# Safety Evaluation Report

NUREG-0053
Suppl. No. 2

U. S. Nuclear Regulatory Commission

## related to operation of

# North Anna Power Station Units 1 and 2

## Virginia Electric and Power Company

Office of Nuclear Reactor Regulation

Docket No. 50-338 and 50-339

August, 1976

## Supplement No. 2

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NUREG-0053, SUPP. 2
AUGUST 2, 1976

# SUPPLEMENT NO. 2

# TO THE

# SAFETY EVALUATION REPORT

# BY THE

# OFFICE OF NUCLEAR REACTOR REGULATION

# U. S. NUCLEAR REGULATORY COMMISSION

# IN THE MATTER OF

# VIRGINIA ELECTRIC AND POWER COMPANY

# NORTH ANNA POWER STATION-UNITS 1 AND 2

# DOCKET NOS. 50-338 AND 50-339

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# 1.0 INTRODUCTION AND GENERAL DISCUSSION

## 1.1 INTRODUCTION

On June 4, 1976 the Nuclear Regulatory Commission (Commission) issued its Safety Evaluation Report regarding the application for licenses to operate the North Anna Power Station, Units 1 and 2 (North Anna facility, North Anna plants, facility or plant). The application was filed by the Virginia Electric and Power Company (applicant). Supplement No. 1 to the Safety Evaluation Report was issued on June 30, 1976. Supplement No. 1 to the Safety Evaluation Report documented the resolution of several outstanding items, and summarized the status of the remaining outstanding issues.

The purpose of this supplement is to update our Safety Evaluation Report (and Supplement No. 1) by providing (1) our evaluation of additional information submitted by the applicant since the issuance of Supplement No. 1 of the Safety Evaluation Report, (2) information regarding the current status of matters that were still under review and (3) additional information for those sections of the Safety Evaluation Report where further discussion or changes are in order.

Each section of this supplement is numbered the same as the section of the Safety Evaluation Report, and is supplementary to and not in lieu of the discussion in the Safety Evaluation Report, except where specifically so noted. Appendix A is a continuation of the chronology of our principal actions related to the processing of the application.

A summary of the remaining outstanding issues is presented in Section 22.0 of this supplement.

# 2.0 SITE CHARACTERISTICS

## 2.4 HYDROLOGIC ENGINEERING

### 2.4.2 Flood Potential

We stated in the Safety Evaluation Report that the applicant had recently advised us by letter, dated April 30, 1976, that it had been reevaluating the analysis for predicting the probable maximum flood and would submit a report on the results of this reanalysis by June 30, 1976. We also stated that we would evaluate this report to determine if our conclusions regarding protection against flood potential are still valid and report our findings in a subsequent report.

In Amendment 53 to the Final Safety Analysis Report the applicant submitted its revised probable maximum flood analysis. We have reviewed the applicant's revised probable maximum flood analysis and based on this review and our independent analyses, we conclude that the applicant's revised estimate of the maximum Lake Anna water level of 267.3 feet above mean sea level (including wave action) is conservative and meets the criteria outlined in Regulatory Guide 1.59 "Design Basis Floods for Nuclear Plants." This level is 3.7 feet below plant grade. We concur with the applicant that this level will have no safety impact on the plant, since service water is available from the service water reservoir, located 45 feet above plant grade.

The applicant also proposes to establish a technical specification to restrict facility operation when the water level in Lake Anna exceeds elevation 256 feet above mean sea level, to assure that pressure boundary failures within the circulating water system do not adversely affect plant safety due to internal flooding. We conclude that such a technical specification can be implemented to preclude flooding of safety related equipment. We therefore consider this issue resolved (see Section 3.4 of this report).

### 2.4.4 Groundwater

In Amendment 54 to the Final Safety Analysis Report, the applicant states that the design basis groundwater level for North Anna Power Station, Units 1 and 2 originally was elevation 256 feet mean sea level, but that as a result of recent rising groundwater levels, the maximum groundwater levels that could occur have been recomputed. Table 2.1 lists specific locations and the estimated maximum groundwater level that could occur at each location.

On the basis of our independent evaluation, we conclude that these levels are conservative and therefore acceptable (See Section 3.4 of this report).

TABLE 2.1

GROUNDWATER LEVELS

| Location | Maximum Groundwater Level (feet above mean sea level) |
| --- | --- |
| Fuel Building | 267 |
| Auxiliary Feedwater Pipe Tunnel | 267 |
| Auxiliary Building | 265 |
| Main Steam Valve and Quench Spray Pump House Unit 1 | 263 |
| Main Steam Valve and Quench Spray Pump House Unit 2 | 266 |
| Safeguards Area Unit 1 | 263 |
| Safeguards Area Unit 2 | 267 |
| Service Building | 262 |
| Buried Fuel Oil Tanks | 270.5 |
| Waste Gas Decay Tank Enclosure | 267 |
| Containment Building Unit 1 | 264 |
| Containment Building Unit 2 | 266.5 |

## 2.5 GEOLOGY AND SEISMOLOGY

We stated in the Safety Evaluation Report that the applicant had filed a report on the microseismic data obtained with the Phase 2 network. We also stated that we were evaluating the data and would report our findings in a subsequent report. We have now completed our review of this data.

In May 1973, the applicant informed us that a family of faults had been discovered in the foundations of the North Anna Power Station Units 3 and 4. We immediately initiated an intensive review to determine whether these faults were capable within the meaning of Appendix A to 10 CFR Part 100. We decided early in our review that such a determination would require findings as to (1) whether the faults were capable as of the time Lake Anna, the cooling reservoir, was impounded and (2) if not, whether the presence of Lake Anna had reactivated the faults.

With respect to the latter consideration, after a thorough review of the pertinent professional literature and consultation with several scientists who were actively engaged in the study of artificial stimulation of earthquakes, we concluded that Lake Anna had not reactivated the faults. We based our conclusion on the observations that no reservoir as shallow as Lake Anna located in a similar geologic environment is known to have triggered an earthquake. We also determined that no earthquakes had been felt in the vicinity of the site since the impoundment of the lake, two years earlier. Because both theory and observation indicate that earthquakes triggered by reservoir loading tend to occur within a short time following impoundment, we considered the latter point to be a significant indication that Lake Anna had not triggered any earthquake. Nevertheless, we concluded that confirmatory monitoring should be conducted. We, therefore, required the applicant to implement a dense microearthquake monitoring network in order to verify that there were no small earthquakes occurring in association with the faulting.

In response to our requirements, the applicant proposed a two phase program. Phase I was to be essentially a reconnaissance program utilizing five portable seismographs. These were to be located so as to best determine those basic characteristics of seismicity in the vicinity of the site which would be needed to design the denser Phase II network. With the one modification that seven rather than five instruments be used in Phase I, we accepted the program proposed by the applicant. The seven station, Phase I network has been operational since January 21, 1974. Installation of sixteen of the seventeen stations scheduled to comprise the Phase II network was completed March 31, 1975. Following equipment modification, check-out and calibration, these sixteen stations became fully operational April 10, 1975. The seventeenth has since been installed.

