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TECHNICAL SPECIFICATIONS FOR REDUNDANT DECAY HEAT REMOVAL CAPABILITY, ARKANSAS NUCLEAR ONE, UNIT NO. 1

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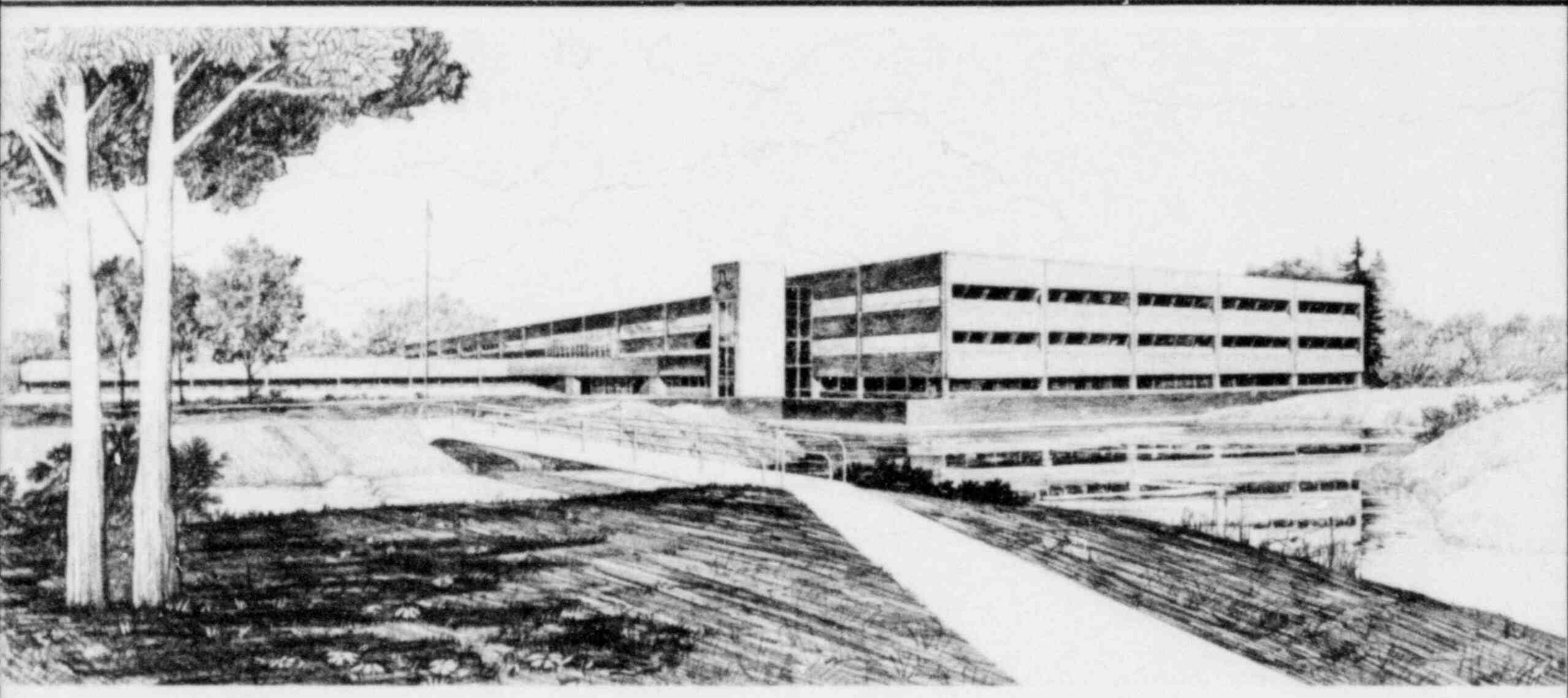

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INTERIM REPORT

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TECHNICAL SPECIFICATIONS FOR REDUNDANT DECAY HEAT REMOVAL CAPABILITY ARKANSAS NUCLEAR ONE, UNIT NO. 1

Docket No. 50-313

February 1982

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ABSTRACT

This report reviews the Arkansas Nuclear One, Unit No. 1 proposed technical specification requirements for redundancy in decay heat removal capability in all modes of operation.

FOREWORD

This report is supplied as part of the "Selected Operating Reactor Issues Program (III)" being conducted for the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Licensing, by EG&G Idaho, Inc., Reliability and Statistics Branch.

