

Safety Evaluation Report
Environmental Qualification of Electrical Equipment
Response to Commission Decision CLI-84-11
Office of Nuclear Reactor Regulation
Equipment Qualification Branch
Three Mile Island Unit 1
Docket No. 50-289

INTRODUCTION

On January 27, 1984, the Commission took review of five issues in the Appeal Board's decision, ALAB-729, on plant design and procedures in the Three Mile Island Unit 1 (TMI-1) restart proceeding. One of the issues involved the environmental qualification (EQ) of electrical equipment. The Commission decided to review whether the Appeal Board erred in holding that that issue has been removed from the proceeding by the Commission's generic rulemaking on the subject. The Commission issued its decision in CLI-84-11, dated July 26, 1984. With regard to the EQ issue, the Commission directed the staff to certify the status of the environmental qualification of electrical equipment, located in containment and the auxiliary building and whose operation is necessary to mitigate small break LOCAs and loss of main feedwater transients, for radiation levels associated with the DOR Guidelines for large break LOCAs. Further, the Commission directed that if any of the equipment will not be properly qualified for radiation prior to restart, the licensee is to provide a specific

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justification for interim operation (JIO), and the staff is to review that justification and present its recommendation to the Commission.

BACKGROUND/DISCUSSION

By letter dated August 8, 1984, the staff informed GPU of the Commission's order to the staff, discussed above, described how the staff intended to comply with that order, and requested certain information it needed for review and evaluation.

By letter dated August 23, 1984, as amended by letter dated August 27, 1984, GPU provided its response to the staff's letter of August 8, 1984. As Attachment 1 to its letter, GPU provided a list of the electrical equipment located in a harsh radiation environment that is necessary to mitigate small break LOCAs and loss of main feedwater transients and is required to be qualified. Attachment 2 to that letter identified the additions/deletions made since a May 18, 1981 submittal from the licensee, along with the reasons for them. In its May 18, 1981 submittal, the electrical equipment required to be qualified to respond to a design basis small break LOCA had been identified by the licensee. Attachment 3 to the August 23, 1984 letter described GPU's resolution of equipment items whose radiation qualification documentation was incomplete at that time.

On September 6 and 7, 1984, the staff and a consultant from EG&G, Idaho, performed an audit of the TMI-1 EQ files at the GPU corporate offices. During that audit the staff discussed with GPU the method used to identify the

equipment within the scope of this review. The staff also reviewed a tabulation, for each item of equipment then identified as qualified, of the required radiation level and radiation level to which the equipment was qualified. In addition, the staff reviewed eight EQ files in detail. The staff also discussed with GPU its resolution for the Incore Thermocouples, as described in Attachment 3 of GPU's August 23, 1984 letter, whose radiation qualification documentation was incomplete.

By letter dated September 26, 1984, the staff provided GPU with the results of its September 6 and 7, 1984 audit. That letter identified equipment that, in the staff's view, should be added to the list of equipment within the scope of this review that is required to be qualified, stated that the decay heat removal flow indication should be qualified for normal operation radiation doses, and that procedural revisions proposed by GPU to permit excluding makeup tank level indication from the list of equipment required to be qualified needed to be implemented prior to staff certification of this item. In its letter, the staff also stated that documentation in seven of the eight EQ files reviewed in detail provided adequate evidence the equipment was qualified for radiation, but that the EQ file for the TransZorb diodes was deficient. During the audit, GPU identified these diodes as within the scope of this review and required to be qualified. In addition, the staff informed GPU that the JIO for the Incore Thermocouples was not acceptable. The letter requested the licensee to provide written resolution for the above issues.

By letter dated November 9, 1984, GPU responded to the staff's September 26, 1984 letter. In its letter, GPU agreed to add to the list of equipment within the scope of this review that requires qualification the equipment identified in the staff's September 26, 1984 that, in its view, should be added to the list. The November 9, 1984 letter also identified other equipment that GPU stated it will add to the list of equipment requiring qualification in place of making procedural changes. GPU addressed the qualification of the decay heat removal flow indication by stating it will add the low pressure injection flow indication to the list of equipment requiring qualification by adding two flow transmitters to the equipment list and deleting two others. Information was also provided on the qualification status of the TransZorb diodes and incore thermocouples extension cable.

