Duke Power Company

Oconee Nuclear Station

Conceptual Design Description

ATWS MITIGATION SYSTEM ACTUATION CIRCUITRY "AMSAC"

DIVERSE SCRAM SYSTEM "DSS"

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1.0 INTRODUCTION

In response to the July 26, 1988 NRC letter NRC Evaluation of BWOG Generic Report, "Design Requirements for DSS and AMSAC", Duke Power Company submits the following final Design Description for the Oconee Nuclear Station. Plant specific information is contained in this final design description.

1.1 BACKGROUND INFORMATION

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"). An ATWS is an expected operational transient (such as loss of feedwater, loss of condenser vacuum, or loss of offsite power) which is accompanied by a failure of the reactor trip system (RTS) to shut down the reactor due to a common mode failure. The ATWS rule requires specific improvements in the design and operation of commercial nuclear power facilities to reduce the likelihood of failure to shut down the reactor following anticipated transients, and to mitigate the consequences of an ATWS event.

2.0 CONCEPTUAL DESIGN DESCRIPTION

The basic requirements for pressurized water reactor plants are specified in Paragraph (C)(1) of 10 CFR 50.62,

> "Each pressurized water reactor must have equipment from sensor output to final actuation device, that is diverse from the reactor trip system, to automatically initiate the auxiliary (or emergency) feedwater system and initiate a turbine trip under conditions indicative of an ATWS. This equipment must be designed to perform its function in a reliable manner and be independent (from sensor output to the final actuation device) from the existing reactor trip system."

Specific requirements are also stated in Paragraph (C)(2) of 10 CFR 50.62 for Babcock and Wilcox plants,

> "Each pressurized water reactor manufactured by Babcock and Wilcox must have a diverse scram system from the sensor output to interruption of power to the control rods. This scram system must be designed to perform its function in a reliable manner and be independent from the existing reactor trip system (from sensor output to interruption of power of the control rods)."

For B & W plants, the tripping of the regulatory rod groups have been determined through analysis to be the required reactor shutdown (scram) methodology.

2.1 DESCRIPTION OF THE OCONEE SPECIFIC SYSTEM

The AMSAC system that will be installed at the Oconee Nuclear Station is based upon the Babcock and Wilcox Owners Group (BWOG) document 47-1159091-00, "Design Requirements for Diverse Scram System Actuation Circuitry (AMSAC)" and the staff evaluation of B&W document 47-1159091-00. Additional information specifically relevant to Section 5.6 of the Safety Evaluation Report (SER) is provided in G. Holahan's (NRC) letter to Mr. L. C. Stalter (BWOG) dated September 7, 1988.

The following sections describe the plant specific design for the Oconee Station.

2.1.1 DESIGN DESCRIPTIONS

2.1.1.1 AMSAC - ATWS Mitigation Systems Actuation Circuitry

The AMSAC design is based upon conditions that are indicative of a potential ATWS event. The system will monitor the main feedwater pumps for conditions which indicate a loss of main feedwater from both pumps. When a loss of both main feedwater pumps is detected, the AMSAC system will initiate emergency feedwater flow to the steam generators and trip the main turbine.

The actuation of the AMSAC system upon loss of both main feedwater pumps will be by a pressure switch monitoring the hydraulic control oil pressure to the stop valves for each main feedwater pump turbine and by a pressure switch monitoring the discharge pressure of each feedwater pump. Whenever these pressure switches detect a loss of both main feedwater pumps, they will initiate the AMSAC system to perform its function as described above.

2.1.1.2 DDS - Diverse Scram System

The DSS design is based upon conditions in the reactor primary coolant system that are indicative of a loss of heat transfer from the primary to the secondary side. The variable monitored which is indicative of this loss of heat transfer is reactor coolant pressure. When reactor coolant pressure reaches the set point defined in B&W document 47-1159091-00 (2450 ± 25 PSIG), the DSS will actuate and initiate a diverse scram of the reactor by de-gating the Silicon Controlled Rectifiers (SCR's) providing power to the Control Rod Drive Mechanism's (CRDMs). The control rods will drop due to the loss of power and the reactor will shutdown.

3.0 DESIGN AND FUNCTIONAL REQUIREMENTS

The DSS and AMSAC designs for the Oconee Nuclear Station will conform with the generic design requirements found in the BWOG document 47-1159091-00 and the information provided in the staff SER as well as the September 7, 1988 staff letter to the BWOG.

