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

Report Nos.: 50-280/91-31 and 50-281/91-31

Licensee: Virginia Electric and Power Company
5000 Dominion Boulevard
Glen Allen, VA 23060

Docket Nos.: 50-280 and 50-281 License Nos.: DPR-32 and DPR-37

Facility Name: Surry 1 and 2

Inspection Conducted: November 4-6, 1991.

Inspection Members: M. W. Branch
J. O. Schiffgens
J. E. Tatum
J. F. Wechselberger

Team Leader: P. E. Fredrickson, Section Chief — 12/18/91
Division of Reactor Projects — Date Signed

SUMMARY

Scope:

This special inspection was conducted to verify specific activities and equipment modifications taken credit for to reduce the vulnerability of the plants to Turbine Building flooding, as discussed in an October 29, 1991 licensee letter. This inspection also reviewed interim measures taken by the licensee as discussed in an October 28, 1991 letter.

Results:

The inspection determined that, based on a combination of actions taken prior to the inspection and completion of commitments provided during the inspection, the items stated in the two licensee letters have or will be satisfactorily implemented. Subsequent NRC inspections will review implementation of the licensee's commitments.

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ENCLOSURE 1

TURBINE BUILDING FLOOD COMMITMENTS

1. Expansion Joints

   a. Currently, the Circulating Water system is operating with four main condenser outlet expansion joints per unit that have an indeterminate service life. The primary concern is whether the remaining service life is sufficient for the units to operate until the 1992 Unit 1 outage. The licensee has proposed three methods to determine the actual remaining service life.

      - First, there is some recollection that the licensee replaced these expansion joints during the 1980 time frame. The licensee is reviewing maintenance and procurement documents in an attempt to verify this assertion.

      - Second, the licensee is contacting the vendor, Garlock, in an attempt to determine the remaining useful service life.

      - Third, if one of the above two methods is unsuccessful, the licensee plans to inspect one of the main condenser outlet expansion joint on Unit 1 during a water box cleaning to estimate remaining service life of the 8 affected expansion joints.

      The licensee committed to satisfactory verification of serviceability by one of these three methods for the four per unit not-replaced Circulating Water expansion joints by November 29, 1991.

   b. In addition, assuming the above evaluation supports current serviceability, the licensee committed to replace the four main condenser outlet expansion joints during the Unit 1 refueling outage scheduled for February 1992 and for Unit 2, no later than the outage scheduled for February 1993. For Unit 2, the licensee committed to provide the basis for extending the replacements to the Unit 2 outage. If a review reveals that these expansion joints were replaced in the 1980 time frame, the licensee committed to provide an evaluation, documenting their service life beyond the Unit 1 and 2 outages.

   c. The flow shields around the 96" Circulating Water expansion joints were not in their as-designed condition, but would be effective in fulfilling their design function for the postulated flooding scenario. The licensee committed to upgrade the material condition of the flow shields by December 31, 1991, to include replacement of missing bolts.

d. In addition the Service Water system has 12 expansion joints that were not replaced in 1988. These expansion joints are not considered as significant a contributor to risk as a result of their physical location in the piping system; that is they are connected to smaller diameter pipes and have two isolation valves upstream of the expansion joints. The licensee committed to visually inspect these expansion joints by November 29, 1991 and provide a schedule for replacement of any expansion joints that warrant it.

2. Turbine Building Sump Pumps

Based on the identified need to further improve sump pump reliability in order to maintain seven of nine pumps operable, the licensee committed to develop a periodic test program for these pumps, to include the pumps, level switches, check valves and power supplies. This testing would verify quantitative flow and operability of equipment. The program will be developed by December 31, 1991 with the first series of periodic tests completed by January 31, 1992

3. Turbine Building Sump Backflow Limiters

Based on inspection concerns that annual inspection without testing may not be frequent enough to ensure functionality of the Turbine Building sump backflow limiters, which are an important part of the flood propagation mitigation scheme, the licensee committed to develop and implement a testing and/or replacement program for these backflow limiters by February 28, 1992.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*W. Stewart, Senior Vice President, Nuclear
*E. Harrell, Vice President, Nuclear Operations
*M. Kansler, Station Manager
W. Benthall, Supervisor, Licensing
*D. Benson, Manager, Nuclear Engineering
*R. Berryman, Manager Nuclear Analysis and Fuel
D. Buchett, Senior Staff Engineer, Nuclear Engineering
*M. Bowling, Manager, Nuclear Licensing and Programs
*D. Christian, Assistant Station Manager
J. Downs, Superintendent of Outage and Planning
J. Graf, Supervisor, Project Engineering, Nuclear
R. Green, Supervisor, System Engineering
R. Gwaltney, Superintendent of Maintenance
A. Hall, System Engineer
D. Hanson, Supervisor, Maintenance Support
*L. Hartz, Manager, Nuclear Quality Assurance
D. Hart, Supervisor, Quality Assurance
J. McCarthy, Superintendent of Operations
*J. Price, Assistant Station Manager
R. Scanlon, Senior Staff Engineer, Licensing
T. Sowers, Superintendent of Engineering
J. Stauffer, MOV Program Coordinator
R. Thomas, Nuclear Analyst

