UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA ST., N.W.
ATLANTA, GEORGIA 30323

Report Nos.: 50-325/88-25 and 50-324/88-25

Licensee: Carolina Power and Light Company
P. O. Box 1551
Raleigh, NC 27602

Docket Nos.: 50-325 and 50-324 License Nos.: DPR-71 and DPR-62

Facility Name: Brunswick 1 and 2

Inspection Conducted: August 1-5, 1988

Inspectors: S. Tingen — Date Signed: 9/19/88

A. Szczepaniec — Date Signed: 9/14/88

J. Zeiler — Date Signed: 9/15/88

Accompanying Personnel: F. Jape

Approved by: Frank Jape — Date Signed: 9/21/88
F. Jape, Chief
Test Programs Section
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope: This routine, announced inspection was conducted as a followup to the NRC Augmented Inspection Team (AIT) inspection of January 5-9, 1988, relating to the failure of two sets of redundant primary containment isolation valves. The areas reviewed included maintenance procedures, training, maintenance history of ASCO solenoid valves, ASCO valve procurement, instrument air, trending programs, root cause determination and reportability.

Results: In response to the failure of the two sets of redundant primary isolation valves to close and the follow-up AIT inspection the licensee has taken adequate action to reasonably ensure that similar valve failures will not reoccur. In paragraph 4.a weaknesses were identified that involved operations personnel not being fully aware

of management policies concerning tapping on valves to prompt proper operation or documenting the failure of valve to operate when subsequent attempts to operate the valve are successful. In Paragraph 6.0, a weakness was identified that concerned the lack of management attention involving a 1984 decision to bypass the aftercooler and oil filter unit on the reactor building standby air compressors. When these compressors are in use without the oil filtration and moisture removal equipment, there exist the potential for significant instrument air system degradation due to hydrocarbon and moisture contamination. In Paragraph 8.0 a strength was identified that involved significant licensee effort in the area of root cause determination of ASCO solenoid valve disk to seat sticking.

In the areas inspected, violations or deviations were not identified.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*K. B. Altman, Manager-Maintenance
*K. E. Enzor, Director-Regulatory Compliance
*J. L. Harness, General Manager
*A. S. Hegler, Superintendent-Operations
*R. E. Helme, Manager-Technical Support
*P. W. Howe, Vice President-Brunswick Nuclear Plant
*M. A. Jones, Director-On-site Nuclear Safety
B. Parks, Engineering Supervisor, Technical Support
K. Robinson, Engineer, Technical Support
D. Sullivan, Principal Engineer - Metallurgy Unit, Harris Energy and Environmental Center

Other licensee employees contacted during this inspection included engineers, operators, mechanics, technicians, and administrative personnel.

Other Personnel Contacted

K. Thomas, Automatic Switch Company (ASCO), Senior Service Engineer

NRC Resident Inspector

*W. Levis, Resident Inspector

*Attended exit interview

2. Maintenance Procedures

Findings concerning maintenance procedures were previously presented in the AIT Inspection Report. These findings were: Corrective Maintenance Instruction OCM-SV004A, Corrective Maintenance Instruction for ASCO 206-832 Series Solenoid Valves, did not include requirements that installation of an entire kit into a solenoid valve without any interchanging of old and new parts; allowed the usage of pipe compound for the installation of new valve seats when manufacturers instructions only allow Neolube lubricant; and the licensee did not have a periodic maintenance program for ASCO solenoid valves. The followup review of these findings revealed the following. In Revision 2 to OCM-SV004 dated June 9, 1988, the requirement to use entire kits during part replacement on ASCO solenoids was clarified. The inspectors also verified that the manufacturer's instructions do specify the usage of a thread sealent during the installation of new valve seats, therefore, OCM-SV004A was correct as

written. The periodic maintenance for ASCO solenoid valves at Brunswick is based on the Environmental Qualification Life. For the ASCO Model 206-832 series solenoid valves, the Environmental Qualification Life is approximately 30 years, and therefore should not require any scheduled maintenance for at least 30 years.