Both the August 23 and November 9, 1984 letters discussed above identified equipment that had not been demonstrated qualified for radiation. The resolutions identified by GPU for this equipment were demonstrating qualification, replacing the equipment or components of the equipment, installing radiation shielding, testing, further evaluation of information, or submitting JIOs. In order to obtain a more current status with regard to implementation of these resolutions, the staff reviewed information attached to a December 11, 1984 letter from GPU that had been submitted in response to a staff letter of May 25, 1984. Information in that submittal included the licensee's resolution of environmental qualification deficiencies identified in a Technical Evaluation Report, prepared for the staff by the Franklin Research Center, that was attached to the staff's December 10, 1982 Safety Evaluation

Report addressing the environmental qualification of safety-related electrical equipment for TMI-1. The submittal also addressed compliance with 10 CFR 50.49 and included JICs for some equipment.

After reviewing the December 11, 1984 submittal cited above, the staff held a telecon on January 18, 1985 with GPU to obtain clarification with regard to information in that submittal that applied to equipment identified in the licensee's August 23 and November 9, 1984 submittals as not qualified for radiation. During that telecon, GPU committed to provide a submittal to update the qualification status of that equipment, and stated that by the end of January 1985 documentation would be available to demonstrate that the existing equipment is qualified for radiation or, for equipment that will be replaced prior to restart, the replacement equipment is qualified for radiation.

On January 29 and 30, 1985, the staff and a consultant from EG&G, Idaho, performed another audit of the TMI-1 EQ files at the GPU corporate offices. That audit was a combined audit for both the purposes of this review effort and overall compliance with 10 CFR 50.49. The files reviewed included those that contained the EQ documentation for all the equipment that had been identified by GPU in its August 23 and November 9, 1984 submittals as not qualified for radiation, with the exception of the TransZorb diodes. At that time, the licensee was still reviewing the results of testing that had been recently completed on these diodes. During the audit, the licensee also informed the staff that a Limitorque motorized valve actuator, MUV-12, that had been identified in its August 23, 1984 submittal as requiring qualification, did

not require qualification. The results of the audit are presented later in this evaluation.

By letter dated February 15, 1985, GPU provided the submittal they had committed during the January 18, 1985 telecon to provide. The submittal provided an update of the qualification status of several items of equipment, and addressed the staff's findings from its January 29 and 30, 1985 audit.

The staff reviewed the February 15, 1985 submittal and during telecons informed the licensee that the basis for needing the incore thermocouples for only up to 10 hours following a SBLOCA was not acceptable. The staff also requested clarification of the qualification status of the GE penetrations and some Limitorque motorized valve actuators.

GPU responded to the telecons cited above in a letter dated March 6, 1985.

EVALUATION

Scope of Electrical Equipment

In order for the staff to determine the qualification status of the electrical equipment within the scope of the review required by CLI-84-11, GPU was requested by the staff's August 8, 1984 letter to prepare such a list of equipment. By letter dated August 23, 1984, as amended by letter dated August 27, 1984, GPU provided a list of electrical equipment located in a harsh radiation environment that is necessary to

mitigate small break LOCAs and loss of main feedwater transient and that is required to be qualified. Additions/deletions made to the list provided by the licensee's May 18, 1981 letter were also identified, along with the reasons for them. GPU stated in the August 23, 1984 letter that the list was prepared in accordance with the guidance provided in a staff letter of May 25, 1984. That letter provided guidance to GPU regarding identification of equipment required to be environmentally qualified in accordance with 10 CFR 50.49.