NRC Personnel

*S. Ebneter, Regional Administrator, Region II
*F. Congel, Director, Division of Radiation Protection and Emergency Preparedness, Office of Nuclear Reactor Regulation (NRR)
*W. Beckner, Risk Applications Branch Chief, NRR
*H. Berkow, Project Director, NRR
*M. Branch, Senior Resident Inspector, Region II
*B. Buckley, Senior Project Manager, Region II
*K. Clark, Public Affairs Officer, Region II
*P. Fredrickson, Section Chief, Region II
*J. Schiffgens, Risk Analyst, NRR
*J. Tatum, Senior Reactor Engineer, NRR
*J. Wechselberger, Senior Regional Coordinator, Office of the Executive Director of Operations
*S. Tingen, Resident Inspector, Region II

*Attended exit interview.

Other licensee technical staff members were contacted during the inspection.

2. Background

On August 30, 1991, Virginia Electric and Power Co. submitted an Individual Plant Examination (IPE) on Surry, in response to Generic Letter 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities". This Generic Letter stated that licensees of existing plants should perform a systematic examination, IPE, to identify any plant-specific vulnerabilities to severe accidents and report the results to the Commission. The internal events portion of the IPE, excluding internal flooding, resulted in a point estimate core damage frequency (CDF) of 7.4E-05 per reactor year. CDFs of this magnitude are not unusual. However, the internal flooding portion of the licensee's IPE analysis, which yielded a point estimate CDF of 1.1E-03 per reactor year, identified internal flooding as a vulnerability. The NRC staff agrees that a CDF of this magnitude is unusual and indicative of a significant vulnerability. The licensee's analysis showed that the most important flooding sequences result from failures in the gravity fed, Circulating Water (CW) and connecting Service Water (SW) systems in the Unit 1 or Unit 2 Turbine Buildings which cause flooding in the Emergency Switchgear Room (ESGR) and the subsequent loss of AC, and eventually DC, power. The flow rate into each of eight, 96 inch diameter CW pipes at the intake is about 190,000 gpm during normal operation. The identified sequences, similar to unrecovered station blackout sequences, are responsible for about 90 percent of the total internal flooding CDF.

The unique design feature of Surry responsible for its vulnerability to internal flooding is the location of the ESGR off the lowest level of the Turbine Building, 20 feet below the level of the intake canal. Consequently, breaks in CW or SW pipes or equipment which cannot be isolated by closing appropriate intake or isolation valves, and leak more water into the Turbine Building than its sump pumps can remove, which is a total of about 9,100 gpm, would, in the absence of mitigative measures, lead to core damage.

The licensee, while acknowledging that this vulnerability is real, also believes the CDF estimate is very conservative. In a letter dated October 28, 1991, the licensee presented a schedule for planned, internal flooding related modifications, proposed further discussion of its ongoing reanalysis of internal flooding, and stated the following:

> "In the interim, Virginia Electric and Power Company will augment the present shift coverage of potential flood areas with a dedicated flood watch for those areas. The dedicated flood watch would specifically be observing internal flood-important valves, pipes, and expansion joints on a continuous basis for early indications of leakage or other degraded performance. Furthermore, as an enhancement to flood mitigation capabilities, administrative controls will be added, on an interim basis, to require operability of all

nine sump pumps to further increase expected availability. In the event of a sump pump being inoperable, priority will be given to prompt restoration of the pump to an operable condition. Finally, procedures for installation of stop logs at the high level intake will be formalized and the resources (both material and personnel) required for installation will be identified and dedicated to ensure the most timely action possible in the use of stop logs for flood mitigation."

In a letter dated October 29, 1991, the licensee discussed its reanalysis aimed at better understanding the internal flooding issues and obtaining a more realistic CDF. In this letter, the licensee stated that reanalysis yielded a CDF of 1.7E-04 per reactor year, taking into account specific equipment changes that had not been considered in the initial analysis and additional modifications resulting from the IPE identification of the internal flooding vulnerability. According to the October 29 letter, the following items have been factored into calculation of a reduced CDF for internal flooding:

a) "Expansion joints on the Circulating Water and Service Water systems and associated MOVs, which are significant contributors to any flood damage state frequency, have recently been replaced."

b) "Inspections on MOV bolting have recently been completed. (MOV bolt failure was considered a significant initiating event in the original IPE analysis.)"

c) "A minimum of seven of nine turbine building sump pumps are being maintained operable."

The NRC believes that, if satisfactorily implemented, the above actions and interim measures will reduce the risk to internal flooding. This inspection was to verify statements a), b), and c) in the October 29, 1991 letter and to review the interim measures taken by the licensee discussed in the October 28, 1991 letter.

