APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 50-397/94-15

Operating License: NPF-21

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

Facility Name: Washington Nuclear Project 2 (WNP-2)

Inspection At: WNP-2 site near Richland, Washington

Inspection Conducted: March 28 through May 7, 1994

Inspectors: R. C. Barr, Senior Resident Inspector
D. L. Proulx, Resident Inspector

Approved: for D. F. Kirsch, Chief, Reactor Project Branch E — 6 JUNE 1994 Date

Inspection Summary:

Areas Inspected: Special, announced, resident inspection of the licensee's discovery that degraded Buna-N components, diaphragms, in scram solenoid pilot valves (SSPVs) caused Control Rod 06-39 not to insert and four other control rods to exhibit slow movement, but within Technical Specification (TS) limits, on start of motion (SOM) during surveillance testing. During the inspection, Inspection Procedures 92901, 92903, 92904, and 93702 were used.

Results:

General Conclusions and Specific Findings:

On December 4, 1993, the supply system failed to take prompt corrective action upon finding significantly increased time for SOM for Control Rod 14-55. This failure resulted in the time for SOM of this control rod to be in excess of TS limits on January 7, 1994, at which time the licensee inserted the rod in compliance with the TS. On February 7 and 17, 1994, the supply system failed to take prompt corrective action upon finding significantly degraded diaphragms in the SSPVs of Control Rods 02-19 and 14-55, respectively. These failures resulted in reactor operation for 7 weeks with a significantly degraded control rod system and the failure of Control Rod 06-39 to insert during surveillance testing conducted on March 26, 1994.

The supply system failed to adhere to procedures requiring the performance of prompt operability assessments (POAs) when finding physical evidence of degraded equipment. On December 4, 1993, the licensee found the time for SOM of Control Rod 14-55 to have degraded by approximately a factor of three and did not perform a POA. On February 7 and 17, 1994, the supply system found significantly degraded diaphragms in the SSPVs of Control Rods 02-19 and 14-55, respectively, and failed to perform POAs.

The supply system failed to adequately trend rod control system performance and failed to implement an effective preventive maintenance program in response to industry information associated with Buna-N components in the control rod SSPVs.

Weaknesses:

This inspection identified additional examples of the following problems that the NRC has previously identified at the supply system: failure to take prompt corrective actions when finding degraded safety-related components, inadequate evaluation and corrective action for problems identified by industry communications, inadequate management oversight, poor communications between organizations, and the failure to adhere to procedures.

Summary of Inspection Findings:

- Apparent Violation 397/9415-01 was opened (Section 6).
- Apparent Violation 397/9415-02 was opened (Section 6).

Attachment:

- Persons Contacted and Exit Meeting

DETAILS

1 PLANT STATUS

At the start of this inspection period, the plant was operating at approximately 68 percent power with five control rods fully inserted. Control Rods 54-47, 54-15, 30-31, and 10-15 were fully inserted because operators had declared these rods inoperable when the control rods exhibited slow SOM during surveillance testing performed on March 26, 1994. Control Rod 30-03 was fully inserted on March 26, 1994, since it could not be scram time tested due to a failed transponder card that was located in the testing circuitry. Licensee craftsmen were replacing the Buna-N components (diaphragms) of the SSPVs for the four control rods that had exhibited slow SOM. Because Control Rod 06-39 had failed to insert on March 26, 1994, licensee engineers were testing the diaphragms that had been removed from Control Rod 06-39. At the conclusion of the period, the reactor was shut down in Mode 5 (Refueling) and the Buna-N diaphragms of all the SSPVs had been replaced.

2 CONTROL ROD SYSTEM DESCRIPTION AND DESIGN BASES

The control rod system is one of the reactivity control systems for the WNP-2 boiling water reactor (BWR). The reactor control rods are positioned by hydraulics. The control rods can be positioned in small increments or rapidly inserted into the core (scrammed). Rapid control rod insertion is achieved by the following means: (1) automatically, the reactor protection system deenergizes the SSPVs of each of the 185 control rods which redirects the pneumatics of each individual control rod; (2) automatically, the reactor protection system energizes the backup SSPVs which redirects the pneumatics of all control rods; and (3) automatically, when reactor level reaches -50 inches or reactor pressure reaches 1076 psig, the anticipated transient without scram automatic rod insertion scram system which redirects the pneumatics of all control rods. Each of the individual control rod SSPVs, which the licensee procured as Quality Class 1 components, has four normally energized Automatic Switch Company (ASCO) solenoid operated valves that have internal components made of Buna-N rubber. The system also contains two normally deenergized backup SSPVs consisting of two ASCO solenoid valves, which were procured as Quality Class 2 components. The internal components of the backup scram valves are made of Buna-N rubber. The anticipated transient without scram-automatic rod insertion system uses valves that do not contain Buna-N components.

The design basis of the reactivity control system is to provide sufficient nuclear reactivity control devices (control rods) to control excess reactivity in the core and to provide for adjustments of the control rods to permit power generation. The safety functions of the reactivity control system are to provide sufficient excess negative reactivity to keep the reactor shut down and to provide sufficient rapid insertion of control rods (reactivity) so that no fuel damage results from any operating transient.