3. Training

A finding of the AIT Inspection Report was that Instrument and Control technicians had received generic training on solenoid valves but no training on the specific requirements of kit replacement for ASCO solenoid Model 206-832 valves. The licensee considers that general training in the area of kit replacement for ASCO solenoid valve Model 206-832 is not warranted However, the licensee has developed a new policy of kit replacement and overhaul of ASCO solenoid valves in that it will require special management approval to perform either one of these maintenance items. The current practice is now to replace ASCO solenoids Model 206-832 with vendor supplied valves in lieu of kit installation or overhaul.

A finding of the AIT Inspection Report was that operations was improperly informed by maintenance that the control switch for Valves 2-G16-F003, -F004, -F019, and -F020 must be held in the closed position until the valve goes fully closed. Operations personnel have since been retrained that the control switch for these valves must be held until the red indication light goes out. The inspector verified this training by review of the Training Report conducted on January 14, 1988.

4. Maintenance History Of ASCO Solenoid Valves

The four valves that failed to close upon receipt of an automatic actuation signal on January 2, 1988, were 2-G16-F003, -F004, -F019, and -F020. The failure for three of the valves, 2-G16-F003, -F019, and -F020, to close has been attributed to the failure of each valve's ASCO solenoid valve. The failure to close for the fourth valve, 2-G16-F004, has been attributed to the failure of the K-18 relay and/or its ASCO solenoid valve. One of the purposes of this inspection was to evaluate if other Brunswick solenoids valves had maintenance histories of failure similar to the four Unit 2 valves that failed to close on January 2, 1988.

Brunswick has approximately 500 ASCO solenoid valves per unit. Over 20 different ASCO solenoid valve model numbers exist and for some model numbers different variations exist. The inspectors reviewed maintenance histories dating back to 1985 for 65 ASCO solenoid valves that are important to safety. The maintenance histories for the four valves that failed are extensively discussed in the AIT Inspection Report and therefore were not reviewed again during this inspection; however, the maintenance histories for other ASCO solenoid valves with the same model numbers as the valves that failed were requested from the licensee for review. In addition to reviewing ASCO solenoid valve maintenance histories, an inspector held a discussion with a Unit 2 Senior Reactor

Operator pertaining to Brunswick policies on tapping on solenoids in order to achieve valve operation and the performance of second attempts in order to achieve satisfactory stroke time results. Since reactor operators perform the majority of valve stroke time testing, a Senior Reactor Operator would be aware of the the governing policies. The following findings are based on a discussion with a Unit 2 Senior Reactor Operator and the review of maintenance histories:

a. The Unit 2 Senior Reactor Operator interviewed was unaware of any Brunswick policy pertaining to tapping on valves in order to get them to stroke and test satisfactorily, and was hesitant when asked if this was an allowable practice. An inspector then asked the Unit 2 Senior Reactor Operator what the practice was if the first attempt to stroke a valve failed. The reply was that a second and third attempt would be made. If these attempts were successful then the valve stroke test would be considered satisfactory. Documentation of the first attempt to fail may or may not be made. Discussion with Brunswick licensing personnel indicated that it was Brunswick policy that tapping on valves to obtain satisfactory stroke time results was not acceptable and all attempts to stroke time test a valve that fails are required to be documented. Brunswick licensing personnel then discussed the subjects of tapping on valves and documenting valve failures to initially stroke with other Brunswick reactor operators. The responses were similar to that of the Unit 2 Senior Reactor Operator. During the exit interview Brunswick management expressed concern over these matters and indicated that action would be taken to ensure that personnel were aware of the policies in these areas. Management action to ensure that personnel are aware of valve tapping and documentation of valve failure policies is identified as Inspector Followup Item 50-325/88-25-01 and 50-324/88-25-01.

b. Based on the review of the 65 ASCO solenoid valve maintenance histories, ASCO solenoid valves do not appear to be an obvious maintenance concern. Of the 65 ASCO solenoid valves reviewed, only six solenoid valves had maintenance problems. Four of the solenoid valves had to be replaced due to excessive seat leakage, one valve had a coil which had to be replaced, and one solenoid valve would not operate and was replaced. If tapping on the solenoid valves, or failures on first attempts to stroke the valves occurred, without any documentation of such, then the conclusion that ASCO solenoids are not maintenance problems may not be valid. There were some cases where work requests were written on valves that would not initially stroke but then later stroked without any corrective action taken. However, since the cause of failure was not determined, this was not attributed by the licensee to be an ASCO solenoid maintenance problem, and therefore was not provided as part of the ASCO solenoid maintenance history. If this occurred to any extent, then the conclusion that ASCO solenoid valves at Brunswick are not significant maintenance problems, again, may not be valid. As discussed in the AIT Inspection Report, Valves 2-G16-F003 and -F004 had a history of operating, after initially failing, due to subsequent tapping on the

solenoid. It was observed in those cases that when failure of the valve was properly documented on a work request, it was not Brunswick practice to only tap on the solenoid valve as corrective action. The final corrective action was either replacing the coil or rebuilding the solenoid valve.

