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TECHNICAL SPECIFICATIONS FOR REDUNDANT DECAY HEAT  
REMOVAL CAPABILITY, ARKANSAS NUCLEAR ONE, UNIT NO. 2

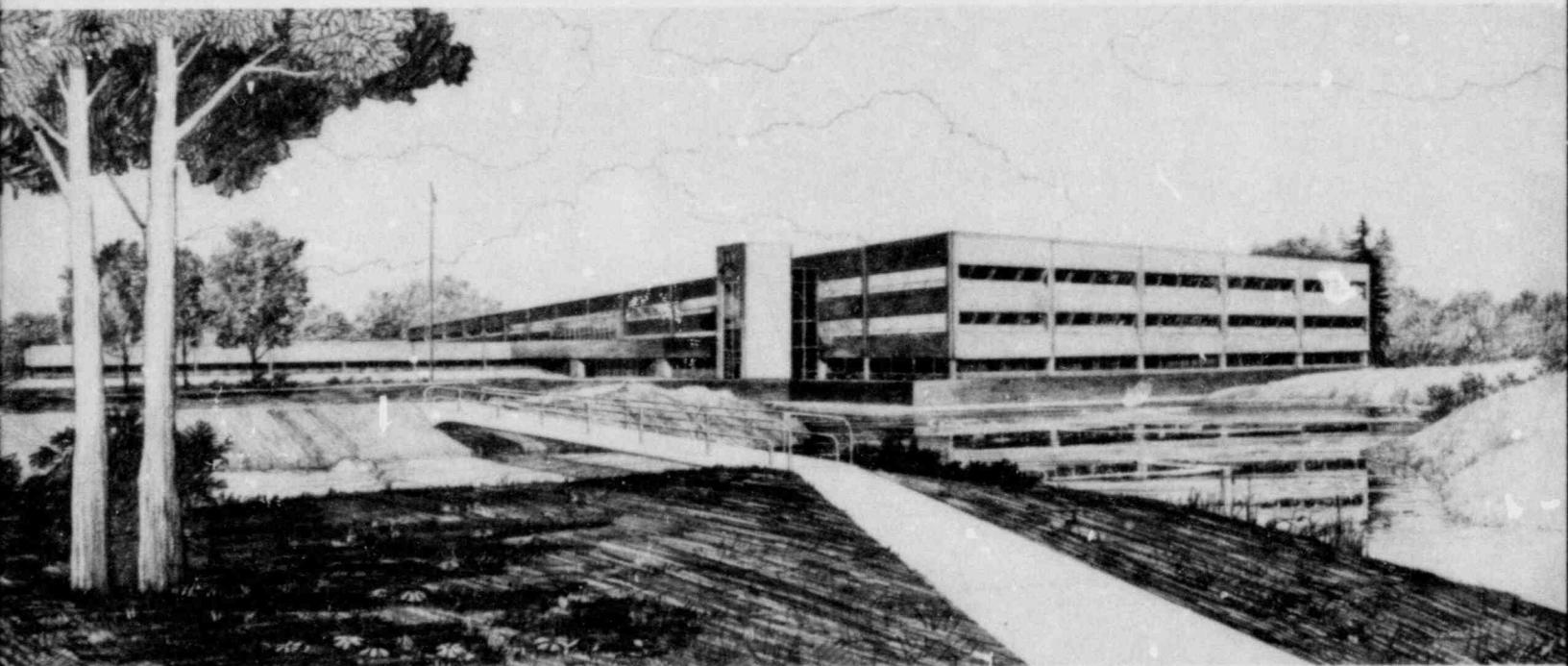
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NRC Research and Technical  
Assistance Report

U.S. Department of Energy

Idaho Operations Office • Idaho National Engineering Laboratory



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INTERIM REPORT

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TECHNICAL SPECIFICATIONS FOR REDUNDANT DECAY HEAT REMOVAL CAPABILITY

ARANSAS NUCLEAR ONE, UNIT NO. 2

Docket No. 50-368

August 1981

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NRC Research and Technical  
Assistance Report

TAC No. 42107

## ABSTRACT

In response to D. G. Eisenhut letter dated June 11, 1980, Arkansas Power & Light Co. submitted "Proposed Revisions to Technical Specifications" for the Arkansas Nuclear One, Unit No. 2. These proposed revisions would provide for redundancy in decay heat removal capability in all modes of operation.

After review of the proposed revisions, it is concluded that existing and proposed technical specifications assure redundant decay heat removal capability in all operating modes except for hot standby (mode 3).

## 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 ARKANSAS NUCLEAR ONE, UNIT NO. 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,<sup>1</sup> occurred at the Davis-Besse, Unit No. 1 plant on April 19, 1980. In IE Bulletin 80-12<sup>2</sup> 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,<sup>3</sup> 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 Co. (AP&L) submitted proposed revisions for decay heat removal to their TS for Arkansas Nuclear One, Unit 2 (ANO-2), on October 31, 1980.<sup>4</sup>

#### 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)<sup>5</sup> 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). The general review criteria are:

1. Two independent methods for decay heat removal are required in the plant TS for each operating mode.
2. Periodic surveillance requirements should insure the operability of the systems.