3 CONTROL ROD DRIVE (CRD) SYSTEM TS AND BASES

The following TS are applicable to the control rods while in operational conditions one and two:

TS 3.1.3.1 All control rods shall be operable.

TS 3.1.3.2 The maximum scram insertion time of each control rod from the fully withdrawn position to notch Position 6, based on deenergization of the SSPVs as time zero, shall not exceed 7 seconds.

TS 3.1.3.4 The average scram insertion time of all operable control rods from the fully withdrawn position, for control rods arranged in a two-by-two array, based on the deenergization of the SSPVs as time zero shall not exceed any of the following:

Position Inserted From Fully Withdrawn	Average Scram Insertion Time (Seconds)
45	0.430
39	0.868
25	1.936
5	3.497

The following sentences describe the bases for these TS. The requirements for the various scram time measurements ensure that any indication of systematic problems with rod drives will be investigated on a timely basis. The occurrence of scram times longer than those specified should be viewed as an indication of a systemic problem with the rod drives and, therefore, the surveillance interval is reduced in order to prevent operation of the reactor for long periods with a potential serious problem. The number of control rods permitted to be inoperable could be more than eight allowed by the TS, but the occurrence of eight inoperable rods could be indicative of a generic problem and the reactor must be shutdown for resolution of the problem.

4 INDUSTRY EXPERIENCE (92904)

4.1 NRC Information Bulletin (IB) 78-14, "Deterioration of Buna-N Components in ASCO Solenoids"

On December 19, 1978, the NRC issued IB 78-14 to notify licensee's operating BWRs about the thermal aging of SSPV Buna-N components. This IB required that licensees with an operating license: (1) review Buna-N material applications in control rod scram systems, determine the time since installation, and describe a schedule for replacement, both in response to this IB and for periodic maintenance; (2) report the results of that review; and (3) describe the basis for the replacement schedule and describe any proposed replacement time in excess of 3 years. For all BWR licensees with construction permits, which applied to WNP-2 in 1978, this IB was provided for information only. The licensee initiated a plant tracking log (PTL) item to track the

development and implementation of a preventive maintenance task to perform periodic replacement of Buna-N components in SSPVs.

In an interoffice memorandum, licensee management determined to replace Buna-N diaphragms and O-rings of SSPVs at a rate of 25 percent per year, starting in April 1986. In an inspection conducted during March 1-5 and March 15-19, 1982, the NRC closed this IB based on the licensee's interoffice memorandum plan to initiate a 25 percent replacement program. During this inspection, the inspectors found that the licensee did not implement this plan. This deviation from a commitment is not being cited due to the age of the issue, the complete refurbishment of the SSPVs in 1994, and the supply system's intent to replace the Buna-N components with Viton components in 1995.

The inspectors found that the licensee replaced the Buna-N components of 10 percent of the control rod SSPVs in 1986. Following this replacement, the licensee changed the preventive maintenance scheduling method. As a result of this change, the planned replacements in 1987, 1988, and 1989 did not occur. In May of 1989, when the SSPVs of two control rods failed due to hardened Buna-N components, the licensee identified that they had not implemented the specified replacement program. Therefore, the licensee decided to replace the Buna-N components of all the SSPVs in May of 1990. The licensee did not notify the NRC that they had failed to implement the 25 percent replacement commitment. The licensee also failed to notify the NRC that they did not plan to implement a 25 percent replacement following the 1990 refurbishment, since they had qualified the Buna-N components to a service life of 5.5 years based on their operating experience.

4.2 NRC Information Notice 86-78, "Scram Solenoid Pilot Valve Rebuild Kit Problems

On September 2, 1986, the NRC issued this notice to alert licensees to potential problems with kits used to refurbish SSPVs. This notice described quality control problems associated with the SSPV rebuild kits. The licensee took no action in response to this notice. The licensee noted that, in May 1986, 38 SSPVs had been rebuilt and were properly functioning. The system engineer noted that close attention would be given to the control rods with the rebuilt SSPVs.

4.3 NRC Generic Letter (GL) 91-015, "Operating Experience Feedback Report, Solenoid-Operated Valve Problems At U.S. Reactors"

This GL dated September 23, 1991, required no specific action or written response by the licensee. However, the NRC expected that the licensee would review the information presented in the GL and consider actions as appropriate to avoid similar problems. The GL specifically mentioned control rod failures in BWRs due to hardening of Buna-N components.

On October 22, 1991, the licensee performed an initial screening and determined that the GL was applicable to WNP-2. The licensee completed the screening on September 2, 1993, by assigning actions to evaluate the

recommendations of NUREG 1275, Volume 6, "Operating Experience Feedback Report, Solenoid-Operated Valve Problems." The actions were being tracked by PTL 44726. This PTL item was open at the time of the failure of Control Rod 06-39 to insert. The NRC inspectors found that the lack of timeliness of this review had been previously discussed in NRC Inspection Report 50-397/94-08. The failure to consistently perform detailed timely assessment of industry experience is a continuing problem.

