



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

ENCLOSURE 2

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TEMPORARY EXEMPTIONS FROM THE REQUIREMENTS

OF GDC-2 AND 10 CFR 50.49

FOR

PHASE 1, STAGE 1 OF THE SERVICE WATER SYSTEM

RESTORATION PROJECT

NORTH ANNA POWER STATION, UNITS NO. 1 & NO. 2

DOCKET NOS. 50-338 AND 50-339

SUMMARY

The Virginia Electric and Power Company (VEPCO, the licensee) has planned a Service Water System Restoration Project for North Anna Power Station (NAPS). Units 1 and 2 share the two-train Service Water System (SWS). The two trains are completely redundant with four service water pumps, of which one pump per unit is normally in operation. However, major portions of the system serving either unit cannot be readily isolated (e.g., by closing valves) from the whole system.

The plan calls for the project to begin approximately one month before the planned Unit 1 Steam Generator Replacement Program (SGRP) outage and terminate approximately one month after returning the unit to power. In order to implement the plan, the licensee has requested temporary exemptions from the requirements of 10 CFR Part 50, Appendix A, Criterion 2 (GDC-2) and 10 CFR 50.49.

Most of Phase I, Stage 1 of the project is planned to coincide with a previously scheduled Unit 1 steam generator replacement and refueling outage. However, the plan calls for the project to be implemented while Unit 2 is in full power operation. To accomplish this, the plan relies on repeated, voluntary entry into one of the plant's Service Water System Technical Specifications action statements. The Nuclear Regulatory Commission (NRC) has specific guidance concerning voluntary entry into action statements, (Generic Letter 91-18). Since Stage 1 is not in conformance with Generic Letter 91-18 and represents a deviation from NRC guidelines for on-line preventative maintenance, the NRC staff has chosen to review the entire project, including the repeated, voluntary entry into the action statements.

The NRC staff has reviewed the licensee's plans for the Phase I, Stage 1 of the project and concludes: 1) the risk associated with the effects of natural phenomena on exposed safety-related systems is acceptable, 2) the risk associated with the change in environmental qualification for the control room and emergency switchgear room air conditioning system is acceptable, and 3) the overall risk of Phase I, Stage 1 of the project to the operating units is acceptable.

#### SCOPE AND OBJECTIVES

This evaluation addresses the safety issues raised by Phase I, Stage 1 of the SWS Restoration Project in terms of the guidance provided by Generic Letter 91-18, and the requirements of GDC-2 and 10 CFR 50.49. This review and evaluation is concerned with the safety of operating Unit 1 during part of the project and Unit 2 throughout the project. The review focuses on the project plans contained in the licensee's submittal and supplements. The staff has not reviewed an overall assessment of plant risk for North Anna. The licensee currently plans to submit its Individual Plant Examination (IPE) report for North Anna in December 1992.

Evaluation of the operations and construction procedures to be implemented during Phase I, Stage 1 of the project is not part of this review. It is expected that they will be audited by the NRC Resident Inspector and/or Region II staff to: (1) provide reasonable assurance that following the procedures is not likely to adversely affect the health and safety of the public or utility personnel, (2) assure that equipment, in particular back-up and contingency equipment described in the licensee's relevant submittals and referenced procedures, is in place during the project so as to maximize the likelihood of safe completion of the project, and (3) verify that the appropriate utility personnel have received adequate training on the procedures.

#### BACKGROUND

VEPCO informed the NRC, by letter dated May 18, 1992, of plans to extensively refurbish certain portions of the SWS at NAPS. In its July 16, 1992 letter to the NRC, VEPCO provided additional information on its schedule and plans.

The restoration is planned as a two-phase project. Phase I activities consist of an extensive refurbishment program for approximately 2100 feet of buried or concrete-encased 24-inch diameter SWS piping. This phase is planned to extend from December 1992 through June 1995. Phase II includes potential reservoir relining, internal recoating of the 36-inch diameter SWS headers, and repair and/or replacement of other accessible piping. This phase is not as yet scheduled and is not considered in this review.

Phase I is to be performed in five stages. Stage 1, which is the subject of this evaluation, is planned for the interval from December 1992 through June 1993, spanning the Unit 1 steam generator replacement and refueling outage scheduled to begin in January 1993 and extend through May 1993.

The July letter requests a temporary exemption from the requirements of 10 CFR Part 50, Appendix A, Criterion 2 (GDC-2), "Design bases for protection against natural phenomena," and points out that the licensee intends to rely on multiple entries into Limiting Condition for Operation (LCO) Action Statement b, Technical Specification (TS) 3/4.7.4, "Service Water System." The Limiting Condition for Operation states that at least two service water loops (shared by Units 1 and 2) shall be operable. In 1985, the licensee had Action Statement b for TS 3/4.7.4 modified, extending the allowable inoperable time from 72 hours to 168 hours when the action statement is entered as part of SWS upgrades. The licensee plans to enter this action statement six times during Stage 1.

