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TECHNICAL SPECIFICATIONS FOR REDUNDANT DECAY HEAT REMOVAL CAPABILITY, ZION STATION, UNITS 1 AND 2

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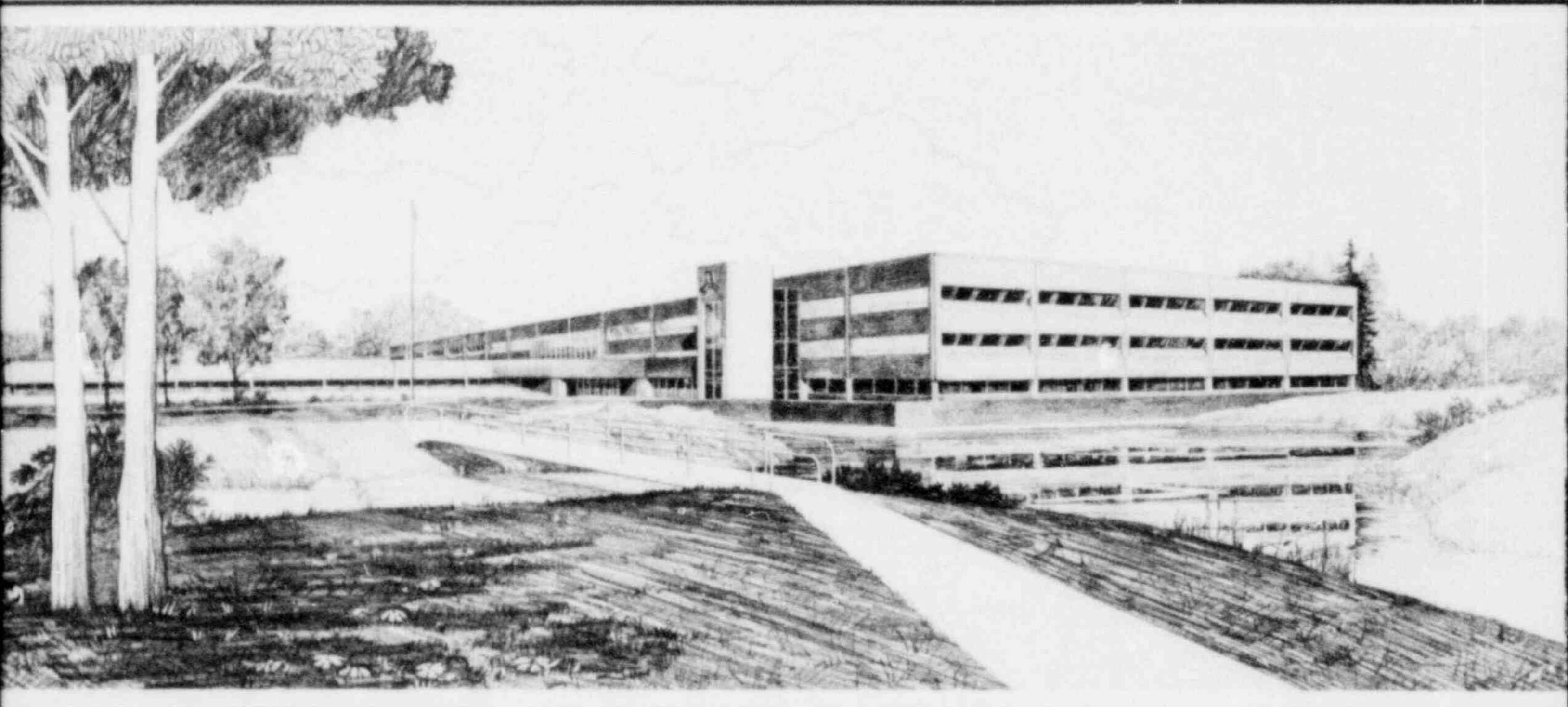

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TECHNICAL SPECIFICATIONS FOR REDUNDANT DECAY HEAT REMOVAL CAPABILITY

ZION STATION, UNITS 1 AND 2

Docket Nos. 50-295 and 50-304

November 1981

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ABSTRACT

This report reviews the Zion Station Units 1 and 2 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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TECHNICAL EVALUATION REPORT

TECHNICAL SPECIFICATIONS FOR REDUNDANT DECAY HEAT REMOVAL CAPABILITY ZION STATION, UNITS 1 AND 2

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 the 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.

Commonwealth Edison (CE), Chicago, Illinois, submitted proposed revisions for decay heat removal to their Technical Specifications (TS) for Zion Units 1 and 2,[4] on November 7, 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 actions when redundant systems are not available for a typical four loop plant (Appendix A). This review will determine if the licensees existing and/or proposed plant TS are in agreement with the MTS as required by the NRC.

