TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401

5N 157B Lookout Place

SEP 23 1988

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of) Docket Nos. 50-259
Tennessee Valley Authority) 50-260
50-296

BROWNS FERRY NUCLEAR PLANT (BFN) - RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION - OVERLOAD PROTECTION OF THE MOTOR CONTROL CENTER CIRCUITS (TAC 62260-F)

This letter provides TVA's response to the August 10, 1988 NRC request for additional information on the above subject. The following documents are enclosed for your review.

- QIR EEB 87031 - Motor Overload Heater Section
- SCR BFN 8536 R2
- Thermal Overload Heater Calculations:
  - ED-Q2268-87322 480V Reactor MOV Board 2A (w/data sheet attachments 1-6, 11, 13, 14)
  - ED-Q2268-87324 480V Reactor MOV Board 2C (w/all attachments)
- Drawings:

  480V Reactor MOV Board 2A
  DCA- H1239-003, -004, -005, -006

  480 V Reactor MOV Board 2C
  DCA- H1239-011, -012, -013

  480V Shutdown Aux Power
  45N 779-2, -3,-6,-7,-14,-15,-16,-17

The quality information report (QIR EEB 87031) contains the criteria used for selection of the thermal overload (TOL) heaters.

TVA was requested to provide the condition adverse to quality reports (CAQRs) written to document the inadequate TOL heaters identified during plant walkdowns. Significant condition report (SCR) BFN 8536 R2 was written to document that the TOL heaters ratings and settings were not documented in design drawings. To resolve this condition, BFN is generating calculations using updated design standards to specify the appropriate TOL heaters for each application. The proper TOL heater and settings are documented on design drawings (enclosed Design Change Authorizations (DCAs)) for implementation in the field.

D030 1/1 Drawings To: Reg Files

U.S. Nuclear Regulatory Commission SEP 23 1988

Please refer any questions concerning this submittal to Patrick Carier at (205) 729-2689.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

R. Gridley, Manager
Nuclear Licensing and
Regulatory Affairs

Enclosures
cc (Enclosures):
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Browns Ferry Resident Inspector
Browns Ferry Nuclear Plant
Route 12, Box 637
Athens, Alabama 35611

U.S. Nuclear Regulatory Commission SEP 23 1988

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QUALITY INFORMATION RELEASE EEB 87031

QUALITY INFORMATION REQUEST / RELEASE (QIR)
DIVISION OF NUCLEAR ENGINEERING
(INTERNAL USE ONLY)

QA Record

RIMS ACCNO: B43 '87 0203 903

TO: All Electrical Lead Engineers & ABC	DOCUMENT NUMBER: QIR EEB 87031
FROM: W. S. Raughley	PAGE 1 OF 6
TYPE OF DOCUMENT: ☐ REQUEST NEED DATE	DATE: 1/30/87
☒ RELEASE REF. QIR N/A	PLANT AND UNIT: All

REFERENCED DOCUMENTS

AVAILABLE IN ONE OF THE RIMS SYSTEMS		ATTACHMENT TO THIS QIR	
DOCUMENT	IDENTIFYING NUMBER	DOCUMENT	ATTACHMENT NUMBER
			(6)
		870327S0061	

SUBJECT: Motor Overload Heater Selection

SYSTEMS AFFECTED	UNID / SYSTEM ID
N/A	N/A

QUALITY INFORMATION REQUESTED / RELEASED

See attached pages 2 through 6.

PREPARED	REVIEWED (RELEASES ONLY)
G L Nicely	M. F. Pyatt MRB

APPROVED (BRANCH CHIEF/PROJECT ENGINEER)

R. D. Hunter on WSR

GDH

ATTACHMENT 1

MOTOR OVERLOAD HEATER SELECTION

The purpose of this QIR is to establish criteria, effective immediately, for the selection of thermal overload (TOL) heaters to protect continuous-duty ac and dc motors and motor operated valves for Browns Ferry, Sequoyah, Watts Bar, and Bellefonte Nuclear Plants.