During the monitoring period, we have required that VEPCO report the locations and magnitudes of all earthquakes having a magnitude greater than about 1.0 and close enough to the network that the difference between the shear wave and compressional wave travel times is less than five seconds.

The applicant has submitted a thorough analysis of the resulting microearthquake data in a report titled "Summary Report on the In-Progress Seismic Monitoring Program at the North Anna Site, January 21, 1974 through May 1, 1976 " (May 1976 Report). It includes all locatable microearthquakes in addition to those larger than magnitude one and with the difference between the shear wave and compressional wave travel time less than five seconds as we had requested. Of the microearthquakes recorded only four were as large as approximately magnitude one within 10 kilometers of the plant between January 1974 and May 1976. Three have approximately the same epicenter. Both epicentral locations are close to the northeast boundary of Lake Anna. Two other microearthquakes were located within 30 kilometers of the plant.

Extremely small microearthquakes (magnitude less than one) that could be located by the array, appear to cluster near the boundaries of Lake Anna. Such microearthquake activity is not unexpected at new reservoirs, and can be detected only by sensitive monitoring equipment.

Because the microearthquakes are so small, not all seismographs are likely to record each earthquake, and consequently, focal plane mechanisms cannot be well determined, if at all. However, if clusters of microearthquakes are considered to have the same source, enough data points can be plotted to determine a combined focal plane solution. Such solutions yield two alternative fault-strike, dip and slip-vector results. At places where such a determination was possible neither best-fit alternative solution agreed with the strike of faulting in the vicinity of the plant site or the north 35 east trend of Neuschel's Lineament which is parallel to an extension of the 35 mile long Stafford Fault Zone which approaches the site to within 25 miles from the northeast.

Microearthquake activity in the North Anna Plant vicinity appears to be less than that predicted for all of central Virginia on the basis of the historic record for larger earthquakes and it poses no hazard in itself to the plant or dam impounding Lake Anna.

Operation of a network at the level required by the Nuclear Regulatory Commission has continued since December 1975. Microearthquake activity in the vicinity of Lake Anna appears bounded, or nearly so, to the northwest approximately coincident with an extrapolation of the plant site faulting to the northeast, (see figures 7 and 10 of the May 1976 report).

There is no aspect of the data from the microearthquake network which indicates in any way that the microearthquakes recorded or that the faults through the plant site pose a hazard to the safe operation of the plant.

However, because there is a tenuous relationship between the limits of occurrence of microearthquakes and a boundary approximately defined by an extrapolation of the faults in the vicinity of the plant site we require continued operation of the 17 station network for at least one year commencing August 1, 1976, in order to 2-7 provide data to determine if this relationship dissipates or changes in such a way that additional action may be required. Appropriate reports regarding status of station operation (downtime, malfunctions, etc.) calibration and analysis of data are to be submitted by the utility to the Nuclear Regulatory Commission quarterly and a final report is to be submitted at the end of the monitoring period. If this additional data indicates that additional action should be taken to insure safe operation of the facility we will require that the applicant take any necessary actions.

In April 1976, the U. S. Geological Survey published two open file reports: "Detailed Investigations of a Coastal Plain-Piedmont Fault Contact in Northeastern Virginia," by Mixon & Newell. The structures described in these reports consist of three en-echelon faults and a monocline, which collectively compose the Stafford Fault Zone. They were mapped over a distance of 56 kilometers and displacements on the faults range from 15 to 60 meters. The closest known approach of this faulting to the North Anna Site is approximately 25 miles.

The interpretation of the age of faulting indicates that the major deformation occurred during Cretaceous and middle Tertiary with lessor movements extending into Late Tertiary or possibly Quaternary. Because the date of last movement was not adequately substantiated in these reports, the Nuclear Regulatory Commission requested Potomac Electric Power Company (PEPCO) to investigate further and determine what hazard, if any, these structures posed to PEPCO's proposed Douglas Point Nuclear Power Station.

An investigation was carried out on PEPCO's behalf by Dames and Moore, Incorporated. These findings were transmitted to the Nuclear Regulatory Commission on June 14, 1976, in a report entitled "Geologic Investigation of the Stafford Fault Zone." The report concluded: "No evidence has been found during these studies to indicate surface or near surface movement along any of the investigated structures once within the past 35,000 years, or of a recurrent nature within the last 500,000 years. At present, no capable faults with which to associate the Stafford Fault Zone are known to exist within the central eastern seaboard. In addition, the zone demonstrates no recognizable association with instrumental macroseismicity. Therefore, in consideration of the presently available information, it is concluded that neither the Stafford Fault Zone, nor any of its component structures, is capable according to NRC criteria as defined in Appendix A of 10 CFR 100."

The Nuclear Regulatory Commission has not yet taken a position on the age of last movement of the Stafford Fault Zone and is requesting additional evidence upon which to base a conclusion. We will report the results of our review in a subsequent supplement to the Safety Evaluation Report.

Mixon and Newell in their April 1976 report, suggest that the Stafford Fault System is related to Neuschel's lineament which is parallel to and on line with the Stafford Faults. If so, the zone would be extended south an additional 25 to 30 miles and would pass within four or five miles of the North Anna site. Neuschel's lineament was discovered by aeromagnetic and radiometric surveys. Although Neuschel postulated a basement fault with the lineament, no evidence of faulting was observed when the region was mapped by the U. S. Geological Survey. This lineament has been described and considered previously in the North Anna facility licensing proceeding (North Anna 1 and 2 show cause proceeding, LBP-74-49, June 27, 1974). In that proceeding we concluded that the lineament, if it is a tectonic structure, developed during the Paleozoic and has no evidence of young movement or associated seismicity. That conclusion is unchanged by subsequent data.

## 2.6 FOUNDATION ENGINEERING

### 2.6.2 Evaluation of Foundation Engineering

We stated in the Safety Evaluation Report that the applicant was conducting additional investigations (sampling, testing and analyses) to reassess the capability of the service water reservoir, dikes, and pump house to reliably perform their intended function. In addition to this work, the applicant had committed to provide additional information on the following items in an amendment to the Final Safety Analysis Report:

(1) A program to control groundwater levels under the pump house in order to reduce the potential for unexpected future settlement and to increase its resistance to seismic effects.

(2) An assessment of foundation conditions and dike stability and a description of measures to be taken for remedial drainage features and stabilization or replacement, if warranted, to assure adequate resistance to seismic effects.

(3) A program to monitor water inventory losses from the service water reservoir to assure that leakage rates from the reservoir do not reach levels that would affect the safe shutdown of the plant.

(4) Results of a program to measure the settlement of all seismic Category I structures that has occurred since the start of construction, and a comparison of these measurements to predicted settlements and to allowable settlements.

(5) Results of a program to (a) inspect seismic Category I structures for settlement induced distress, particularly in areas of critical external penetrations such as safety related conduits and pipes; and (b) check settlement effects on the spray piping in the reservoir.

We also stated that we would review the above information after it had been submitted by the applicant and would report our findings in a subsequent report.

