Omaha Public Power District
1623 Harney Omaha, Nebraska 68102
402/536-4000

November 16, 1984
LIC-84-370

Mr. Harold R. Denton, Director
U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Division of Licensing
Washington, DC 20555

Reference: Docket No. 50-285

Dear Mr. Denton:

Environmental Qualification
of Safety - Related Electrical Equipment

In a letter dated May 31, 1984, the Omaha Public Power District provided the NRC with documentation based on a March 23, 1984, meeting between District personnel and your staff. This meeting was to provide the staff with current information concerning outstanding items identified by the Franklin Research Center in their Technical Evaluation Report, to enable the staff to issue its final Safety Evaluation Report (SER).

This May 31, 1984, submittal contained among other things, a discussion of compliance with 10 CFR 50.49. The District has subsequently been informed by telephone that additional information would be required in order for the staff to complete its evaluation and issue its final SER. Several telephone conversations have taken place and the District has agreed to revise portions of the May 31, 1984 submittal to reflect the desired wording.

Accordingly, the attachment to this letter is intended to replace Attachment 3 to the District's May 31, 1984, letter in its entirety. Those changes made are denoted by vertical lines in the right hand margin.

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The District believes this information accurately reflects our the environmental qualification program at Fort Calhoun Station. This should allow your staff to complete its evaluation of this matter.

Sincerely,

R. L. Andrews
Division Manager
Nuclear Production

RLA/DJM/dao

Attachment

cc: Leboeuf, Lamb, Leiby & MacRae
1333 New Hampshire Avenue, N.W.
Washington, DC 20036

Mr. E. G. Tourigny
Mr. L. A. Yandell

Omaha Public Power District
Fort Calhoun Station
Electrical Equipment Qualification Program and
Compliance With 10 CFR 50.49 (b)(1), (b)(2), (b)(3)

I. History

The District's present program for compliance with the electrical equipment in a harsh environment qualification rule 10 CFR 50.49 began in January of 1980 with the actions required by IE Bulletin 79-01B Environmental Qualification of Class 1E Equipment. The required action expanded the scope of IE Bulletin 79-01 and its related documents.

The District based its investigation on the DOR Guidelines provided with IE Bulletin 79-01B. The exceptions to this are those items which require different qualification criteria as provided in NUREG-0578 and subsequently NUREG-0737.

Several submittals to the NRC were made including the "45 day", "90 day", "November 1, 1980", "Inclusion of Equipment to Achieve Cold Shutdown", and several to note equipment changes. A large submittal of test reports was also made to the Franklin Research Center, from which the latest TER was written.

The District has also responded to one SER with many specific questions.

The unit is in a refueling outage and the modifications which were discussed in the response to the TER are to be accomplished. The submittal document used by the District is being transformed into a more streamlined document to be used during the day-to-day operation by District personnel. Necessary Qualified Life Program maintenance is to be performed. Documentation open items are to be closed out and the District has hired an independent contractor experienced in equipment qualification to audit the District's entire Electrical Equipment Qualification Program.

Additionally, the District believes it would be beneficial to explain the manner in which IE Information Notices are handled. Upon receipt, the Licensing Department makes an assessment of the notice to determine the appropriate department for response preparation. An assignment is made and progress is tracked via the District's Licensing Action Log. The assignment requests a review with respect to applicability, potential impact, and possible corrective action. The results of the review are documented for in-house record-keeping purposes and are retained by the District's Licensing Department.

II. District's Electrical Equipment Qualification "Philosophy" (10 CFR 50.49 (b)(1)

A. Definition of Equipment Requiring Environmental Qualification:

1. A master list of all equipment required to remain functional during or after a design basis accident (DBA) and which is exposed to a harsh environment as a result of the design basis accident was prepared. The plant specific Loss of Coolant Accident (LOCA) and High Energy Line Break (HELB)

II. District's Electrical Equipment Qualification "Philosophy" (10 CFR 50.49 (b)(1) (Continued)

A. Definition of Equipment Requiring Environmental Qualification (Continued)

1. (Continued)

analysis, FSAR Appendix M, identified the LOCA and Main Steam Line Break (HELB) as the only DBA resulting in a harsh environment which required qualification investigation. The actual master list was prepared based on equipment requirements and equipment location derived from the FSAR, Technical Specifications, Emergency Procedures, P&IDs (flow diagrams) and electrical diagrams.