c. The review of Valve 2-SW-V130 maintenance history revealed that when an ASCO solenoid valve would fail to operate, the solenoid coil would be checked for proper operation. If the coil was satisfactory, but the valve did not operate, the solenoid valve would be replaced. No further investigation by the licensee was performed to determine why the valve had failed to operate.

d. On May 12, 1986, Valve 2-B32-F019 failed to stroke when performing a stroke time test. A work request was written and, for corrective action, the valve was to be stroked. During the next attempt to stroke the valve it stroked satisfactorily; no additional corrective action was performed. The cause as to why the valve initially failed was not determined. Valve 2-B32-F019 has the same model number as the valves that failed to close during the manual reactor scram on January 2, 1988.

e. The findings in Items c and d above occurred prior to the ASCO solenoid valve failure on January 2, 1988. After January 2, 1988, Brunswick has been extremely sensitive to all ASCO valve failures. An example of such is that on March 7, 1988, the ASCO solenoid to Valve 2-CAC-V9 was replaced due to excessive seat leakage. Brunswick then conducted extensive research to determine what caused the excessive seat leakage to occur. Recently, Valve 2B32-F019 failed to stroke; the problem was found to be in the actuator and not with the ASCO solenoid valve. However, since this ASCO solenoid valve is the same type as the four that failed on January 2, 1988, the solenoid valve was replaced and the old solenoid valve is undergoing examination.

5. Review of ASCO Valve Procurement Practices

The AIT Report identified what appeared to be a minor procurement problem discovered during a review of two maintenance work requests. The work requests involved the failure and replacement of the ASCO solenoid valve for Containment Isolation Valve (CIV) 2-G16-F003. The Report stated that for work requests 86-BDLK1, dated July 12, 1986, and 87-AYMF1, dated July 17, 1987, wrong replacement valves were drawn from stock and installed. In both work requests, the wrong valves drawn from stock were ASCO solenoid Type "G" instead of Type "F" valves.

As part of followup to the AIT Report, the inspectors discussed this matter with the licensee's Maintenance Supervisor for Instrumentation and Control to determine if a procurement problem occured. The licensee provided the following valve history which occured before either of the work requests were initiated. The solenoid valve for CIV 2-G16-F003 was initially replaced with an ASCO model 206-832, Type "G" valve by Plant

Modification (PM) 82-066. The "G" in the valve model number specified this as a fail open valve. Afterwards, when the valve failed to operate properly, it was discovered that an incorrect valve drawing had specified CIV 2-G16-F003 as a fail open valve instead of fail close. By a field revision to the PM, the solenoid valve was converted, using an ASCO solenoid valve conversion kit, to a Type "F" valve. Type "F" solenoid valves operate on a fail close principle. PM 82-066 was completed in April, 1986.

The licensee explained that for the two work requests, the most probable cause that the Type "G" valves were ordered for replacement instead of Type "F" involved an oversight on the part of the Maintenance Planning Department. In planning the two work requests, the inspectors were told that the Maintenance Planner may have overlooked the field revision to the PM and ordered the valves according to the original PM, which specified a Type "G" valve. Also, the licensee reported that during this same period, the solenoid valve had been rebuilt using an ASCO rebuild kit. Normally, the rebuild kits provided by the vendor are supplied with new nameplates, but in this case, the nameplate was not provided. This problem may also have hampered efforts to retrieve the correct valve. Concerning the missing nameplate, the licensee added that in the future, the intent will be to replace the valves instead of rebuilding, and proper nameplates will be supplied with the new replacement valves, by the manufacturer.