With respect to Item 1, the applicant has committed to the installation of a system of well points to control groundwater levels under the service water pumphouse. We find this an acceptable method of controlling groundwater level. We have determined that the well point system does not need to be seismic Category I because of the low permeability of the saprolite underlying the pumphouse. Before installation, the details of the system design will be required to be included in the Final Safety Analysis Report and reviewed and approved by the staff to insure that it will fulfill its function without causing a loss of fines from the saprolite. We will report the results of our review in a subsequent supplement to the Safety Evaluation Report.

With respect to Item 2, the applicant has assessed the condition of the saprolite underlying critical sections of the dike which impounds the service water reservoir. The applicant has also performed laboratory tests on these materials and re-evaluated the stability of the dike. The applicant has proposed a shallow trench drain to control groundwater levels below the dike.

The necessary reliability of a source of service water to safely shutdown the plant in the event of the design basis earthquake is based on the existence of the service water reservoir and Lake Anna. These two sources are described in Section 2.4.1 of the Safety Evaluation Report. The service water systems are described in Sections 9.2.1 and 9.2.3 of the Safety Evaluation Report. Our judgments regarding the reliability of the dikes impounding the service water reservoir are based on our review of the results of the applicant's investigations and, by inference, on the apparent reliability of an earth-fill dam which retains a second source of service water, Lake Anna.

There are two sources of service water for North Anna Power Station, Units 1 and 2. We find that the dikes for the service water reservoir and North Anna dam together have an adequate degree of stability, and resulting reliability, under the seismic effects of the proposed safe shutdown earthquake. Our review of the applicant's information on the main dam on Lake Anna, and its foundations, indicates that this dam has considerable seismic resistance and would likely survive the effects of the safe shutdown earthquake. We thus conclude that the foundations and earthworks features of these two service water sources combined have adequate reliability, under seismic conditions. We will require that the systems necessary to utilize the Lake Anna service water source be maintained and monitored to assure their functional reliability. This requirement will be included in the technical specifications.

With respect to Item 3, the applicant has committed to a program to monitor, on a semi-annual basis, the water losses from the service water reservoir in order to assure that leakage rates will not affect the safe shutdown of the plant. We find this acceptable.

With respect to Item 4, we asked the applicant to check the settlement and differential settlement of North Anna Power Station, Units 1 and 2, safety related structures because of the unexpected settlement of structures founded on saprolites.

The applicant reported the results of its measurements in Amendment 5 to the Final Safety Analysis Report. All reported settlements and differential settlement values were reasonable and within allowable limits except for a few points along the crane rail at the northwest corner of the service building, an area occupied by the heating boiler room and a part of the emergency generator area. The applicant has stated that there were no adverse affects to safety related equipment due to this settlement. We will review this matter and report the results of our review in a subsequent supplement to the Safety Evaluation Report. The applicant's program for monitoring future settlement will detect any settlement before hazardous conditions can develop.

With respect to Item 5(a), the applicant has conducted an inspection of safety related structures to detect any signs of distress caused by differential settlement of these structures. The applicant reported no signs of movements or distress to critical structures or pipes, although widened cracks along one wall of the service building were noted.

With respect to Item 5(b), the applicant has placed an extensive set of monuments to check the settlement of spray pond piping in the service water reservoir and has established criteria for acceptable settlement within the piping system. We find this program adequate to detect the development of adverse pipe stresses.

### 2.6.3 Conclusions

Subject to (1) our review and approval of the design of the system of well points and (2) resolution of the settlement of the northwest corner of service building, and based on information and commitments provided by the applicant, we find that the foundations and earthworks for the North Anna Power Station, Units 1 and 2 are adequate to provide for the safe shutdown of this plant under the proposed normal and extreme environmental conditions. The proposed monitoring programs combined with adequate design and construction provides assurance of the continuing functional reliability of foundation features for this facility.

# 3.0 DESIGN CRITERIA - STRUCTURES, SYSTEMS, AND COMPONENTS

## 3.4 WATER LEVEL (FLOOD) DESIGN CRITERIA

We stated in the Safety Evaluation Report that (1) the applicant was reevaluating the analyses for predicting the probable maximum flood and would submit the results of that analysis, (2) we would determine the effects of this analysis on the design flood level and would assure that all seismic Category I structures are protected against the effects of the flood level, and (3) we would report our findings in a subsequent report.

As discussed in Section 2.4.2 of this report, the applicant has submitted a revised analysis for the probable maximum flood in Amendment 53 to the Final Safety Analysis Report, which predicts a maximum water level of 267.3 feet above mean sea level (including wave action). The finished plant grade is at 271 feet mean sea level. We have reviewed the effect of the revised probable maximum flood level on safety related structures and equipment. We have determined that the revised maximum water level does not affect the design criteria of all the below grade structures and have concluded that all seismic Category I structures are protected against the effects of the revised flood level.

The one area of concern related to safety related equipment involves a failure of the circulating water system. Although the turbine building does not contain safety related equipment, there are three doors at the bottom level of the turbine building which connect between it and the emergency switchgear rooms, control room air conditioning chiller rooms and the battery rooms. A failure of the system in the turbine building will automatically trip the circulating water pumps and inlet valves when the water level reaches one foot above the turbine building floor level. The building design includes water tight barriers at these doors to an elevation of 257 feet mean sea level, or three feet above the turbine building floor. The North Anna facility technical specifications will have provisions for taking the facility out of service and closing the circulating water valves when the lake level exceeds 256 feet mean sea level. On the basis of our review, we find the facility design for protection of essential structures and equipment from the effects of the probable maximum flood acceptable. We therefore consider this matter resolved.

As discussed in Section 2.4.4 of this report, the applicant has submitted a revised list of maximum groundwater levels that could occur at the North Anna facility. In Amendment 54 to the Final Safety Analysis Report, the applicant submitted the results of a revised structural analysis reflecting these groundwater levels. We have reviewed the effect of the revised groundwater levels on safety related structures and equipment.

Protection of structures is provided by water stops and subsurface drainings. We have determined that the results of a structural reanalysis for the revised groundwater levels indicate acceptable minimum factors of safety against overturning and sliding in the event of a postulated safe shutdown earthquake. Therefore, the stability of all seismic Category I structures will be assured in the event of a safe shutdown earthquake. In Amendment 42 to the Final Safety Analysis Report, the applicant has provided the results of an analysis which demonstrates that displacement of the underground diesel generation fuel tanks and piping due to groundwater buoyancy will not occur even for the most conservative assumption that the water table reaches grade elevation.

On the basis of our review, we find the facility design for protection of essential structures and equipment from the effects of groundwater acceptable.