4.4 General Electric (GE) Service Information Letters (SILs)

4.4.1 GE SIL Number 128

GE issued SIL Number 128, Revision 0, "Preventive Maintenance for Control Rod Drive (CRD) Scram Pilot Valves," on March 31, 1975. The SIL discussed failures, due to diaphragm cracking, of SSPV Buna-N components. The purpose of the SIL was to recommend a maintenance program for scheduled replacement of all SSPV diaphragms. GE recommended that licensees establish a program so that all SSPV diaphragms were replaced after 3-4 years of initial service. The SIL noted that the initial operating service life was due to the longer storage time of the rubber parts prior to initial plant operation. GE also stated that the replacement of these components could be performed while the reactor was operating at high powers. Because WNP-2 was in construction, the licensee took no immediate action.

GE issued Revision 1 to this SIL on January 30, 1976. This revision notified customers of the unacceptability of performing diaphragm replacements at power since the replacement conflicted with GE fuel preconditioning recommendations for minimizing CRD movements at high power levels. Because WNP-2 was in construction, the licensee took no immediate action.

GE issued Revision 1, Supplement 1, to this SIL in August 1978. This supplement notified customers of the delayed CRD insertion of two control rods at an operating BWR. The purpose of the SIL was to discuss the cause of the occurrence and to recommend a preventive program to help in preventing future occurrences. GE recommended the following: (1) establish a preventive maintenance program to replace all core assemblies, diaphragms, and associated parts in all SSPVs, backup scram valves, and scram discharge volume vent and drain pilot valves at periodic intervals, and (2) rebuild the SSPVs periodically to assure that the Buna-N parts do not exceed a combined shelf life-service life of 7 years. Because WNP-2 was in construction, the licensee took no immediate action. The licensee initiated operation evaluation report (OER) 75003 to track the development and implementation of a preventive maintenance program for the SSPVs.

GE issued Revision 1, Supplement 2, to this SIL on March 2, 1984. This supplement notified customers to discontinue using "Loctite" on the acorn nut on the solenoid housing. In this supplement, GE reemphasized their recommendation that the Buna-N components for the CRD SSPVs should be replaced

periodically to assure that the age of these components would not exceed 7 years. The licensee incorporated this recommendation in OER 75003.

On July 2, 1984, the licensee closed out all actions associated with this SIL by revising their scheduled maintenance system to include a preventive maintenance task that would begin replacement of Buna-N components, in 25 percent of the SSPVs, in April 1986.

4.4.2 GE SIL Number 575

GE issued SIL 575, "CRD Slow Start of Motion (SOM)," on October 27, 1993. This SIL described the failures and offered recommendations for preventing recurrence of CRD slow SOM. The purpose of the SIL was to recommend actions which would reduce the probability that slow scram SOM times would occur. GE stated that there was no safety concern because scram time surveillances would identify any slow SOM drives. GE provided the following recommendations: (1) routinely check the scram air header pressure to be within 70 to 75 pounds; (2) pay close attention to degradation of the SOM times and, if unusual SOM times are detected, replace the Buna-N components; and (3) Buna-N components should be limited to approximately 4 years of plant service and, before extending the service life of Buna-N components beyond the recommended 3-4 years, evaluate the components based on plant specific operating service conditions to determine whether they will perform acceptably.

On November 14, 1993, the licensee initiated OER 75003G to consider the recommendations of this SIL. On January 21, 1994, the licensee closed the OER after having implemented actions to address GE's recommendations. In their response to this OER, the licensee noted that their program was working because surveillance testing had identified that Control Rod 14-55 had slow SOM on December 4, 1993. However, the licensee failed to note that the delay in replacing the SSPVs of Control Rod 14-55 did not conform to GE's recommendation to replace the Buna-N components if unusual SOM times were detected and that this delay resulted in operating in violation of TS 3.1.3.4. The licensee implemented the other recommendations of this SIL.

4.5 Conclusions

During the period of 1986 through 1989, the licensee failed to implement the commitment to perform an annual replacement of the Buna-N components in 25 percent of the control rod SSPVs. Further, the inspector concluded that the Supply System was not timely in evaluating GL 91-15 and did not effectively implement all the recommendations of GE SIL 575.

5 CONTROL ROD 06-39 FAILURE TO INSERT (92901)

5.1 Licensee Immediate Response to Control Rod 06-39 Failure to Insert

At 1:43 p.m. (PST), Saturday, March 26, 1994, with the reactor at 75 percent power, Control Rod 06-39 failed to insert when WNP-2 operators initiated a scram signal during surveillance testing. Licensed operators concluded that

the control rod had malfunctioned because the positions of Control Rod 06-39 switches and valves had been verified as correct.