3. Systems Descriptions--Turbine Building

a. Circulating Water System

The CW System draws water from the James River to provide cooling water for the main condensers and to provide water for the SW System. The eight CW pumps discharge into a common, one and one-half mile long, concrete-lined intake canal that directs CW to the station area. The High Level Intake Structure on each unit directs the water into four concrete pipes. For maintenance purposes, i.e. with the relevant portion of the CW System in a maintenance configuration, isolation of flow at this point can be made by the insertion of large plates (4 per pipe) called stop logs. The concrete pipes connect to four buried 96 inch diameter steel pipes that carry water from the concrete pipe to the individual condenser half-shells in the Turbine Building. Condenser inlet flow is secured by four butterfly motor operated valves (MOVs). In addition, each inlet line contains an expansion joint downstream of the inlet MOV, which allows for settling of system components after installation without putting unacceptable stresses on the piping. Each condenser half-shell has two tube bundles. Water leaving each tube bundle flows through a 96 inch outlet line, two expansion joints and another butterfly MOV isolation valve. The four outlet lines tie into a discharge tunnel which also receives SW System flow. The discharge tunnels from both units go to the common discharge canal, which returns the water to the James River.

b. Service Water System

The SW piping taps off the CW intake piping in the Turbine Building between the High Level Intake Structure and the condenser inlet MOVs. Gravity provides the motive force for the flow of the SW to the various loads and subsystems of the SW System. The SW System supplies cooling water through the plant with several supply headers, which can be isolated by hand operated valves or MOVs. The Bearing Cooling Water System and the Component Cooling Water System are the main systems that use SW in the Turbine Building (36" and 42" lines, respectively). Both contain SW water butterfly isolation MOVs and expansion joints. Return headers collect the SW from the cooled components and subsystems and return the water to the James River via the Discharge Tunnel and the Discharge Canal.

c. Condenser Flood Control Subsystem

The purpose of the Condenser Flood Control Subsystem is to alert the operator through alarms that flooding is taking place in the Turbine Building that could impair safety-related equipment. This subsystem allows the operator some period of time, depending on the severity of the flood, to isolate the source of the flooding after receipt of the first alarm before the condenser CW inlet valves are automatically closed. The system consists of six level sensing detector assemblies, three for alarm and three for CW valve closing. The alarm assemblies are located in both the condenser and amertap pits. The isolation assemblies are mounted 9" off the Turbine Building floor. This system also contains associated alarm circuitry, and a control system using a redundant matrix to initiate automatic closing of the associated condenser CW inlet valves.

4. Replacement of CW System and SW System MOVs

a. Description

During the approximately one year period between May 1988 and July 1989, the licensee replaced the following MOVs in the SW and CW Systems on both Unit 1 (100 series) and Unit 2 (200 series):

100A,B,C,D/200A,B,C,D	Condenser Waterbox Outlet Isolation Valve (96")

101A,B/201A,B	Bearing Cooling Water Heat Exchanger Inlet Isolation Valve (36")
102A,B/202A,B	Component Cooling Heat Exchanger Inlet Isolation Valve (42"/10")
103A,B,C,D/203A,B,C,D	Recirculation Spray Heat Exchanger Inlet Isolation Valve (30")
106A,B,C,D/206A,B,C,D	Condenser Waterbox Inlet Isolation Valve (96")

Except for the condenser waterbox outlet isolation valves (100/200), these are the first isolation valves in the CW and SW systems and there are no expansion joints upstream of these valves.

b. Problem History

The original recirculation spray heat exchanger inlet isolation valves (103/203) were aluminum bronze butterfly valves and they were replaced with butterfly valves of the same material that were designed to provide better seat tightness. The original valves were leaking SW through their seats and allowing hydroid growth formation and fouling of the heat exchangers. The other valves (100/200, 101/201, 102/202, and 106/206) were replaced in response to NRC Information Notice 84-71, "Graphitic Corrosion of Cast Iron in Salt Water," to eliminate graphitic corrosion problems. The original valves were cast iron butterfly valves and over time graphitic corrosion would have reduced the strength of these valves, so they were replaced with ductile iron butterfly valves.

c. Valve Replacement and Design Review

The inspectors reviewed the following documents to verify the adequacy of the valve replacement activities that were previously completed:

NUS 2074	Specification for Motor-Operated Butterfly Valves for Service Water and Circulating Water Systems (Rev. 1)
DC 86-10	Service Water and Circulating Water Butterfly Valve Replacement/Surry 1
DC 86-11	Service Water and Circulating Water Butterfly Valve Replacement/Surry 2
DC 85-17	Service Water Motor Operated Butterfly Valves Surry 1
DC 85-18	Service Water Motor Operated Butterfly Valves Surry 2