The first step in the assessment program was to conduct a review of the facility flow diagrams to establish which systems were required to mitigate the consequences of a LOCA. After the bases for the LOCA conditions were established, the District began an evaluation of the high energy piping systems to determine where failure of a pipe could cause Engineered Safeguards systems to be challenged.

After these lines were identified, a cross-check of areas within the plant was made to determine if a HELB would affect any Class 1E electrical equipment which was required to function under the postulated accident conditions.

The components which were identified as a result of the above studies were then further evaluated for their suitability for operation in the postulated environment.

The following is a description of the safety systems, high energy lines, and areas taken under consideration by the District.

a. Identification of Safeguards System:

In order to ensure that all of the components required to operate to mitigate design basis events were identified and assessed for their impact on plant safety, a survey of each plant system was made to identify required flow paths for accident mitigation.

In addition, all systems were reviewed for isolation requirements after receipt of Engineered Safeguards Signals. As a result of this survey, the following systems were identified as either being required to operate or as having components which required isolation on receipt of Engineered Safeguards Signals:

(1) Reactor Coolant System
(2) High Pressure Safety Injection System
(3) Low Pressure Safety Injection System

II. District's Electrical Equipment Qualification "Philosophy" (10 CFR 50.49 (b)(1) (Continued)

A. Definition of Equipment Requiring Environmental Qualification (Continued)

1. (Continued)

a. Identification of Safeguards System: (Continued)

(4) Containment Spray System
(5) Containment HVAC System (Containment cooling units and isolation valves)
(6) Component Cooling System
(7) Raw Water System
(8) Main Steam System
(9) Steam Generator Feedwater and Blowdown System
(10) Chemical and Volume Control System
(11) Containment Hydrogen Purge System
(12) Control Room Ventilation System
(13) Instrument Air System (Isolation valves only)
(14) Plant Air System (Isolation valves only)
(15) Sampling System (Isolation valves only)
(16) Demineralized Water System (Isolation valves only)
(17) Waste Disposal System (Isolation valves only)
(18) Electrical Auxiliary Components (which were common for all of the above systems)
(19) Nitrogen System (Isolation valves only)
(20) Charging and Concentrate Boric Acid[6]
(21) Reactor Protective System[5]
(22) ESF Actuation System[1]
(23) 120 VAC 1Ø and 130V DC Instrument and Control Power[2]
(24) 480 VAC 3Ø and 4160 VAC 3Ø Power[2]
(25) Emergency Diesel Generator[2]
(26) Ventilation for Areas Containing Safety Related Equipment[3]
(27) Post Accident H_2 Sampling and Radiation Monitoring
(28) Long Term Core Cooling[7]

Identification of Safeguards System Notes

1 Engineered Safeguards Actuation - The system components which initiate safeguards actuation are contained and evaluated as components within the systems identified for Fort Calhoun.

2 Emergency Power - The emergency power system for Fort Calhoun consists of two diesel generators and associated distribution equipment such as switchgear and motor control centers. In addition a 130VDC system consisting of fully redundant batteries, chargers and associated distribution equipment is available at Fort Calhoun.

II. District's Electrical Equipment Qualification "Philosophy" (10 CFR 50.49 (b)(1) (Continued)

A. Definition of Equipment Requiring Environmental Qualification (Continued)

1. (Continued)

a. Identification of Safeguards System: (Continued)

2 (Continued)

None of the postulated accident situations affect the environment where this equipment is located. Since this is the case, no evaluation of individual components has been done.

3 Ventilation for Areas Containing Safety Equipment - Where ventilation equipment is required for operation of safety equipment, and it is affected by the postulated event, then it has been assessed for the resultant environmental conditions.