Specific information relative to each design requirement is provided as follows.

3.1 DIVERSITY FROM EXISTING RPS

The AMSAC and DSS for Oconee are designed to maximize the diversity between equipment used for AMSAC/DSS and the existing Reactor Protection System (RPS).

B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC, describes this requirement in Paragraph 3.A.3.

The Reactor Coolant system pressure transmitters used for the DSS will not have any interfaces with the existing RPS. The transmitters used to provide the wide range RC pressure signals to the DSS logic are those used to provide the RG 1.97 indications in the main control room. These transmitters are ITT/Barton Model 753 with a 0-3000 PSIG range. The ITT/Barton transmitters use Westinghouse Monitor-86 signal processing equipment which is digital based, while the Reactor Protection System (RPS) uses Bailey Model 880 analog processing equipment and Rosemount 1152GP9 transmitters.

The pressure switches used for loss of main feedwater detection as used in AMSAC will not have any interfaces with the RPS. The pressure switches will be of diverse manufacture from the control oil and discharge pressure switches used in the EFDW Initiation Circuitry and in the Anticipatory Reactor Trip System (ARTS). Specific pressure switch types are not available at this time. Electrical control equipment will be diverse from the specific equipment used in the RPS.

3.2 ELECTRICAL INDEPENDENCE FROM EXISTING RPS

B&W document 47-1159091-00, the generic design requirements for DSS and AMSAC, describes this requirement in Paragraph 3.A.4.

The transmitters, associated signal conditioners and signal isolators used to provide the RCS Pressure signals to the DSS logic are powered from the same vital busses used to provide power to the RPS, but are electrically isolated from the RPS circuitry by individual Class 1E circuit breakers which are electrically coordinated.

Analysis was specifically performed as part of this conceptual design development on the circuit breakers used to provide the power source to the DSS RC Pressure monitoring circuits and the RPS. This analysis confirmed that these breakers which provide power to the RPS are coordinated. Likewise the breakers which provide the DSS RC Pressure monitoring circuits on the Class 1E side of the isolator are also coordinated. This breaker coordination assures that the RPS and DSS are available independent of each other.

The pressure switch circuits used to provide the loss of both main feedwater pumps-turbine control oil pressure signals to the AMSAC logic are powered from a battery backed non-vital buss which is supplied from offsite power. The pressure switch circuits used to provide loss of both main feedwater pumps-discharge header pressure signals to the AMSAC logic are powered from the vital batteries via their 125 VDC distribution centers. Vital and non-vital busses used for this equipment automatically transfer to the on-site emergency power source in the event of a loss of off-site power.

Electrical independence of the DSS/AMSAC logic circuitry will be provided by powering this circuitry via a dedicated Uninterruptible Power Supply (UPS) which in turn will be connected to a bus powered from off-site power.

Electrical independence of the final actuation relays for DSS will be provided by powering these relays from the dedicated UPS for the DSS/AMSAC logic.

Electrical independence of the final actuation relays for the turbine trip portion of AMSAC will be by powering these relays from the dedicated UPS for the DSS/AMSAC logic.

Electrical independence of the final actuation relay(s) for the start of the Emergency Feedwater (EFDW) Pumps will be by powering these relay(s) from the dedicated UPS for the DSS/AMSAC logic. The EFW pumps will be started directly by the AMSAC logic. The Class 1E Emergency Feedwater Pumps Motor start circuitry will be isolated from the AMSAC logic using already accepted isolation methodologies.

The 1E to non-1E interfaces will have signal isolation provided by existing 1E isolators previously installed for RG 1.97 or other Class 1E to Non-1E applications or equivalent isolators of similar design.

The SER suggests that the plant-specific submittal should use Appendix A of the SER to provide information that the existing 1E to non-1E electrical isolators will function under the maximum worst case fault conditions. The DSS/AMSAC system will utilize the same 1E to non-1E isolation devices which are in use presently at Oconee. The Duke design of the DSS/AMSAC system does not utilize sensors common to the Reactor Protection System (RPS). Therefore no isolators are required for sensor isolation. The control interfaces between the non-safety DSS/AMSAC system and the existing Class 1E plant systems described above are the only places where isolation occurs. This employs previously utilized methods and devices. Duke believes that this commitment, which is consistent with the licensing basis for Oconee, completely satisfies the requirements of 10 CFR 50.62. The selection of isolators will be carried out in a manner that new applications of the DSS/AMSAC isolators are bounded by the original plant criteria and separation requirements.