Applicability

These criteria shall be applied as follows:

Existing Design

Each project Lead Electrical Engineer shall review the installed thermal overload heaters obtained by the Design Baseline and/or verification program for his plant to determine if sized properly, and if not replace the TOL prior to restart and/or fuel load of each unit except for the following case:

For safety-related and selected non-safety-related loads (e.g., emergency bearing oil pump) performance of function takes precedence over load protection; therefore, it is acceptable not to adequately protect the load as long as the following can be shown:

1. If adequate testing of the motor or motor-operated valve under its design flow or load and with the currently installed TOL can be documented to show that inadvertent tripping would not occur, or

2. If the currently installed TOL can be analytically shown to provide protection at least as conservative as the selection guidelines given in this criteria.

If this cannot be shown, then testing under its design flow or load must be performed (only for non-ambient-compensated circuits) or the TOL must be replaced in accordance with this criteria.

Existing installed TOL relays shall be documented on "b" size drawings for each applicable load center that includes:

1. Compartment number
2. Motor starter size, if applicable
3. TOL manufacturer and model number

MOTOR OVERLOAD HEATER SELECTION (continued)

New Design

All requirements must be met for any new design initiated after the issue date of this QIR. All thermal overload relays added must be documented on "b" size drawings that include the same information that is noted above for the existing design.

INSTRUCTIONS:

Motor overload protection philosophies and their references should be as follows:

Continuous Duty Motors

Reference: National Electric Code - Articles 430-32 and 430-34

Continuous duty motors (ac and dc) shall be protected against overload by separate overload heaters selected to trip at the following percent of motor nameplate full-load current:

Motors with a marked service factor not less than 1.15	125 percent
Motors with a marked temperature rise not over 40°C	125 percent
All other motors	115 percent

Where the selected overload heater is not sufficient to start the motor or to carry the load current, the next higher-size overload heater shall be permitted provided the trip current of the device does not exceed approximately the following percentage of motor full-load current rating:

Motors with a marked service factor not less than 1.15	140 percent
Motors with a marked temperature rise not over 40°C	140 percent
All other motors	130 percent

Motor-Operated Valves (MOV)

Reference: IEEE Transactions - Vol. PAS-100, No. 1, January 1981, page 43, Motor Overload Protection for Motors on Motor-Operated Valves.

MOTOR OVERLOAD HEATER SELECTION (continued)

Motor-operated valve motors shall be protected against (1) stator winding overheating during running overloads and (2) stator winding and rotor overheating during locked rotor. Selection of the thermal overload heaters shall be selected to trip as follows:

motor nameplate full-load current times service factor: Not less than the motor duty rating (15 minute typical) except as noted below.

200% of motor nameplate full-load current: $\geq$ 2 minutes and $\leq$ 8 minutes

motor nameplate locked rotor current: $\geq$ 10 seconds $\leq$ 15 seconds with 15 seconds being preferable.

If the above selection criteria cannot be satisfied for a unique application, then priority should be given to the criteria given for locked rotor and full-load current. The rated full-load current time can be reduced to not less than 200 percent of the valve maximum stroke time. For small horsepower MOVs where the smallest TOL available exceeds the time limits listed above, selection if the TOL is acceptable.

If the TOLs for MOVs are not bypassed for accident conditions, the selection criteria listed above and the additional selection criteria listed below meets the requirements of Regulatory Guide 1.106 position C2.

To address TOL drift, inaccuracies, etc., the minimum operating band for maximum ambient temperature given by the manufacturer of the TOL should be used to determine operating time for the TOL. Additionally, TOLs for MOVs should not be compensated for temperature differences between the controller and the MOV.

TOLs for valves that may be automatically repositioned by an accident signal immediately after testing during operation shall allow this duty cycle without tripping.

Justification

If thermal overload protection devices are not bypassed under accident conditions, NRC Regulatory Guide 1.106 position C.2 states the following:

1. The trip setpoint of the thermal overload protective devices should be established with all uncertainties resolved in favor of completing the safety-related action.

2. With respect to those uncertainties, consideration should be given to (a) variations in the ambient temperature at the installed location of the overload protection devices and the valve motors, (b) inaccuracies in motor heating data and the overload protective device trip characteristics and the matching of these two items, and (c) setpoint drift.