# 5.0 REACTOR COOLANT SYSTEM

## 5.2 REACTOR COOLANT PRESSURE BOUNDARY

### 5.2.8 Overpressure Protection

As a result of recent reviews, we have determined that several reported instances of reactor vessel overpressurization in Pressurized Water Reactors have occurred in which 10 CFR Part 50 Appendix G limitations have been exceeded. The majority of cases have occurred during cold shutdown in which the reactor coolant system has been in water-solid conditions. We view each of these occurrences with concern and consider any violation of Appendix G to 10 CFR Part 50 limitations to be undesirable. It is therefore considered appropriate that steps be taken to preclude the possibility of further occurrences of reactor vessel overpressurization. The staff has discussed this concern with the applicant as it relates to the Surry Power Station Units 1 and 2 (Docket Nos. 50-280 and 50-281). We intend to continue these discussions on the North Anna Power Station Units 1 and 2. In addition we plan to review overpressurization incidents with Westinghouse Electric Corporation and the other pressurized water reactor vendors generically, and will report resolution of this item as it relates to the North Anna Power Station Units 1 and 2 in a subsequent supplement to the Safety Evaluation Report.

# 6.0 ENGINEERED SAFETY FEATURES

## 6.3 EMERGENCY CORE COOLING SYSTEM

### 6.3.3 Performance Evaluation

We stated in Section 6.3.3 of Supplement No. 1 to the Safety Evaluation Report that we would require the applicant to provide a list of specific electrical equipment that may be submerged as the result of a postulated loss-of-coolant accident condition.

The applicant has provided a list of this electrical equipment. For evaluation purposes, the equipment has been divided into three categories: Safety Related Electrical Equipment, Non-Safety Related Electrical Equipment, and Electrical Penetrations associated with submerged equipment.

#### 6.3.3.1 Safety Related Electrical Equipment

For those cases where motor operated valves in the emergency core cooling system are required to operate following a postulated loss-of-coolant accident, the motor operators are located above the potential post-accident level.

The other safety related electrical equipment includes equipment not required to function following a postulated loss-of-coolant accident. It includes the primary loop flow instrumentation which is energized during normal operation. Protection against adverse conditions affecting the associated safety related electrical equipment, is provided by Class IE protective devices including breakers, fuses, and the power supply's current limiting capabilities.

6.3.3.2 Non-Safety Related Electrical Equipment

The non-safety related equipment, supplied from a Class IE electrical source which may get submerged, is isolated from the Class IE electrical source in one of the following manners:

(1) The equipment is de-energized by the safety injection signal, or

(2) The equipment has safety grade redundant current limiting and overcurrent protection devices.

6.3.3.3 Electrical Penetrations

The applicant has reviewed the containment electrical penetrations which are associated with the potentially submerged equipment to ensure that the integrity of the penetration will be maintained for the postulated post-accident flooding conditions. In all cases, either the potentially submerged equipment is automatically de-energized or the maximum fault currents are within the design ratings of the respective penetrations.

6.3.3.4 Conclusions

We conclude that the applicant has adequately analyzed the effects on plant safety of potentially submerged electrical equipment and that the results of the evaluation are acceptable. We therefore consider this matter resolved.

## 10.0 STEAM AND POWER CONVERSION SYSTEM

### 10.2 MAIN STEAM SUPPLY SYSTEM

We stated in the Safety Evaluation Report that we requested the applicant to analyze the consequences if the residual heat release control valve sticks open or if a pipe ruptures downstream of the stop-check valves.

In Amendment 53 to the Final Safety Analysis Report, the applicant stated that the three-inch stop check valves would be administratively locked closed until an acceptable analysis is provided. The stop check valves were seat leakage tested in the reverse direction at maximum pressure differential and found acceptable. A similar seat leakage test will be performed for pressure differential in the normal direction with the valves closed, under full steam pressure conditions, and, if necessary, appropriate actions will be taken to reduce the leakage to the prescribed limits.

Based on our review, we conclude that the main steam supply system is in conformance with the single failure criterion, the seismic recommendations of Regulatory Guide 1.29 "Seismic Design Classification" and main steam isolation valve closure time positions, and, is acceptable. Therefore, we consider this matter resolved.

## 10.7 TURBINE MISSILES

The North Anna Power Station, Unit I and 2 turbine generators are arranged in a nonpeninsular orientation. This arrangement is such that low trajectory turbine missiles have the potential for directly impacting the auxiliary building, containment, control room and other structures housing safety-related equipment. The applicant's analysis indicates that if a turbine failure occurs, as a result of destructive overspeed, there is about a 20 percent chance that any large, potentially damaging missile would strike (impact) such structures. Using this strike probability and the historically observed destructive overspeed turbine failure rate of $10^{-4}$ per turbine year, we estimate that the upper limit probability for unacceptable damage by turbine missiles is about $2 \times 10^{-5}$ per turbine year. This is a demonstrably conservative estimate since it is based on the assumption that given a missile strike the probability for structural penetration and unacceptable damage is unity. It should also be noted that the applicant predicts a much lower failure probability based on improvement in materials and design. Whether a reduction in failure probability of two orders of magnitude, as compared with historically observed rates has in fact been achieved requires in our view confirmation by additional operating experience with more recent turbine designs and more detailed reviews of turbine missile risks.

increased inspection, maintenance and testing procedures will in our view substantially reduce the likelihood of major contributors to turbine failure - degraded valve performance and continued operation with flawed turbine materials. While the specific requirements for North Anna still remain under development it is our intent that the applicant adhere to the turbine valve inspection, maintenance and testing procedures outlined in Section 10.2 of the Standard Review Plan* and to the turbine inspection provisions indicated in Section 10.2.3 of the Standard Review Plan. The specific requirements will be included in the applicant's technical specifications. We conclude that this requirement will provide protection from turbine missiles adequate to permit plant operation until we have completed our generic study of design criteria for turbine missiles. When the results of this study are available, we will determine if additional protection is required beyond that offered by the proposed plant design as supplemented by the technical specification requirements identified above. At that time, appropriate action will be taken.

*Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (NUREG-75/087).

## 11.0 RADIOACTIVE WASTE MANAGEMENT

### 11.1 SUMMARY DESCRIPTION

We stated in the Safety Evaluation Report that our detailed evaluation as to the capability of the proposed liquid and gaseous radioactive waste management systems to the requirements of Appendix I to 10 CFR Part 50 would be provided in a subsequent report when the information was filed by the applicant.

In amendments to the Final Safety Analysis Report the applicant has provided the necessary information. In Amendment 54 to the Final Safety Analysis Report, the applicant chose to comply with the Commission's September 9, 1975* amendment to Appendix I. This amendment provides for persons who have filed an application for construction permits for light-water-cooled nuclear power reactors which were docketed on or after January 2, 1971, and prior to June 4, 1976, the option of dispensing with the cost-benefit analysis required by Paragraph II.D of Appendix I. This option permits an applicant to design his radwaste management systems to satisfy the Guides on Design Objectives for Light-Water-Cooled Nuclear Power Reactors proposed in the Concluding Statement of Position of the Regulatory Staff in Docket RM-50-2, dated February 20, 1974**. As indicated in the Statement of Considerations

*Title 10, CFR Part 50, Amendment to Paragraph II.D of Appendix I, Federal Register, V. 40, p. 40918, September 4, 1975.