4 Emergency Shutdown - The District has performed an analysis of the systems required to bring the reactor to a cold shutdown condition after an accident involving rapid depressurization of the primary system with no breach of the reactor coolant pressure boundary. The safety analysis for Fort Calhoun shows one possible event which could cause this situation to occur. The event is a steam line rupture incident. Plant emergency procedure EP-6 "Uncontrolled Heat Extraction" was referenced to determine those systems necessary to limit the consequences of this event. After review of EP-6, it was determined that there are no additional systems required to function than those which have been previously identified.

5 Reactor Trips - For the LOCA analysis, Low Pressurizer Pressure initiates a reactor trip. See the following discussion on Small Break LOCA.

Review of the small break LOCA analysis has shown that for all small break LOCAs, low pressure is the parameter which initiates a reactor trip. The reactor protective system (RPS) uses loop temperatures and reactor power (Delta T or nuclear whichever is higher) to generate a calculated pressure (thermal margin low pressure) which is fed into a bistable and compared with actual reactor pressure. If reactor pressure falls below the calculated number, the reactor

II. District's Electrical Equipment Qualification "Philosophy" (10 CFR 50.49 (b)(1) (Continued)

A. Definition of Equipment Requiring Environmental Qualification (Continued)

1. (Continued)

a. Identification of Safeguards System: (Continued)

5 (Continued)

trips. In addition, the bistable is set with an absolute low limit such that no matter what the calculated input, the reactor will trip at a pressure no lower than 1750 psig. It is this 1750 psig trip point which trips the plant in the small break LOCA analysis.

Since the failure of unqualified equipment in containment cannot effect the low limit trip value and the RPS pressurizer input are LOCA qualified, no further analysis is required for small break LOCA reactor trip. The remaining equipment used to mitigate a small break LOCA is discussed in the master list.

Discussions with the District's NSSS vendor have indicated that for small steam line breaks, low steam generator levels will be the reactor trip initiating parameter. Therefore, worksheets are included for the low steam generator level LOCA qualified transmitters.

For the MSLB, the reactor trip is initiated by Low Steam Generator Pressure which is LOCA qualified. No other reactor trips are required to be qualified.

Clutch deenergization is accomplished in the control room mild environment.

6 The Fort Calhoun Station Safety Analysis does not take credit for the charging pumps or concentrated boric acid system.

7 The long term core cooling system is made up of components from other systems previously listed. See Enclosure 18. It should be noted that hot shutdown condition is defined as safe shutdown condtion for Fort Calhoun Station.

After identification of the systems had been completed, the system list was cross-checked against Appendix A of the Guidelines for Evaluating Environmental Qualifications of Class 1E Electrical Equipment in Operating Reactors.

II. District's Electrical Equipment Qualification "Philosophy" (10 CFR 50.49 (b)(1) (Continued)

A. Definition of Equipment Requiring Environmental Qualification (Continued)

1. (Continued)

a. Identification of Safeguards System: (Continued)

In general, there is a close correlation between Appendix A and the system listed for the Fort Calhoun facility. However, certain specific systems are not required at Fort Calhoun to achieve a safe shutdown under the postulated accident condition. In addition, some of the systems listed are unaffected by either LOCA or HELB environments since they are located outside of affected areas. It should be noted that the hot shutdown condition (Mode 4) is defined as safe shutdown condition for Fort Calhoun Station.

A master list has been prepared for each system, listing those components which were identified as Class 1E and which could be affected by a LOCA or a high energy line break. This completed the first step of the District's review.

All instrumentation identified as being required to function for either automatic operation or required by the operator to make a decision on a specific post accident (i.e., long term core cooling) has been identified and included in the master list. Instrumentation which may aid the operator in identification of problem (i.e., containment humidity) has not been included since the information provided is of little or no value in a post DBA condition.

Certain of the required NUREG-0737 instruments are included. See (b)(3) for Supplement 1 (Regulatory Guide 1.97 information).