3.3 PHYSICAL SEPARATION FROM EXISTING RPS

B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC, describes this requirement in Paragraph 3.A.5.

Specific details on the final location of the DSS/AMSAC are not available at this time, however, no physical interfaces between the existing RPS Cabinets and the DSS/AMSAC will be allowed. All existing physical separation requirements between Class 1E and non-Class 1E components will be maintained.

3.4 ENVIRONMENTAL QUALIFICATIONS

The cabinets, equipment and control devices that comprise the DSS/AMSAC system will be located in areas of the plant that have been analyzed to be a mild environment.

3.5 QUALITY ASSURANCE

In response to Generic Letter 85-06, "Quality Assurance Guidance for ATWS Equipment that is not Safety Related", the existing Duke quality programs were reviewed to determine the need for any necessary changes or additions. This review indicated that no new or separate quality program was needed to adequately cover non-safety related ATWS equipment. However, based on the eighteen criteria of the NRC quality assurance guidance, some adjustments were required to the implementing practices and procedures in order to clearly apply these to ATWS items. The results of the review are described below on a criterion-by-criterion basis.

I. Organization - the existing Duke organization meets the guidance of Generic Letter 85-06.

II. Program - a new and separate quality program for non-safety related ATWS equipment was not developed. The existing Duke practices and procedure were determined to be adequate in overall content to cover

ATWS items. However, minor changes to the existing Duke practices and procedures have been made as described for each appropriate criterion.

III. Design Control - the existing Duke Design Engineering Department procedures and the Nuclear Station Modification Program were determined to meet Generic Letter 85-06.

IV. Procurement Document Control - the existing Duke Design Engineering Department procedures and the <u>Nuclear Production Department Administrative Policy Manual for Nuclear Stations</u> were determined to meet Generic Letter 85-06.

V. Instructions, Procedures, and Drawings - a requirement for the development and use of plant procedures on ATWS items was added to the <u>Nuclear Production Department Administrative Policy Manual for Nuclear Stations</u>. This was the only change to Duke practices and procedures determined to be necessary to meet Generic Letter 85-06.

VI. Document Control - the existing Duke practices and procedures were determined to meet Generic Letter 85-06.

VII. Control of Purchased Items and Services - the requirement to control purchased items and services for ATWS equipment including receipt inspections was added to the <u>Nuclear Production Department Administrative Policy Manual for Nuclear Stations</u>.

VIII. Identification and Control of Purchased Items - station specific listings of ATWS related systems and components will be added to each station's Quality Standards Manual to facilitate identification. Otherwise, the existing Duke practices and procedures were determined to meet Generic Letter 85-06.

IX. Control of Special Processes - the requirement to control special processes for ATWS equipment was added to the Nuclear Production Department Administrative Policy Manual for Nuclear Stations.

X. Inspection - the inspection of ATWS items was added to the Nuclear Production Department Administrative Policy Manual for Nuclear Stations.

XI. Testing - the testing of ATWS items was added to the Nuclear Production Department Administrative Policy Manual for Nuclear Stations.

XII. Control of Measuring and Testing Equipment - the control of measuring and test equipment for ATWS items was added to the Nuclear Production Department Administrative Policy Manual for Nuclear Stations.

XIII. Handling, Storage and Shipping - the existing Duke practices and procedures were determined to meet Generic Letter 85-06.

XIV. Inspection, Test and Operating Status - the existing Duke practices and procedures were determined to meet Generic Letter 85-06.

XV. Non Conformances - the existing Duke practices and procedures were determined to meet Generic Letter 85-06.

XVI. Corrective Action System - the existing Duke practices and procedures were determined to meet Generic Letter 85-06.

XVII. Records - the existing Duke practices and procedures were determined to meet Generic Letter 85-06.

XVIII. Audits - the existing Duke practices and procedures were determined to meet Generic Letter 85-06.

3.6 SAFETY-RELATED (1E) POWER SUPPLIES

B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC, discusses this requirement in Paragraph 3.A.8.