On August 7, 1992, the NRC staff informed the licensee that additional information beyond that provided in the July letter and its attachments was required for NRC review. The licensee met with the NRC staff at NRC headquarters on August 25, 1992, to discuss the restoration project. On September 11, 1992, VEPCO forwarded to the NRC the report "Probabilistic Risk Assessment, North Anna Power Station, Service Water Preservation Project," Part 1, Rev. 2, and requested a temporary exemption from the requirements of 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants" to allow isolation of service water from the Unit 1 control room and emergency switchgear room chillers and permit temporary use of the common bearing cooling water system to cool the chillers.

By telephone on September 14, 1992, the NRC staff provided VEPCO with a description of the type and scope of information needed to review the risk aspects of the planned restoration project. VEPCO provided written and oral response to comments and questions raised by the staff in the September 14 telephone call at a meeting with the staff on September 28, 1992. At this meeting the NRC reminded the licensee that, in light of Generic Letter 91-18, "Information to Licensees Regarding Two NRC Inspection Manual Sections on Resolution of Degraded and Nonconforming Conditions and on Operability," including (by reference) NRC Inspection Manual Section, "Maintenance - Voluntary Entry Into Limiting Conditions for Operation Action Statements to Perform Preventive Maintenance," the NRC staff intended to review and evaluate the entire project, not just those portions associated with the specific exemption requests.

After reviewing the information provided by the licensee, in particular that presented at the September 28 meeting, the staff requested clarification and amplification of the licensee's responses as well as answers to several additional questions, by telephone, on October 14, 1992. At VEPCO's request, the staff again met with the licensee on November 2, 1992, to discuss VEPCO's response to the NRC's October 14 telephone call. In response to staff concerns, the licensee made some modifications to its project plans.

## OVERVIEW

### 1. Service Water System Restoration Project

The NAPS SWS is shared by Units 1 and 2. The existence of pitting corrosion in the system has been known for some time. Numerous upgrades

of the SWS have been implemented in response to the discovery of the corrosion problems, including a) the replacement of smaller distribution lines, b) redesign and replacement of the spray arrays and headers in the service water reservoir, c) mechanical and chemical cleaning of the service water piping, and d) improvements in chemical addition and control in the SWS. VEPCO believes it is now better able to accurately characterize microbiologically-influenced corrosion pitting depths and pit population densities in representative areas of the system. The 24-inch SWS lines have been identified as the most susceptible to both general and pitting corrosion due to the stagnant and low flow conditions present.

The stated objective of the project is to clean, evaluate, and restore internal SWS pipe surfaces as required to assure continued structural integrity and to apply a protective coating to minimize or eliminate further corrosion. In general, the refurbishment process will only be used on concrete-encased pipe sections; all other 24-inch piping in the area encompassed by Phase I, Stage 1 of the project will be replaced.

All SWS pipe sections which are buried in soil under the alleyway between the Unit 1 Quench Spray Pump House and Service Building and the exposed Auxiliary SWS piping in the Unit 1 Service Building will be replaced with new piping similarly coated internally and protected externally from corrosion. Each of the steps in the process is to be followed by licensee inspection, as necessary, by certified inspectors to ensure quality.

According to the licensee's plan, the replacement of approximately 160 feet (four parallel lines approximately 40 feet in length and 6 feet apart) of buried 24-inch piping (13 to 23 feet below grade) necessitates the removal of missile barrier protection and exemption from the requirements of GDC-2. In addition to the buried 24-inch service water lines to the Unit 1 recirculation spray heat exchangers, the alleyway also contains two concrete-encased electrical duct banks with safety-related cables (6 to 20 feet below grade and over top of the 24-inch SW lines), a concrete encasement which encloses the 4-inch service water lines to the Unit 1 control room chillers (8 feet below grade, above and off to one side of the 24-inch SW lines), and various non-safety-related storm drains.

## 2. Licensee's Basis for the Exemption Requests

- a) Pursuant to 10 CFR 50.12(a), VEPCO requested an exemption for Units 1 and 2 from the requirements of 10 CFR 50, Appendix A, General Design Criterion 2 (GDC-2). According to GDC-2, "Structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions."



As applied to the buried piping and ducts described above, Stone & Webster (the NAPS Architect/Engineer) performed calculations to establish 6 feet of silty sands (selected from the site and placed in layers and compacted to a minimum density of 95 percent of the maximum obtained in the standard compaction test ASTM D689-66T, Method D) as adequate protection from natural phenomena (per discussion in the NAPS FSAR and NAS-78, Design Instructions, Tornado Protection for Buried Piping, Tanks, and Conduits).

