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TECHNICAL SPECIFICATIONS FOR REDUNDANT DECAY HEAT REMOVAL CAPABILITY, CRYSTAL RIVER, UNIT NO. 3

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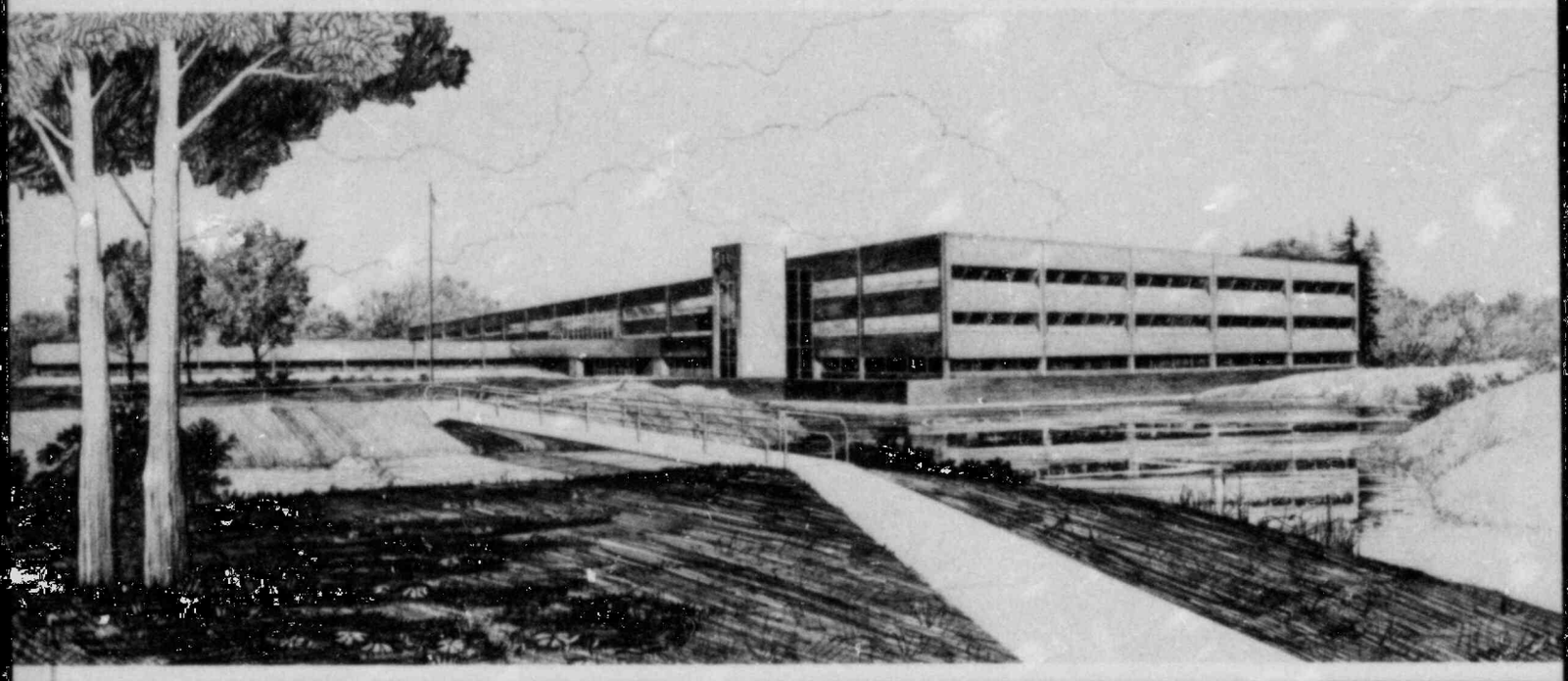
Idaho Operations Office • Idaho National Engineering Laboratory



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TECHNICAL SPECIFICATIONS FOR REDUNDANT DECAY HEAT REMOVAL CAPABILITY CRYSTAL RIVER, UNIT NO. 3

July 1982

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Reliability and Statistics Branch
Engineering Analysis Division
EG&G Idaho, Inc.