B. Establishing Environments

1. Identification of High Energy Lines

The basis for evaluation for HELB affects on Class 1E electrical components is Appendix M of the Final Safety Analysis Report. A review of the high energy lines listed in Appendix M was conducted to determine which, if any, would have an effect on plant systems and equipment. It was determined from the review that only a main steam or main feedwater line break could cause an accident condition under which plant safety systems might be challenged. Since a HELB for any other systems listed would not require engineered safeguards

II. District's Electrical Equipment Qualification "Philosophy" (10 CFR 50.49 (b)(1) (Continued)

B. Establishing Environments (Continued)

1. Identification of High Energy Lines (Continued)

systems to operate for any reason, these lines were excluded from this analysis.

After determination that main steam and main feedwater lines could cause actuation of safety systems, these lines were reviewed to determine where Class 1E equipment could be affected as a result. Two areas were subsequently identified and investigated in greater depth.

The first area is within the reactor containment itself. Since a main steam line break is of more consequence than a main feedwater line break, the main steam break was addressed. The Fort Calhoun facility is equipped with an automatic containment spray system equipped with redundant pumps, lines and spray headers. As such, it is not subject to disabling by single component failures. Therefore, in accordance with Enclosure 4 of IE Bulletin 79-01B, it has been determined that the LOCA environment will govern qualification of equipment located within the containment.

For a main steam line or main feedwater line break outside of containment, the only Category 1E electrical equipment which could be affected is located in Room 81. The effects of a main steam or feedwater line break on the environment of Room 81 are discussed in Appendix M of the Final Safety Analysis Report and in Enclosure 2 of this document. The break within Room 81, results in the "worst case environment". The analysis conducted on the components within the areas affected was thus governed by the main steam line break, with the exception of flooding.

It is the District's belief that this represents all design basis accidents which result in a harsh environment (including flooding) which could expose safety related electrical equipment required to function to mitigate the accident to the harsh environment.

Flooding within Room 81 is more limited for a main feedwater line break and the flood level predicted in the FSAR was utilized to analyze the components subject to possible flood damage. This completed the second step of the District's review.

2. Areas Where Fluids Are Recirculated to Accomplish Long-Term Core Cooling

The areas which have been addressed for consideration of fluids from inside containment are Rooms 13, 21, 22, 59, 60, and 69. These areas were chosen since this is the only area

B. Establishing Environments (Continued)

3. Loss of Coolant Accident (LOCA) (Continued)

The flood level used as the basis for this evaluation is 1000.9'. This level was arrived at by investigating all possible sources of water which could be pumped into the containment or released from systems within the containment prior to entering the recirculation mode. For conservatism, the entire contents of the Safety Injection Tanks, the Safety Injections Refueling Water Tank, and the Reactor Coolant System were assumed to be dumped into containment prior to any recirculation actuation.

The resultant flood level thus represents the entire water inventory available to mitigate the consequences of a LOCA and is considered to be a conservative number.

C. Component Qualification Philosophy

The District's "Philosophy" on Electrical Equipment Qualification stems from the manner (method) in which qualification was demonstrated. Specifically, the District's Qualification Program is organized to demonstrate the listed equipment's ability to function under environmental stress (harsh environment) and have adequate margin to insure operation, and operating time.

The methods used to demonstrate the compliance of equipment to the above philosophy can be placed in four categories:

As discussed in Section B, "Establishing Environments," the FSAR was used to provide LOCA and HELB information. For evaluation of equipment, plant specific environmental profiles were used as provided in the FSAR Section 14 and Appendix M. Please note, for the LOCA profile this was modified by the first SER which required the use of 305°F temperature.

The methods used to demonstrate the compliance of equipment to the above philosophy can be placed in four categories:

1. For those items where analysis indicated that qualification could not be accomplished or where testing of some type was available, but where analysis to demonstrate complete qualification could not be accomplished, a replacement to fully qualified equipment was, or is presently being, accomplished.

   The solenoid and limit switch upgrades are examples of equipment in which analysis indicated that qualification was not feasible. The Foxboro transmitters are examples of equipment which were upgraded when analysis and testing could not be combined to demonstrate qualification.