The reason for the exemption request is to permit the licensee to initiate the restoration project approximately one month before the scheduled Unit 1 steam generator replacement and refueling outage and extend the project approximately one month beyond the end of the outage. Also, NA-2 will be operating throughout the entire period. The exemption is needed (1) the entire time Unit 1 is in Modes 1 through 4 while the electric duct bank and 4-inch SWS piping is covered by less than 6 feet of backfill material, and (2) the entire time the section of the 24-inch SWS piping is not isolated while covered by less than 6 feet of compacted backfill material.

- b) Pursuant to 10 CFR 50.12(a), VEPCO also requested a temporary exemption for Unit 2 from the requirements of 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants." This section of the CFR states, in part:
- "(a) Each holder of or each applicant for a license to operate a nuclear power plant shall establish a program for qualifying the electric equipment defined in paragraph (b) of this section." ...
- "(e) The electric equipment qualification program must include and be based on the following: (1) Temperature and pressure. The time-dependent temperature and pressure at the location of the electric equipment important to safety must be established for the most severe design basis accident during or following which this equipment is required to remain functional. (2) Humidity. Humidity during design basis accidents must be considered..."

Ventilation for each unit's chiller room (each containing three control room and emergency switchgear room (CR/ESGR) air conditioner (AC) chillers) is taken from and exhausted to the respective unit's turbine building basement. Since all the chillers for each unit are located in the same environmental zone, an environmental qualification evaluation of the CR/ESGR AC was performed which resulted in a station standing order requiring that at least one CR/ESGR chiller on a unit in Mode 5 or 6 (shutdown) be maintained operable while the other unit is in Mode 4 or above. However, since bearing cooling (BC) water is used to substitute for service water while the work is conducted on the 24-inch SWS pipes, which supply SW to the 4-inch lines, the reliability of the Unit 1 chillers is called into question because bearing cooling is not safety-related, necessitating the exemption request.

- c) The licensee cites 10 CFR 50.12(a) as the basis for its exemption requests. According to 10 CFR 50.12(a), the Commission may grant the requested exemptions provided they do not present an undue risk to the

public health and safety and special circumstances are present. Specifically, the licensee claims no undue risk to public health and safety and that the following three special circumstances (of the six listed in 10 CFR 50.12(a)) apply to its request: "(iii) Compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted, or that are significantly in excess of those incurred by others similarly situated; or (iv) The exemption would result in benefit to the public health and safety that compensates for any decrease in safety that may result from the grant of the exemption; or (v) The exemption would provide only temporary relief from the applicable regulation and the licensee or applicant has made good faith efforts to comply with the regulation."

3. Generic Letter 91-18

Generic Letter (GL) 91-18, "Information to Licensees Regarding Two NRC Inspection Manual Sections on Resolution of Degraded and Nonconforming Conditions and on Operability," intended by the NRC to ensure consistency during the review of operability determinations and resolutions of degraded and nonconforming conditions by licensees, was issued November 7, 1991. The GL requires no specific licensee actions. However, licensees were encouraged to consult with the Regional Office regarding the application of specific staff positions in the guidance.

With regard to preventive maintenance (PM), according to subsection 6.4 of the NRC Inspection Manual Section on Operable/Operability: "For equipment subject to the Technical Specifications, the PM activity and any other action that may be required by the Limiting Conditions for Operation, is expected to be completed within the Allowed Outage Time (AOT)." "In all cases, care should be exercised in removing equipment from service for PM to avoid accumulating long out-of-service times of safety trains." "See 'Maintenance - Voluntary Entry into Limiting Conditions for Operation Action Statements to Perform Preventive Maintenance.' NRC Inspection Manual, Part 9900, Technical Guidance."

The purpose of the above-mentioned Manual Section on Maintenance is to provide a set of safety principles for guiding the performance of PM at licensed nuclear reactor facilities when performance of PM requires rendering the affected system or equipment inoperable (i.e., on-line PM). The guidance provides qualitative criteria to assist in recognizing abuses of on-line PM. According to this Manual Section: "Performing such PM (e.g., emergency diesel generator overhaul at power) requires intentionally entering the TS LCO for the affected system. If the licensee does this, it must complete the PM and restore compliance with the LCO Operability requirements within the time specified in the appropriate action statement of the LCO (i.e., the AOT)." The NRC is only beginning to quantitatively study the significance to safety (risk) of the trend to perform more PM during power operation. Therefore, the NRC cannot yet establish quantitative criteria by which the NRC or a

licensee can determine the net effect on safety that on-line PM would have at a facility. Until studies concerning the risk of on-line PM are completed, this guidance establishes conservative principles for safely performing PM that involves entering into LCO action statements.