During the September 6 and 7, 1984 audit, the staff discussed with GPU the method used to develop the list of equipment provided by the August 23 and 27, 1984 letters. GPU had prepared Technical Data Report (TDR) No. 598, Revision 0, "Methodology and List of Electrical Components Requiring Radiation Qualification for SBLOCA Mitigation," in order to document the completeness of the equipment list. Except for common components that require qualification, such as cable and terminal blocks identified in GPU's August 23, 1984 submittal, Appendix A of the TDR was identified as a complete list of electrical components required for SBLOCA mitigation and that are located in a postulated harsh radiological environment. Components on that list were also identified as either requiring qualification or not. For the equipment identified as not requiring qualification, justification was also provided. The list of equipment which provides for emergency core cooling, reactor protection and accident monitoring was discussed in detail during the audit.

Based on the audit review discussed above, the staff identified three items of equipment that should be added to the list, namely the pressure switches for the high pressure injection auxiliary oil pumps, the high pressure injection

auxiliary oil pumps, and the high pressure injection flow indication. In addition, the staff found that the decay heat removal flow indication should be qualified for normal operation radiation doses, and informed GPU that procedural revisions proposed to permit excluding makeup tank level indication from the list needed to be implemented. The staff's concern regarding decay heat removal flow indication was that DPT-802 and 803, flow transmitters identified by GPU on the list provided in its August 23, 1984 letter, provided flow indication on the remote shutdown panel. The flow transmitters that provide indication in the control room were not included in the list of equipment required to be qualified.

GPU addressed the staff's audit findings in a letter dated November 9, 1984. In that letter GPU stated that the three items of equipment identified by the staff will be added to the list of equipment requiring qualification. To address the staff's concern regarding decay heat removal flow indication, the licensee stated it will add to the list of equipment required to be qualified the flow transmitters that provide indication in the control room and delete DPT-802 and 803. In lieu of procedural changes, GPU stated that level transmitters will be added to the list of equipment requiring qualification to provide makeup tank level indication. GPU also stated that they had added to the list of equipment required to be qualified the RCP seal injection flow transmitter rather than make procedural changes that would allow excluding it from the list.

In its February 15, 1985 letter, GPU identified the TransZorb diodes as required to be qualified and stated that Limitorque motorized valve actuator

MUV-12 was not. The diodes were inadvertently left off the list of equipment identified in the August 23, 1984 submittal, but had been identified to the staff as requiring qualification during the September 6 and 7, 1984 audit. In accordance with TDR No. 598, Revision 0, MUV-12 was justified as not requiring qualification, and was inadvertently identified in the August 23, 1984 submittal as requiring qualification.

Based on its review and the results of the September 6 and 7, 1984 audit, the staff concurs that the electrical equipment within the scope of this review that is required to be environmentally qualified for radiation is identified in the licensee's submittal of August 23, 1984, as amended by letters from GPU dated August 27 and November 9, 1984, and February 15, 1985.

Qualification Status of the Equipment

The equipment within the scope of this review and that is required to be qualified, as discussed above, must be demonstrated qualified for radiation levels associated with the DOR Guidelines for large break LOCAs. Radiation levels postulated by the licensee to exist both inside and outside containment following a large break LOCA were previously reviewed by the staff, and for the staff by the Franklin Research Center, and found to be acceptable. This is documented in the staff's March 24, 1981 SER for TMI-1 and the Technical Evaluation Report attached to the staff's December 10, 1982 SER for TMI-1.

As stated previously, the staff and a consultant from EG&G, Idaho, performed audits of the licensee's EQ files at the GPU corporate offices on

September 6 and 7, 1984, and January 29 and 30, 1985. The combined audits involved a review by the staff and its consultant of the EQ documentation relied upon by GPU to demonstrate environmental qualification, for radiation levels associated with a large break LOCA, of 55% of the electrical equipment items within the scope of this review and required to be qualified. During the first audit, EQ documentation for the following equipment was reviewed:

- o Limitorque Motorized Valve Actuators (located inside containment)
- o ASCO Solenoid Valves (qualified to the DOR Guidelines)
- o Rosemount Transmitters (Model 1153D)
- o Microswitch Limit Switches
- o TransZorb diodes
- o Target Rock Solenoid Valves
- o Ross Solenoid Valves
- o Samuel Moore Cable

In addition to a detailed review of EQ documentation for the above equipment, as previously stated the staff also reviewed during its first audit a tabulation, for each item of equipment identified at that time as qualified, of

the required radiation level and radiation level to which the equipment was qualified.