The inspectors talked with a Maintenance Planning representative who confirmed the posibility that the Planner of the work requests may have overlooked the field revision to PM 82-066. However, he pointed out that presently the primary reference used in identifying replacement parts when planning a work request is the computerized Equipment Data Base System (EDBS), which lists parts for a given piece of equipment. At the time that the work requests were initiated, the licensee stated that it was unsure if the particular valve information was present on EDBS. Since that time, EDBS has become more reliable with the addition of more equipment and component information loaded into the system. This should help prevent similar events of this nature from occuring in future work request planning.

The inspectors concluded that since the solenoid valves ordered in the work requests were the same valves that were provided, this was not indicative of a purchasing problem. Rather, the problem involved the specification of the incorrect solenoid valve type in planning the work requests.

As part of further follow-up in this area, the inspectors discussed purchasing practices with the Engineering Procurement Supervisor and found no weaknesses in the licensee's procurement process. Also, the inspector's reviewed complete purchasing packages of selected ASCO solenoid valve model numbers. No discrepancies or weaknesses were identified from the review and the inspectors had no further concerns in this area.

6. Improvements in Instrument Air Quality

Preliminary checks of the air system quality and pressure conducted by the NRC AIT resulted in satisfactory results. However, one of the findings identified in the AIT report was that the licensee had experienced continuing problems with service air quality and deterioration of pneumatic control equipment and that improvements to the system were planned. The inspectors discussed these and other concerns associated with instrument air quality with cognizant licensee personnel to determine what improvements have been performed or are planned.

Several improvements to instrument air quality have been identified by the licensee. On May 12, 1988, Project Identification (PID) G001A was approved to address the following modifications associated with service and instrument air systems.

a. Installation of particulate filters on the instrument air lines in the reactor building.

b. Modification of the design of the plant's air system to remove hydrocarbons from service and instrument air.

c. Modifications to the Reactor Building Standby Air Compressors to put back in service the oil filter and aftercooler.

The proposed particulate filters will be located at the carbon steel to stainless steel interface points between the service and instrument air systems. The inspectors were told that present filters in the service air system were capable of removing particulate material of 5 microns or larger. ASCO solenoid valve information recommends that the instrument air used be as free from dirt and foreign material as possible. The inspectors contacted a representative from ASCO and asked for a more quantitative value concerning the maximum particulate size contained in instrument air for the reliable operation of their solenoid valves. ASCO stated that such a limit would be difficult to determine and would depend on the size of the solenoid valves and the application for which the valves would be used. However, ASCO stated that if it was forced to provide a general, quantitative value for maximum particulate size, the specifications found in the Instrument Society of America (ISA) Standard S7.3 would be supported. ISA Standard S7.3 recommends that particle size within the air stream be no greater than 3 microns to preclude plugging and blockage of the small air passage within equipment supplied by instrument air. Again, the plant's present instrument air system is not capable of meeting this recommendation.

PID G001A indicated that the modification of the design of the plant's air system to remove hydrocarbons would involve either the installation of filters on the discharge of the Reactor Building Compressors or the removal of hydrocarbon sources. The PID also called for a provision for a means of monitoring the hydrocarbon and moisture content in the air. Hydrocarbon contamination can cause the degradation of material, such as

elastomers, used in solenoid valve seats. The elastomers become deformed and brittle, causing sticking and binding of internal components such as valve discs within a solenoid valve. The licensee had previously experienced failure of the main steam isolation valve ASCO solenoid valves in September, 1985. This failure was partially attributed to hydrocarbon contamination of the air system. The licensee's corrective action was to replace the solenoid valve elastomer material with material less subject to degradation from hydrocarbon contamination. Since these failures, no modifications to the air system have been performed to reduce the hydrocarbon content. Instrument air samples taken during the NRC AIT resulted in hydrocarbon content as high as 2 ppm. ISA Standard S7.3 recommends that oil content be as close to zero as possible and under no circumstances be allowed to exceed 1 ppm to preclude degradation and wear of components. The inspectors also discussed with ASCO the problem of solenoid valve material degradation due to hydrocarbon contamination. ASCO stated that to ensure the reliability of the operation of its solenoid valves, the air quality standards of ISA S7.3 should be followed.