The specific power sources for the different ATWS circuit components are as follows:

1. Wide range RC Pressure transmitters and associated analog signal processors are powered from the station vital busses which are supplied via battery backed inverters. The isolation device that converts the Class 1E signal to non-Class 1E will be powered from the same power source as the transmitter power supply which is identified in Section 3.2.

2. The DSS/AMSAC logic circuitry will be powered via a dedicated UPS installed for the DSS/AMSAC. The Uninterruptible Power Supply (UPS) installed to meet the ATWS rule will be in turn connected to a buss supplied from a power

source which is backed-up by the on-site emergency sources and is available during a loss of offsite power event.

The Uninterruptible Power Supply (UPS) will consist of a battery, inverter, and charger; and will provide 120 VAC power to the DSS/AMSAC logic circuitry for a limited period of time on loss of normal sources. This UPS meets the Option 1 requirements set forth the in the NRC's September 7, 1988 letter to Mr. L.C. Stalter Chairman of the B & WOG/ATWS Committee. The UPS will be sized and installed to assure power availability for the DSS/AMSAC logic and assure their functions proceed to completion during a loss of off-site power.

3. The actuation relay coil which trips the main turbine will be powered from the UPS described in 2 above. The actual turbine trip mechanism (solenoid) is powered from turbine self-generated power sources.

3.7 TESTABILITY AT POWER

B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC, discusses this requirement in Paragraph 3.A.9.

Testability at power is provided by designing both DSS and AMSAC systems to be 2 out of 2 systems and incorporating provisions to disable the system output when placing the first channel into the test condition. Post Modification Test Acceptance Criteria will be provided as part of the design modification package. A testing bypass alarm will be provided to alert the control room and operators to the testing bypass condition.

3.8 INADVERTENT ACTUATION

B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC, discusses this requirement in Paragraph 3.A.10.

The proposed Duke design provides for maximum protection from inadvertent actuation by designing a 2 out of 2 system for DSS and AMSAC which operates in the energize to trip mode.

3.9 MAINTENANCE BYPASSES

B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC, discusses this requirement in Paragraph 3.B.6.

The proposed Duke design provides for disabling of a channel for maintenance, testing, repair or calibration by placing the specific channel in Test. Administrative controls will be provided to require placing a DSS or AMSAC channel in test in order to provide a Control Room alarm anytime work is to be performed which would disable operation of the other channel. These administrative controls should also prohibit personnel from working on more than one DSS or AMSAC channel simultaneously.

3.10 OPERATING BYPASSES

B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC, discusses this requirement in Paragraph 3.B.8.

The proposed Duke designs for the DSS and AMSAC do not require any operational bypasses and none are provided.

3.11 INDICATION OF BYPASSES

B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC, discusses this requirement in Paragraph 3.B.7.

The proposed Duke design provides for indication of DSS and AMSAC status in the Control Room by providing inputs to the plant computer and providing bypass indication status lights at the bypass initiation location.

The computer displays alarm status to the operators via a color CRT mounted the Main Control Board.

3.12 MEANS FOR BYPASSING

This item is not directly addressed in B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC. The proposed Duke design provides bypass capability for maintenance and testing by means of installed test devices (switches, lights, etc.).

3.13 COMPLETION OF PROTECTIVE ACTION

B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC, discusses this requirement in Paragraph 3.B.5.

The design will provide lock-up of the DSS trip functions as described in Paragraph 3.B.5. Reset of the DSS trip function will require manual operator action and will be accomplished from the control room.

Lock-up of the AMSAC logic function is not provided in the proposed Duke design since it is not identified as a requirement in B&W Document 47-1159091-00. The proposed design will utilize the reset features normally provided as part of the main feedwater pump turbine control scheme.

3.14 INFORMATION READOUT

This item is not directly addressed in B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC.

The proposed Duke design provides indication of DSS and AMSAC system status remotely by means of the plant computer and locally at the DSS and AMSAC logic cabinet by means of indicating lights.

3.15 SAFETY-RELATED INTERFACES

B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC, discusses this requirement in Paragraph 3.A.1.

The proposed Duke design does not interface with existing RPS and Engineered Safeguards Systems (ES) protection systems. There is no possibility of compromising the safety criteria for these systems.

Interfaces with the safety-related Emergency Feedwater System (EFDW) will be by previously licensed isolation methods.

