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SUBJECT: Forwards completed executive summary of App R high impedance fault analysis,per NRC 880606 request.

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Docket No. 50-397

July 15, 1988
G02-88-157

Mr. J.B. Martin
Regional Administrator
U. S. Nuclear Regulatory Commission
Region V
1450 Maria Lane, Suite 210
Walnut Creek, CA 94596

Attention: C. Ramsey

Subject: NUCLEAR PLANT NO. 2
OPERATING LICENSE NPF-21
APPENDIX R HIGH IMPEDANCE FAULT
ANALYSIS - EXECUTIVE SUMMARY

During the Fire Protection Audit the week of June 6, 1988, the staff requested that we submit an Executive Summary of the Appendix R High Impedance Fault Analysis upon its completion. That Summary is now complete and is attached hereto.

Very truly yours,

S.L. McKay for

C.M. Powers
WNP-2 Plant Manager

bn

Attachment

cc: R.B. Samworth - NRC
NRC Site Inspector - 901A

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EXECUTIVE SUMMARY

APPENDIX R HIGH IMPEDANCE FAULT ANALYSIS

PURPOSE

The purpose of this calculation is to identify all "high resistance loads" and a single worst case "spurious load" on the Appendix R safe shutdown power distribution system that results from a design basis fire in each fire area; to ensure that safe shutdown capability is not lost.

ASSUMPTIONS AND DEFINITIONS

1. High resistance/spurious loads are defined as follows:

   EXPLANATION USING DETAIL "A"

   A design basis fire (DBF) in a Division 2 fire area presumes the loss of "Appendix R Division 2 Safe Shutdown" (which includes its power distribution system). Therefore, a high resistance fault on a Division 2 Appendix R distribution center is not considered as a high resistance load in a Division 2 fire area since the entire system is presumed inoperative. However, a high resistance fault on a Division 1 Appendix R distribution center is identified as a high resistance load in a Division 2 fire area. For purposes of this analysis, a high resistance fault will be categorized along with spurious signals. For a general discussion of spurious signals see Calculation No. NES-02-85-19V.

   DEFINITIONS (AND SEQUENCE OF REVIEW):

   The failure modes resulting from a DBF that cause high resistance faults and "spurious loads" are the consequences of a single fire in a fire area, and are determined in the following sequence:

   a) High Resistance Load:

   An unprotected normally energized power feeder will fail in a manner to cause a high resistance ground with a fault current increasing to just below the fuse rating breaker trip setting. The interconnected control circuits in this fire area do not have to be considered since their failure would result in a smaller "spurious load".

   b) Spurious Load:

   If the power feeder is not normally energized or is completely protected in this fire area or does not route into this fire area then the interconnected control circuits in this fire area will be reviewed to determine if a possible failure mode exists (i.e., hot short, ground, or open) that could cause the load to become connected due to a DBF in this fire area--that is a load that results from a spurious signal actuation.

EXPLANATION USING DETAIL "A"

It should be noted that the review of cables in fire areas is limited to only those cables that are potentially "spurious loads". As such, a Division 1 cable or Division 1 associated cable in a Division 2 fire area that is connected to an "Appendix R Division 1 Safe Shutdown Distribution Center" (which is most probably located outside the Division 2 fire area) does reqiure a review since a DBF in this Division 2 fire area is not permitted to cause the loss of the Division 1 load source:

2. The assumptions and references that apply to each of the Appendix R Safe Shutdown Systems as described in this calculation in sections NES-02-19-II, III, and IV also apply to those respective systems in this calculation.

3. During the interval of time between the main control room evacuation and the operation of the remote control transfer switches, no high resistance faults will occur of such a nature as to cause coordinated "upstream" fuses to fail before the "down stream" fuses fail.

4. If the maximum net spurious load on a bus is less than 25% of the designed load and the resultant load on the diesel generatoris between 50% and 100% of its rated load, then no further analysis is necessary since feeder sizes include a 25% margin and the distribution buses are designed accordingly.

5. Distribution centers that are (shunt) tripped by loss of "off-site power signals" and are not automatically (i.e., remain tripped until manually closed) reset do not contribute to the Appendix R distribution loads.