**U. S. Atomic Energy Commission Concluding Statement of Position of the Regulatory Staff (and its Attachment) - Public Rulemaking Hearing on: Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criteria "As Low As Practicable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactors, Docket Number RM-50-2, Washington, D. C., February 20, 1974.

included with the amendment, the Commission noted it is unlikely that further reductions to radioactive material releases would be warranted on a cost-benefit basis for light-water-cooled nuclear power reactors having radwaste systems and equipment determined to be acceptable under the proposed staff design objectives set forth in Docket RM-50-2. In the case of plants whose applications for construction permits were filed prior to January 2, 1971, Appendix I does not provide specific guidance concerning the need for these plants to submit a detailed cost-benefit analysis to determine conformance with Section II.D of Appendix I. The staff is in the process of determining whether plants for which construction applications were filed prior to January 2, 1971 can be treated in a manner similar to the treatment given plants docketed after January 2, 1971, including the cost-benefit option provided by the Commission's September 4, 1975 amendment to Appendix I. Until this determination has been made the staff's evaluation of the radwaste systems was performed to determine conformance with the criteria set forth in the Concluding Statement of Position of the Regulatory Staff, Docket RM-50-2, in lieu of a detailed cost-benefit analysis as required by Section II.D. The applicant's commitment was for the North Anna Power Station and will include Units 1, 2, 3 and 4.

We have assessed this information and have extended our review to include North Anna Power Station Units 3 and 4 to demonstrate compliance with site-related criteria. Our evaluation was performed to determine if the proposed North Anna Power Station, Units 1, 2, 3 and 4, meet the numerical design objectives specified in Sections II.A, B, C and D of Appendix I of 10 CFR Part 50*. The Safety Evaluation Report for North Anna Power Station, Units 3 and 4 was issued in December 1972 (Docket Nos. 50-404 and 50-405).

We have evaluated the radioactive waste management systems proposed for North Anna Power Station, Units 1, 2, 3 and 4, to reduce the quantities of radioactive materials released to the environment in liquid and gaseous effluents. These systems have been previously described in Section 3.5 of the Final Environmental Statement, dated April 1973**, and in Section 11.0 of the Safety Evaluation Reports for North Anna Power Station, Units 1 and 2 and North Anna Power Station, Unit 3 and 4. Based on more recent operating data applicable to the North Anna Power Station, Units 1, 2, 3 and 4, and on changes in our calculational model, we have generated new liquid and gaseous source

*Title 10, CFR Part 50, Appendix I, Federal Register, V. 40, p. 19442, May 5, 1975.

**Staff of the U. S. Nuclear Regulatory Commission, "Final Environmental Statement Related to the Continuation of Construction and the Operation of North Anna Power Station, Unit Nos. 1 and 2, and the Construction of Unit Nos. 3 and 4," Docket Nos. 50-338, 50-339, 50-404, and 50-405, Washington, D. C., April 1973.

terms to determine conformance with Appendix I. These values are different from those given in Tables 3.7, 3.8, and 3.11 of the Final Environmental Statement.

The new source terms, shown in Tables II.1, II.2., II.3 and II.4 of this report, were calculated using the models and methodology described in NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-GALE Code)," April 1976. These source terms were used to calculate the doses as described below. The dispersion of radionuclides in and the deposition of radionuclides from the atmosphere were based on analyses performed by the staff for this evaluation.

The mathematical models used to perform the dose calculations are contained in Regulatory Guide 1.109, "Calculation of Annual Average Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Implementing Appendix I," March 1976.

Included in our analysis are dose evaluations of three effluent categories: (1) pathways associated with liquid effluent releases to Lake Anna, (2) noble gases released to the atmosphere, and (3) pathways associated with radioiodines, particulates, carbon-14 and tritium released to the atmosphere.

## TABLE II.1

## CALCULATED RELEASES OF RADIOACTIVE MATERIAL

## IN LIQUID EFFLUENTS FROM

## NORTH ANNA POWER STATION, UNITS 1 AND 2

| Nuclide | Curies Per Year Per Reactor |
|---|---|
| Corrosion and Activation Products[a,b] | |
| Chromium 51 | 3(-4) |
| Manganese 54 | 8(-5) |
| Iron 55 | 2.7(-4) |
| Iron 59 | 2(-4) |
| Cobalt 58 | 2.7(-3) |
| Cobalt 60 | 3.9(-4) |
| Neptunium 239 | 1.8(-4) |
| Fission Products | |
| Bromine 83 | 1.3(-3) |
| Bromine 84 | 3(-5) |
| Rubidium 86 | 2(-5) |
| Rubidium 88 | 2(-5) |
| Strontium 89 | 7(-5) |
| Strontium 91 | 5(-5) |
| Yttrium 91m | 3(-5) |
| Zirconium 95 | 2(-5) |
| Niobium 95 | 3(-5) |
| Molybdenum 99 | 1.2(-2) |
| Technetium 99m | 9.8(-3) |
| Ruthenium 106 | 2(-5) |
| Tellurium 127m | 3(-5) |
| Tellurium 127 | 8(-5) |
| Tellurium 129m | 2(-4) |
| Tellurium 129 | 1.6(-4) |
| Iodine 130 | 8.6(-4) |
| Tellurium 131m | 2.9(-4) |
| Tellurium 131 | 5(-5) |
| Iodine 131 | 1(-1) |
| Tellurium 132 | 3.1(-3) |
| Iodine 132 | 3.6(-2) |
| Iodine 133 | 1.5(-1) |
| Iodine 134 | 2.8(-3) |
| Cesium 134 | 4.7(-3) |
| Iodine 135 | 7.7(-2) |
| Cesium 136 | 2.4(-3) |
| Cesium 137 | 3.6(-3) |
| Barium 137m | 3.1(-3) |
| Barium 140 | 3(-5) |
| Lanthanum 140 | 2(-5) |
| Cerium 141 | 1(-5) |
| Cerium 144 | 6(-5) |
| All Others | 5(-5) |
| Total (except Tritium) | 4.1(-1) |
| Tritium | 5.8(+2) |

a = Exponential notation; 1(-4) = 1 × $10^{-4}$.

b = Nuclides whose release rates are less than $10^{-5}$ Curies per year per reactor are not listed individually, but are in the category "All Others".

## TABLE II.2

## CALCULATED RELEASES OF RADIOACTIVE MATERIAL IN LIQUID EFFLUENTS FROM NORTH ANNA POWER STATION, UNITS 3 AND 4

| Nuclide | Curies Per Year Per Reactor | Nuclide | Curies Per Year Per Reactor |
|---|---|---|---|
| Corrosion and Activation Products[a,b] | | Tellurium 129 | 6(-5) |
| | | Iodine 130 | 7(-5) |
| Chromium 51 | 1.2(-4) | Tellurium 131m | 5(-5) |
| Manganese 54 | 4(-5) | Iodine 131 | 5.4(-2) |
| Iron 55 | 1.1(-4) | Tellurium 132 | 1.2(-3) |
| Iron 59 | 7(-5) | Iodine 132 | 1.7(-3) |
| Cobalt 58 | 1.1(-3) | Iodine 133 | 1.7(-2) |
| Cobalt 60 | 2.1(-4) | Iodine 134 | 2(-5) |
| Zirconium 95 | 1(-5) | Cesium 134 | 2.5(-3) |
| Niobium 95 | 2(-5) | Iodine 135 | 4.6(-3) |
| Neptunium 239 | 7(-5) | Cesium 136 | 1.1(-3) |
| | | Cesium 137 | 2(-3) |
| Fission Products | | Barium 137m | 1.7(-3) |
| Bromine 83 | 3(-5) | Barium 140 | 1(-5) |
| Strontium 89 | 3(-5) | Cesium 144 | 5(-5) |
| Strontium 91 | 2(-5) | | |
| Vitrium 91m | 1(-5) | All Others | 6(-5) |
| Molybdenum 99 | 4.6(-2) | | |
| Technetium 99m | 3(-2) | Total (except Tritium) | 1.6(-1) |
| Ruthenium 106 | 2(-5) | | |
| Tellurium 127m | 1(-5) | Tritium | 5.5(+2) |
| Tellurium 127 | 3(-5) | | |
| Tellurium 129m | 9(-5) | | |