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CONTENTS

TECHNICAL EVALUATION REPORT

TECHNICAL SPECIFICATIONS FOR REDUNDANT DECAY HEAT REMOVAL CAPABILITY ARKANSAS NUCLEAR ONE, UNIT NO. 1

1.0 INTRODUCTION

A number of events have occurred at operating PWR facilities where decay heat removal capability has been seriously degraded due to inadequate administrative controls during shutdown modes of operation. One of these events, described in IE Information Notice 80-20,[1] occurred at the Davis-Besse, Unit No. 1 plant on April 19, 1980. In IE Bulletin 80-12[2] dated May 9, 1980, licensees were requested to immediately implement administrative controls which would ensure that proper means are available to provide redundant methods of decay heat removal. While the function of the bulletin was to effect immediate action with regard to this problem, the NRC considered it necessary that an amendment of each license be made to provide for permanent long term assurance that redundancy in decay heat removal capability will be maintained. By letter dated June 11, 1980,[3] all PWR licensees were requested to propose technical specification (TS) changes that provide for redundancy in decay heat removal capability in all modes of operation; use the NRC model TS which provide an acceptable solution of the concern and include an appropriate safety analysis as a basis; and submit the proposed TS with the basis by October 11, 1980.

Arkansas Power & Light (AP&L), Little Rock, Arkansas, submitted proposed revisions for decay heat removal to their technical specifications (TS) for Arkansas Nuclear One, Unit 1,[4] on October 31, 1980.

2.0 REVIEW CRITERIA

The review criteria for this task are contained in the June 11, 1980 letter from the NRC to all PWR licensees. The NRC provided the model technical specifications (MTS) which identify the normal required redundant coolant system and the required action when redundant systems are not available for a typical two loop plant (Appendix A). The purpose of this report is to review the licensee's proposed TS and note any differences between them and the model TS as provided by the NRC.

3.0 DISCUSSION AND EVALUATION

Arkansas Nuclear One, Unit 1 (ANO-1) is a two coolant loop Babcock & Wilcox (B&W) PWR plant. The following discussion presents an evaluation of the proposed technical specifications submitted by AP&L for redundant decay heat removal as requested by the NRC. Because ANO-1's proposed TS are not in the NRC MTS format, wording and organization are quite different. This evaluation compares the ANO-1 proposed TS to the NRC MTS requirements during equivalent operating conditions; the conditions defining each of the following modes are those given by the B&W Standard Technical Specifications.[5]

3.1 Startup and Power Operation--Modes 1 and 2
($K_{eff} \geq 0.99$, Rated Thermal Power >5%, $T_{avg} \geq 305°F$)

The NRC model TS require both coolant loops and both reactor coolant pumps in each loop to be in operation. With one of the four coolant pumps not in operation, STARTUP and POWER OPERATION may be initiated and may proceed provided thermal power is restricted. Within four hours of losing one pump, the setpoints for the following trips are required to be reduced: 1) Nuclear Overpower, 2) Nuclear Overpower based on RCS flow and AXIAL POWER IMBALANCE, and 3) Nuclear Overpower based on pump monitors.

The proposed ANO-1 TS refer to Table 15.2.3-1 of the technical specifications for required pump combinations at given power levels.[6] Four pumps are required at full power. With the loss of one pump, setpoints for 1) Nuclear Overpower and 2) Nuclear Overpower based on RCS flow and AXIAL POWER IMBALANCE are reduced as required; however, no time limit (as 4 hours) is specified. The table indicates that resetting the trip values for Nuclear Overpower based on pump monitors is not applicable with three pumps in operation.

Periodic surveillance is required by the NRC MTS to ensure that the limiting conditions discussed above are satisfied. However, the MTS also require verification that the trip setpoints be reduced either (a) within 4 hours after switching to a different pump combination if the switch is made while operating, or (b) prior to reactor criticality if the switch is made while shutdown. This requirement is not included in the proposed TS.

3.2 Hot Standby--Mode 3
(K_{eff} <0.99, Rated Thermal Power = 0%, $T_{avg} \geq 305°F$)

The NRC model TS require Reactor Coolant Loop (A), Reactor Coolant Loop (B), and at least one associated reactor coolant pump in each loop to be operable in mode 3. At least one of the coolant loops and an associated pump must be in operation.[a] With less than the above reactor coolant loops operable, the MTS require the loop(s) be restored to OPERABLE status within 72 hours; otherwise the reactor must be in HOT SHUTDOWN within the next 12 hours. With no reactor coolant loop in operation, all operations involving a reduction in boron concentration must be suspended and immediate action must be taken to return the required loop to operation.