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ABSTRACT

This report reviews the Crystal River, Unit No. 3 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 Reactors 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 SPECIFICATIONS FOR REDUNDANT DECAY HEAT REMOVAL CAPABILITY

CRYSTAL RIVER UNIT, NO. 3

1.0 INTRODUCTION

A number of events have occurred at operating Pressurized Water Reactor (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 Station, Unit No. 1, 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 specifications (TS) changes that provide for redundancy in decay heat removal capability in all modes of operation; use the NRC model TS[4] 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.

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 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 TS and note any differences between them and the model TS as provided by the NRC.

3.0 DISCUSSION AND EVALUATION

Crystal River, Unit No. 3 (CR-3) is a two coolant loop Babcock & Wilcox (B&W) PWR plant. The following discussion presents an evaluation of the existing TS submitted by Florida Power for redundant decay heat removal as requested by NRC.[5] CR-3's TS closely parallel the NRC model TS.

3.1 Startup and Power Operation--Modes 1 and 2

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 4 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 CR-3 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 to less than 79.92% of RATED THERMAL POWER and within 4 hours the setpoint for the Nuclear Overpower Setpoint is reduced; no mention is made of setpoint reduction for Nuclear Overpower based on RCS flow and AXIAL POWER IMBALANCE or pump monitors.

The surveillance requirements of the CR-3 TS match those of the NRC model TS except that verification of coolant loop operation at least once per 12 hours is not required.

3.2 Hot Standby--Mode 3

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 (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). With less than the above reactor coolant loops operable, the model TS 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 CR-3 TS require at least one reactor coolant loop in operation with either an associated reactor coolant pump or decay heat removal pump; the TS contain no ACTION requirement equivalent to that of model TS paragraph 3.4.1.2, nor do they contain surveillance requirements equivalent to model TS paragraphs 4.4.1.2.1 and 4.4.1.2.2.

3.3 Hot and Cold Shutdown--Modes 4 and 5

The NRC model TS 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) 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 model TS 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.

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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.

The CR-3 TS require at least one reactor coolant loop in operation with either an associated reactor coolant pump or decay heat removal pump in Modes 4 and 5; in Mode 4 only, they also require that each steam generator and each decay heat removal loop be OPERABLE. With less than these OPERABLE, the TS require immediate initiation of corrective action to return the required systems to OPERABLE status within 72 hours or be in at least Hot Standby within the next 6 hours and Cold Shutdown within the following 30 hours.

The CR-3 TS require decay heat removal loops be demonstrated to be OPERABLE by verifying, at least once per 31 days, that each applicable valve is in its correct position; they contain no surveillance requirements equivalent to those of model TS paragraphs 4.4.1.3.2, 4.4.1.3.3, and 4.4.1.3.4.

3.4 Refueling--Mode 6

During refueling operations, the model TS 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 model TS 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 model TS require two independent DHR loops to be operable.[a] With less than two loops operable, immediate corrective action must be taken to return the required loops to OPERABLE status as soon as possible.

The CR-3 TS meet the above requirements except that they do not require two independent DHR loops to be operable with less than 23 feet of water above the top of the irradiated fuel assemblies. The TS requires at least one DHR be verified to be in operation and circulating reactor coolant at a flow rate of at least 2700 gpm at least once per 24 hours, as compared with the model TS requirement of 2800 gpm verified at least once per 4 hours.

4.0 CONCLUSION

An evaluation of the existing TS for Crystal River, Unit No. 3, 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:

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

1. In Modes 1 and 2, no mention is made of setpoint reduction for Nuclear Overpower based on RCS flow and AXIAL POWER IMBALANCE or pump monitors, and verification of coolant loop operation at least once per 12 hours is not required.

2. In Mode 3, operation of a reactor coolant pump is not required, nor are there ACTION or surveillance requirements equivalent to those of the model TS.

3. In Mode 4, operation of a reactor coolant pump is not required and time limits for ACTION differ from those of the model TS, as do the surveillance requirements.

4. In Mode 5, in addition to the points noted for Mode 4, steam generators and DHR loops are not required to be operable.

5. In Mode 6, there is no requirement for two DHR loops to be operable with less than 23 feet of water above the top of irradiated fuel assemblies; also, surveillance requirements differ slightly from the model TS.

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

5. Technical Specifications for Crystal River, Unit 3, revised through Amendment 46.

APPENDIX F

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

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.

REACTOR COOLANT SYSTEM

SHUTDOWN

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.

REFUELING OPERATIONS

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.

REFUELING OPERATIONS

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.

BASES

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.