These valves were designed to withstand at least 50 psi normal operating pressure whereas the nominal system operating pressure was about 9 psig. The valves were also designed for a maximum differential pressure of 20 psig; the worst-case pipe break would result in a maximum differential pressure of about 10 psig.

d. Current Practices

The licensee monitors valve performance by cycling the valves quarterly per the ASME Code in accordance with the following procedures:

1-PT-25.1	Quarterly Testing of Circulating Water and Service Water System Valves
2-PT-25.1	Quarterly Testing of Circulating Water and Service Water System Valves

Local and remote valve position is verified per the ASME Code each refueling outage by the following procedures:

1-PT-18.10P	Verification of Local and Remote Valve Position Indications in the Turbine and Service Buildings
2-PT-18.10P	Verification of Local and Remote Valve Position Indications in the Turbine and Service Buildings

Valve seat leakage is monitored each refueling outage by the following procedures:

1-OPT-CW-001	Leak Test of the Circulating Water Inlet and Outlet 96" Valves
2-OPT-CW-001	Leak Test of the Circulating Water Inlet and Outlet 96" Valves
1-OPT-SW-001	Leak Test of SW Valves 1-SW-MOV-101A and 1-SW-MOV-101B
2-OPT-SW-001	Leak Test of SW Valves 2-SW-MOV-101A and 2-SW-MOV-101B
1-OPT-SW-002	Leak Testing of Component Cooling Water Heat Exchanger Service Water Valves
2-OPT-SW-002	Leak Testing of Service Water Valves 2-SW-MOV-202A and 2-SW-MOV-202B

e. Conclusion and Recommendations

Based on a review of the information discussed above, the inspectors concluded that the replacement of CW and SW System valves in conjunction with the current practices of monitoring valve status and performance provide an increased level of assurance that: (1) the CW and SW isolation valves will be maintained intact, and (2) the CW and SW isolation valves will be capable of isolating a flooding event. The inspectors did identify that, although these valves are in the MOV Program, the licensee should consider including these MOVs as part of the station Reliability-Centered Maintenance Program

5. Valve and Fastener Inspection

a. Description

In order to minimize the risk of flooding in the Turbine Building, the licensee performed a visual inspection of CW and SW System valves which serve to isolate the high level intake canal. The accessible parts of the valves and exposed adjacent piping were inspected for general pressure boundary integrity including bolt engagement and condition, condition of expansion joints, integrity of connecting bolts for the valve operators, and overall general condition. The following valves (and adjacent piping) from both Unit 1 and Unit 2 were included in the inspection:

100A,B,C,D/200A,B,C,D	Condenser Waterbox Outlet Isolation Valve (96")
101A,B/201A,B	Bearing Cooling Water Heat Exchanger Inlet Isolation Valve (36")
102A,B/202A,B	Component Cooling Heat Exchanger Inlet Isolation Valve (42"/10")
103A,B,C,D/203A,B,C,D	Recirculation Spray Heat Exchanger Inlet Isolation Valve (30")
106A,B,C,D/206A,B,C,D	Condenser Waterbox Inlet Isolation Valve (96")

Several other SW valves were also included in the inspection.

b. Inspection Basis

The licensee's inspection was not based on site-specific problems that had been experienced previously at Surry, but rather the inspection was based on industry experience in general. Excessive corrosion and degradation of fasteners, valve bodies, and piping; inadequate tensioning of fasteners, and fatigue failure of fasteners used to secure valve operators in place have resulted in piping system transients and failures.

c. Inspection Results

The licensee documented the results of the inspection in a memorandum dated October 7, 1991. The following discrepancies were identified:

a. The amertap barrel upstream of 1-CW-MOV-100D (4- bolt flange) was missing one bolt.

b. The amertap barrel upstream of 2-CW-MOV-200A had one nut out of approximately 80 cross-threaded.

c. All of the flow shields around expansion joints upstream of 1/2-CW-MOV-100A,B,C,D and -200A,B,C,D did not have the bottom 10 to 20 bolts installed which caused a gap to exist between the pipe and expansion joint shield in excess of one inch.

The inspectors reviewed the inspection results and noted that, although the inspection appeared to be adequately implemented, the licensee did not have a formal procedure for performing the inspection. The licensee is currently developing a procedure for inspecting CW and SW bolted connections. Maintenance requests were submitted on these deficiencies and several were corrected prior to the inspection team arrival. Independent of the licensee's effort, the inspectors selectively inspected some of the CW and SW fasteners and valves and made the following observations:

a. The expansion joints downstream of 1-SW-MOV-103C and 2-SW-MOV-203A had fasteners contacting the rubber expansion joint.

b. The expansion joints downstream of 1-SW-MOV-103C&D had been nicked and gouged in places.

d. Conclusion and Recommendations

The inspectors concluded that the licensee's valve and fastener inspection provided an increased level of assurance that the equipment that was inspected would continue to provide the pressure boundary integrity it was designed to provide. However, the inspectors did identify some discrepancies, as discussed above, that were not identified by the licensee. The licensee's inspection procedure which is currently being developed should include consideration for such discrepancies. Additionally, the licensee is expected to review the specific observations identified by the NRC and resolve them accordingly.