With regard to taking equipment out of service to perform on-line maintenance, the Manual Section on Maintenance states that the licensee may proceed if it expects the reliability of the equipment to improve such that the overall risk to safe operation of the facility should decrease. Furthermore, "The licensee should be able to justify such an expectation of improved safety. Part of this justification should be based upon adherence to the following conservative safety principles:

1. Performance of a PM action on-line rather than during shutdown should improve safety (as described above) and be warranted by operational necessity, not just by the convenience of shortening a refueling outage.
2. The licensee should not abuse the allowance to perform a PM action on-line by repeatedly entering and exiting LCO action statements. The licensee should carefully plan the PM action to prevent such abuse.
3. ... If a piece of equipment is Operable, but is degraded, or is tending towards a degraded condition, the licensee should not remove its redundant counterpart equipment from service for a routine PM action.
4. While performing an on-line PM action, the licensee should avoid performing other testing or maintenance that would increase the likelihood of a transient..."

The reason for reviewing the overall risk of Phase I, Stage 1 of the project is that it is on-line PM which requires repeated entering and exiting LCO action statements. The licensee did not address GL 91-18 in its initial submittal. In subsequent meetings, the staff reminded the licensee of GL 91-18 and the licensee provided additional information about the project.

#### 4. Project Chronology

According to the licensee's schedule, Unit 2 will be operating at full power throughout Phase I, Stage 1 of the restoration project. The buried portions of the service water supply and return lines to the Unit 1 containment recirculation spray heat exchangers will be excavated during the approximately one-month period prior to the scheduled outage start date for Unit 1. Likewise, the licensee plans to replace backfill material over the exposed pipe during a one-month period following the return of Unit 1 to operation.

In order for the licensee to implement the planned project, it is necessary to isolate the Unit 1 portion of the SWS east of the 36-inch to 24-inch reducers in the Service Building from the main headers so as to maintain normal operation of Unit 2 and common sections of the SWS. This is to be accomplished by entering Action Statement b of Technical Specification 3/4.7.4 a total of six times: twice (once for each header) to install welded-in plugs in the 24-inch piping for header A near the 36-inch to 24-inch reducers, then in header B near the 18-inch manways, twice to relocate them (reversing the positions of the plugs in headers A and B) so as to isolate the auxiliary service water header not isolated before, and then twice to remove the plugs altogether. These actions would a) isolate the Unit 1 recirculation spray heat exchangers and control room and emergency switchgear room air conditioning chillers, b) remove back-up cooling to containment recirculation air coolers and auxiliary feedwater pumps, and c) remove the supply and return paths for the two auxiliary service water headers, one at a time.

A summary of the planned sequence of activities during Phase I, Stage 1 of the project is as follows:

a) Units 1 and 2 in Mode 1, power operation.

- Install cross ties from the bearing cooling system to the Unit 1 control room chiller service water piping.
- Machine excavate concrete roadway and near-surface backfill material (all remaining excavation to be done using hand-operated power and manual tools).
- Excavate 4 feet of backfill material (electrical duct banks and service water piping still covered) and install temporary seismic supports for 4-inch service water lines (leading to the control room and emergency switchgear room air conditioning chillers) and electrical duct banks (which contain no cables, the rupture of which would initiate an event, i.e., a plant trip, but which contain accident mitigating component power cables, the rupture of which could disable two Outside Recirculation Spray (ORS) pumps, two motor-driven Auxiliary Feedwater (AFW) pumps, and two Low Head Safety Injection (LHSI) pumps).
- Continue excavation to no closer than 1 foot of the 24-inch SWS lines.

During this portion of the project, the missile protection barrier for the 24-inch and 4-inch SWS piping, and the electrical duct banks, is to be removed, but the 24-inch SWS lines are to remain under a minimum of 1 foot of compacted backfill material.

b) Unit 1 in Modes 5 or 6 (shutdown) and Unit 2 in Mode 1 (power operation).