The licensee has identified the Reactor Building Standby Air compressors as a source of hydrocarbon (oil) and moisture contamination. These compressors provide a backup function and should instrument air pressure decrease below 95 psig, the compressors would automatically start. Besides starting automatically, when air pressure drops to this pressure, the compressors are routinely started every 18 months. The licensee stated that the oil filter and aftercooler for the compressors had been manually bypassed since 1984, when the plastic sump on the aftercooler prefilter was damaged due to overheating. Also, the inspectors were told that an engineering evaluation was not performed subsequent to this decision to bypass the oil filter and aftercooler to determine the effect on instrument air quality. Since the compressors are not classified as oil free, bypassing the oil filter allows greater chance of oil contamination of the air system. Bypassing the aftercooler allows greater potential for moisture to be added to the system, which can cause pipe corrosion. The licensee's representative indicated that corrosion had been a problem in the system. Putting the oil filter and aftercooler back in service should help in removing oil and moisture from the instrument air. In addition to this, the licensee reported that the Unit 2 Service Air Dryer is scheduled for replacement sometime this year. This should also reduce the moisture content and outlet temperature of the air.

The inspectors concluded that the licensee is planning air system modifications which should significantly improve instrument air quality. However, based on discussions with ASCO, which recommends the air quality standards of ISA S7.3, greater licensee attention may be warranted in this area.

7. Trending Programs

The licensee has taken action to improve the trending program and to escalate the identification of repetitive failures to the appropriate levels of management. The improvements included a revision to Corrective

Maintenance Procedure (MP)-14A and issuance of Standard Operating Procedure (SOP)-02.40 dated January 12, 1988.

Revision 7 of MP-14A included the addition of mechanics in instructions regarding the importance of determination of root cause and in examining equipment to determine why repetitive failures are occurring. SOP-02.40 established a program for identification and resolution of repetitive failures of plant equipment, which goes beyond the requirement of MP-14A. The major elements in the SOP include:

a. The review of those packages identified by the maintenance planner/analyst as repetitive by the Maintenance Department Principal Engineer for adequacy of root cause determination.

b. The maintaining of a listing of repetitive failures.

c. The generation of a monthly report as to the status of open repetitive failure corrective actions.

e. The presentation by the Maintenance Manager of the equipment failure report to the Plant Nuclear Safety Committee (PNSC) on a monthly basis.

f. The identification of parts used four or more times during the past eighteen months.

g. Generation of a quarterly report identifying parts having repetitive usage.

h. Presentation of the repetitive parts usage report by the Maintenance Manager to the PNSC on a quarterly basis.

This SOP however is issued as an interim procedure due to expire December 31, 1988. The intent of management is to use the interim repetitive failure detection program of the SOP until full implementation of the proposed permanent program. The permanent program development is addressed in Project Plan for Repetitive Failure Detection Program with implementation projected for October 28, 1988.

The institution of a permanent program for repetitive failure identification, which includes provisions for the elevation of repetitive items to the appropriate levels of management, is identified as Inspector Followup Item (IFI) 50-325/88-25-02 and 50-324/88-25-02, Implementation of Permanent Program for Repetitive Failure Identification.

The program being developed is heavily dependent upon computer software, but will still be dependent upon proper input to achieve the desired results. These input necessitate not only the proper analysis of the root causes of a failure, but also the initial recognition that a failure did occur so that it can be considered in the first place. This need is recognized by existing procedures, but the failure to recognize the

initial inability of the ASCO valves to properly operate, as a failure, after subsequent cycling attempts were successful, would prohibit even the interim program from working as intended. The intent of the program being developed is to ensure all failures are documented as such, so repetitiveness can be identified. This proper documentation of failures will be reviewed during future inspections.

8. Root Cause Determination

As a result of the manual scram of the Unit 2 reactor on January 2, 1988 reactor vessel water level decreased to below the low level "1" set point. When reactor vessel water level decreases to below this set point, a Group 2 containment isolation signal is generated. Upon initiation of the Unit 2 containment isolation signal all Group 2 containment isolation valves shut as required except Valves 2-G16-F003 and -F004, redundant containment isolation valves in the drywell floor drain line, and Valves 2-G16-F019 and -F020, redundant isolation valves in the drywell equipment drain line, all of which remained open. When it was noted that the four valves did not shut upon a Group 2 isolation signal, the reactor operator attempted to manually shut the valves by placing the individual control room handswitch for each of the four valves in the "closed" position. Valves 2-G16-F003 and -F004 shut immediately upon placing the respective handswitch in the closed position. Valves 2-G16-F019 and -F020 did not shut on the manual attempt. Additional unsuccessful attempts were then made to shut Valves 2-G16-F019 and -F020. Six minutes following the initiation of the Group 2 containment isolation signal, Valve 2-G16-F020 was noted to be shut, and eight minutes after the Group 2 containment isolation signal Valve 2-G16-F019 was noted to be shut. This was after manual attempts to shut the valves had failed. Valves 2-G16-F019 and -F020 did not shut as a direct result of the operator's manual attempts. After restoration from the Unit 2 reactor scram, the licensee performed several tests in an attempt to repeat the failure of Valves 2-G16-F003, -F004, -F019, and F020 to close. The licensee has been unable to repeat the failures of these four valves to close.