6. Expansion Joint Replacement

a. Description

The expansion joints are used to allow for the thermal expansion of the CW and SW piping systems. In addition to thermal expansion, the expansion joints permit ease of maintainability of the butterfly valves in the CW and SW systems. The expansion joints vary in size from 96" diameter for the CW system to 42", 36", 30" and 10" diameters for the SW system. The expansion joints are concentric spool type rubber joints with galvanized retaining rings. The composition of the rubber joints, as specified in the original specification (NUS-38, revised July 3, 1969), is essentially synthetic rubber. A more recent specification (NUS-2076, dated December 16, 1987), describes the material as EPDM (ethylene propylene diamine rubber) and polyester. The licensee indicated that NUS-2076 was used to procure the expansion joints for the MOV and expansion joint maintenance conducted in 1988 (see paragraph 4). The expansion joints function in brackish, untreated, river water and are considered nuclear safety related components. As a result of an earlier study on internal flooding, the licensee installed flow shields around the circumference of the 96" CW system, expansion joints. The purpose of the shields is to limit the flow from an expansion joint should it fail.

b. History of Replacement

In reviewing the CW and SW expansion joints, the inspectors reviewed the status of the 52 expansion joints that the licensee determined can cause Turbine Building flooding. Thirty-two of these expansion joints had been replaced in 1988. The remaining 20 expansion joints comprise 8 main condenser outlet expansion joints in the CW system and 12 expansion joints in the SW supply to the bearing cooling water heat exchangers. The following list identifies these 52 joints:

Description	Number EJ Replaced	Total EJ's
REJ-2: 96"(CW)	8	8
REJ-3 & 4: 96"(CW)	8	16
REJ-7: 42"(SW to component cooling)	2	2
REJ-8: 36"(SW to bearing cooling)	4	4
REJ-5: 30"(SW to bearing cooling)	0	12
REJ-6: 30"(SW to component cooling)	8	8
REJ-16: 10"(SW pump)	2	2
Totals:	32 EJs replaced	52 EJs

The inspectors questioned the apparent discrepancy between the October 29, 1991 letter, in which the licensee stated that expansion joints that are "significant contributors" to flood damage had been replaced and the fact that several important expansion joints had not been replaced. The licensee stated that these not-replaced expansion joints were not significant, but initially did not provide a documented technical basis for this determination. Pending receipt of this evaluation, the inspectors decided to review the material condition of the not-replaced expansion joints. Later in the inspection period the licensee provided an evaluation memorandum dated November 6, 1991, stating that the not-replaced expansion joints were not "significant contributors" in that they are located significantly downstream of the first CW or SW isolation valve. Although these expansion joints were not considered as "significant contributors" by the licensee, the inspectors and the licensee determined that their importance was significant enough to warrant inspection and evaluation for serviceability.

c. Present Status

The service life of the not-replaced expansion joints has exceeded the vendor's recommendations and an engineering evaluation for extending the life of these expansion joints has not been conducted by the licensee. NUS-38 specification indicated that the service life for the original type of expansion joint was about 15 to 17 years while NUS-2076 indicates for that particular material specified, the expected service life would be about 8 to 10 years. The licensee initiated discussions with the original manufacturer who indicated that the useful service life may be extended due to the mild service condition experienced for the specific CW system installation at Surry.

The inspectors also reviewed the installation of the flow shields on the CW system. The inspector's review as well as two previous licensee inspections found missing bolts and gaps between the shield and the mounting flange. On October 7, 1991, the systems engineer and a VT-2 Level II Inspector inspected the CW and SW system valves and adjacent piping which included the expansion joints. Results of these inspections are discussed further in paragraph 5 of this report. Between October 30 and November 2, 1991, Quality Assurance conducted an assessment of the flood protection program and compensatory actions. The original analysis assumed a uniform 1/2 inch gap around the flow shield, but in the actual installation the gap varies. In some locations the gap may be as large as 1 to 1.5 inches wide. The inspectors questioned, assuming a uniform 1 inch gap, if this would significantly effect the flooding analysis. Through discussions with the licensee and by reviewing the original flooding analysis, the inspectors determined that the flow shield restricted flow would increase from approximately 16,000 gpm to about 32,000 gpm. The licensee contends that this would not significantly effect the overall CDF.

The inspectors reviewed procurement documentation to determine if any significant failures had occurred in the past. Maintenance histories were not specifically kept in the past at this component level. Apparently an expansion joint (REJ-5) was replaced in the SW outlet line to a bearing cooling water heat exchanger. This occurred in July 1985. A procurement document indicated that a 96" condenser discharge expansion joint (REJ-4) was also replaced in June of 1987. The documentation did not clearly indicate a specific failure mechanism. No definitive conclusions on expansion joint maintenance or failure could be drawn from these replacements.

