ENCLOSURE 1

SAFETY EVALUATION INPUT
SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2
COMPLIANCE WITH ATWS RULE 10 CFR 50.62
DOCKET NOS: ~~50-250/251~~
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## 1.0 INTRODUCTION

On July 26, 1984, the Code of Federal Regulations (CFR) was amended to include Section 10 CFR 50.62, "Requirements for Reduction of Risk from Anticipated Transients Without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants" (known as the ATWS Rule). The requirements of Section 10 CFR 50.62 apply to all commercial light-water-cooled nuclear power plants.

An ATWS is an anticipated operational occurrence (such as loss of feedwater, loss of condenser vacuum, or loss of offsite power) that is accompanied by a failure of the Reactor Trip System (RTS) to shut down the reactor. The ATWS Rule requires specific improvements in the design and operation of commercial nuclear power facilities to reduce the probability of failure to shut down the reactor following anticipated transients and to mitigate the consequences of an ATWS event.

Paragraph (c)(1) of 10 CFR 50.62 specifies the basic ATWS mitigation system requirements ~~for~~ Westinghouse plants. Equipment, diverse from the RTS, is required to initiate the auxiliary feedwater (AFW) system and a turbine trip for ATWS events. In response to paragraph (c)(1), the Westinghouse Owners Group (WOG) developed a set of conceptual ATWS mitigating system actuation circuitry (AMSAC) designs generic to Westinghouse plants. WOG issued Westinghouse Topical Report WCAP-10858, "AMSAC Generic Design Package," which provided information on the various Westinghouse designs.

The staff reviewed WCAP-10858 and issued a safety evaluation of the subject

topical report on July 7, 1986 (Ref. 1). In this safety evaluation, the staff concluded that the generic designs presented in WCAP-10858 adequately meet the requirements of 10 CFR 50.62. The approved version of the WCAP is labeled WCAP-10858-P-A.

During the course of the staff's review of the proposed AMSAC design, the WOG issued Addendum 1 to WCAP-10858-P-A by letter dated February 26, 1987 (Ref. 2). This Addendum changed the setpoint of the C-20 AMSAC permissive signal from 70% reactor power to 40% power. On August 3, 1987, the WOG issued Revision 1 to WCAP-10858-P-A (Ref. 3), which incorporated Addendum 1 changes and provided details on changes associated with a new variable timer and the C-20 time delay. For those plants selecting either the feedwater flow or the feedwater pump/valve status logic option, a variable delay timer is to be incorporated into the AMSAC actuation logics. The variable time delay will be inverse to reactor power and will approximate the time that the steam generator takes to boil down to the low-low level setpoint upon a loss of main feedwater (MFW) from any given reactor power level between 40% and 100% power. The time delay on the C-20 permissive signal for all logics will be lengthened to incorporate the maximum time that the steam generator takes to boil down to the low-low level setpoint upon a loss of MFW with the reactor operating at 40% power. The staff considers the Revision 1 changes to be acceptable.

Paragraph (c)(6) of the ATWS Rule requires that detailed information to demonstrate compliance with the requirements be submitted to the Director, Office of Nuclear Reactor Regulation (NRR). In accordance with paragraph (c)(6) of the ATWS Rule, Public Service Electric & Gas Company (PSE&G) (licensee) provided information by letter, dated July 31, 1987 (Ref. 4). The letter forwarded the detailed design description of the ATWS mitigating system actuation circuitry proposed for installation at the Salem Nuclear Generating Station, Units 1 and 2.

The staff held a conference call with the licensee on November 9, 1987, to discuss their AMSAC design. As a result of the conference call, the licensee responded to the staff concerns by letter dated December 24, 1987 (Ref. 5). On

January 25, 1988, and February 19, 1988, conference calls were held with the licensee during which the isolation devices and their compliance to the requirements of Appendix A of the generic SER (Ref. 1) were discussed. By letter dated February 26, 1988 (Ref. 6), the licensee responded with the isolation device qualification information.

## 2.0. REVIEW CRITERIA

The systems and equipment required by 10 CFR 50.62 do not have to meet all of the stringent requirements normally applied to safety-related equipment. However, the equipment required by the ATWS Rule should be of sufficient quality and reliability to perform its intended function while minimizing the potential for transients that may challenge the safety systems, e.g., inadvertent scrams.