- Enter (168 hour) TS LCO 3.7.4.1 Action Statement b for header "A" and install plugs in the 24-inch SWS supply and return lines west of the 18-inch manways but east of the connections for the Auxiliary SWS supply and return lines for header A, leak test header A, return it to service, and clear the Action Statement. Begin restoration work in header A east of the plugs.
- Place the chiller piping cross tie in service. Enter (168-hour) TS LCO 3.7.4.1 Action Statement b for header "B" and install plugs in the 24-inch SWS supply and return lines at the 36-inch to 24-inch reducers west of the 18-inch manways and the connections for the Auxiliary SWS supply and return lines for header B (to allow for restoration of these lines), leak test header B, return it to service, and clear the Action Statement. After this entry to Action Statement b, all SWS piping in the alleyway is isolated from the rest of the SWS and work is to commence on removing the remaining 1 foot of backfill over the 24-inch SWS piping.
- As soon as (1) restoration of the supply and return lines for header B up to between the connections for the Auxiliary SWS supply and return lines for header B and the 18-inch manways is completed, and (2) restoration and replacement of Auxiliary SWS supply and return lines for header B is completed, enter (168-hour) Action Statement b to relocate the plugs in SWS header B. The plugs are to be relocated to points west of the 18-inch manways but east of the connections for the Auxiliary SWS supply and return lines for header B, header B is to be leak tested, returned to service, and the Action Statement cleared.
- Enter (168-hour) Action Statement b for header A and relocate plugs in the supply and return lines to the 36-inch to 24-inch reducers, west of the 18-inch manways and the connections for the Auxiliary SWS supply and return lines for header A (to allow for restoration of these lines), leak test header A, return it to service, and clear the Action Statement.
- Complete (1) restoration and replacement of remaining SWS piping, as appropriate, (2) construction of a manway vault in alleyway adjacent to the Service Building wall, and (3) installation of four new manways on the A and B headers in the manway vault. After hydrotesting the alleyway SWS piping between the Quench Spray Pump House and the manway vault wall, the return of backfill material in the excavated alleyway is to begin.
- After all the 24-inch SWS lines have been covered with at least 1 foot of compacted backfill, enter the (168-hour) Action Statement for header A to remove the plugs, test the header A SWS piping in the Service Building up to and including the new manway vault, return header A to service, and clear the Action Statement.

- While returning and compacting backfill material in the alleyway proceeds (using hand-operated power and manual tools), enter the (168-hour) Action Statement for header B to remove the plugs, test the header B SWS piping in the Service Building up to and including the new manway vault, return header B to service, and clear the Action Statement.

While missile barrier protection (6 feet of backfill) for some of the 24-inch SWS piping is to be restored before completing this portion of the project (the piping exits the Quench Spray Pump House at an elevation 10 feet higher than the elevation at which it enters the Service Building), some of the concrete-encased electrical duct banks and 4-inch SWS piping encasement will remain uncovered. However, at no time during this phase of the project is any part of the 24-inch SWS piping in the alleyway covered by less than 1 foot of compacted backfill when not isolated.

c) Units 1 and 2 in Mode 1, power operation.

- Continue returning and compacting backfill material in the alleyway to restore missile protection for the 24-inch SWS piping and remove the temporary seismic supports on the electrical duct banks and 4-inch SWS line encasements.
- Complete returning and compacting backfill material to restore missile protection for the electrical duct banks and 4-inch SWS line encasement. Replace the concrete roadway.

## DISCUSSION

### 1. Protection Against Natural Phenomena (Units 1 and 2)

The licensee's first request and this portion of the NRC review concern exemption from 10 CFR Part 50, Appendix A, GDC-2, for the time period from about December 1, 1992 through June 30, 1993, and only evaluates events with outcomes that are likely to present a new or significantly altered challenge to safe operation of the plant, should they occur during the project. In general, the natural phenomena considered for analysis are earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches.

Of these phenomena, the latter two are eliminated from consideration by the location of the NAPS relative to a large body of water. The plant is located above the surface elevation of Lake Anna, which is a relatively small lake. The service water reservoir and Reactor Water Storage Tank (RWST) are above the excavation area and the only significant sources of flood water. However, flooding associated with a) earthquake-induced disturbances of the service water reservoir or b) rupture of the RWST or c) failure of the earth dam of the reservoir are remote, and would, due to grading and structures, result in water flowing away from the excavation area, and would likely produce effects not significantly altered by the project.

Of greater concern are events capable of producing projectiles of high energy which could penetrate exposed or lightly covered piping, and earth motion which may cause poorly supported piping or electrical duct to rupture.

The time of year Phase I, Stage 1 of the project is undertaken and the location of the plant make a hurricane hazard unlikely. Coupled with this is the fact that hurricanes are observed and carefully tracked long before they reach shore, allowing ample time to temporarily discontinue the project or shut down the units.

With regard to earthquakes, the licensee has performed an analysis of the risk from seismic events if adequate supports are not provided. The analysis showed that the probability of seismic ground motion sufficient to exceed the design basis for components in soil is in the non-negligible range of  $6.5E-05$  to  $3.4E-04$  during the total of two 30-day periods at each end of the Unit 1 outage. Hence, the licensee plans to install seismically qualified supports for the electrical duct banks and encased 4-inch service water lines which would in any case, according to the licensee, require support structures of some sort to adequately support their own weight once the backfill is removed. The analysis for the seismic supports and their construction is to be subject to review by NRC Resident Inspectors and/or the Region II staff. Concerning the 24-inch SWS piping, it is to remain supported by and covered with at least 1 foot of compacted backfill while not isolated from the rest of the SWS system. It should be noted that due to the 10-foot change in elevation of the 24-inch SWS piping as it traverses the alleyway, this commitment means that most of the piping would be covered by well in excess of 1 foot of compacted backfill.