The inspectors examined a Goodall 36" expansion joint in the warehouse and verified that expansion joints were being properly stored in a dark, dry location. This particular expansion joint did not have a "filled arch". The "filled arch" expansion joint is generally used in safety related systems in horizontal applications. In this application the "filled arch" prevents debris buildup in the arch which could restrict free movement of the expansion joint. The inspectors were concerned that this expansion joint could be inadvertently installed in a safety related system. The licensee agreed to review this and ensure that the expansion joint would only be used in the intended application.

The inspectors questioned the licensee with regard to testing and installation of the expansion joints. Hydrostatic testing was conducted for the expansion joints by the supplier of the joints. The inspectors reviewed some hydrostatic test reports and NUS-2076 to verify that the joints were tested at 1.5 times the maximum design pressure and at the specified vacuum pressure. NUS-38 specifies a maximum design pressure of 40 psig and NUS-2076 lists a maximum design pressure of 80 psig for the 96" expansion joints. The operating pressure of the system is approximately 9 psig with the design maximum operating pressure of 20 psig. The inspectors also reviewed the Design Change Package (DCP) - 86-11-2 to ensure proper installation methods were specified and followed. The licensee installation procedures were found to be adequate, including the requirement to tighten the bolts and nuts in a uniform star pattern, achieving uniform gasket compression and developing the required bolt torque in a minimum of three steps. Testing and installation practices were adequate.

The licensee has not yet formerly developed a maintenance program for the expansion joints. The inspectors questioned the licensee with regard to the basic maintenance program elements and time of implementation. The major effort of the program will involve a visual inspection of the expansion joints. The licensee indicated the visual inspection will involve examination to determine if any significant offset has occurred, dry rot, cracks, abrasions, cuts, leaks or other signs of mechanical damage. It is anticipated that this inspection of the expansion joints of concern will be conducted on an annual or every refueling outage basis. Specifics of the program have not been finalized, but the licensee did indicate that a visual inspection would be conducted during the next outage. Based on the results of the periodic inspections the licensee will determine if any expansion joints should be replaced. In addition the licensee anticipates having the expansion joint manufacturer measure the expansion joint configurations and fabricate expansion joints to the precise measurements to account for any slight misalignments that may exist. These are some of the considerations for the new program, but the specifics have not been finalized by the licensee.

Recently, the licensee has begun injecting hypochlorite in the SW system to achieve 10 ppm chlorine concentration. The purpose is to reduce the amount of fouling that occurs in the springtime in the SW system. The inspectors wanted to ensure the licensee had adequately evaluated any effect the addition of hypochlorite might have on the expansion joints. The licensee had conducted an engineering evaluation of the effect on the material. This evaluation determined that non-metallic materials indicated satisfactory performance after exposure to chlorine water treatment. The inspectors were satisfied that this question had been appropriately addressed.

d. Commitments and Recommendations

Currently, the CW system is operating with four main condenser outlet expansion joints per unit that have an indeterminate service life. The primary concern is whether the remaining service life is sufficient for the units to operate until the 1992 Unit 1 outage. The licensee has proposed three methods to determine the actual remaining service life.

- First, there is some recollection that the licensee replaced these expansion joints during the 1980 time frame. The licensee is reviewing maintenance and procurement documents in an attempt to verify this assertion.

- Second, the licensee is contacting the vendor, Garlock, in an attempt to determine the remaining useful service life.

- Third, if one of the above two methods is unsuccessful, the licensee plans to inspect one of the main condenser outlet expansion joints on Unit 1 during a water box cleaning to estimate remaining service life of the 8 affected expansion joints.

The licensee committed to satisfactory verification of serviceability by one of these three methods for the four per unit not-replaced CW expansion joints by November 29, 1991.

In addition, assuming the above evaluation supports current serviceability, the licensee committed to replace the four main condenser outlet expansion joints during the Unit 1 refueling outage scheduled for February 1992 and for Unit 2, no later than the outage scheduled for February 1993. For Unit 2, the licensee committed to provide the basis for extending the replacements to the Unit 2 outage. If a review reveals that these expansion joints were replaced in the 1980 time frame, the licensee committed to provide an evaluation, documenting their service life beyond the Unit 1 and 2 outages.

The flow shields around the 96" CW expansion joints were not in their as-designed condition, but, as discussed above, would be effective in fulfilling their design function for the postulated flooding scenario. The licensee committed to upgrade the material condition of the flow shields by December 31, 1991, to include replacement of missing bolts.

In addition the SW system has 12 expansion joints that were not replaced in 1988. These expansion joints are not considered as significant a contributor to risk as a result of their physical location in the piping system; that is they are connected to smaller diameter pipes and have two isolation valves upstream of the expansion joints. The licensee committed to visually inspect these by November 29, 1991 and provide a schedule for replacement of any expansion joints that warrant it.