The selection criteria established for MOVs in this QIR will meet the requirements of Regulatory Guide 1.106 stated above for the following reasons:

The selection criteria selects a TOL that will actuate in a maximum of 15 seconds for locked-rotor current to protect the motor operator from damage. Abnormal conditions such as a frozen bearing, tight packing, mid-travel obstruction, and torque or limit switch failures can cause a MOV to draw locked-rotor current. If a safety-related valve has a frozen bearing, the motor will not move and failure of the motor is imminent. If the valve experiences partial binding, due to tight packing, that permits restricted movement of the valve, then the motor may draw a current anywhere from full load current to locked rotor current depending on the degree of binding. If the binding is severe enough to cause locked-rotor current, then failure of the motor is imminent. For other degrees of binding, the selection criteria allows sufficient margin in the setting to accommodate increased stoke time. If a safety-related valve encounters an obstruction during travel and the torque produced,exceeds the setting of its torque switch, the switch will actuate instantaneously to deenergize the circuit. If, however, the torque switch has failed to operate or is bypassed, the MOV would have drawn locked-rotor current with motor failure being imminent. Likewise, if a MOV reaches the end of its stroke and its limit switch fails to operate, then the MOV would draw locked-rotor current with motor failure being imminent. From the discussion above, it is reasonable to trip the MOV for conditions where severe motor damage or failure is imminent. Leaving the MOV connected under these conditions could adversely degrade, possibly to failure, the other connected loads to the board, although this would be within the single failure criteria.

With respect to other uncertainties listed above (i.e. variations in temperature, inaccuracies in motor heating data and overload devices, and setpoint drift) selection criteria for the TOLSs for MOVs do not compensate for differences in ambient temperature of the controller/MOV and requires that the minimum operating band of the manufacturer's TOL curve be utilized. This approach is conservative and will minimize the effects of any inaccuracies in device operation.

Constraints in Applying the Above Criteria

1. Automatic protection is not provided for successive starts where the motor is not given sufficient time to cool before starts.

MOTOR OVERLOAD HEATER SELECTION (continued)

2. For protecting continuous duty motors, overload relays are designed with a current versus ambient temperature characteristic that closely follows the corresponding characteristic of a typical motor with class B insulation. As long as both are in similar non-accident ambient temperatures (typically, 10-18°C of each other, manufacturer's recommendations should be followed), the selection of the overload heater follows routine instructions included in its manufacturer application data. When the difference in non-accident ambient temperatures is more than recommended by the manufacturer's application data, the motor full-load current must be multiplied by a correction factor before a heater can be selected. That correction factor is the ratio of the motor ambient temperature correction factor and the overload heater ambient temperature correction factor, both of which are given in manufacturers' application data. The current correction factor is larger than unity when the temperature at the starter is higher than at the motor, and less than unity for the opposite temperature relationship.

SIGNIFICANT CONDITION REPORT BFN 0536 R2

QA Record

SIGNIFICANT CON ON REPORT

RIMS Accession Number → B22 '870 1 002

A. Identification and Documentation (Must complete within 8 days.)

1 Project/Plant and Unit: Browns Ferry Engineering Project - Units 1, 2, 3

2 Date: 1/20/87

3 SCR Number and Rev.: SCRBFNEEB8536R2

4a Preparer and Organization: J. A. Krieg DNE-DETS-EEB-BFEP

4b NU CON NCR No./Deficiency Report (For NU CON Use Only)

4c ASME Code: ☐ Yes ☒ No

5a Contract Number: Various

5b Vendor: Various

5c Requirement Violated: Design and documentation control shall provide for verifying or checking the adequacy of design.

5d Source of Requirement: 10CFR50 Appendix B; Section III, Section VI

5e Description of Condition:

Browns Ferry design drawings do not reflect over load (OL) element ratings. Since the ratings of these devices are not reflected on OE drawings, there is no indication that their ratings have been selected or reveiwed by the appropriate OE designers.