The specific sections of the Combustion Engineering Standard Technical Specifications<sup>5</sup> 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

Arkansas Nuclear One, Unit 2, is a two coolant loop Combustion Engineering (CE) PWR plant. Due to plant design the proposed TS for this plant vary from the NRC model developed from Westinghouse standard TS. The following discussion takes into account the differences between the two different plant technical specifications.

### 3.1 Startup and Power Operation--Modes 1 and 2

The proposed TS require that both reactor coolant loops and coolant pumps are to be operational. If these conditions are not met, the reactor is to be in Hot Standby (Mode 3) within 1 hour. The proposed TS require verification that the required reactor coolant loops are in operation at least once per 12 hours.

The above described proposed TS are in agreement with the MTS since two coolant loops are required and the periodic surveillance assures the operability of the systems.

### 3.2 Hot Standby--Mode 3

The proposed TS require two coolant loops and at least one associated coolant pump for each loop shall be operable and at least one of the coolant

loops shall be in operation during this operating mode.<sup>a</sup> There are no proposed requirements for operation or operability of associated steam generators. Section 3.1.1.2<sup>b</sup> of existing approved plant TS require only one steam generator to be operable during the hot standby mode. The proposed TS require the plant to be in Hot Shutdown (Mode 4 & 5) in 72 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 7 days and at least one cooling loop is in operation at least once per 12 hours.

The proposed and existing plant TS are in agreement with the MTS; except that the MTS require at least two steam generators to be operable during this operating mode. The proposed and existing TS surveillance requirements are in agreement with the MTS requirements.

### 3.3 Shutdown--Modes 4 & 5<sup>b</sup>

The proposed TS satisfy the requirements for the shutdown modes by having at least two coolant loops operable; either the two reactor coolant loops (including at least one of their associated coolant pumps and their associated steam generators) or the two shutdown cooling loops.<sup>c</sup> The TS also require one of the above loops to be in operation.<sup>d</sup> 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.

- 
- 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. 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 600 cubic feet or (2) the secondary water temperature of each steam generator is less than 43°F (31°F when measured by a surface contact instrument) above each of the RCS cold leg temperatures.
  - c. The normal or emergency power source may be inoperable in MODE 5.
  - d. 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.

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

### 3.4 Refueling--Mode 6

AP&L did not propose new technical specifications for all water levels (per MTS 3.9.8.1 and 4.9.8.1) as existing approved TS<sup>6</sup> meet the requirements of the MTS. However they did provide proposed TS for the low water level.

In the low water level mode, (<23 feet water above the reactor pressure vessel flange) if either of the shutdown cooling loops are determined inoperable, the proposed TS require that immediate corrective action be initiated to return the required cooling loop(s) to operable status.

The proposed TS for the low water level agree with the MTS; requiring at least two cooling loops be operable and surveillance to assure their operability.

Section 3.8 of Arkansas Nuclear One, Unit 2, TS<sup>6</sup> include provisions requiring redundant heat removal capability for all water levels. This satisfies the requirements of the NCR.

## 4.0 CONCLUSION

The AP&L proposed and existing TS do not meet the MTS redundancy requirements during the ANU-2 hot standby mode; since, the TS do not require two steam generators to be operable. The ANO-2 proposed and existing TS satisfy the redundancy and surveillance requirements in all other operating modes and provide redundancy with respect to single failure considerations.

## 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. AP&L Letter, W. Cavanaugh to N.R.C., D. G. Eisenhut, dated October 31, 1980.
5. Standard Technical Specifications for Combustion Engineering Pressurized Water Reactors, NUREG-0212, Rev. 1, Fall 1980.
6. Arkansas Nuclear One, Unit 2, License Application FSAR, Volume VIII. (Arkansas Power & Light Co., Little Rock, Arkansas) 1974.

APPENDIX A

MODEL TECHNICAL SPECIFICATIONS FOR REDUNDANT DECAY  
HEAT REMOVAL FOR ALL 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.. 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.

REACTOR COOLANT SYSTEM

HOT STANDBY

LIMITING CONDITION FOR OPERATION

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- 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.

REACTOR COOLANT SYSTEM

- 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

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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)<sup>0</sup>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 \_\_\_\_\_<sup>0</sup>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 10<sup>0</sup>F below saturation temperature.

REACTOR COOLANT SYSTEM

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

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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

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

APPLICABILITY: MODE 6

ACTION:

- a. With 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

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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.

REFUELING OPERATIONS

LOW WATER LEVEL

LIMITING CONDITION FOR OPERATION

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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

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4.9.8.2 The required Residual Heat Removal loops shall be determined OPERABLE per Specification 4.0.5.

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

### 3/4.4 REACTOR COOLANT SYSTEM

#### BASES

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##### 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) $^{\circ}$ 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 ( ) $^{\circ}$ F above each of the RCS cold leg temperatures.

## REFUELING OPERATIONS

### BASES

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#### 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.