The SW system has no flow shields installed. The licensee stated in their October 29, 1991 letter that the flow shields will be installed on 6 SW expansion joints in the SW supply lines to bearing and component cooling by November 22, 1991. The inspectors identified that the licensee needs to ensure that these flow shields are properly installed.

e. Conclusion

The inspectors concluded that through the combination of inspection, remaining service life determination and replacement when required, the licensee has improved the reliability of the SW and CW expansion joints.

7. Turbine Building Sump Pump (TBSB) Improvements

a. Description

The Turbine Building Sump and Floor Drain Subsystem is composed of the three sumps; with three sump pumps for each sump; and the associated valves, instruments and piping. The major components are the sumps and the sump pumps. The Unit 1 sump is called floor drain sump number 1. The common sump between Unit 1 and Unit 2 is referred to as floor drain sump number 2. The Unit 2 sump is floor drain sump number 3. The sumps receive floor and equipment drainage from components in the Turbine Building and some areas of the Service Building. The sumps are approximately 12 feet wide, 12 feet long, and 8.5 feet deep. Each sump has metal plate covers for access, as necessary.

The three-per-sump high volume (1300 gpm) sump pumps operate automatically, based upon signals from sump level switches. The combined discharge of the three pumps for each sump is directed to the Yard Drain System, which empties into the discharge canal. The Turbine Building sump pumps discharge through individual check and isolation valves to prevent reverse flow and to permit isolation of a pump, respectively.

b. Performance History

The TBSPs are not designed as safety related components. Therefore, there are no safety related electrical power supplies, nor is there built-in redundancy of equipment or control circuits. Because of the system's initial design there are several ways that the system could become non-functional. For example the failure of the single sump level switch for the 36 inch pump shutoff could render all three pumps for that sump inoperable. Additionally, the failure of a single pump discharge check valve could result in bypass flow, back to the sump, of the other two pumps for that sump.

The inspectors reviewed the following information in order to assess the reliability of the TBSPs:

- . Maintenance History
- . Reliability Information
- . Planned Changes to Improve Reliability
- . Spare Parts Management
- . Testing
- . Control Circuits and Power Supply Reliability
- . Attendant Equipment

The inspectors reviewed a computer printout of the TBSP maintenance history. The printout covered the period from 1985 when the history program was established to the present. The TBSP history covered the attendant equipment such as the level switches and the discharge check valves since those items did not have unique identifiers assigned. The history indicated that all of the nine pumps and associated equipment have experienced frequent failures. The inspectors discussed the TBSP past reliability with the maintenance PM coordinator and the system engineering supervisor.

c. Present Status

When the inspectors arrived on site, the only inspection and testing of the TBSPs was a review of switch and breaker position per Operational Checklist OC-47, dated October 29, 1991. This procedure required the administrative maintenance of 9 out of 9 TBSPs operable, as initially stated in the licensee's October 28, 1991 letter. If the operators determined that less than 9 of 9 were operable, the procedure required immediate attention to initiate pump repair. This reliability level was changed to 7 of 9 by the licensee's October 29, 1991 letter. Based on the non-safety related status of these pumps and their relatively high failure rate, the inspectors determined that this procedure was insufficient to ensure that TBSP reliability could be maintained at either the 9 of 9 or 7 of 9 level as stated in the licensee's October 28 and 29 letters.

The TBSPs, level switches, and discharge check valves are not currently in the PM program, nor are the TBSPs covered by the licensee's Reliability-Centered Maintenance Program. However, the motors have been in the PM program since 1986. Additionally, the level switches, check valves, and the pumps are not periodically tested to verify performance. All nine pumps were tested during the period between October 3, and November 4, 1991, and passed the criteria established. MDAP 0009 specifies frequency of predictive testing and provides program guidance. The actual controlling instruction is provided by a computer based program that specifies frequency of testing.

The check valves and level switch history is not completely well known since there is no unique identifier assigned to this equipment and the failure history of the breaker protective devices is not known. In addition, the power supplies for the TBSP motors are located at an elevation where flooding could result in a loss of power to the motors.

The warehouse supply of spare parts is limited and currently consist of the following: 1) three impellers, 2) bearings and seals for approximately three pumps, 3) two pump shafts, 4) no motors, 5) no pump casings, and 6) no level switches. The licensee did however indicate that some spare parts are on order and some are stored at North Anna.

d. Commitments and Recommendations

Based on the inspectors' evaluation that the licensee's actions to improve sump pump reliability were insufficient to maintain seven of nine pumps operable, the licensee committed to develop a periodic test program for these pumps, to include the pumps, level switches, check valves and power supplies. This testing would verify quantitative flow and operability of equipment. The program will be developed by December 31, 1991 with the first series of periodic tests completed by January 31, 1992

The inspectors also identified that the licensee needs to consider including the TBSPs and related equipment in the Reliability-Centered Maintenance Program. In addition, the inspectors determined that the licensee should place more emphasis on improving parts staging for sump pump repair.

e. Conclusion

Based on the above, the inspectors verified that the licensee has placed additional emphasis on improving the reliability of the TBSP. However, without an on-going PM and testing program, the inspectors did not believe that the degree of TBSP reliability stated in the October 29, 1991 letter could be assured. After complete implementation of the licensee commitments in this area the licensee-stated TBSP reliability should be realized.