With regard to tornadoes/high winds, the licensee estimates the probability of a tornado striking any point in the plant as  $5.4E-06$  during the total of two 30-day periods at each end of the Unit 1 outage. Furthermore, since the exposed safety-related piping and electrical cable is at least 6 feet below grade, and the excavation area is closely surrounded by buildings on three sides, the licensee estimates the probability of damage to these components to be well below  $1E-06$  and, hence, negligibly small. Also, tornado watches are normally issued sufficiently in advance of tornadoes to permit the removing or securing of potentially damaging projectiles near the excavation area or to temporarily discontinue the project or shut down the units.

2. Control Room and Emergency Switchgear Room Chillers (Unit 2)

The licensee's second request and this portion of the NRC review concern the exemption from 10 CFR 50.49, for the time period from about December 1, 1992 through June 30, 1993, and only evaluates events with outcomes that are likely to present a new or significantly altered challenge to safe operation of the plant should they occur during the project. This portion of the review addresses the change in reliability of the control room and emergency switchgear room air conditioning system resulting from implementation of the project.

By station standing order, the Unit 1 CR/ESGR chillers provide backup to the Unit 2 CR/ESGR chillers when Unit 1 is in shutdown and Unit 2 is in operation. Since the BC water system, a non-safety-related system, is substituted for the SWS during the exemption period, the normal environmental qualification design basis for the Unit 2 CR/ESGR chillers is affected. For example, BC could not be considered available in the event of a loss of off-site power or a design base earthquake coincident with a main steam line break in the turbine building outside the CR/ESGR chiller room.

The licensee performed an analysis to calculate the change in core damage probability (CDP) due to the change in the operational configuration of the backup chillers for the Unit 2 CR/ESGR AC system. According to the licensee, the change in CDP for either example mentioned above would be much less than  $7E-06$ , the calculated failure probability of the Unit 2 AC system. However, it should be noted that when the BC system is used as a source of water to Unit 2 AC system backup chillers, the increase in the CDP due to operation of the SWS in one header configuration (discussed below) will be reduced from  $5.1E-06$  to  $3.0E-06$ . This reduction is mainly due to an independent source of water to the chillers which, in turn, introduces defense against common cause failure of water supply to the chillers.

The licensee is committed to maintaining at least one Unit 1 BC water pump and flow path operable and to supplying the Unit 1 chiller piping while the normal service water source is unavailable.

3. Overall SWS Restoration Project Plan (Units 1 and 2)

Construction and implementation activity associated with the project during power operation present potential challenges to the plant. This portion of the NRC review concerns the impact of the project on safe operation of Units 1 and 2 and the staff position presented in GL 91-18.

According to the licensee, the NAPS SWS piping is experiencing degradation because of general corrosion and relatively rapid wall loss in localized areas because of microbiologically-induced corrosion. The restoration project has been planned to replace sections of buried pipe and clean, weld repair, and coat encased pipe.

Excavation of the 24-inch SW lines which are to be replaced exposes the concrete-encased bank of four 4-inch SW lines and two concrete-encased electrical conduit ducts to possible hazards which may interrupt power to critical equipment. The ducts contain cables to Unit 1 accident mitigating components (2 ORS pumps, 2 motor driven AFW pumps, and 2 LHSI pumps) but no cables to any component or group of components whose failure would initiate a manual or automatic plant trip. The licensee's PRA showed that for a duct damage event probability of 0.01 (for the two 30-day periods at the beginning and end of the project) the change in core damage frequency (CDF) is about  $2.5E-06$  per year for the case of damage to one duct and  $7.5E-06$  per year for the case of common cause damage to both ducts. However, plant Technical Specifications require



the plant to commence shutdown within 72 hours should any of these pumps become inoperable. None of the equipment that would be affected by rupture of the duct banks is needed for normal shutdown of the units.

With regard to the 4-inch SW lines, they are to remain in service and exposed until the 24-inch SW lines to the Unit 1 Recirculation Spray System are isolated. However, since cross-ties from the BC system are to be installed before excavation begins, rupture of these lines would only require 1) closing a valve to isolate the Unit 1 chiller lines from the SW system, 2) opening a valve in the BC system, and 3) closing a valve to isolate the ruptured SW lines from the 24-inch headers. Rupture of these lines would place Unit 1 in an LCO action statement for the CR/ESGR AC system TS and could cause minor flooding of the excavation area which, in turn, could ground damaged electrical cables, but should not interfere with normal shutdown of the units.