a = Exponential notation; 1(-4) = 1 × $10^{-4}$

b = Nuclides whose release rates are less than $10^{-5}$ Curies per year per reactor are not listed individually, but are in the category "All Others".

## TABLE II.3

## CALCULATED RELEASES OF RADIOACTIVE MATERIAL

## IN GASEOUS EFFLUENTS FROM

## NORTH ANNA POWER STATION, UNITS I AND 2

Curies Per Year Per Reactor

| Radionuclide[d] | Reactor Building | Auxiliary Building | Turbine Building | Air Ejector | Decay Tanks | Total |
|---|---|---|---|---|---|---|
| Krypton 83m | a | 4 | a | 2 | a | 6 |
| Krypton 85m | a | 17 | a | 11 | a | 2.8(+1) |
| Krypton 85 | a | a | a | a | 2(+2) | 2(+2) |
| Krypton 87 | a | 1.2(+1) | a | 7 | a | 1.9(+1) |
| Krypton 88 | 1 | 3.5(+1) | a | 2.1(+1) | a | 5.7(+1) |
| Krypton 89 | a | 1 | a | a | a | 1 |
| Xenon 131m | 2 | a | a | a | 2 | 4 |
| Xenon 133m | 5 | 7 | a | 4 | a | 16 |
| Xenon 133 | 3.8(+2) | 2.9(+2) | a | 1.8(+2) | 4 | 8.5(+2) |
| Xenon 135m | a | 3 | a | 2 | a | 5 |
| Xenon 135 | 5 | 3.8(+1) | a | 2.4(+1) | a | 6.7(+1) |
| Xenon 137 | a | 2 | a | 1 | a | 3 |
| Xenon 138 | a | 1(+1) | a | 6 | a | 1.6(+1) |
| Iodine 131 | 3.2(-4) | 4.7(-3) | 7.8(-4) | 2.9(-2) | a | 3.5(-2) |
| Iodine 133 | 1.4(-4) | 9.2(-3) | 1.3(-3) | 5.8(-2) | a | 6.9(-2) |
| Manganese 54 | 5.8(-5) | 1.8(-4) | c | c | 4.5(-5) | 2.8(-4) |
| Iron 59 | 2(-5) | 6(-5) | c | c | 1.5(-5) | 9.5(-5) |
| Cobalt 58 | 2(-4) | 6(-4) | c | c | 1.5(-4) | 9.5(-4) |
| Cobalt 60 | 7(-5) | 2.7(-4) | c | c | 7(-5) | 4.3(-4) |
| Strontium 89 | 3.3(-6) | 1.3(-5) | c | c | 3.3(-6) | 2.1(-5) |
| Strontium 90 | 6(-7) | 2.4(-6) | c | c | 6(-7) | 3.8(-6) |
| Cesium 134 | 4.5(-5) | 1.8(-4) | c | c | 4.5(-5) | 2.8(-4) |
| Cesium 137 | 7.5(-5) | 3(-4) | c | c | 7.5(-5) | 4.7(-4) |
| Tritium | 5.8(+2) | c | c | c | c | 5.8(+2) |
| Carbon 14 | 1 | a | a | a | 7 | 8 |
| Argon 41 | 2.5(+1) | c | c | c | c | 2.5(+1) |

a = less than 1.0 Curies per year per reactor for noble gases and carbon-14, less than $10^{-4}$ Curies per year per reactor for iodine

b = exponential notation; $1.4(-2) - 1.4 \times 10^{-2}$

c = less than 1 percent of total for this nuclide

d = radionuclides not listed are released in quantities less than those specified in notes a and c from all sources

TABLE II.4

CALCULATED RELEASES OF RADIOACTIVE MATERIAL

IN GASEOUS EFFLUENTS FROM

NORTH ANNA POWER STATION, UNITS 3 AND 4

Curies Per Year Per Reactor

| Radionuclide[d] | Reactor Building | Auxiliary Building | Turbine Building | Air Ejector | Decay Tanks | Total |
|---|---|---|---|---|---|---|
| Krypton 85m | 1 | 2 | a | 1 | a | 4 |
| Krypton 85 | 9 | a | a | a | 1.9(+2) | 2(+2) |
| Krypton 88 | 2 | 3 | a | 2 | a | 7 |
| Xenon 131m | 1.4(+1) | a | a | a | 2 | 1.6(+1) |
| Xenon 133m | 2.2(+1) | 2 | a | 1 | a | 2.5(+1) |
| Xenon 133 | 2.4(+3) | 1.3(+2) | a | 8.3(+1) | 4 | 2.6(+3) |
| Xenon 135 | 9 | 5 | a | 3 | a | 1.7(+1) |
| Iodine 131 | 5(-3) | 5.4(-3) | 7.7(-4) | 3.4(-2) | a | 4.5(-2) |
| Iodine 133 | 1.3(-3) | 6.3(-3) | 8.9(-4) | 4(-2) | a | 4.8(-2) |
| Manganese 54 | 5.8(-3) | 1.8(-4) | c | c | 4.5(-5) | 6(-3) |
| Iron 59 | 2(-3) | 6(-5) | c | c | 1.5(-5) | 2.1(-3) |
| Cobalt 58 | 2(-2) | 6(-4) | c | c | 1.5(-4) | 2.1(-2) |
| Cobalt 60 | 9(-3) | 2.7(-4) | c | c | 7(-5) | 9.3(-3) |
| Strontium 89 | 4.5(-4) | 1.3(-5) | c | c | 3.3(-6) | 4.7(-4) |
| Strontium 90 | 7.9(-5) | 2.4(-6) | c | c | 6(-7) | 8.2(-5) |
| Cesium 134 | 5.8(-3) | 1.8(-4) | c | c | 4.5(-5) | 6(-3) |
| Cesium 137 | 1(-2) | 3(-4) | c | c | 7.5(-5) | 1(-2) |
| Tritium | 5.5(+2) | c | c | c | c | 5.5(+2) |
| Carbon 14 | 1 | a | a | a | 7 | 8 |
| Argon 41 | 2.5(+1) | c | c | c | c | 2.5(+1) |

a = less than 1.0 Curies per year per reactor for noble gases and carbon-14,
less than $10^{-4}$ Curies per year per reactor for iodine

b = exponential notation; $1.4(-2) = 1.4 \times 10^{-2}$

c = less than 1 percent of total for this nuclide

d = radionuclides not listed are released in quantities less than those specified in notes a and c from all sources