Based on the results of the first audit, the staff found that the tabulated radiation levels indicated the equipment was qualified, and that the documentation reviewed in detail supported that finding, with the exception of the TransZorb diodes. The EQ documentation for these diodes included test results, but did include the test report itself. These findings were identified to GPU in the staff's letter of September 26, 1984.

During the second audit on January 29 and 30, 1985, the staff reviewed EQ documentation for the following equipment within the scope of this evaluation:

- o Limitorque Motorized Valve Actuators (located inside containment)
- o Limitorque Motorized Valve Actuators (located in the auxiliary building)
- o G.E. Terminal Blocks
- o Static O-Ring Pressure Switches (qualified to NUREG-0588)
- o Rosemount Transmitters (Model 1153D)
- o General Electric Pump Motors

- o General Electric Fan Motors
- o Rosemount RTDs
- o Conax Electrical Seals
- o Weed RTDs
- o Ross Solenoid Valves
- o Continental Wire and Cable Co. Cable (incore thermocouple extension cable)
- o Samuel Moore Cable
- o ASCO Pressure Switches
- o Rosemount Transmitters (Model 1153B)

EQ documentation for four of the equipment items listed above, i.e., the Limitorque motorized valve actuators located inside containment, the Model 1153D Rosemount transmitters, the Ross solenoid valves and the Samuel Moore cable, was reviewed during both audits. The reason for that, as stated previously, was that the second audit was a combined audit for both the purposes of this review and the overall 10 CFR 50.49 review. The EQ documentation for these four equipment items, and others listed above, was

reviewed as part of the 10 CFR 50.49 review. That review includes qualification for radiation levels associated with a large break LOCA.

Based on the results of the second audit, the staff found that the EQ documentation reviewed provided adequate evidence that the equipment is qualified for radiation levels associated with a large break LOCA, except for some Limitorque motorized valve actuators located inside containment, the Weed RTDs and the incore thermocouple extension cable. The staff's findings with regard to this equipment, provided to GPU at the time of the audit, are given below.

Limitorque Motorized Valve Actuators - Included in the EQ documentation were the results of a recently completed field walkdown of safety-related equipment in TMI-1. As a result of that walkdown, deficiencies were identified for some of the actuators, some of which affect their qualification for radiation. These deficiencies were incorrect limit and/or torque switch material, and splice-taped connections that needed to be replaced with qualified terminal blocks or Raychem heat shrink tubing.

Weed RTDs - Although the EQ documentation addressed similarity of the installed/to be installed RTDs and those tested, the staff felt that further evaluation was needed to completely establish similarity. (The relationship of these RTDs to the incore thermocouple system also needed clarification.)

Incore Thermocouple Extension Cable - The EQ documentation did not completely establish qualification. Further evaluation was required to justify the length of time the cable was required to function, and to address the failures experienced in the TMI-2 Incore Thermocouple System.

By its letter dated February 15, 1985, GPU provided an update of the qualification status of several items of equipment, and addressed the above audit findings. The staff reviewed this information and JIO-TI-84-6 Revision 1, which was submitted by letter from GPU dated February 12, 1985. The JIO was referenced in the February 15, 1985 letter as providing the basis for the length of time the incore thermocouple extension cable was required to function following a SBLOCA. The staff found that for breaks larger than 0.085 ft^2 , the incore thermocouples were not required to function. However, for smaller breaks the incore thermocouples could be needed beyond 10 hours, the maximum length of time the licensee's analyses showed the incore thermocouples would be needed. With regard to the Limitorque motorized valve actuators, the staff found that the splice-taped connection deficiency discovered during the walkdown for valves RC-V-3 and 4 was not addressed, nor was it clear how the frayed motor leads on valves DHV-4A and B affected radiation qualification. In addition, the GE electrical penetrations, previously identified as qualified for radiation, now appeared to be undergoing further review to determine if they are qualified.