The following review criteria were used to evaluate the licensee's submittals:

1. The ATWS Rule, 10 CFR 50.62.

2. "Considerations Regarding Systems and Equipment Criteria," published in the Federal Register, Volume 49, No 124, dated June 26, 1984.

3. Generic Letter 85-06, "Quality Assurance Guidance for ATWS Equipment That Is Not Safety Related."

4. Safety Evaluation of WCAP-10858 (Ref. 1).

5. WCAP-10858-P-A, Revision 1 (Ref. 3).

## 3.0 DISCUSSION AND EVALUATION

To determine that conditions indicative of an ATWS event are present, the licensee has elected to implement the WCAP-10858-P-A AMSAC design associated with monitoring the steam generator water level and activating the AMSAC when

the water level is below the low-low setpoint. Also, the licensee will implement the new time delay (as described in the introduction section) associated with the C-20 permissive consistent with the requirements of Revision 1 to the WCAP.

Many details and interfaces associated with the implementation of the final AMSAC design are of a plant-specific nature. In its safety evaluation of WCAP-10858, the staff identified 14 key elements that require resolution for each plant design. The following paragraphs provide a discussion of the licensee's compliance with respect to each of the plant-specific elements.

1. Diversity

The plant design should include adequate diversity between the AMSAC equipment and the existing Reactor Protection System (RPS) equipment. Reasonable equipment diversity, to the extent practicable, is required to minimize the potential for common-cause failures.

The licensee has provided information to confirm that the AMSAC logic circuits will be diverse from the RPS in the areas of design, equipment, and manufacturer. Where similar types of components are used, such as relays, the AMSAC will utilize a relay of a different make and manufacturer than those used in the RPS.

2. Logic Power Supplies

Logic power supplies need not be Class 1E, but must be capable of performing the required design functions upon a loss of offsite power. The logic power must come from a power source that is independent from the RPS power supplies.

The licensee has provided information verifying that the logic power supplies selected for the Salem AMSAC logic circuits will provide the maximum available independence from the RPS power supplies. The AMSAC will be powered from nonsafety-related power supplies which will be independent of the RPS and capable of operating upon a loss of offsite power.

3. Safety-Related Interface

The implementation of the ATWS Rule shall be such that the existing RPS continues to meet all applicable safety criteria.

The proposed Salem AMSAC design interfaces at its input with the existing Class 1E circuits of the steam generator narrow-range water level and turbine first-stage impulse pressure channels within the reactor protective system. At its output, the AMSAC will interface with the Class 1E circuits of the AFW pumps. Connections with the AFW control circuits will be made downstream of approved Class 1E isolation devices. The licensee has confirmed to the staff that the existing safety-related criteria that are in effect at the Salem station will continue to be met (i.e., the RPS will continue to perform its safety functions without interference from AMSAC). Refer to Item 9 for further discussion.

4. Quality Assurance

The licensee is required to provide information regarding compliance with Generic Letter (GL) 85-06, "Quality Assurance for ATWS Equipment That Is Not Safety Related."

The criteria of the NRC quality assurance guidance (GL 85-06) were reviewed by the licensee. The licensee stated that the quality assurance practices at the Salem station, as applicable to nonsafety-related AMSAC equipment, comply with the guidance of GL 85-06.

5. Maintenance Bypasses

Maintenance bypass indications should be incorporated into the continuous indication of bypass status in the control room.

The licensee provided information showing how maintenance will be accomplished at power. The staff was informed that maintenance at power will be performed by inhibiting the operation of AMSAC's output relays which will block the output signal and, thus, prevent it from reaching the final actuation devices. The continuous indication of bypass status will be provided in the main control room through the use of status lights and annunciation. It is the staff's understanding that the licensee will conduct a human-factors review of the subject indication consistent with the plant's control room design process.

6. Operating Bypasses

The operating bypasses should be indicated continuously in the control room. The independence of the C-20 permissive signal should be addressed.