At 1:52 p.m., the operators manually inserted Control Rod 06-39, deenergized its electrical components and declared it inoperable in accordance with WNP-2 TS 3.1.3.1.a.1.a. The shift manager (SM) notified supply system management of the malfunction; however, he did not notify the NRC resident inspector of this failure.

The SM initiated problem evaluation request (PER) 294-0235 to document the failure of Control Rod 06-39 to insert. He initiated emergency Work Order HS 28 to remove, disassemble, and rebuild CRD-V-117 and CRD-V-118, the SSPVs for Control Rod 06-39. At 3 p.m., the SM decided to perform scram time testing on 20 of the 185 control rods to eliminate the concern over a generic failure mode. Subsequently, the plant manager (PM) concluded that scram testing of all 185 control rods was necessary to ensure acceptable operation. At 8:16 p.m., on March 27, 1994, the operators completed the scram time testing of the 185 control rods. The testing identified that four control rods (54-47, 54-15, 30-31, and 10-15) were slow on SOM, but within the time limits of TS 3.1.3.4. Additionally, operators had also fully inserted Control Rod 30-03 because it could not be scram time tested, due to a failure of a transponder card in the control rod testing circuitry.

At approximately 6 p.m., March 26, 1994, the system engineer determined that Control Rod 06-39 had failed to insert because the Buna-N exhaust diaphragm, an environmentally qualified (EQ) component of SSPV CRD-V-118, had failed due to hardening. The system engineer characterized the failure as brittle cracking of the exhaust diaphragm of CRD-V-118, with the crack going approximately 180 degrees around the interior circumference of the exhaust diaphragm, and hardening without cracking of the pressure diaphragm. At 8 p.m., the licensee concluded that the failure of the exhaust diaphragm could have caused the failure of the rod to scram due to the air leakage rate into the exhaust diaphragm being greater than the rate being exhausted through the vent.

On March 27, 1994, at 3:58 p.m., the repair of the SSPVs of Control Rod 06-39 was completed and operators declared that control rod operable. At 8:16 p.m., operators completed the scram time testing of all 185 control rods and increased reactor power to 88 percent.

Based on the guidance provided in licensee Plant Procedure Manual (PPM) 1.3.12B, "Operability Evaluation," Revision 0, the SM considered that, with the exception of the four rods which were slow on SOM and the one rod that could not be tested, all the control rods were operable because the rods had met surveillance requirements. Paragraph 3.7 of PPM 1.3.12B states that, when qualification is called into question, performance of surveillance requirements alone may not be sufficient to determine operability, unless the surveillance testing adequately verifies the capability of the equipment by accounting for the degraded condition.

5.2 Licensee Followup Response to Control Rod 06-39 Failure to Insert

At 1 p.m., on March 28, 1994, the PM met with resident inspectors and discussed the failure of Control Rod 06-39 to insert. The PM confirmed that he considered that the control rods were operable because the control rods had repeatedly met surveillance requirements during the testing performed over the weekend. The PM discussed the safety significance of the event and the supply system's planned actions to prevent event recurrence. The planned actions included replacing the Buna-N components of the SSPVs for the five control rods that had been declared inoperable. The PM considered that the failure of Control Rod 06-39 to insert and the slow SOM of the other four control rods had limited safety significance because the safety analysis assumes one rod does not insert and that up to eight control rods can be slow without adverse impact to fuel. He also noted that the backup scram valves would probably have functioned, resulting in the insertion of all control rods (including 06-39). At 4:45 p.m., the PM agreed to a 10 a.m., March 29, 1994, conference call with the NRC to discuss the failure of Control Rod 06-39 to insert and licensee corrective actions.

On the evening of March 28, 1994, after having examined the diaphragms of the SSPVs that had been refurbished, the licensee decided to rebuild the SSPVs of all 185 control rods (six at a time) with the reactor operating at reduced power.

At 10 a.m., March 29, 1994, the licensee, NRC Region V, and the Office of Nuclear Reactor Regulation (NRR) had a conference telephone call to discuss the events of March 26, 1994, licensee actions to prevent recurrence of these events, and supply system and industry experience with Buna-N components in control rod SSPVs. The participants discussed continued power operation with degraded SSPV diaphragms, the operability of the control rods, and the replacement of the SSPV diaphragms while at power. The licensee related that they had reviewed the scram times of the control rods and believed that they could predict the condition and failure of the SSPV diaphragms based on scram times. The licensee stated that they planned to have an operability determination and a basis for continued operation (BCO) completed by March 30, 1994. The PM also committed to scram testing the control rods each week and to immediately shut down the reactor if another control rod failed to insert during the SSPV diaphragm testing and replacement.

From March 29-31, 1994, the licensee continued to rebuild SSPVs, to collect and organize data to incorporate in the BCO, and to hold Plant Operating Committee meetings to discuss drafts of the BCO. The licensee found that the diaphragms installed in the SSPVs had come from procurements in 3 separate years - 1983, 1987, and 1990. Furthermore, the licensee found that they had not maintained records to be able identify which lot diaphragms were in which valves. A technical expert from GE arrived on site to assist the licensee in assessing the degradation of the control rod SSPVs.