The dose evaluation of pathways associated with liquid effluents was based on the maximum exposed individual. The dietary and living habits for an adult individual included the consumption of 21 kilograms per year of fish harvested in the immediate vicinity of the discharge from the cooling arm of the lake, consumption of 730 liters per year of water from the lake, and recreational use of the lake and its shoreline for 10 hours per year. For an infant, the diet included consumption of 510 liters per year of water from the lake. These pathways have been addressed in this evaluation utilizing the most recent NRC source terms and dose models. For these dose assessments, the critical radionuclides (tritium, cesium-134 and cesium-137) were permitted to reconcentrate in the reservoir water as determined by expected flows, with no significant dilution of the liquid releases prior to downstream use. The maximum dose commitment (all four units operating) resulting from ingestion of water from the lake was estimated to be 0.095 millirem per year (total body) and 0.61 millirem per year (thyroid) for an infant.

As shown in Tables II.1 and II.2 of this report, the expected quantity of radioactive materials released in liquid effluents from Units 1, 2, 3 and 4 will be less than 5 Curies per year per reactor (0.41 Curies per year per reactor for Units 1 and 2, 0.16 Curies per year per reactor for Units 3 and 4), excluding tritium and dissolved gases, in conformance with the amendment to Section II.D. The liquid effluents released from Units 1, 2, 3, and 4 will not result in an annual dose or dose commitment to the total body or to any organ of an individual, in an unrestricted area from all pathways of exposure, in excess of 5 millirem (see Table II.5 of this report).

The dose evaluation of noble gases released to the atmosphere included a calculation of beta and gamma air doses at the site boundary and total body and skin doses at the residence having the highest dose. The maximum air doses at the site boundary were found at 0.85 miles north-northeast relative to North Anna Power Station, Unit 1. The location of maximum total body and skin doses were determined to be at a residence 1.09 miles south of the North Anna facility (see TABLE II.5 of this report).

The dose evaluation of pathways associated with radioiodine, particulates, carbon-14 and tritium released to the atmosphere was also based on the maximum exposed individual. One such individual is a child whose diet included the consumption of 520 kiligrams per year of crops, 330 liters per year of milk, and 41 kilograms per year of beef and poultry produced at the location of the milk cow having the highest calculated dose from these and two other pathways noted below. This location is 1.86 miles east of the North Anna facility. Another such individual is a child whose diet includes the consumption of 520 kilograms per year of crops grown at the location of the residence having the highest calculated dose from this and two other pathways noted below. This location is 1.09 miles south of the North Anna

TABLE 11.5

COMPARISON OF NORTH ANNA POWER STATION, UNIT NOS. 1, 2, 3, AND 4, WITH APPENDIX I TO 10 CFR PART 50, SECTIONS II.A, II.B AND II.C (MAY 5, 1975)[a] AND SECTION II.D, ANNEX (SEPTEMBER 4, 1975)[b]

| Criterion | Appendix I[a] Design Objectives | Annex[b] Design Objectives[c] | Calculated Doses Unit Nos. 1 and 2 | Calculated Doses Unit Nos. 3 and 4 |
|---|---|---|---|---|
| Liquid Effluents | | | | |
| Dose to total body from all pathways (infant) | 3 mrem/yr/unit | 5 mrem/yr/site | 0.025 mrem/yr/unit | 0.023 mrem/yr/unit |
| Dose to any organ from all pathways (infant-thyroid) | 10 mrem/yr/unit | 5 mrem/yr/site | 0.20 mrem/yr/unit | 0.11 mrem/yr/unit |
| Noble Gas Effluents[d] | | | | |
| Gamma dose in air | 10 mrad/yr/unit | 10 mrad/yr/site | 0.10 mrad/yr/unit | 0.13 mrad/yr/unit |
| Beta dose in air | 20 mrad/yr/unit | 20 mrad/yr/site | 0.14 mrad/yr/unit | 0.34 mrad/yr/unit |
| Dose to total body of an individual | 5 mrem/yr/unit | 5 mrem/yr/site | 0.030 mrem/yr/unit | 0.041 mrem/yr/unit |
| Dose to skin of an individual | 15 mrem/yr/unit | 15 mrem/yr/site | 0.072 mrem/yr/unit | 0.12 mrem/yr/unit |
| Radioiodines and Other Radionuclides Released to the Atmosphere[e] | | | | |
| Dose to any organ from all pathways (infant-thyroid) | 15 mrem/yr/unit | 15 mrem/yr/site | 0.78 mrem/yr/unit | 1.2 mrem/yr/unit |

[a] Federal Register, V.40, p. 19442, May 5, 1975.

[b] Federal Register, V. 40, p. 40816, September 4, 1975.

[c] Design Objectives given on a site basis. Therefore, these design objectives apply to 4 units at the site.

[d] Limited to noble gases only.

[e] Carbon-14 and Tritium have been added to this category.

mrem/yr/unit - millirem per year per unit
mrem/yr/unit - millirad per year per unit
mrem/yr/site - millirem per year per site
mrad/yr/site - millirad per year per site

facility. These maximum exposed individuals were also exposed to inhaled radionuclides in this category, as well as those deposited on the ground at each of the locations described above (see Table 11.5 of this report).

Based on our evaluation of the gaseous radwaste management systems, the total quantity of radioactive materials released in gaseous effluents from the North Anna Power Station, Units 1, 2, 3, and 4 will not result in an annual gamma air dose in excess of 10 millirads and a beta air dose in excess of 20 millirads at every location near ground level, at or beyond the site boundary, which could be occupied by individuals (see Table 11.5 of this report). As shown in Tables 11.3 and 11.4 of this report, the annual total quantity of iodine-131 released in gaseous effluents will be less than 1 Curie per reactor (0.035 Curies per year per reactor for Units 1 and 2 and 0.045 Curies per year per reactor for Units 3 and 4) in conformance with the amendment to Section 11.0 and the annual total quantity of radioiodine and radioactive particulates released in gaseous effluents from North Anna Power Station, Units 1, 2, 3, and 4 will not result in an annual dose or dose commitment to any organ of an individual in an unrestricted area from all pathways of exposure in excess of 15 millirem (see Table 11.5 of this report).

Our evaluation demonstrates that the radwaste treatment system proposed for North Anna Power Station, Units 1, 2, 3, and 4 are capable of maintaining releases of radioactive materials in effluents during normal operation such that the doses will not exceed the design objectives of Sections II.A, B and C of Appendix I of 10 CFR Part 50.

Our evaluation also shows that the applicant's proposed design of North Anna Power Station, Units 1, 2, 3, and 4 satisfies the design objectives set forth in RM-50-2 specified in the option provided by the Commission's September 4, 1975, amendment to Appendix I and, therefore, meets the requirements of Section II.D of Appendix I of 10 CFR Part 50.