The hazards of greatest concern are those associated with activities in and around the 24-inch SW headers to and from the Unit 1 recirculation spray heat exchangers. There are no valves to isolate these lines from the rest of the SWS. Significant damage to both headers prior to isolation or failure of the isolation of one while the other is being isolated could cause a total loss of SW. Loss of SW could result in loss of cooling to emergency switchgear which would induce a station blackout and/or loss of reactor coolant pump (RCP) seal cooling, due to the failure of charging pumps and loss of component cooling to the RCPs, and a loss of instrument air compressors.

a) SW System and System Interfaces

The sources of water for the shared SWS are the SW reservoir and Lake Anna (via Auxiliary SW lines). The purpose of the SWS is to provide long-term cooling after a loss-of-coolant accident and to supply cooling water to the following safety-related components during normal plant operations: component cooling heat exchangers; recirculation spray heat exchangers; control room and emergency switchgear room air conditioning condensers; charging pump seal coolers, gear reducers, and lube oil coolers; and instrument air compressors.

b) Hazards

At the beginning of Phase I, Stage 1, excavation of the Unit 1 SW lines is to be performed prior to the outage while both units are operating. At the end of Phase I, Stage 1, the return of backfill material to the area is to be performed after restart of Unit 1. During excavation and return of backfill material, there is the possibility of damage to the SW lines. The greatest danger is associated with heavy objects falling and causing the rupture of both of the SW lines or one of the SW lines while the other is being plugged.

In addition, during the restoration work, each SW header must be isolated and partially drained to install and remove weld-in plugging devices on the SW lines leading to the Unit 1 Recirculation Spray Heat Exchangers. This will result in a loss of redundancy in the SW system for Unit 2 for six periods of up to seven days each. During these periods there is the possibility of improper valve alignment as SW headers are closed off and drained, and loads are repeatedly shifted from one header to the other. Beyond this there is the possibility of SWS failures due to pipe damage during the project or weld-in plug failure. If this were to occur in one line while the other is being plugged, the result would be total loss of SW.

c) Precautions and Countermeasures

In order to decrease the potential for construction mishaps which could rupture the 24-inch SW lines, the one-foot depth of backfill material (well-compacted dense granular crushed stone) is to be maintained over the lines when they are not isolated from the rest of the SW system. The lifting of heavy loads over the excavation during periods when the service water lines are operable is to be evaluated by the licensee and specific controls for the movement of these loads are to be imposed such that if any load were dropped, it would not compromise the pressure boundary integrity of the lines. In addition, the licensee plans to use survey methods and manual probes to locate ducts and pipes, install barriers to limit vehicle access to the excavation, and install shoring at lower elevations before exposing the 24-inch SW piping.

The major difficulty with the refurbishment process is the limited access (through four 18-inch manways) and confined conditions (working inside 24-inch piping). The activities required for the interior restoration and coating work are to be tested on a full-scale mock-up to demonstrate under simulated conditions that the procedures, techniques, equipment, and personnel can accomplish the objectives of the project.

The routine periodic tests required of Unit 1 during cold shutdown and refueling outages and for Unit 2 during power operation were reviewed by the licensee to ensure compatibility with the SWS operating configurations created during the SWS Restoration Project. The licensee reviewed safety system functional tests which require portions of the SWS to be operable, SW component level tests, and component level tests on other systems which affect the SWS (e.g., Control Room Chiller Pump and Valve Tests and Emergency Diesel Generator Tests) to assure that surveillance, tests, and maintenance efforts will not have a negative impact on safe operation of the units. In addition, Station Operations is to maintain cognizance and control of system and equipment operability via the component tag-out procedures.

The licensee has prepared numerous operations, construction, and restoration procedures to be used during Phase I, Stage 1. It is expected that the NRC Resident Inspector and/or Regional Inspectors will audit these procedures to verify that they are adequate and that those implementing them have received appropriate training on their use. In particular, special attention should be given to assessing the potential for properly inserting and removing weld-in plugs.

With regard to Unit 2, the following countermeasures for total loss of SWS are to be in place during Phase I, Stage 1: 1) an alternate source of water (primary grade or fire protection) to the charging pumps cooling system (to prevent RCP over heating and RCP seal LOCA) is to be staged at or prior to project initiation to assure that it can be placed in service within approximately 10 minutes; 2) an alternate source of water (bearing cooling) to the CR/ESGR cooling system (to prevent emergency switchgear overheating and station blackout) is to be installed at project initiation; and 3) the capability to repair the SW piping (in the alleyway or Auxiliary Building) is to be provided to expedite recovery (in less than 8 hours) due to SWS header rupture.