The specific sections of the Westinghouse Standard Technical Specifications[5] that apply to this task are as follows:

3/4.4	Reactor Coolant System
3/4.4.1	Reactor Coolant System and Coolant Circulation

Startup and Power Operation (modes 1 & 2)

3.4.1.1	Limiting Conditions for Operation
4.4.1.1	Surveillance Requirement

Hot Standby (mode 3)

3.4.1.2	Limiting Conditions for Operation
4.4.1.2.1	Surveillance Requirement
4.4.1.2.2	Surveillance Requirement

Shutdown (modes 4 & 5)

3.4.1.3	Limiting Conditions for Operation
4.4.1.3.1	Surveillance Requirement
4.4.1.3.2	Surveillance Requirement
4.4.1.3.3	Surveillance Requirement
4.4.1.3.4	Surveillance Requirement

Refueling Operations (mode 6)

3.9.8.1	Limiting Condition for Operation
3.9.8.2	Limiting Condition for Operation
4.9.8.1	Surveillance Requirement
4.9.8.2	Surveillance Requirement

3.0 DISCUSSION AND EVALUATION

Zion Station Units 1 and 2, are four loop Westinghouse (West) PWR plants. Zion's operating modes as described in the proposed TS differ from those of the Nuclear Regulatory Commission (NRC) MTS. Zion includes startup and power operation in Mode 1, hot standby in Mode 2, hot shutdown in Modes 3 and 4, cold shutdown in Mode 5, and refueling in Mode 6. These different operating modes were determined to be satisfactory and provide redundant decay heat removal as required by the NRC. The evaluations of the Commonwealth Edison proposed TS are as follows:

3.1 Power Operation and Hot Standby--Modes 1 and 2(T_{oper}).

The proposed TS require that all reactor coolant loops shall be operating. If this condition is not met, the reactor is to be in Hot Shutdown (Mode 3) within 1 hour. The proposed TS require verification that the required reactor coolant loops are in operation at least once per shift.

The above described proposed TS provide redundant heat removal since four coolant loops are required to be operating and the periodic surveillance assures the operability of the systems.

3.2 Hot Shutdown--Mode 3 (350°F< $T_{avg.}$ <T_{oper}.)

The proposed TS require at least two coolant loops (with their associated steam generators and coolant pumps) shall be operable and at least one of the coolant loops shall be in operation during this operating mode.[a] The proposed TS require the plant to be in Hot Shutdown (Tavg <350°F) (Mode 4) in 12 hours if the two coolant loops are not operable and cannot be restored to operable status in 72 hours, suspend all operations involving a reduction in boron concentration in the coolant system and initiate corrective action to return the coolant loop to operation. Proposed TS require verification that at least one coolant pump is operable once per week and at least one cooling loop is in operation at least once per shift.

The proposed TS meet the requirements of the MTS for the hot shutdown mode, since they require two coolant loops to be operable including at least one associated coolant pump and steam generator per loop. Operability is assured through periodic surveillance.

3.3 Shutdown--Mode 4 (200° < T_{avg} < 350°F) and Mode 5 (≤200°F)

The proposed TS satisfy the requirements for the shutdown modes by having at least two coolant loops operable; either two of the four reactor coolant loops (including at least one of their associated coolant pumps and their associated steam generators) and/or two residual heat removal (RHR) loops[b] to be in operable status, and requiring that at least one of the six coolant loops be in operation.[c] If this criteria is not met and immediate corrective action does not restore the loop(s) to operable or operational status, the reactor is to be in Cold Shutdown within 20 hours and reduction of boron concentration operations are to be suspended.

The requirements for this mode of operation are met by requiring two coolant loops and associated pumps and steam generators to be operable with one of the two loops operating. Operation and operability of the loops are required to be verified periodically.

3.4 Refueling--Mode 6 (≤140°F)

The proposed TS for this mode states that the limiting condition for operation is for all water levels and requires at least one residual heat removal (RHR) loop to be in operation. If less than one shutdown cooling loop is in operation, except for the provision to alter the core configuration without the cooling loop in operation, all operations that would

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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.

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

c. All reactor coolant pumps and shutdown cooling 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.

increase the decay heat load or boron reduction of the reactor coolant system are to be suspended. All containment penetrations that allow direct inside to outside atmosphere accesses are to be closed in 4 hours. At least one shutdown cooling loop shall be verified in operation at least once per day.

The proposed TS require that in the refueling mode with the water level less than 22 feet above the irradiated fuel assemblies in the pressure vessel, two independent RHR loops shall be operable and, if either of the RHR loops are determined inoperable, corrective action to return the required loop(s) to operable status be initiated immediately.

Zion's proposed TS for all water levels do not agree with the NRC MTS for this operating mode. The surveillence requirements of the MTS (4.9.8.1) require verification of at least one RHR loop operational and circulating coolant at a flow rate of ≥(2800) gpm at least once per 4 hours. Zion's proposed TS do not require the verification of the coolant flow rate. In addition, the proposed TS only require verification that one loop is operational once per day rather than once per 4 hours as required by the MTS.