To determine the cause of the four valves failure to close, one of the areas investigated by the licensee was the K-17 and K-18 relays since failure of these relays would prevent automatic closure of valves 2-G16-F003, -F004, -F019, and F020. The K-17 and K-18 relays are GE CR120 industrial relays. Inspection of the K-18 relay identified a heavy arc strike on Contact 4 and signs of metal transfer on the movable contact assembly for Contact 3. The conclusion of the inspection of the K-18 relay is that the arc strike could have provided a current path sufficient to cause welding of Contacts 3 and 4 together. The contacts were not welded together at the time of the inspection but showed signs of being previously welded together. With any one of the contacts welded in the K-18 relay, operation of all remaining contacts in the relay is prevented. Several months prior to the event, a door hinge pin in the electrical cabinet door adjacent to the K-18 relay was found to be missing and was replaced. The missing door hinge pin was never found and per the licensee the dimensions of the pin were such that if it fell on the K-18 relay

Contacts 3 and 4, arcing would have occurred, resulting in welding of Contacts 3 and 4 together. The breaker protecting this current is rated at 15 amps, but the instantaneous current surge provided by an arc strike could be at least 150 amps without tripping of the breaker. No deficiencies were noted during the inspection of the K-17 relay.

Based on the inspection results of the K-18 relay a probable cause of the Valve 2-G16-F004 failure to close on initiation of the Group 2 containment isolation signal was Contacts 3 and 4 being welded together which prevented the other contacts in the relay to reposition and open. The K-18 relay only effects the operation of Valves 2-G16-F004 and -F020 while the K-17 relay effects the operation of Valves 2-G16-F003 and -F019. If Relay K-18 Contacts 3 and 4 were welded together, Valves 2-G16-F004 and F020 would not have closed automatically upon receipt of a Group 2 containment isolation signal; however, the valves would have closed on an operator manual attempt. As previously discussed when the reactor operator placed the control switches in the "closed" position for Valves 2-G16-F004 and -F020, Valve 2-G16-F004 immediately closed and Valve 2-G16-F020 remained open. Valve 2-G16-F004 shutting on manual initiation is positive indication that the K-18 relay was malfunctioning. Valve 2-G16-F020 not closing when manually attempted from the control room is indication that another problem in addition to the K-18 relay had prevented closure of the valve. As previously discussed Valve 2-G16-F003 also shut when manual closure was initiated by the reactor operator, and automatic closure of this valve is dependent on the K-17 relay which did not yield any deficiencies during visual inspection. When the reactor initiated manual closure of Valves 2-G16-F003 and -F004 both control switches were simultaneously placed in the "closed" position. Valve 2-G16-F003 may have closed due to jarring of the piping caused from the closing of 2-G16-F004.

As corrective action the K-18 relay was replaced. Per Technical Specifications every 18 months the K-17 and K-18 relays in the control and logic circuitry for containment isolation valves are tested. Approximately 16 months ago during the last Unit 2 refueling outage these relays were satisfactorily tested. The licensee has not had previous maintenance problems with these relays and no further corrective action is planned.

The final determination of the root cause of the problem with Valves 2-G16-F003, F019 and F020, failing to go shut has not yet been determined. The licensee is continuing its efforts, primarily through the Harris Energy and Environmental Center (HE&EC), to determine the exact cause, but at this time the evidence and testing results tend to indicate that the problem involved sticking of the solenoid valves' lower disk to lower seat. The disks are Copper Alloy and the seats are Ethylene Propylene Diene Monomer (EPDM). Lab work conducted by HE&EC indicates that EPDM may have a higher than expected oxidation rate when in contact with copper. The HE&EC has also indicated that this oxidation will occur at lower than previously assumed temperatures. This possibly lower temperature could cause the EPDM degradation which is thought to be the cause of the lower

copper alloy disk to stick to the lower EPDM seat which prevents the solenoid valve from repositioning when deenergized.