The licensee has provided information stating that an AMSAC operating bypass (C-20) will be used to enable the operators to bring the plant up in power during startup and to avoid spurious AMSAC actuations at power levels below 40% reactor power (the C-20 setpoint). Above 40% reactor power, the C-20 will automatically arm the AMSAC logics. For the Salem AMSAC logic, the time delay for the C-20 permissive is to be set at 260 seconds. This setpoint is based on the results of plant-specific analyses, and it has been determined by the licensee that this time delay will be sufficient to ensure that AMSAC will perform its required function in the event of a turbine trip (loss of load ATWS). The C-20 permissive signal will originate from existing first-stage turbine impulse chamber pressure sensors. This signal will be taken downstream from qualified isolators and, thus, will not interfere with the RPS. The operating bypass will be indicated continuously in the control room via annunciation and status

lights whenever it arms or enables the AMSAC. It is the staff's understanding that the licensee will conduct a human-factors review of the subject indication consistent with the plant's detailed control room design process.

7. Means for Bypasses

The means for bypassing shall be accomplished by using a permanently installed, human-factored, bypass switch or similar device. Disallowed methods for bypassing mentioned in the guidance should not be utilized.

The licensee's response stated that a permanently installed control switch will be used for the bypass function. The disallowed methods for bypassing, such as lifting leads, pulling fuses, blocking relays, tripping breakers, will not be used. The bypass switch will be located on the AMSAC Test/ Maintenance panel.

It is the staff's understanding that the licensee will conduct a human-factors review of the AMSAC bypass controls consistent with the plant's detailed control room design process.

8. Manual Initiation

Manual initiation capability of the AMSAC mitigation function must be provided.

In the plant-specific submittal, the licensee discussed how manual turbine trip and auxiliary feedwater actuation are accomplished by the operator. The operator can use existing manual controls located in the control room to perform a turbine trip and to start auxiliary feedwater flow. Thus, no additional manual initiation capability is required as a result of installing the AMSAC equipment.

9. Electrical Independence From Existing Reactor Protection System

Independence is required from the sensor output to the final actuation device, at which point nonsafety-related circuits must be isolated from safety-related circuits by qualified Class 1E isolators.

The licensee discussed how electrical independence is to be achieved. The proposed design requires isolation between the non-Class 1E AMSAC and the Class 1E circuit inputs associated with the steam generator (SG) level and the turbine first-stage impulse chamber pressure signals and the AMSAC output signals to the AFW system.

The licensee stated that the Class 1E inputs to the AMSAC will be isolated from the AMSAC using Westinghouse 7100 Series isolation devices. The AMSAC output to the Class 1E circuits will be isolated using Struthers-Dunn Model 219 relays. Also, the entire AMSAC design implementation will be consistent with the electrical separation criteria established for the Salem station during original plant licensing. The subject isolation devices are acceptable for use at Salem as qualified isolators.

10. Physical Separation From Existing Reactor Protection System

The implementation of the ATWS mitigating system must be such that the separation criteria applied to the existing RPS are not violated.

The licensee stated that the AMSAC circuitry will be physically separated from the RPS circuitry. The licensee has further stated that the cable routing will be independent of protection system cable routing and that the ATWS equipment cabinets will be located so that there will be no interaction with the protection system cabinets. Separation of the train A and B circuits within the AMSAC cabinet is to be achieved through a combination of metal barriers, conduit, and distance. The existing separation criteria associated with the RPS will not be compromised as a result of the AMSAC installation and implementation.

11. Environmental Qualification

The plant-specific submittal should address the environmental qualification of ATWS equipment for anticipated operational occurrences.

The licensee stated that AMSAC mitigation equipment will be located in areas of the plant that are considered to be a mild environment. The licensee also stated that the equipment will be environmentally qualified for anticipated operational occurrences that might occur assocaited with the respective equipment locations.

12. Testability at Power

Measures to test the ATWS mitigating system before installation, as well as periodically, are to be established. Testing may be performed with the system in the bypass mode.

The licensee stated that a complete end-to-end test of the AMSAC system, including the AMSAC outputs through to the final actuation devices, will be performed during each refueling outage. With the plant at power, the system will be tested every 3 months with the AMSAC output actuation devices bypassed. The testing capability consists of a series of overlapping tests. These tests will verify analog channel accuracy, setpoint (bistable trip) accuracy, coincidence logic operation, and operation and accuracy of all timers.