For the low water level operating mode, Zion's proposed TS differ from the MTS by the amount of water above the fuel assemblies seated within the pressure vessel. Zion requires two independent RHR loops to be operable when the water level is 22 feet above the fuel. THe NRC MTS requires two indpendent RHR loops to be operable when the water level is 23 feet above the fuel. This does not conform to the MTS.

4.0 CONCLUSION

An evaluation of the proposed TS for Zion, Units 1 and 2 indicates that they provide adequate decay heat removal capability for operating modes 1 thru 5. The proposed TS for operating mode 6 (refueling) contains differences from the MTS in that: (1) there is no requirement for coolant flow rate verification for all water levels; (2) RHR loop operability is only verified daily instead of every four hours; and (3) the low water level begins at 22 feet instead of 23 feet as required by the MTS.

With the above exceptions, the proposed TS changes are in conformance with the model TS for redundant decay heat removal capability.

5.0 REFERENCES

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

2. NRC IE Bulletin 80-12, May 9, 1980.

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

4. CE Letter, T. R. Tramm to NRC, Harold R. Denton, November 7, 1980.

5. Standard Technical Specifications for Westinghouse Pressurized Water Reactors, NUREG-0452, Rev. 1, July 1979.

APPENDIX A

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

3/4.4 REACTOR COOLANT SYSTEM

3/4.4.1 REACTOR COOLANT LOOPS AND COOLANT CIRCULATION

STARTUP AND POWER OPERATION

LIMITING CONDITION FOR OPERATION

3.4.1.1 All reactor coolant loops shall be in operation.

APPLICABILITY: MODES 1 and 2.*

ACTION:

With less than the above required reactor coolant loops in operation, be in at least HOT STANDBY within 1 hour.

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.

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* See Special Test Exception 3.10.4.

HOT STANDBY

LIMITING CONDITION FOR OPERATION

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

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

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

3. Reactor Coolant Loop (C) and its associated steam generator and reactor coolant pump,

4. Reactor Coolant Loop (D) and its associated steam generator and reactor coolant pump.

b. At least one of the above 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.

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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.

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 corrective 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.

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 reactor coolant pump,*

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

3. Reactor Coolant Loop (C) and its associated steam generator and reactor coolant pump,*

4. Reactor Coolant Loop (D) and its associated steam generator and reactor coolant pump,*

5. Residual Heat Removal Loop (A),**

6. Residual Heat Removal Loop (B).**

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

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* A reactor coolant pump shall not be started with one or more of the RCS cold leg temperatures less than or equal to (275)°F unless 1) the pressurizer water volume is less than ____ cubic feet or 2) the secondary water temperature of each steam generator is less than ____ °F above each of the RCS cold leg temperatures.

** 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 .0°F below saturation temperature.

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.

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 ( )% at least once per 12 hours.

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 (RHR) loop shall be in operation.

APPLICABILITY: MODE 6

ACTION:

a. Witn less than one residual heat removal 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 residual heat removal 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 residual heat removal 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 Residual Heat Removal (RHR) 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 RHR loops OPERABLE, immediately initiate corrective action to return the required RHR 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 Residual Heat Removal loops shall be determined OPERABLE per Specification 4.0.5.

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

BASES

3/4.4.1 REACTOR COOLANT LOOPS AND COOLANT CIRCULATION

The plant is designed to operate with all reactor coolant loops in operation, and maintain DNBR above 1.30 during all normal operations and anticipated transients. In MODES 1 and 2 with one reactor coolant loop not in operation this specification requires that the plant be in at least HOT STANDBY within 1 hour.

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 RHR 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 RHR loops to be OPERABLE.

The operation of one Reactor Coolant Pump or one RHR 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.

The restrictions on starting a Reactor Coolant Pump with one or more RCS cold legs less than or equal to (275)°F are provided to prevent RCS pressure transients, caused by energy additions from the secondary system, which could exceed the limits of Appendix G to 10 CFR Part 50. The RCS will be protected against overpressure transients and will not exceed the limits of Appendix G by either (1) restricting the water volume in the pressurizer and thereby providing a volume for the primary coolant to expand into, or (2) by restricting starting of the RCPs to when the secondary water temperature of each steam generator is less than ( )°F above each of the RCS cold leg temperatures.

3/4.9.8 RESIDUAL HEAT REMOVAL AND COOLANT CIRCULATION

The requirement that at least one residual heat removal (RHR) 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 RHR loops OPERABLE when there is less than 23 feet of water above the core ensures that a single failure of the operating RHR loop will not result in a complete loss of residual 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 RHR loop, adequate time is provided to initiate emergency procedures to cool the core.