage conditions, as might be expected during an outage, were higher than during normal operations due to the reduced bus loading. Voltage supplied to the heater cabinets was measured to be 9% higher than nominal voltage (460V). Due to the exponential relationship between voltage and power which exists in resistive loads such as heaters, the heat generation was approximately 20% greater than would have been expected at 460V, on which the 20.7 kW power rating was based.

The licensee initiated PER 291-250 to address this issue. The surveillance procedure was revised to change the methodology for calculating heat dissipation. Essentially, the actual heat output was normalized to what would have been expected had the voltage at the heaters been 460V. The normalized heat outputs for SGT-EHC-1A1 and 1B1 were calculated to be 19.5 and 20.1 respectively. Based on these results, the licensee concluded that the TS surveillance requirement had been met, and the PER was closed.

Problem Evaluation Report Documentation

The review and resolution of this issue were not well documented in PER 291-250. The Management Review Committee (MRC), which reviews all PERs, selected as the problem resolution method "NONE/CLOSE PER."

The comments section provided the details of the resolution:

"High bus voltage is normal on plant shutdown. Equip. previously evaluated in LER [Licensee Event Report] to withstand high voltage. This has been evaluated by compliance and found to be acceptable. Closed with the PDF [Procedure Deviation Form] already written."

Weaknesses noted in this evaluation were:

* The PER referenced an LER as supporting the ability of the heaters to withstand high voltages. It did not provide an LER number or maximum high voltage allowed. When questioned, the licensee could not produce the supporting LER.

* The PDF number and date were not provided, nor was the date the surveillance was performed. These documents were subsequently retrieved by the inspector.

* The MRC resolution was misleading; the PDF was the resolution method.

The lack of thorough documentation of the problem and path of resolution appears to have contributed to a less than thorough technical review as discussed below. The inspector discussed these weaknesses with the licensee at the exit meeting. The licensee committed to reopen the PER and address this issue.

Maximum Heater Output

The licensee had not performed an adequate review of the ability of the heaters to withstand heat dissipation in excess of their TS limit. This demonstrated an incomplete review of the technical issues raised by the failed surveillance test.

The TS surveillance acceptance criteria provide 10% allowance above and below the 20.7 kW rating of the heaters. The 20.7 kW, according to design documents, was based on 460V supplied to the heaters. The licensee stated that the 10% rating was typical of heaters.

The measured output on one heater was 23.8 kW, or 15% greater than the design rating. The inspector questioned whether this could have damaged the heater. After discussions with the vendor regarding these heaters, the licensee found that under low flow conditions a watt density of 60 W/in^2 would have been acceptable. Higher watt densities could reduce the life of the heaters or, if substantially higher, damage the heaters. The licensee determined that 23.8 KW provided a watt density of 56.7 W/in^2, and concluded that the heaters were not damaged (20.7 KW provides 49.3 W/in^2).

The licensee should have included an engineering review of the acceptable watt density effects on the heaters in the resolution of the PER. In this case, the heaters had additional margin.

Operation of the Heaters Under All Design Conditions

Operation of the heaters at elevated voltages does not appear to have been considered in the plant design. This point should have been recognized during the review of PER 291-250. A complete review should have considered the maximum voltage condition at which the heaters would be expected to operate.

Licensee procedure TSS 7.4.8.3.2, which required that bus voltages be measured on a weekly basis, allowed a maximum voltage at the bus of 520 V. If a surveillance test found that a heater dissipated its maximum acceptable output of 22.8 KW at 460 V, this heater would operate at a watt density (according to calculations performed by the inspector) of 69.3 W/in^2 at 520 V. According to vendor data, this worst case situation could result in heater degradation.

Conclusion

The licensee's disposition of PER 291-250 was not rigorous in either technical or administrative aspects. In this case, adequate margin existed to prevent equipment damage.

The licensee committed at the exit meeting to reopen PER 291-250 and address the issues discussed above.

b. SGTS Fan Motor Loading

The inspector reviewed the design change which allowed the SGTS fans to provide up to 5600 cfm. The inspector found that the design change did not adequately consider whether the installed fan motors could operate the fans at the greater flow under all design conditions. In response to this finding, the licensee determined that under worst case conditions, the nameplate rating of the fan motor and the full load current would be exceeded. However, taking into account the fan motor service factor and the size of the fan motor overload device, the licensee concluded that the fans would operate under the conditions described in their Justification for Continued Operation (JCO) regarding the SGTS, discussed in LER 89-40, Revision 1.