This bypass of the AMSAC output actuation devices will be accomplished through a permanently installed bypass switch which negates the need to lift leads, pull fuses, trip breakers, or physically block relays. Status outputs to the plant computer and main control board, indicating that a general warning condition exists for AMSAC, will be initiated when the system's outputs are bypassed. Plant procedures will be used to test the

AMSAC circuitry and outputs. These procedures will ensure that AMSAC is returned to service when testing is complete.

It is the staff's understanding that the licensee will conduct a human-factors review of the controls and indications used for testing purposes that is consistent with the plant's detailed control room design process.

13. Completion of Mitigative Action

The licensee is required to verify that (1) the protective action, once initiated, goes to completion and (2) the subsequent return to operation requires deliberate operator action.

The licensee responded that the system design will be such that AMSAC is consistent with the circuitry of the auxiliary feedwater and turbine trip control systems, as well as the blowdown and sampling systems. Once initiated, the design will ensure that protective action goes to completion. Deliberate operator action is then necessary to terminate AFW flow, clear the turbine trip signal, and re-open the turbine stop valves.

14. Technical Specifications

The plant specific submittal should address Technical Specification requirements for AMSAC.

The licensee responded that no Technical Specification action is proposed with respect to the AMSAC and that normal administrative procedures are sufficient to control AMSAC.

The equipment required by the ATWS Rule to reduce the risk associated with an ATWS event must be designed to perform its functions in a reliable manner. A method acceptable to the staff for demonstrating that the equipment satisfies the reliability requirements of the ATWS Rule is to

provide limiting conditions for operation and surveillance requirements in the Technical Specifications.

In its Interim Commission Policy Statement of Technical Specification Improvements for Nuclear Power Plants [52 Federal Register 3788, February 6, 1987], the Commission established a specific set of objective criteria for determining which regulatory requirements and operating restrictions should be included in Technical Specifications. The staff is presently reviewing ATWS requirements to criteria in this Policy Statement to determine whether and to what extent Technical Specifications are appropriate. Accordingly, this aspect of the staff review remains open pending completion of, and subject to the results of, the staff's further review. The staff will provide guidance regarding the Technical Specification requirements for AMSAC at a later date.

## 4.0 CONCLUSION

The staff concludes, based on the above discussion and subject to final resolution of the Technical Specification issue, that the AMSAC design proposed by the Public Service Electric & Gas Company for the Salem Station is acceptable and is in compliance with the ATWS Rule, 10 CFR 50.62, paragraph (c)(1). The staff's conclusion is further subject to the successful completion of certain noted human-factors engineering reviews to which the licensee has committed. Until staff review is completed regarding the use of Technical Specifications for the ATWS requirements, the licensee should continue with the scheduled installation and implementation (planned operation) of the ATWS design utilizing administratively controlled procedures.

## 5.0 REFERENCES

1. Letter, C E. Rossi (NRC) to L. D. Butterfield (WOG), "Acceptance for Referencing of Licensing Topical Report," July 7, 1986.

2. Letter, R. A. Newton (WOG) to J. Lyons (NRC), "Westinghouse Owners Group Addendum 1 to WCAP-10858-P-A and WCAP-11233-A: AMSAC Generic Design Package," February 26, 1987.

3. Letter, R. A. Newton (WOG) to J. Lyons (NRC), "Westinghouse Owners Group Transmittal of Topical Report, WCAP-10858-P-A, Revision 1, AMSAC Generic Design Package," August 3, 1987.

4. Letter, C. A. McNeill, Jr., (PSE&G) to U.S. NRC, "ATWS Mitigation System Actuation Circuitry (AMSAC)," July 31, 1987.

5. Letter, C. A. McNeill, Jr., (PSE&G) to U.S. NRC, "ATWS Mitigation System Actuation Circuitry (AMSAC)," December 24, 1987.

6. Letter, S. E. Mittenberger (PSE&G) to U.S. NRC, "ATWS Mitigation System Actuation Circuitry (AMSAC)," February 26, 1988.