The licensee's Engineering Evaluation Request 88-076 states that the test data has suggested that if the solenoid valve temperature is reasonably low, no degradation of the EPDM elastomer is expected. The solenoid valve temperature is directly affected by both ambient temperature and the internal temperature of the solenoid valve affected by the energization of the solenoid coil. The licensee's review of test data indicates that ASCO solenoid valves that are normally energized, having EPDM elastomers are more susceptible to premature degradation of the EPDM elastomer then those solenoid valves that are normally de-energized.

Therefore as a temporary corrective action, the licensee is cycling the 12 safety-related ASCO solenoid valves that it has identified as having EPDM elastomers and being normally energized on a weekly basis. This is so the EPDM material will not have a chance to stick to the copper alloy disk as would a solenoid valve that is continually energized over a long period of time. This weekly cycling is to continue until each of the solenoid valves has had its EPDM seats replaced with Viton seats Viton elastomers are believed better for higher temperatures. This replacement of the seat material is the long term corrective action, however as any new or more complete information becomes available concerning the operability of ASCO solenoids with EPDM elastomers, the licensee has stated further evaluations will be made.

Although the final root cause concerning the sticking has not yet been determined, the following conclusions have been reached by the licensee. The electrical circuitry, other than the K-18 relay failure discussed earlier, was not a contributing factor in the valve malfunctions. A mechanical failure of the valve operators did not occur. The oily film found in the solenoid valve internals was not from the valve operator, and as best as could be determined was probably the lubricant used in the assembly of the solenoid. The contribution to the sticking problem by the use of internal silicon-based lubricants is thought to be a possibility but is not the subject of the investigation for the failure of the solenoid valves in this case.

The vendor report of the event states that its investigation could not determine the root cause of the valve malfunction. However, the licensee is requesting assistance from other laboratories in investigating the problem.

9. Reportability

The licensee has revised and clarified its NRC reporting procedures to assure that all pertinent information is promptly provided to the NRC headquarters duty officer and to the resident inspector.

Reporting procedures have previously been included in Regulatory Compliance Instruction (RCI) 6.5, "NRC Reporting Requirements". On

April 25, 1988, the licensee issued Operating Instruction (OI)-51, "NRC 1-hour, 4-hour and 24-hour Reporting Requirements" under the cognizance of the Operations Department. The new OI is a revision of the 1, 4, and 24 hour reportability requirements of the old RCI. Major changes involved control for these reports and included the addition of a checklist for aiding in the determination of the initial safety significance of reportable events. The Event Notification Work Sheet, a separate attachment of OI-51, has also been expanded to provide a separate section for the initial safety significance evaluation, and the on-call manager is now specifically designated as the person responsible for the resident inspector notification time frame.

After OI-51 was issued, the licensee immediately started conducting training for appropriate plant personnel, including licensed personnel and shift technical advisors. Training consisted of lectures and workshops in an eight hour block of instruction. Training encompassed NUREG 1022, 10 CFR 50.72 reportability requirements, OI-51, and evaluation and understanding of the significance of events and their reporting requirements. Past events at Brunswick were reviewed and practice Red Phone Reports were made. Training was conducted between April 25 and June 3, 1988.

The licensee has stated that a revision to RCI 6.5 is being prepared to delete the 1, 4 and 24 hour reportability requirements now covered by OI-51. The RCI will remain in effect for other NRC reportability requirements.

10. Exit Interview

The inspection scope and results were summarized on August 5, 1988, with those persons indicated in Paragraph 1. The inspectors described the areas inspected and discussed in detail the inspection results listed below. Proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

| Item Number | Description and Reference |
|---|---|
| 325,324/88-25-01 | Inspector Followup Item - Management action to ensure that personnel are aware of valve tapping policies and documentation of valve failure policies. |
| 325,324/88-25-02 | Inspector Followup Item - Implementation of permanent program for repetitive failure identification. |