The licensee's proposed TS, (having $T_{avg} \geq 280°F$ for mode 3), satisfy the conditions required by the NRC MTS. No statement is made, however, concerning the action taken when there are no coolant loops in operation, i.e. suspending all operations involving a reduction in boron concentration. Also, the special condition in note[(a)] below, is not discussed in the proposed TS.

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a. All reactor coolant pumps may be de-energized for up to 1 hour provided (1) no operations are permitted that would cause dilution of the reactor coolant system boron concentration, and (2) core outlet temperature is maintained at least 10°F below saturation temperature.

The NRC MTS surveillance requirements assuring operation and operability are met in ANO-1's proposed TS.

3.3 Hot and Cold Shutdown--Modes 4 and 5
(K_{eff} <0.99, Rated Thermal Power = 0%, 200°F < T_{avg} < 305°F and T_{avg} ≤200°F)

The NRC MTS require in modes 4 and 5, at least two of the following coolant loops to be operable: Reactor Coolant Loop (A), Reactor Coolant Loop (B), (including their associated steam generators and at least one associated reactor coolant pump), Decay Heat Removal Loop (A)[a] and Loop (B).[a] At least one of the above coolant loops must be in operation.[b] With less than the required coolant loops operable, the MTS require immediate action to return the loop(s) to OPERABLE status as soon as possible or the plant must be in COLD SHUTDOWN within 20 hours. With no coolant loops operating, all operations involving a reduction in boron concentration of the Reactor Coolant System must be suspended.

The licensee's proposed TS meet all the NRC MTS operating and surveillance requirements for modes 4 and 5.

3.4 Refueling--Mode 6
(K_{eff} <0.95, Rated Thermal Power = 0%, T_{avg} ≤140°F)

During refueling operations, the MTS require at least one decay heat removal (DHR) loop to be in operation. With less than one DHR loop in operation, all operations involving an increase in the reactor decay heat load or a reduction in boron concentration must be suspended. The MTS also require all containment penetrations providing direct access from the containment atmosphere to the outside atmosphere be closed within four hours. The DHR loop may, however, be removed from operation for up to 1 hour per 8 hour period during the performance of CORE ALTERATIONS in the vicinity of the reactor pressure vessel (hot) legs.

During refueling when the water level above the top of the irradiated fuel assemblies seated within the reactor pressure vessel is less than 23 feet, the MTS require two independent DHR loops to be operable.[c] With less than two loops operable, immediate corrective action must be taken to return the required loops to OPERABLE status as soon as possible.

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a. The normal or emergency power source may be inoperable in MODE 5.

b. All reactor coolant pumps may be de-energized for up to 1 hour provided (1) no operations are permitted that would cause dilution of the reactor coolant system boron concentration, and (2) core outlet temperature is maintained at least 10°F below saturation temperature.

c. The normal or emergency power source may be inoperable for each DHR loop.

The proposed TS meet the above requirements. The NRC MTS, however, require surveillance once every 4 hours to verify that at least one DHR loop is operating and circulating reactor coolant at a flow rate of equal to or greater than 2800 gpm. ANO-1's proprosed TS do not discuss the flow rate of the DHR loop.

4.0 CONCLUSION

An evaluation of the proposed TS for Arkansas Nuclear One, Unit No. 1, indicates they are in general agreement with the NRC model technical specifications for redundant decay heat removal. The following differences were noted and discussed in previous sections of this report:

1. With the loss of one pump in startup and power operation, ANO-1 TS do not specify a time limit for which trip setpoints must be reduced.

2. With the loss of one pump in startup and power operation, ANO-1 TS do not require a reduction of the trip setpoint for Nuclear Overpower based on pump monitors.

3. When there are no coolant loops in operation in hot standby, ANO-1 TS do not require that all operations involving a reduction in boron concentration must be suspended.

4. During refueling, ANO-1 TS do not require the flow rate of the reactor coolant in the DHR loop to be equal to or greater than 2800 gpm.