5f System: 450V MCCS

5g UNID/Component Code (For ONE Use Only): N/A

6 Date of Occurrence: Various ☐ Estimated ☐ Actual

7 Method of Discovery: CAR 85-037 Estimate Request Research

8 Significant Condition Adverse to Quality → ☒ Yes ☐ No

9 Organization to Determine Corrective Action: BFEP

10a If significant, NEB-NLS Contact: N/A

10b Date: N/A

10c Contacted by: N/A

11 Is a Potential Generic Condition Evaluation Required? ☒ Yes ☐ No (If no, describe in block 28.)

If yes, initiate Attachment 5 of NEP-9.1 and list Attachment 5 RIMS Accession No.: B22 '870120011

12 Branch Chief/Project Engineer/DNQA Quality Site Manager (Distribute as required—see block 30.)

Don F Faulkner for WSR 1/20/87

B. Determination of Corrective Action (Must complete within 60 days.)

13 Root Cause:

The overload elements were originally documented on GE drawings but these drawings were not maintained. This appears to be a documentation discrepancy applicable to overload elements only.

14a Corrective Action:

See Attachment 1

14b Coordination Review of ONE Work (Provide initials)

14c Scheduled Date of Completion: 3/2/87

15a Action Required to Prevent Recurrence (ARPR)

The overload elements rating will be documented on TVA drawings which will become part of the design control documentation subject to change control for all future modifications.

(cont on p. 2)

SCR Number and Revision

B. Determination of Corrective Action (Continued)

15a ARPR (continued)

15b Scheduled Completion Date of DNE Work → ~~12/1/86~~ 3/21/87 JAK 1/20/87

FOR DNE USE

16 Does the corrective action deviate from a design criteria requirement? ☐ Yes ☒ No

17 Design Criteria Document Number

18 Exception Request Number

19 Is an ECN required? ☐ Yes ☒ No — If yes, ECN number

20 Impact on Schedule?
☐ Affects project completion schedule
☐ Affects schedule of related activities
☒ No impact

21a Verification of Adequacy and Accuracy of Blocks 13-20 Above → Signature and Date S. A. Thibodeaux 1-20-87

21b Approval Signature and Date (Distribute as required - See block 30.) D. A. Faulkner for WSR 1/20/87

RIMS Accession Number 822 '870121 002

FOR NU CON USE

22 Is it a generic condition? ☐ Yes ☐ No

If yes, describe.

23 Preparer and Date

24 Supervisor and Date

25 ARPR Recommended By and Date

26 ARPR Approved By and Date

27 Concurrence of Designated Quality Reviewer for ARPR and Date (Distribute as appropriate--See block 30.)

RIMS Accession Number

C. Closure

28 Remarks

Revision 2 changes Block 11 to require a Generic Condition Evaluation. This revision does not add any additional scope to this SCR for BFNP

☐ See Continuation Sheet

29 All DNE/NU CON Action Complete (Attach Completion Verification Sheet) → Signature, Organization, and Date

Indicate additional distribution with an "X".

30 (If needed, attach a separate sheet for additional distribution.)

- ☒ RIMS, SL 26 C-K
- ☐ NU CON Site Dedicated Data Base
- ☒ NMRG
- ☒ DNE Project Engineer
- ☐ NU CON Project Manager
- ☐ Manager, Engineering Assurance
- ☐ Director of DNE
- ☐ NEB-CMS (for ASME Code Items)
- ☐ Director of DNQA
- ☐ NRC Resident Inspector
- ☐ Director of NU CON
- ☐ Records Storage Facility
- ☐ ANI (For ASME Code Items Only)
- ☐ DNQA Site Quality Manager
- ☒ Preparer J. A. Krieg, D48-BFN

RIMS Accession Number

Corrective Action:

The current lack of documentation concerning Browns Ferry overload element ratings will be resolved as follows:

1. The 480VAC and 250VDC motor control centers will be walked down and the installed overloads tabulated.

2. A sizing criteria or guideline will be established.

3. The overloads identified in the field walkdown (item 1) will be evaluated for conformance with the sizing criteria (item 2).

4. Any improperly applied overload elements will require that the overload element and its associated components be evaluated for possible damage and replacement.

5. All properly sized overloads and/or replacement overloads will be reflected on a "B" size drwaing which will be produced to document overload ratings.

6. Documentation of OL elements will ensure future changes will include proper OL element consideration.

The schedule for completing this effort is determined by the Unit 2 restart and is therefore required by ~~December 1, 1986.~~ MARCH 21, 1987. SJK 1/20/87

2458A