On March 31, 1994, the licensee, NRC Region V, and NRR had a conference telephone call to discuss the licensee's progress in developing and

documenting an operability determination and BCO. The licensee discussed their assessment of the data that had been recently collected. The licensee noted that, instead of refurbishing the four SSPVs of each control rod, only the exhaust diaphragms of each CRD-V-118 valve would be replaced. When performing this replacement, if the exhaust diaphragm was found to be brittle, the pressure diaphragm of the CRD-V-118 valve would also be replaced. The licensee related that the BCO had not been completed, but would be available in draft for discussion on April 1, 1994.

On April 1, 1994, the licensee, NRC Region V, and NRR had a conference telephone call to discuss the draft BCO. In the draft BCO the licensee concluded the following: (1) data taken and reviewed showed that when severe degradation is present, there is increased scram time; (2) catastrophic failures have not resulted in failure to scram, but rather increased scram time; (3) shelf-life and storage are minimal contributors to the degradation, and installed service in the plant under elevated temperature and stress are major contributors to degradation; (4) the failure of Control Rod 06-39 was an unusual failure of two or more diaphragms in the SSPVs; (5) based on scram time testing, there were no SSPVs and control rods which would not perform their safety function.

With respect to operability, the BCO stated that successful testing demonstrates that the currently installed elastomers are meeting their design basis function. However, all remaining diaphragms were being replaced on an expedited basis.

The NRC participants had the following comments with respect to the BCO: (1) it did not appear that time to scram was a reliable means of determining the extent of degradation and, without understanding the extent of degradation, it would be difficult to predict the remaining useful life of the diaphragms; (2) the BCO stated that it took the failure of two diaphragms to cause the failure of a control rod to insert but that the licensee could not reproduce this in testing and the pressure diaphragm of CRD-V-118 for Control Rod 06-39 had not failed, it was only stiff and brittle; and (3) the licensee believed that the degradation was temperature related although the data did not support the assumption.

The licensee stated that these comments would be factored into the final BCO. The PM reiterated that he believed all the control rods would function if required.

On April 8, 1994, the licensee, NRC Region IV, the Walnut Creek Field Office, and NRR had a conference telephone call to discuss the final BCO. The BCO discussed the previous NRC comments. The licensee stated they believed that the failures of the diaphragms was a generic industry issue and that they would continue with their root cause evaluation. They statused the diaphragm replacement, stating the effort would be completed by April 12, 1994.

At the close of the inspection period, the licensee was continuing with their root cause evaluation. To date, they had identified that all the severely

degraded diaphragms appeared to have been procured in 1989, that there appeared to be manufacturing and chemical differences between the diaphragms procured in 1989 and those procured earlier, and that the configuration of the failure of the exhaust diaphragm was critical in determining the control rod insertion time.

5.3 Conclusions

The licensee was not timely in developing a BCO. The licensee's initial operability assessment appeared to rely heavily on control rods meeting surveillance requirements and not on data collected from the disassembly and examination of the SSPVs of Control Rods 02-19, 14-55, and 06-39. The licensee refurbishment of the SSPVs was generally well controlled.

6 FOLLOWUP OF CONTROL ROD SURVEILLANCE TESTING AND REPAIR (92701)

6.1 NRC Followup Inspection of the Failure of Control Rod 06-39 to Scram and the Slow SOM of Four Other Control Rods

On March 28, 1994, during the resident inspector's daily plant walkdown, the inspector learned that Control Rod 06-39 failed to automatically insert, that Control Rods 54-47, 54-15, 30-31, 10-15 were slow on SOM, and that Control Rod 30-03 could not be scram time tested due to a failed transponder card. In reviewing the event against the WNP-2 TSs, the resident inspectors identified that the licensed operators had incorrectly logged that the facility entered limiting condition for operation 3.1.3.1.a.1.a instead of 3.1.3.1.b.1.b. This error had no safety significance; however, the error indicates a weakness in operator understanding of the TSs and incomplete management oversight. The operators corrected the log entry on March 29, 1994.

At 1 p.m., the resident inspector met with the licensee to further discuss actions that the licensee planned with respect to the failure of Control Rod 06-39 to insert and the slow SOM of the other four rods. The PM stated that the SSPVs for the four slow rods would be rebuilt prior to declaring the rods operable. Additionally, he stated that he considered that the other 180 rods were operable because these rods had consistently passed surveillance tests and showed no history of being slow. The inspector identified that, even though the licensee considered that the control rods were operable, the licensee did not perform a POA. PPM 1.3.12B, "Operability Evaluation," Revision 0, required a POA be performed that included documenting the problem, the basis for considering the equipment operable, and the BCO. The failure to perform a POA is an apparent violation of 10 CFR Part 50, Appendix B, Criterion V (Violation 397/9415-01).