8. Turbine Building Sump Backflow Limiters

a. Current Status

Although not specifically addressed in the October 28 or 29, 1991 letters, an important issue involving Turbine Building sump backflow limiters was identified during the inspection. Through reviews of the drawings associated with the Turbine Building sumps the inspectors determined that Turbine Building sumps receive floor drains from several adjacent areas that contain safety related equipment. The areas involved included the Unit 1 and 2 ESGR as well as Mechanical Engineering Room (MER)-3, MER-4 and the Unit 1 and 2 cable vaults. Through the floor drain system Turbine Building flooding could communicate with the other areas and possibly incapacitate safety related equipment. The licensee has installed back-flow limiters in the floor drains in the areas above. The backflow limiter resemble a rubber float that checks flow into the room. The inspectors performed a visual inspection of the backflow limiters in MER-3 and the ESGRs for Units 1 and 2. The three backflow limiters in MER-3 appeared to be clogged with debris and non-functional. The backflow limiter in both the Unit 1 and Unit 2 ESGR were covered with water and there was also a large amount of debris in those sumps as well. The inspectors' review of the recent test of the backflow limiters revealed several problems.

First, the backflow limiters in the ESGRs and the cable vaults for both units had been tested per STP-70.4, Flood Protection Floor Drain Back Water Sewer Stop Valve Operability Test, dated February 20, 1990. This procedure is an annual test and based on review of past test results and discussions with plant personnel, the inspectors determined that the backflow limiters do not meet test criteria every time the test is conducted.

Second, the backflow limiters in MER-3 and MER-4 are not periodically tested and based on the condition observed by the inspectors are not routinely maintained. The licensee indicated that the backflow devices in the two MERs are not easily tested since there is no adjacent standpipe to allow back fill of the drain system.

b. Conclusion and Commitments

The inspectors consider that annual inspection without testing may not be frequent enough to ensure functionality of the backflow limiters which are an important part of the flood propagation mitigation scheme. Based on the inspectors' concerns the licensee replaced the backflow limiters in MER-3. In addition the inspectors questioned the acceptability of current testing methods and frequency for the backflow limiters in the Unit 1 and 2 ESGRs and cable vaults. Based on these concerns, the licensee committed to develop and implement a testing and/or replacement program for these backflow limiters by February 28, 1992. With this program, the inspectors consider that the Turbine Building sump backflow limiters should be maintained in an operable condition.

9. Interim Measures

In their October 28, 1991, letter, the licensee committed to several interim administrative measures to reduce the risk of plant damage due to internal flooding. An important note is that these measures are not included in the actions necessary to reduce the CDF. The inspectors reviewed the implementation of two specific interim measures; dedicated flood watch and procedural controls for stop log installation.

a. Dedicated Flood Watch

The flood watch patrol was initially implemented by utilizing the existing fire watch in the area. This resulted in a dilution of the individual's ability to perform either function well. The inspectors discussed this concern with station management and a dedicated flood watch was established and procedures were developed to implement this interim administrative control. Procedure GMP-012, Roving Flood Watch Responsibilities, dated October 21, 1991, was issued. This procedure specified the level of training required, the equipment necessary, the vulnerable equipment, and the route to follow. The inspectors verified adequate implementation of this interim action by interviewing several flood watches, as well as witnessing several of them performing their duties.

b. Procedural Controls for Stop Log Installation

The inspectors also verified that the commitment to proceduralize stop log installation was also implemented. Procedure GMP-011, Installation and Removal of Stop Logs, dated November 1, 1991, was reviewed. This procedure ensures that equipment is prestaged and that personnel are trained to perform the task. The procedure instructs the mechanics to attempt to install the four logs per intake bay and, if problems are encountered, they are to request assistance from the Station Emergency Manager or the Technical Support Center, if manned.

It should be noted that under high flow conditions, calculations indicate that the stop logs may not be able to be inserted. Additionally, the station did not test the ability to insert the stop logs under flow conditions. However, they did review previous stop log installations for maintenance purposes and factored that experience into the new stop log procedure.

10. Exit Interview

The inspection scope and results were summarized on November 6, 1991, with those individuals identified by an asterisk in paragraph 1. Specifically, the recommendations and conclusions from paragraphs 4.e, 5.d, 6.d and e, 7.d and e, 8.b, and 9 were discussed with the licensee. The licensee acknowledged the inspection conclusions with no dissenting comments and provided the commitments as discussed in the above paragraphs. The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspectors during this inspection.