II. District's Electrical Equipment Qualification "Philosophy" (10 CFR 50.49 (b)(1) (Continued)

C. Component Qualification Philosophy (Continued)

As a result of the above-mentioned requirements, the District defined four levels of required qualification - 1 hour, 1000 hours (42 days), 100 days and 1 year. The 1 hour specification is applied to equipment whose safety function is completed within a few seconds after receipt of an accident signal. This 1 hour equipment was evaluated for the effects of subsequent failure on the safety systems and the potential for misleading the operator. Where subsequent failure could degrade the plant safety system status or the potential for misleading the operator existed, the level of required qualification was increased. The 1000 hour specification is applied to equipment which is required for LOCA, HELB, or safe shutdown. The equipment in this category functions during the entire DBE until the plant environments return to essentially the same levels that existed before the postulated accident (see discussion below). The 100 days are expected to be adequate to detect a containment H_2 problem and take necessary action. The long term (1 year) specification is applied to equipment which must operate for a significant amount of time after LOCA and is not accessible during the course of the accident. Long term is defined as the maximum time necessary to achieve cold shutdown. The long term specification is consistent with Supplement 2 of IE Bulletin 79-01B.

In some instances the District did not believe a rigorous aging solution was required, as in the case of Fisher 304 limit switches which are not subjected to high temperatures or pressure, and which use materials which do not show significant aging. The only environmental stress is that of radiation, for which the switch is tested; the temperature exposure is within the range the vendor feels is correct for the limit switch application. Since the material shows no significant aging and no radiation induced failures were encountered, the switches are considered qualified for forty years.

The last area of the EEQ program is that of presentation of information to the operator. This is divided into two areas, accuracy of analog information and a method to insure that instrumentation which may fail does not mislead the operator into taking an improper action.

With regard to instrument accuracy, the District has performed analyses to show that although the accident stress causes inaccuracies, these should not mislead the operator, or cause actions which are detrimental to plant safety. Also, for any accident, not all transmitters are required to function, nor could these be expected to give a large amount of useful information. This is defined in the analysis. For those transmitters which must initiate an automatic action in an accident, the environmental stress induced inaccuracies are accounted for.

II. District's Electrical Equipment Qualification "Philosophy" (10 CFR 50.49 (b)(1) (Continued)

C. Component Qualification Philosophy (Continued)

The other area of operator interface is the quick and easy identification of valid information. The District believes that this must be presented in a way which is quickly identified and does not cause confusion. To accomplish this, orange dots have been placed on the control board name plates to identify qualified equipment. This allows the operators to conduct post-accident operation without referring to special additional instructions.

III. Qualified Life Program

The District's Qualified Life Program (QLP) is the means by which the District has implemented a system which accomplishes several aspects of an ongoing Electrical Equipment Qualification Program. These items may be characterized as, 1) qualified equipment tracing program, 2) qualification documents, 3) maintenance or refurbishment schedule to maintain qualification, 4) breakdown maintenance, and 5) future modification control.

As implemented, administrative and technical direction for the QLP resides in three documents, 1) Fort Calhoun Station Standing Orders, 2) Generating Station Engineering Manual, and 3) the Electrical Equipment Qualification Manual.

The QLP's operation is summarized in the following discussion.

First is the actual maintenance of qualification (refurbishment to account for aging). This is accomplished by the previously discussed Items 1, 2 and 3.

The District has elected to maintain a central file which contains, in the District's judgment, all the test and analysis documents necessary to establish equipment qualification. These documents (tests, analyses, etc.) must be tied to field equipment to both demonstrate qualification and establish any needed refurbishment interval. This is done in the form of an Equipment Qualification Documentation Form (EQDF) in which one of these, per device, is issued.

Once necessary maintenance (or cycling) has been identified, the refurbishment, including procedures, must be placed in the plant maintenance system. The effort is controlled by plant Standing Order.

Maintenance Procedures were written as required to refurbish. However, maximum use was made of existing plant procedures including surveillance tests, calibration procedures, and existing preventive maintenance procedures.

When refurbishment is completed, an FC-198 form is completed which updates the central file to document continued qualification. It should be noted that although such things as cycling are noted and accomplished, the central file is not updated. In many of these cases existing procedures are used.

III. Qualified Life Program (Continued)

Breakdown maintenance and equipment failure is controlled under plant Standing Orders. These controls insure compliance with 10 CFR 50.49 - spare or replacement parts - and documentation of continued qualification.