6.2 Followup of Previous Control Rod Deficiencies

6.2.1 Control Rod 14-55 Slow SOM

On March 28, 1994, at 5 p.m., when performing followup inspection of failure of Control Rod 06-39 to scram, the NRC resident inspector learned from a

licensee materials engineer that, during surveillance testing performed on December 4, 1994, Control Rod 14-55 had exhibited increased SOM time. On August 8, 1993, during previous surveillance testing, Control Rod 14-55 inserted in 0.28 seconds and had a 2X2 array SOM of 0.31 seconds. On December 4, 1993, Control Rod 14-55 SOM time was 0.72 seconds and the 2X2 array SOM time was 0.41 seconds. Even though Control Rod 14-55 exhibited an approximately three times slower insertion speed, the 2X2 array SOM was only 0.030 of a second from exceeding the TS limit, and the control rod had never previously exhibited increased insertion time, the licensee did not initiate a PER. The inspector found that the licensee did not initiate a PER because the 2X2 array average SOM time did not exceed TS limits. Also, the licensee did not establish an increased surveillance frequency to minimize the chance of exceeding the TS limit.

Early in January 1994, the licensee wrote Maintenance Work Request DL93 to replace the SSPVs of Control Rod 14-55. On January 7, 1994, prior to replacing the SSPVs, the licensee again performed surveillance testing on Control Rod 14-55. That testing identified that Control Rod 14-55 inserted in 1.20 seconds and that the 2X2 array SOM time was 0.58 seconds, which exceeded the TS limit of 0.43 seconds. The licensee, therefore, declared Control Rod 14-55 inoperable, entered the appropriate TS limiting condition for operation, initiated PER 294-0014, and replaced the SSPVs.

In PER 294-0014 the licensee stated, "following removal of the SSPVs, they will be retained for disassembly and inspection to determine possible failure modes and any generic implications for valves remaining in service." On March 9, 1994, the licensee initiated the following PTL actions associated with this PER: (1) by April 1, 1994, perform a material analysis of the elastomers from Hydraulic Control Units 02-19 and 14-55; (2) by April 1, 1994, perform a review of scram time history to determine SSPV rebuild impact to Refueling Outage 9; and (3) by April 15, 1994, evaluate the need to rebuild the SSPVs in Refueling Outage 9 vice Refueling Outage 10. The inspector learned that the licensee planned to have GE perform a failure analysis of the SSPVs.

6.2.2 Control Rod 02-19 Air Leakage

The inspector also learned from the materials engineer that on January 31, 1994, a licensee system engineer had identified air leakage coming from the vent of the SSPVs for Control Rod 02-19. The engineer documented this deficiency in PER 294-0067. In this PER, the engineer, based on discussions with GE, concluded, "the cause of the problem was likely due to air leakage past the exhaust diaphragm of SSPV CRD-V-117, but could have resulted from leakage by the pressure diaphragm of solenoid valve CRD-V-118." The licensee also concluded that the air leakage did not prevent the control rod from performing its intended scram safety function. It was understood, however, that the control rod may not meet its SOM limits. The system engineer recommended rebuilding the SSPVs at the next available opportunity.

On February 1, 1994, the licensee performed a prompt operability assessment. In this assessment the licensee concluded that Control Rod 02-19 was operable and recommended that the SSPVs for Control Rod 02-19 be replaced in the near term. The licensee stated in the assessment that GE believed the most likely source of air leakage was past the seat of the CRD-V-117 exhaust diaphragm and not past the CRD-V-118 pressure diaphragm. The licensee further stated that GE felt, based on the recent scram time for Control Rod 02-19, that the diaphragms were reaching normal end-of-life for the diaphragm material (Buna-N) in the SSPVs for this control rod. Even though Control Rod 14-55 had exhibited slow rod motion in January 1994 and the cause was determined to be the Buna-N components reaching end-of-life, the licensee concluded that the diaphragm seat leakage would not interfere with normal scram time or contribute to increased rod insertion time. The licensee did not scram time test Control Rod 14-55 to verify their assumption.

The licensee initiated the following PTL action associated with this PER: by March 18, 1994, perform a material analysis of the elastomers from Hydraulic Control Units 02-19 and 14-55 to support rebuild in Refueling Outages 9 or 10.

6.2.3 Disassembly and Inspection of the SSPVs of Control Rods 02-19 and 14-55

On February 6, 1994, the licensee received GE's cost estimate for the disassembly and failure analysis of Control Rod 14-55 SSPVs. Because the estimate was high, the licensee performed the failure analysis themselves. On February 7, 1994, after having replaced the CRD-V-117 and CRD-V-118 valves for Control Rod 02-19, licensee engineers disassembled and inspected those SSPVs. The engineers found that the exhaust diaphragm of CRD-V-118 had cracked 180 degrees around its outer circumference, and the pressure diaphragm, while intact, was stiff and very brittle. Even though the findings of this disassembly significantly differed from the conclusions the licensee reached in PER 294-0067 and the licensee committed to perform a generic impact assessment, the licensee did not revise the previous operability assessment or perform a new prompt operability determination. PPM 1.3.12B, "Operability Evaluation," Revision 0, requires a prompt operability determination when finding physical evidence of degraded or nonconforming components that have undergone physical change from a previous acceptable condition or has failed testing requirements. The failure to perform a prompt operability determination is an apparent violation of 10 CFR Part 50, Appendix B, Criterion V (Violation 397/9415-01).