METHODOLOGY

A general approach to this analysis would be to analyze each cable in each fire area with a "cause and effect" relationship; the cause being a design basis fire and the effect being the worst case load on the required Appendix R distribution system. The sum total of the loads due to the design basis fire would then be analyzed. This type of an analysis would not only be very repetitious it would involve many distribution centers not connected to the required Appendix R distribution centers. A more selective approach to the analysis was taken by identifying the extended distribution system for the Appendix R sSafe Shutdown System. Since one of three different systems are used; depending upon the fire area involved, three "extended" Appendix R distribution systems were identified. Each of these distribution systems contain all the load centers that would be connected to them during an Appendix R design basis fire (which postulates loss of off-site power). Every load center, such as switchgears (both 4160V and 480V), motor control centers, power panels, lighting panels, chargers or inverters that supply other panels that are in the extended Appendix R distribution system are studied individually. All the power cables (and their interconnect control cables) that are

attached to the load center are listed and a circuit review is provided that allows tabulation of cables by the fire area they are routed into. Pertinent information relating to each cable is also listed. Once all of the cable reviews for each load center are completed, a review of a specific fire area is made listing only those cables that are connected to the required Appendix R distribution center. These loads are analyzed to ensure that they are not duplicated by "upstream" spurious loads on the same distribution system. For example, a panel feeder and its branch circuit feeder are in the same fire area where the high resistance fault load on the panel feeder encompasses the simultaneous fault on the branch feeder (i.e., the branch load is not added on top of th maximum panel feeder load). The resultant high resistance/spurious loads that are due to a design basis fire in the identified fire area are then added to the required Appendix R distribution system load. Justification for the continuous resultant high resistance/spurious load in a fire area is based upon the margin that exists between the diesel generator's seven-day load rating which is 4900 KVA and the continuous load following a loss of "off-site" power (which is shown on Tables 8.3.1 and .2 in the FSAR) coupled with the initiation of the Appendix R safe shutdown system. The task was divided into three phases as follows:

Phase I

A listing of the Appendix R load centers was prepared to assign work and identify each worksheet. The three Appendix R distribution systems that identify each load center are included in Attachment I.

1. A worksheet was prepared for each load center in accordance with the instructions contained in Attachment II.

2. A cable routing diagram identifying each fire area was provided in accordance with the example provided in Attachment II.

3. An evaluation of each cable is made using the elementary wiring diagram to determine high resistance loads or spurious loads as required by instructions in Attachment II.

Phase II

The individual load centers were reviewed for correctness and then the following steps were taken:

1. All Division 1 fire areas were reviewed on every Appendix R Division 2 load center worksheet. These loads were reviewed and summarized.

2. All Division 2 fire areas were reviewed in every Appendix R Division 1 load center worksheet. These loads were reviewed and summarized.

3. All multi-division (dedicated) fire areas were reviewed on every Appendix R Division 2 load center worksheet. These loads were reviewed and summarized.

4. All non-Appendix R fire areas were reviewed on every Appendix R Division 2 load center worksheet. These loads were reviewed and summarized.

5. Fire area RC-IIC, the 20' area of non-intervening combustibles in the cable spreading room, was reviewed on every Appendix R load center worksheet. These loads were reviewed and summarized.

6. Fire area RC-X, the main control room, was reviewed in every Appendix R remote shutdown load center worksheet. These loads were reviewed and summarized.

Phase III

An Appendix R distribution diagram was prepared for each fire area that indicates the total high resistance load including a single worst case spurious load along with the justification. These loads are considered on top of the normal operating load plus operation of Appendix R loads (see Attachment I).

The results of this study are shown on the Phase III distribution diagrams which are included as Attachment III and the load summary sheets are included as Attachment IV. All the load center worksheets and cable routing diagrams were done on Phase I, an index of the load centers and the signature of the preparer and checker has been included in Attachment V. The worksheets are contained in several volumes that are identified as Attachment V and can be requested individually.

ANALYSIS RESULTS/RESOLUTIONS

The addition of spurious loads to the Appendix R safe shutdown distribution system, that results from a design basis fire in any fire area will not cause the loss of reactor safe shutdown capability (the load on the diesel generator is between 50 and 100% of its rated load). This analysis indicates that the Division 1 DC distribution system is available for at least 30 minutes following a main control room evacuation. This is sufficient to open the three Division 1 safety relief valves for 10 minutes (during a 20 minute period).

The analysis indicates that the three Division 2 relief valves are available from event initiation to 7.9 days (50% open). However, in order to ensure the availability of the Division 2 DC distribution system, some operator actions are required. Within two hours following a main control room evacuation, certain loads must be removed from the main distriubtion panel (DP-SI-2) providing the Division 2 battery charger C1-2 is running at or near maximum output (revision to PPM 4.12.1.1 is required). In addition, DG-2 powered emergency lighting is required for operator actions in the room containing DP-SI-2 and C1-2.