3.16 ACCURACY REQUIREMENTS

B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC, describes this functional requirement in Paragraph 3.B.11.

The objective of the Duke DSS design shall be to meet this functional requirement. A loop accuracy calculation will be performed as part of the final DSS design process to verify this objective.

3.17 TECHNICAL SPECIFICATIONS

SER section 5.16 requests that Technical Specifications be adopted on surveillance and testing of the DSS and AMSAC systems. Duke's position is that any potential technical specifications must be addressed as a part of the Technical Specification Improvement Program (TSIP). It was acknowledged by the NRC during the August 17, 1988 meeting that this position was reasonable in light of the continuing TSIP discussions between the NRC and the industry.

By letter dated September 15, 1986, Duke Power proposed a means by which items that do not meet the proposed technical specification selection criteria may be maintained. Duke considers that the DSS and AMSAC systems do not meet any one of three criteria proposed by the AIF (and endorsed by the Staff in SECY-86-10) in that ATWS is an event that is beyond the Design Basis of the plants.

Due to the high degree of reliability of the components of the system, Duke considers that testing on an every refueling outage frequency is sufficient.

4.0 INPUT PARAMETERS

B&W Document 47-1159091-00, the generic design requirements for DSS and AMSAC, discusses this requirement in Paragraphs 3.B.2 and 3.B.9.

The proposed Duke design provides for DSS actuation based on wide range (0-3000 psig) RC pressure and AMSAC actuation based on loss of both main feedwater pumps. The DSS setpoint is specified in Paragraph 3.B.9 as 2450 ± 25 psig and will be implemented using adjustable signal monitor modules.

The AMSAC setpoint is also specified in Paragraph 3.B.9 of the B&W document as that representative of complete (100%) loss of feedwater flow. Since zero flow is not an operationally realistic setpoint, the actual setpoint will be equivalent to a flow level greater than zero and will be determined during the detail design process. AMSAC will actuate when both Main Feedwater pumps have stopped providing feedwater to the Once Through Steam Generators (OTSG's). This actuation will be implemented using pressure switches.

4.1 INPUT SELECTION-AMSAC

The methodology employed to monitor feedwater flow for AMSAC is indicative of a total loss of capability to feed the steam generators.

The pressure switches that monitor main feedwater pump turbine stop valve control oil status do so by responding to hydraulic pressure changes on the stop valve trip headers.

The hydraulic trip header pressure reflects steam stop valve position via pressure required to hold the stop valves open. When hydraulic pressure decreases to 75 PSIG, the pressure switches actuate to reflect that the stop valves are no longer open and no steam is being admitted to the control valves. The decrease in hydraulic pressure reflects that both the high and low pressure steam stop valves are closed. Without steam supply to the main feedwater pump turbine no feedwater can be pumped to the steam generators.

In addition to monitoring the hydraulic control oil pressure to the stop valves, the AMSAC system also monitors main feedwater pump discharge pressure. These pressure switches monitor the discharge pressure to determine if there is sufficient pump head to provide feedwater to the steam generators. The pressure switches are provided with a setpoint of 750 PSIG, which indicates that insufficient pump discharge head is available to feed the steam generators.

The combination of main feedwater pump turbine stop valve hydraulic control oil pressure and pump discharge pressure provides for complete monitoring of a potential loss of feedwater condition. An additional benefit provided by this combination of monitoring is that the AMSAC requires no low power bypassing in order to initiate startup of the condensate-feedwater system and main turbine.

5.0 RESPONSE TO APPENDIX A, DSS AND AMSAC ISOLATION DEVICE

The present design concept for DSS/AMSAC does not call for use of isolators between it and the existing RPS. The use of isolators to access available sensors also utilized by the RPS would require a detailed response to Appendix A. Because the Duke design concept does not utilize RPS sensors, no Appendix A response is provided.

6.0 IMPLEMENTATION SCHEDULES

Potential outages have already been identified which would allow installation on each unit. The outages are identified as follows:

Oconee Unit 1	EOC13	-	September 1991
Oconee Unit 2	EOC12	-	January 1992
Oconee Unit 3	EOC12	-	May 1991

NRC approval of the proposed conceptual design and any additional requests for information is needed by June 1, 1989 to accommodate the proposed installation schedules.