With regard to Unit 1, loss of SWS would result in loss of Residual Heat Removal (RHR) cooling which would be the cooling mode for Unit 1 during most of Phase I, Stage 1. The licensee's abnormal procedure for loss of RHR provides instructions to use gravity feed from the RWST or to use LHSI pumps which take suction from the RWST as an alternate mode to RHR cooling.

d) GL-91-18 Implications

With regard to GL-91-18, the licensee's proposed Phase I, Stage 1 of the project does not conform with NRC guidance relative to on-line preventative maintenance. In particular, the licensee is not in conformance with the second of the four above-noted NRC safety principles; i.e., the licensee plans repeated entering and exiting of LCO action statements to perform on-line preventive maintenance. In addition, the staff has general safety concerns with performing extensive construction on a shared safety-related system at a multi-unit site while one of the units is operating.

The licensee performed a probabilistic analysis of the SWS to determine the change in the Unit 2 CDP resulting from isolating each train of SW for six periods of 7 days to install weld-in plugs and to estimate the change in CDP associated with construction activities. The analysis determined that the change in CDP due to loss of SWS redundancy for 42 days is  $5E-06$ . Although there is the possibility for an event that leads to total loss of the SWS during the project, it is practically impossible to determine the probability for such events as a construction mishap or the incorrect installation of a weld-in plug. However,

the licensee has been made aware of the staff's concerns regarding project risk, has taken steps to reduce the risk, and has planned compensatory measures.

4. Summary of Contingency and Compensatory Measures to be Implemented

The licensee is providing contingency measures with compensatory actions to provide added assurance of safe operation of the facility during the exemption period. Although the exemption is requested only for missile protection, the risk to the plant due to construction mishaps is more pronounced than the risk due to natural phenomena. Therefore, the compensatory measures are geared toward preventing such mishaps in addition to minimizing the potential for missile generated by severe weather. The contingency measures and compensatory actions include but are not limited to the following:

- o Electronic scanning and nondestructive locating methods will be used to accurately determine underground locations of piping, duct banks, and other buried utilities prior to excavation.
- o Machine excavation will be limited to near surface depths. The bulk of the excavating will be hand-operated power and manual tools.
- o Physical barriers will be used to keep vehicles a safe distance from the excavation.
- o Loose materials will be limited to only those absolutely necessary for activities in progress.
- o All lifting and rigging will be inspected and load tested. Lifting of equipment or construction materials over the excavating will be prohibited while the piping is exposed and operable.
- o Temporary supports will be used to ensure that exposed safety-related components retain their seismic qualification.
- o Severe weather procedures will be used to provide notification to clear the area of vehicles and loose materials in the event of a tornado watch or other high wind conditions.
- o Adequate wind protection and heating will be provided during freezing weather conditions.
- o A temporary back-up supply and return path to the Unit 1 control room chillers from the common bearing cooling header will be installed. This will remain available during the entire duration of the Unit 1 SWS outage work.



In addition, the following actions will be used during single SWS header operations while in the 168-hour action statement.

- o A temporary water supply from either the primary grade water of fire water systems will be available as a contingency to the charging pump coolers should the normal SWS supply be interrupted.
- o Emergency pipe repair materials will be staged in key areas to reduce response time in the event of a leak or a rupture. Procedures for emergency pipe repair will be developed and plant personnel will be trained in the use of these procedures and materials.
- o As required by the Technical Specifications, three of the four SWS pumps and both of the auxiliary SWS pumps will be operable as a prerequisite for entry into the Action Statements. There will be no planned maintenance on the SWS during an action statement period.
- o Flood prevention and mitigation measures will be in place.

#### CONCLUSIONS

1. Exemption concerning GDC-2

The NRC staff has reviewed the licensee's plans for Phase I, Stage 1 of the project and concludes that the risk from natural phenomena during implementation of the project is acceptable provided the licensee has severe weather procedures in place to provide appropriate safety guidance to protect the plant in the event of a tornado watch or other high wind conditions.

2. Exemption concerning 10 CFR 50.49

The NRC staff has reviewed the licensee's plans for using the BC water system as a substitute for the SWS to provide cooling for the backup Unit 1 CR/ESGR chillers during Unit 2 operation. The staff concludes that the risk associated with the change in environmental qualification for the CR/ESGR AC is acceptable.

3. Generic Letter 91-18

The staff notes that Phase I, Stage 1 is not in conformance with the NRC position on the matter, as discussed in GL 91-18, and represents a deviation from NRC guidelines for on-line preventive maintenance. However, the licensee has been made aware of the staff's concerns regarding project risk, and has taken steps to reduce the risk and has planned compensatory measures. The NRC staff has reviewed the licensee's overall plans for Phase I, Stage 1 of the restoration project and concludes that the risk associated with the construction and implementation activities is acceptable.