5.0 REFERENCES

1. NRC IE Information Notice 80-20, May 8, 1980.

2. NRC IE Bulletin 80-12, May 1980.

3. NRC letter, D. G. Eisenhut, To all Operating Pressurized Water Reactors (PWR's), dated June 11, 1980.

4. AP&L letter, W. Cavanaugh to NRC, D. G. Eisenhut, dated October 31, 1980.

5. Standard Technical Specifications for Babcock and Wilcox Pressurized Water Reactors, NUREG-0103-Rev. 3, July 1979.

6. Arkansas Nuclear One, Unit 1, FSAR, Volume II, (Arkansas Power & Light Co., Little Rock, Arkansas) 1971.

APPENDIX A

MODEL TECHNICAL SPECIFICATIONS FOR REDUNDANT DECAY HEAT REMOVAL
FOR BABCOCK & WILCOX PRESSURIZED WATER REACTORS (PWR's)

3/4.4 REACTOR COOLANT SYSTEM

3/4.4.1 COOLANT LOOPS AND COOLANT CIRCULATION

STARTUP AND POWER OPERATION

LIMITING CONDITION FOR OPERATION

3.4.1.1 Both reactor coolant loops and both reactor coolant pumps in each loop shall be in operation.

APPLICABILITY: MODES 1 and 2.*

ACTION:

With one reactor coolant pump not in operation, STARTUP and POWER OPERATION may be initiated and may proceed provided THERMAL POWER is restricted to less than ( )% of RATED THERMAL POWER and within 4 hours the setpoints for the following trips have been reduced to the values specified in Specification 2.2.1 for operation with three reactor coolant pumps operating:

1. (Nuclear Overpower).
2. (Nuclear Overpower based on RCS flow and AXIAL POWER IMBALANCE).
3. (Nuclear Overpower based on pump monitors).

SURVEILLANCE REQUIREMENT

4.4.1.1 The above required reactor coolant loops shall be verified to be in operation and circulating reactor coolant at least once per 12 hours.

4.4.1.2 The Reactor Protective Instrumentation channels specified in the applicable ACTION statement above shall be verified to have had their trip setpoints changed to the values specified in Specification 2.2.1 for the applicable number of reactor coolant pumps operating either:

a. Within 4 hours after switching to a different pump combination if the switch is made while operating, or

b. Prior to reactor criticality if the switch is made while shutdown.

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* See Special Test Exception 3.10.4.

REACTOR COOLANT SYSTEM

HOT STANDBY

LIMITING CONDITION FOR OPERATION

3.4.1.2 a. The reactor coolant loops listed below shall be OPERABLE:

1. Reactor Coolant Loop (A) and its associated reactor coolant pump,

2. Reactor Coolant Loop (B) and its associated reactor coolant pump,

b. At least one of the above Reactor Coolant Loops shall be in operation.*

APPLICABILITY: MODE 3

ACTION:

a. With less than the above required reactor coolant loops OPERABLE, restore the required loops to OPERABLE status within 72 hours or be in HOT SHUTDOWN within the next 12 hours.

b. With no reactor coolant loop in operation, suspend all operations involving a reduction in boron concentration of the Reactor Coolant System and immediately initiate action to return the required coolant loop to operation.

SURVEILLANCE REQUIREMENT

4.4.1.2.1 At least the above required reactor coolant pumps, if not in operation, shall be determined to be OPERABLE once per 7 days by verifying correct breaker alignments and indicated power availability.

4.4.1.2.2 At least one cooling loop shall be verified to be in operation and circulating reactor coolant at least once per 12 hours.

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* All reactor coolant pumps may be de-energized for up to 1 hour provided (1) no operations are permitted that would cause dilution of the reactor coolant system boron concentration, and (2) core outlet temperature is maintained at least 10°F below saturation temperature.

LIMITING CONDITION FOR OPERATION

3.4.1.3 a. At least two of the coolant loops listed below shall be OPERABLE:

1. Reactor Coolant Loop (A) and its associated steam generator and at least one associated reactor coolant pump,

2. Reactor Coolant Loop (B) and its associated steam generator and at least one associated reactor coolant pump,

3. Decay Heat Removal Loop (A),*

4. Decay Heat Removal Loop (B),*

b. At least one of the above coolant loops shall be in operation.**

APPLICABILITY: MODES 4 and 5.

ACTION:

a. With less than the above required loops OPERABLE, immediately initiate corrective action to return the required loops to OPERABLE status as soon as possible; be in COLD SHUTDOWN within 20 hours.

b. With no coolant loop in operation, suspend all operations involving a reduction in boron concentration of the Reactor Coolant System and immediately initiate corrective action to return the required coolant loop to operation.

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* The normal or emergency power source may be inoperable in MODE 5.

** All reactor coolant pumps and decay heat removal pumps may be de-energized for up to 1 hour provided (1) no operations are permitted that would cause dilution of the reactor coolant system boron concentration, and (2) core outlet temperature is maintained at least $10^{o}F$ below saturation temperature.