On February 17, 1994, the licensee disassembled and inspected the SSPVs of Control Rod 14-55, which had been replaced on January 7, 1994. The licensee found that the CRD-V-118 exhaust diaphragm was hardened and cracked (having a 360 degree crack around its inner circumference), and the pressure diaphragm was brittle and stiff. The licensee did not initiate a prompt operability determination to assess the impact of finding severely degraded components. PPM 1.3.12B, "Operability Evaluation," Revision 0, requires a prompt operability determination when finding physical evidence of degraded or nonconforming components that have undergone physical change from a previous acceptable condition or has failed testing requirements. The failure to

perform a prompt operability determination is an apparent violation of 10 CFR Part 50, Appendix B, Criterion V (Violation 397/9415-01).

The inspector learned that the licensee engineers considered that a new or revised operability assessment was not necessary. The engineers considered that the hardened diaphragms were confirmation of their assumptions in PERs 294-0014 and 294-0067. The inspector considered this logic incorrect, since the earlier assumptions did not consider complete failure of the exhaust diaphragms and believed the air leakage to be originating from the exhaust diaphragms of CRD-V-117. The inspector also learned that equipment qualification personnel had not been informed of the failed diaphragms, even though the engineers were fully aware that these components were qualified components. On one occasion, one of the engineers involved with the diaphragm failures asked an equipment qualification engineer questions about Buna-N qualification but did not mention that the SSPV diaphragms had failed. The inspector visually examined the failed diaphragms of the SSPVs for Control Rod 14-55. The diaphragms were so severely hardened that any torsional or twisting force resulted in the diaphragm cracking. The inspector also noted the circumferential cracking of the exhaust diaphragms. The inspector considered that the degraded and failed Buna-N components (the diaphragms) were a significant condition adverse to quality.

The inspector also learned that the licensee's senior nuclear managers were aware of the failures of the SSPVs for Control Rods 14-55 and 02-19. The senior managers, however, had not seen the diaphragms. Because they had not seen the diaphragms, the managers were not personally aware of the extent of degradation. On March 4, 1994, the Senior Management Review Group met to discuss budget and planning. In this meeting the Senior Management Review Group reallocated resources to perform the SSPV refurbishment in Refueling Outage 9 vice Refueling Outage 10. The PM decided to begin the refurbishment on about April 4, 1994. The refurbishment was to be performed one control rod at a time, with the intent of minimizing the impact on power production.

10 CFR Part 50, Appendix B, Criterion XVI, requires that measures be established to assure that conditions adverse to quality, such as failures, nonconformances, and defective material and equipment are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action shall be documented and reported to the appropriate levels of management. The licensee did not promptly identify and correct the condition of failed and degraded Buna-N components in the SSPVs to prevent the repetitive failures. This is an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI (Violation 397/9415-02).

6.2.4 Control Rod 54-35 and 58-35 Air Leakage

On May 3, 1989, with the reactor shut down and a half-scram inserted, the licensee found air issuing from the vents of the SSPVs of Control Rods 54-35

and 58-35. The system engineer wrote Plant Problem Material Deficiency Report 289-0309 to immediately rebuild the SSPVs of Control Rods 54-35 and 58-35 and rebuild all the control rod SSPVs in 1990. When the licensee disassembled the SSPVs, they found that the valves' Buna-N O-Rings were extremely brittle, resembling bakelite. The licensee concluded that fragments of the hardened O-Rings prevented internal components from moving, causing air leakage and valve malfunction. The licensee noted that the Buna-N diaphragms of these SSPVs were flexible. The craftsmen noted that the diaphragms of the SSPVs for Control Rod 54-35 were covered with a powdery substance that resembled copper or brass dust. The licensee concluded that the powdery substance most likely originated from the air supply tubing; however, a confirmatory analysis was not performed.

The licensee concluded that the root cause of the SSPV failures was that previous corrective actions had not been implemented. Specifically, the 25 percent replacement schedule of SSPV Buna-N components had not been implemented. The corrective action to prevent recurrence was to replace the Buna-N components in all SSPVs in 1990. The inspector considered this action imprudent and untimely. The licensee did not evaluate a larger sample of SSPVs to determine the extent of the problem. The action was untimely because deferring the replacement until 1990 resulted in exceeding the qualified life of the Buna-N components. The licensee did not implement a corrective action to periodically replace the SSPV Buna-N components, which was the root cause of the event.

In 1990, when the Buna-N components of the SSPVs were replaced, the work request did not include instructions that required the craftsmen to document the condition of the Buna-N components upon replacement. The system engineer kept approximately 15 of the diaphragms. These diaphragms were flexible. The engineer, however, did not record from which valves the diaphragms were removed. Without traceability, the licensee could not determine length of service life.