If the repair requires replacement and an upgrade to NUREG-0588 is to be done, the station modification controls (to be discussed later) are used. If a subcomponent is replaced or a one-for-one replacement is justified (sound reasons to the contrary) the FC-198 is used to establish continued qualification.

In order to insure future qualification of yet to be installed (and unknown) modifications it is necessary that all modifications to the station be included in the QLP if their function warrants inclusion. To accomplish this, Standing Orders have been updated to insure that equipment is included in the ongoing program. Other administrative control documents related to station modification control (GSE Manual and the EEQ Manual) serve to insure all modifications meeting the QLP criteria are treated in the same manner as the equipment originally in the QLP scope.

Update of all document files, procedures, and programs will be handled in the same manner as other document and program updates, as required by plant standing orders governing modifications.

It should be noted that the QLP documents provide guidance as to how to establish qualification, fill out necessary forms, and evaluate vendor information.

To summarize, the District's QLP accomplishes three major test tasks, 1) documents qualification, 2) actually maintains equipment in a qualified condition, and 3) accounts for future unknown modifications. The District believes this is accomplished within the guidance of 10 CFR 50.49.

IV. District Position on 10 CFR 50.49(b)(2)

10 CFR 50.49(b)(2), "Nonsafety-related electrical equipment whose failure under postulated environmental conditions could prevent satisfactory accomplishment of safety functions specified in subparagraphs (i) through (iii) of this section by the safety-related equipment."

It is the District's engineering judgement that the Fort Calhoun Station is in compliance with the requirement of 10 CFR 50.49(b)(2).

A review conducted to ensure that all equipment contained in the master list will perform its required function, and that no other equipment failure can compromise this action.

As stated in item II, the equipment master list was generated to include all equipment which must remain functional during or after a design basis accident and which is exposed to a harsh environment as a result of the design basis accident. The plant specific Loss of Coolant Accident (LOCA) and High Energy Line Break (HELB) analysis, FSAR Appendix M,

III. Qualified Life Program (Continued)

identified the LOCA and Main Steam Line Break (MSLB) as the only DBA resulting in a harsh environment which requires equipment qualification. The actual master list was prepared based on DBA equipment requirements, and equipment location based on the FSAR, Technical Specification, Emergency Procedures, P&IDs (flow diagrams and electrical diagrams). This list includes auxiliary devices in the electrical circuit also exposed to the harsh environment, which could prevent the operation of the safety-related (required to function) component. Also included are the auxiliary system (ventilation, cooling water, etc.) which are required for the operation of the safety-related system or components.

A review of the effects of the failure of non-safety related equipment was made. With regards to electrical isolation and faults, the Fort Calhoun Station instrument and control power and three phase AC (4160V and 480V) systems are designed with isolation devices such as fuses to clear any faults which may occur. A fault on a non-safety related device should, therefore, not affect the operation of a safety-related device.

The District also believes that physical proximity should not be of concern. The electrical protection should isolate any equipment before catastrophic (i.e., explosive) failure occurs. This is supported by the separation and segregation design criteria. The results of reviews of IE Bulletin 79-22 on potential unreviewed safety questions caused by the interaction of nonsafety-related and safety grade systems, and IE Bulletin 79-27 on the adequacy of station instrument and control power distribution systems insure the integrity of the safety related components. It should be noted that station modifications were similarly evaluated.

Any equipment identified was included for qualification in the master list.

V. Certain Post Accident Monitoring Equipment (b)(3)

It is the District's judgement that post accident monitoring equipment has been adequately considered. Those items required in the Station Emergency Procedures have been identified and qualified for the required function and environment. This includes those items required by NUREG-0737.

Any changes or upgrades to accident monitoring equipment will be implemented on the negotiated schedule.

Final implementation of post accident monitoring equipment and its scope was directed by NUREG-0737, Supplement 1, which required the review and implementation of Regulatory Guide 1.97 (Rev. 2). This is an ongoing program with a schedule negotiated by the Fort Calhoun Station Project Manager.

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