As discussed in the Section 3, "System Description," the upper flow limit of the SGTS fans was raised from 4457 to 5600 cfm in 1989 to provide a greater reactor building negative pressure. To accomplish this change, the flow limiter setpoints for all four fans (SGT-LMTR-1A1, 1A2, 1B1, and 1B2) were revised by Instrument Setpoint Change Request ISCR 952. The design change review, documented in a 10 CFR 50.59 evaluation, concluded the following:

* The charcoal residence time remained within Regulatory Guide 1.52 requirements,

* Differential pressure across the HEPA filters was within the manufacturer's tolerances, and

* The heaters could maintain relative humidity less than 70%.

The evaluation further stated that "No other elements of the design are considered impacted by the reliance on the higher than design flow rate for a single SGT train."

To support this conclusion, a test was performed for fan SGT-FN-1A1 which found:

* Motor current to be 25.5 amps at 5600 cfm

* Leakage tests and adsorption tests to be with specification

The inspector determined that the licensee should have considered the following design basis parameters, each of which could have affected the maximum current drawn by the SGTS fan motors:

Degraded Voltage: Current requirements increase in these motors under degraded voltage conditions. The licensee stated that the design basis degraded voltage condition for the motors was 405 V and determined that this would increase current draw by 13.6%.

Instrument Inaccuracies: The overall inaccuracy of the flow controllers was 10%. Testing performed on June 5, 1991, in accordance with TS 4.6.5.3.2.d.1, which requires verification of system flow, found that for one of the fans the actual flow was 9% greater than the controller setting.

Cold Building Temperatures: The fan performance curves were established for a building temperature of 104° F. A reduction in building temperature provides a proportional increase in air density and motor amps required to move the same volume of air. A 5° temperature drop corresponds to a 1% increase in the motor current requirement. The difference in temperature between the performance curves and the minimum building temperature of 50° F increases current requirements by 11%.

In response to the inspectors concerns, the licensee performed a calculation which considered these three factors. The results indicated that under the worst-case conditions, motor current would not trip the thermal overload devices. The licensee factored into their analysis the effects of low ambient temperature on the setpoints of thermal overload trip devices. These devices, rated at 104° F, trip at higher currents at lower ambient temperatures.

The calculation performed by the licensee assumed a maximum steady state SGTS fan flow of 5075 cfm versus the flow limiter setpoint of 5600 cfm. This was based on actual performance tests completed in September 1991. These tests concluded that to maintain the required negative pressure, full system flow (5600 cfm) would not be required.

A factor in the tests was that actual air leakage into the reactor building (1475 cfm) was substantially less than the maximum leakage the TS allow (2240 cfm). The licensee's JCO, discussed in LER 89-40, Revision 1, supported the use of lower reactor building air leakage. The LER stated that air leakage into the reactor building would be limited to 1475 cfm until the reactor building negative pressure issue could be completely resolved.

Incomplete Design Change

Revising the SGTS flow requirement from 4457 cfm to 5600 cfm was a design change implemented by ISCR 952. The change included an "unreviewed safety question" evaluation required by 10 CFR 50.59. These evaluations are governed by licensee procedure PPM 1.3.43. The evaluation did not consider the ability of the fan motor to operate the fan at the higher flow under all design basis conditions. These conditions included degraded voltage, instrument inaccuracies, and the effects of building temperature. The failure to consider these conditions in the evaluation is an apparent violation (Enforcement Item 91-42-01).

5. Followup on Open Items

The inspector reviewed the actions taken by the licensee in response to the Notice of Violation (NOV) transmitted with Inspection Report No. 91-24 and found them to be acceptable. The NOV addressed the licensee's failure to initiate a PER to address diesel starting air system high pressures. The licensee's root cause evaluation and corrective actions were discussed in letters dated October 14, 1991 and October 28, 1991.

In addition, the licensee's commitment to improvements in the Plant Technical system engineering program, discussed in their October 14, 1991 letter, were reviewed and found to be appropriate. Enforcement Item 50-397/91-24-01 is closed.

6. Exit Meeting

An exit meetings was conducted on December 6, 1991, with the licensee representatives identified in Paragraph 1. The inspector summarized the inspection scope and findings as described in the Results section of this report.

The licensee did not identify as proprietary any of the information provided to or reviewed by the inspector during this inspection.