6.2.5 Conclusions

The licensee failed to adhere to procedures and perform prompt operability assessments on several occasions when finding safety-related components significantly degraded. On three occasions the licensee failed to take prompt corrective action to prevent recurring failures of safety-related components.

7 EQ OF SSPV BUNA-N COMPONENTS (92903)

7.1 EQ History of Control Rod SSPV Buna-N Components

The inspector reviewed the SSPV environmental qualification documentation (WNP-2 QID number 16700, Revision 6) and discussed this material with the licensee equipment qualification personnel. The licensee described the following qualification history of the SSPV Buna-N components:

(1) From January 1976 to August 1978, the licensee, based on GE SIL 128,

Revision 1, considered Buna-N component service life to be 3 to 4 years and total life (service life plus shelf life) 9 years.

(2) From August 1978 to December 1978, the licensee, based on GE SIL 128, Revision 1, Supplement 1, considered Buna-N component life to be 7 years.

(3) In December 1985, the licensee, based on the supply system's engineering standard, determined that, when Buna-N components were properly stored, shelf life had little effect on natural aging.

(4) In June 1987, based on a GE letter to Vermont Yankee, the licensee again concluded that shelf life had little affect on natural aging and that service life was 5.6 years.

(5) In July 1990, the licensee, based on WNP-2 operating experience (the Buna-N component failure described in paragraph 6.2.4), revised service life to 5.5 years in their qualification documents.

The inspector noted that in 1990 the licensee had used operating experience as the method for determining qualified life of the diaphragms for the SSPVs. 10 CFR 50.49 and NRC Branch Technical Positions permit qualifying equipment using operating experience; however, qualification by operating experience is a lesser preferred method. The inspector noted that the licensee determined that the qualified life of the Buna-N diaphragms used in the SSPVs was 5.5 years. The licensee selected 5.5 years because the diaphragms installed in 1983 successfully operated until May of 1989 with no failures. As described in paragraph 6.2.4, Buna-N components of the SSPVs for Control Rods 54-35 and 58-35 failed on May 3, 1989.

7.2 Conclusions

It appeared to the inspector that the selection of 5.5 years only marginally met the intent of qualifying equipment using operating experience. The Buna-N components in 1990 had failed catastrophically. These components had obviously been degraded and were not reliable for some time before the failure. The licensee used a very limited sample, two failed valves, in determining operating experience. The licensee assumed that the Buna-N components of the other valves were acceptable because the valves had not failed. The licensee did not expand their sample size to determine the extent of the problem. Additionally, the licensee considered the degradation of the Buna-N components to result from thermal degradation; however, they did not perform a temperature survey of the other SSPVs to identify other potentially affected valves.

8 APPARENT VIOLATIONS

10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," states, "Measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. In the case of

significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition." Because the hardening and failure of the SSPV diaphragms of the CRD-V-118 valves for Control Rods 02-19 and 14-55 were significant conditions adverse to quality and the licensee did not take corrective action to preclude failure of diaphragms for the remaining control rod SSPVs, this is an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI.

10 CFR 50, Appendix B, Criterion V states, in part, "Activities affecting quality shall be prescribed by documented instructions, procedures, or drawings of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings."
WNP-2 PPM 1.3.12B, Revision 0, paragraph 4.2.3.a, states, "For degraded conditions impacting equipment operability identified by physical evidence at the Plant, the Prompt Operability Assessment should be completed and documented within 24 hours of when the physical evidence was identified."
Because on February 5 and 16 and March 26, 1994, a POA was not performed upon finding significantly degraded Buna-N components in SSPVs for Control Rods 14-58, 21-55 and 06-39, this is an apparent violation of 10 CFR Part 50, Appendix B, Criterion V.

ATTACHMENT

1 PERSONS CONTACTED

V. Parrish, Assistant Managing Director for Operations
*M. Flasch, Engineering Director
*J. Swailes, Plant Manager
*G. Smith, Operations Division Manager
*M. Reddemann, Technical Services Division Manager
*M. Monopoli, Maintenance Division Manager
*J. Sampson, Maintenance Production Manager
*P. Bemis, Regulatory Programs Manager
*H. Kook, Licensing Manager
D. Larkin, Engineering Services Manager
D. Whitcomb, Nuclear Engineering Manager
*J. Benjamin, Quality Assessments Manager
*J. McDonald, Quality Support Manager
R. Barbee, System Engineering Manager
S. Washington, Nuclear Safety Assurance Division Manager
*C. Noyes, Engineering Programs Manager
*J. Muth, Plant Assessments Manager
*B. Hugo, Licensing Engineer

The inspectors also interviewed various control room operators, shift supervisors and shift managers, maintenance, engineering, quality assurance, and management personnel.

*Attended the exit meeting on May 13, 1994.

2 EXIT MEETING

An exit meeting was conducted on May 13, 1994. During this meeting, the inspectors reviewed the scope and findings of the report. The licensee acknowledged the inspectors' findings. The licensee did not identify as proprietary any of the information provided to, or reviewed by, the inspectors.