We conclude that the liquid and gaseous radwaste treatment systems will reduce radioactive materials in effluents to "as low as is reasonably achievable" levels in accordance with 10 CFR Part 50.34a and, therefore, are acceptable.

# 13.0 CONDUCT OF OPERATIONS

## 13.3 EMERGENCY PLANNING

We stated in Section 22.0 of Supplement No. 1 to the Safety Evaluation Report that the applicant has supplied all the requested information with regard to the Emergency Plan to demonstrate that it meets Appendix E to 10 CFR Part 50 except for several letters of agreement with agencies within Spotsylvania County, Virginia.

In Amendment 54 to the Final Safety Analysis Report, the applicant has provided all the necessary documentation. On this basis, we have determined that the plan meets the requirements of Appendix E to 10 CFR Part 50 and provides an adequate basis for an acceptable state of emergency preparedness. We therefore consider this matter resolved.

# 14.0 INITIAL TESTS AND OPERATIONS

We stated in the Safety Evaluation Report that in order for us to complete our evaluation relating to the staffing and organizational responsibilities of personnel managing and directing the test program, additional information had been requested from the applicant. We also stated that our evaluation of this aspect of the test program will be included in a subsequent report.

In Amendments 52 and 54 to the Final Safety Evaluation Report the applicant has presented the necessary information. We have reviewed this information and conclude that the applicant's plans relative to assigned manpower, responsibilities and qualification requirements for personnel implementing the startup test program are acceptable. We therefore consider this issue resolved.

## 22.0 CONCLUSIONS

In Section 22.0 of Supplement No. 1 to the Safety Evaluation Report we stated that several items as set forth in Section 1.7 of the Safety Evaluation Report were still outstanding and that satisfactory resolution of these items would be required before operating licenses for North Anna Power Station, Units 1 and 2 could be issued. A number of these have been resolved, as reported in this supplement. The remaining items which must be resolved, and their present status, are summarized below. Resolution of each item will be discussed in a future supplement to the Safety Evaluation Report.

(1) Our review of the design of the system of well points for groundwater control and the resolution of the settlement of the northwest corner of the service building is not completed. (Section 2.6 of this report).

(2) The applicant has provided our requested information regarding the dynamic analyses of the effects of a postulated loss-of-coolant accident on fuel elements. Our evaluation of this information has not been completed.
(Safety Evaluation Report Section 4.2.4)

(3) The applicant has submitted information regarding the preoperational tests of the recirculation mode of operation for the low head safety injection pumps. We have reviewed this information and have requested

additional information from the applicant which we have determined necessary for the completion of our review.
(Safety Evaluation Report Sections 6.3.4 and 14.0 and Section 6.3.4 of Supplement No. 1)

(4) The test program results to demonstrate that adequate electrical isolation exists between the safety related and non-safety related portions of the 7300 series process analog system have not yet been submitted.
(Safety Evaluation Report Section 7.2.2)

(5) The applicant has stated in Amendment 53 to the North Anna Power Station, Units 1 and 2 Final Safety Analysis Report that it is considering modifications to the auxiliary feedwater system in order to extend the time required for operator action to 30 minutes in the event of a feedwater line break. In Amendment 54 the applicant has provided a revised analysis of the feedweater line break for a modified system design. We are reviewing these analyses.
(Safety Evaluation Report Section 15.3)

(6) The applicant must provide additional information on the seismic and environmental qualification of seismic Category I instrumentation and electrical equipment.
(Safety Evaluation Report Section 3.10)

(7) We have not completed our evaluation of the steam generator and reactor coolant pump supports.
(Safety Evaluation Report Section 5.4.2)

(8) We have not completed our evaluation of the mass and energy release rates for a postulated main steam line break accident.
(Safety Evaluation Report Section 6.2.1)

(9) We have not completed our evaluation of the applicant's financial qualifications to operate the facility.
(Safety Evaluation Report Section 20.0)

(10) We will verify the acceptability of the service water reservoir for two-unit operation after we have evaluated the results of the initial operational testing program for North Anna Power Station Unit 1.
(Safety Evaluation Report Section 2.4.3)

(11) We plan to review overpressurization incidents of the reactor coolant system when in a water-solid condition on a generic basis.
(Section 5.2.8 of this report)

(12) We have not yet taken a position on the age of last movement of the Stafford Fault Zone and are seeking additional evidence upon which to base a conclusion.
(Section 2.5 of this report)

Subject to satisfactory resolution of the outstanding matters described above, the conclusions as stated in Section 22 of the North Anna Power Station, Units 1 and 2 Safety Evaluation Report remain unchanged.

## APPENDIX A

## CONTINUATION OF CHRONOLOGY OF RADIOLOGICAL REVIEW

| | |
|---|---|
| June 16, 1976 | Summary of meeting held on June 9, 1976 to discuss the outstanding issues in the North Anna Station. |
| June 21, 1976 | Summary of meeting held on June 14, 1976 to discuss foundation of the service water reservoir and service water pump house. |
| June 23, 1976 | Letter from VEPCO requesting withdrawal of their April 21, 1976 transmittal considered proprietary |
| June 23, 1976 | Reconstitution of Atomic Safety and Licensing Appeal Board. |
| June 24, 1976 | Order issued by Atomic Safety and Licensing Appeal Board. Appeal concerning the admittance of Sun Shipbuilding and Dry Dock Company as an intervenor. |
| June 29, 1976 | Order issued by Atomic Safety and Licensing Board. Sun Shipbuilding and Dry Dock Company will serve the Applicant a list of items which it wishes to have produced. |
| June 30, 1976 | Order issued by Atomic Safety and Licensing Appeal Board. Extension of time to and including July 8, 1976 within which the Staff may file its brief. |
| June 30, 1976 | Division of Project Management letter requesting additional information. |
| June 30, 1976 | Issuance of Supplement No. 1 to the Safety Evaluation Report |
| July 1, 1976 | Division of Project Management letter returning VEPCO's letter and enclosures, dated April 8, 1976, in accordance with their request. |
| July 2, 1976 | Order issued by Atomic Safety and Licensing Appeal Board. Oral Argument calendared for 9:00 a.m. on Monday, July 19, 1976 at the East West Highway Building, Bethesda, Maryland. |
| July 2, 1976 | VEPCO letter sending advance copies of pages that will appear in Amendment No. 54 to the Final Safety Analysis Report. |

| | |
|---|---|
| July 7, 1976 | Division of Project Management letter advising that the schematics transmitted on May 18, 1973 are not considered as proprietary information. |
| July 9, 1976 | Division of Project Management letter requesting additional information. |
| July 9, 1976 | VEPCO letter advising they are experiencing minor delays and, therefore, may not be able to commence fuel loading before December 1976. |
| July 12, 1976 | Division of Project Management letter requesting additional information. |
| July 13, 1976 | Division of Project Management letter transmitting VEPCO copies of Supplement No. 1 to the North Anna Safety Evaluation Report. |
| July 14, 1976 | Submittal of Amendment No. 54 to the Final Safety Analysis Report. |
| July 21, 1976 | VEPCO and NRC representatives meet in Bethesda, Maryland to discuss steam generator and reactor coolant pump supports. |