SURVEILLANCE REQUIREMENT

4.4.1.3.1 The required residual heat removal loop(s) shall be determined OPERABLE per Specification 4.0.5.

4.4.1.3.2 The required reactor coolant pump(s), if not in operation, shall be determined to be OPERABLE once per 7 days by verifying correct breaker alignments and indicated power availability.

4.4.1.3.3 The required steam generator(s) shall be determined OPERABLE by verifying secondary side level to be greater than or equal to ( )%.

4.4.1.3.4 At least one coolant loop shall be verified to be in operation and circulating reactor coolant at least once per 12 hours.

3/4.9.8 RESIDUAL HEAT REMOVAL AND COOLANT CIRCULATION

ALL WATER LEVELS

LIMITING CONDITION FOR OPERATION

3.9.8.1 At least one residual heat removal (DHR) loop shall be in operation.

APPLICABILITY: MODE 6

ACTION:

a. With less than one DHR loop in operation, except as provided in b. below, suspend all operations involving an increase in the reactor decay heat load or a reduction in boron concentration of the Reactor Coolant System. Close all containment penetrations providing direct access from the containment atmosphere to the outside atmosphere within 4 hours.

b. The DHR loop may be removed from operation for up to 1 hour per 8 hour period during the performance of CORE ALTERATIONS in the vicinity of the reactor pressure vessel (hot) legs.

c. The provisions of Specification 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENT

4.9.8.1 At least one DHR loop shall be verified to be in operation and circulating reactor coolant at a flow rate of greater than or equal to (2800) gpm at least once per 4 hours.

LOW WATER LEVEL

LIMITING CONDITION FOR OPERATION

3.9.8.2 Two independent DHR loops shall be OPERABLE.*

APPLICABILITY: MODE 6 when the water level above the top of the irradiated fuel assemblies seated within the reactor pressure vessel is less than 23 feet.

ACTION:

a. With less than the required DHR loops OPERABLE, immediately initiate corrective action to return the required loops to OPERABLE status as soon as possible.

b. The provisions of Specification 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENT

4.9.8.2 The required DHR loops shall be determined OPERABLE per Specification 4.0.5.

* The normal or emergency power source may be inoperable for each DHR loop.

3/4.4.1 COOLANT LOOPS AND COOLANT CIRCULATION

The plant is designed to operate with both reactor coolant loops in operation, and maintain DNBR above (1.32/1.30) during all normal operations and anticipated transients. With one reactor coolant pump not in operation in one loop, THERMAL POWER is restricted by the Nuclear Overpower Based on RCS Flow and AXIAL POWER IMBALANCE and the Nuclear Overpower Based on Pump Monitors trip, ensuring that the DNBR will be maintained above (1.32/1.30) at the maximum possible THERMAL POWER for the number of reactor coolant pumps in operation or the local quality at the point of minimum DNBR equal to (22/15)%, whichever is more restrictive.

In MODE 3, a single reactor coolant loop provides sufficient heat removal capability for removing decay heat; however, single failure considerations require that two loops be OPERABLE.

In MODES 4 and 5, a single reactor coolant loop or DHR loop provides sufficient heat removal capability for removing decay heat; but single failure considerations require that at least two loops be OPERABLE. Thus, if the reactor coolant loops are not OPERABLE, this specification requires two DHR loops to be OPERABLE.

The operation of one Reactor Coolant Pump or one DHR pump provides adequate flow to ensure mixing, prevent stratification and produce gradual reactivity changes during boron concentration reductions in the Reactor Coolant System. The reactivity change rate associated with boron reduction will, therefore, be within the capability of operator recognition and control.

3/4.9.8 DECAY HEAT REMOVAL AND COOLANT CIRCULATION

The requirement that at least one DHR loop be in operation ensures that (1) sufficient cooling capacity is available to remove decay heat and maintain the water in the reactor pressure vessel below 140°F as required during the REFUELING MODE, and (2) sufficient coolant circulation is maintained through the reactor core to minimize the effect of a boron dilution incident and prevent boron stratification.

The requirement to have two DHR loops OPERABLE when there is less than 23 feet of water above the core ensures that a single failure of the operating DHR loop will not result in a complete loss of decay heat removal capability. With the reactor vessel head removed and 23 feet of water above the core, a large heat sink is available for core cooling. Thus, in the event of a failure of the operating DHR loop, adequate time is provided to initiate emergency procedures to cool the core.