During several telecons, the staff discussed the above finding and concerns with GPU. By letter dated March 6, 1985, GPU provided information in response

to the discussions that took place during those telecons. That submittal, together with the February 12 and 15, 1985 submittals, included the following information:

Limitorque Motorized Valve Actuators - The walkdown results were reverified and the deficiencies previously identified for some of the actuators were found not to exist. GPU states that the frayed (uninsulated) motor leads for DHV-4A and B will be corrected by March 31, 1985. Because of damaged motor lead wires, the licensee states that the motor for CAV-3 will be replaced in February, 1985.

Weed RTDs - Documentation from Weed establishing similarity of the installed/to be installed RTDs and those tested is in the GPU EQ file for this equipment. Details and drawings are on file in the GPU document center. The Weed RTDs to be installed will be used to replace existing Rosemount 139U RTDs, used for cold junction compensation in the Incore Thermocouple System. GPU states that the Rosemount RTDs will be replaced with Weed RTDs by March 31, 1985.

Incore Thermocouples Extension Cable - Empirical data from the TMI-2 accident show that the TMI-2 cable, which is similar to the TMI-1 cable, has experienced an integrated radiation dose greater than it would receive more than 30 days following a large break LOCA. GPU states that the radiation calculations have been performed using the methodology given in Appendix B to the DOR Guidelines. To address the failures experienced in the TMI-2 Incore Thermocouple System, the licensee cites two reports prepared by EG&G, Idaho, that provide the bases

for concluding that the failures are not the result of extension cable radiation exposure. One of those reports states that extension cable insulation resistance data showed only a minor decrease from the value specified in the original specification.

With regard to the GE electrical penetrations, GPU reiterated in its March 6, 1985 submittal that the penetrations are qualified as identified in the August 23, 1984 submittal. The further review being performed, as indicated in the February 15, 1985 submittal, concerned the overall 10 CFR 50.49 review.

In its February 15, 1985 submittal, GPU states that the TransZorb diodes have been tested for the large break LOCA environment. As a result of a low current leakage anomaly displayed during the test, GPU states that these diodes will be replaced with low leakage TransZorb diodes of the same model by March 31, 1985.

Some of the equipment for which EQ documentation was reviewed during the second audit was not yet installed. These equipment were Rosemount transmitters, model 1153B, to replace existing transmitters with plant ID numbers MU-23-DPT1, 2, 3 and 4, MU-42-DPT, DH-1-DPT 1 and 2, and MU-14-LT; some weed RTDs to replace existing RTDs used for cold junction compensation in the Incore Thermocouple System; and ASCO pressure switches to replace existing pressure switches with plant ID numbers PS-479A, B and C. Also, as identified above, the existing TransZorb diodes are required to be replaced with low leakage TransZorb diodes of the same model, Limitorque motorized valve actuators DMV-4A

and B require correction of the uninsulated motor leads, and the motor in actuator CAV-3 requires replacement. GPU has committed to complete all the above by March 31, 1985. The staff will verify, prior to restart, that the work has been completed by the licensee.

Based on the results of the audits and its review of the information submitted by GPU, discussed above, the staff finds that the electrical equipment within the scope of this review that is required to be environmentally qualified has been demonstrated to be qualified for radiation levels associated with a large break LOCA.

CONCLUSIONS

Based on the results of the above evaluation, the staff concludes the following:

1. The electrical equipment located in containment and the auxiliary building, including replacement equipment to be installed prior to restart and equipment to be modified prior to restart, whose operation is necessary to mitigate small break LOCAs and loss of main feedwater transients, that is located in a harsh radiation environment and required to be qualified, has been properly identified.

2. All such equipment has been demonstrated to be environmentally qualified for the radiation levels associated with the DOR Guidelines for a large break LOCA.