

SAFETY EVALUATION REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

FOR METROPOLITAN EDISON COMPANY THREE MILE ISLAND UNIT 1

DOCKET NO. 50-289

ENVIRONMENTAL QUALIFICATION OF SAFETY-RELATED ELECTRICAL EQUIPMENT

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1 INTRODUCTION

General Design Criteria 1 and 4 specify that safety-related electrical equipment in nuclear facilities must be capable of performing its safety-related function under environmental conditions associated with all normal, abnormal, and accident plant operation. In order to ensure compliance with the criteria, the NRC staff required all licensees of operating reactors to submit a reevaluation of the qualification of safety-related electrical equipment which may be exposed to a harsh environment.

2 BACKGROUND

On February 8, 1979, the NRC Office of Inspection and Enforcement (IE) issued to all licensees of operating plants (except those included in the systematic evaluation program (SEP)) IE Bulletin IEB 79-01, "Environmental Qualification of Class IE Equipment." This bulletin, together with IE Circular 78-08 (issued on May 31, 1978), required the licensees to perform reviews to assess the adequacy of their environmental qualification programs.

Subsequently, Commission Memorandum and Order CLI-80-21 (issued on May 23, 1980) states that the DOR guidelines and portions of NUREG-0588 (which were issued on January 14, 1980, as enclosures 4 and 5 to IEB-79-01B) form the requirements that licensees must meet regarding environmental qualification of safety-related electrical equipment in order to satisfy those aspects of 10 CFR 50, Appendix A, General Design Criterion (GDC)-4. This order also requires the staff to complete safety evaluation reports (SERs) for all operating plants by February 1, 1981. In addition, this order requires that the licensees have qualified safety-related equipment installed in their plants by June 30, 1982.

Supplements to IEB 79-01B were issued for further clarification and definition of the staff's needs. These supplements were issued on February 29, September 30, and October 24, 1980.

In addition, the staff issued orders dated August 29, 1980 (amended in September 1980) and October 24, 1980 to all licensees. The August order required that the licensees provide a report, by November 1, 1980, documenting the qualification of safety-related electrical equipment. The October order required the establishment of a central file location for the maintenance of all equipment-qualification records. The central file was mandated to be established by December 1, 1980. The order also required that all safety-related electrical equipment be qualified by June 30, 1982. In response, the licensee submitted i formation by letters dated October 31, 1980, and January 30 1981.

2.1 Purpose

The purpose of this SER is to identify equipment whose qualification program does not provide sufficient assurance that the equipment is capable of performing the design function in hostile environments. The staff position relating to any identified deficiencies is provided in this report.

2.2 Scope

The scope of this report is limited to an evaluation of the equipment which must function in order to mitigate the consequences of a loss-of-coolant accident (LOCA) or a high-energy-line-break (HELB) accident, inside or outside containment, while subjected to the hostile environments associated with these accidents.

3 STAFF EVALUATION

The staff evaluation of the licensee's response included an onsite inspection of selected Class IE equipment and an examination of the licensee's report for completeness and acceptability. The criteria described in the DOR guidelines and in NUREG-0588, in part, were used as a basis for the staff evaluation of the adequacy of the licensee's qualification program.

The NRC Office of Inspection and Enforcement performed (1) a preliminary evaluation of the licensee's response, documented in a technical evaluation report (TER) and (2) an onsite verification inspection (July 28-August 1, 1980) of selected safety-related electrical equipment. Components of the reactor protection and make-up and purification systems were inspected. The inspection verified proper installation of equipment, overall interface integrity, location with respect to flood level for equipment inside the containment, and manufacturers' nameplate data. The manufacturer's name and model number from the nameplate data were compared to information given in the Component Evaluation Work Sheets (CES) of the licensee's report. The site inspection is documented in report IE 50-289/80-20. The deficiencies noted are discussed in this SER. For this review, the documents referenced above have been factored into the overall staff evaluation.

3.1 Completeness of Safety-Related Equipment

In accordance with IEB 79-01B, the licensee was directed to (1) establish a list of systems and equipment that are required to mitigate a LOCA and an HELB and (2) identify components needed to perform the function of safety-related display information, post-accident sampling and monitoring, and radiation monitoring.

The staff developed a generic master list based upon a review of plant safety analyses and emergency procedures. The instrumentation selected includes parameters to monitor overall plant performance as well as to monitor the performance of the systems on the list. The systems list was established on the basis of the functions that must be performed for accident mitigation (without regard to location of equipment relative to hostile environments). The list of safety-related systems provided by the licensee was reviewed against the staff-developed master list.

Based upon information in the licensee's submittal, the equipment location references, and in some cases subsequent conversations with the licensee, the staff has verified and determined that the systems included in the licensee's submittal are those required to achieve or support: (1) emergency reactor shutdown, (2) containment isolation, (3) reactor core cooling, (4) containment heat removal, (5) core residual heat removal, and (6) prevention of significant release of radioactive material to the environment. The staff therefore concludes that the systems identified by the licensee (listed in Appendix D) are acceptable, with the exception of those items discussed in Section 5 of this report.

Display instrumentation which provides information for the reactor operators to aid them in the safe handling of the plant was not specifically identified by the licensee. A complete list of all display instrumentation mentioned in the LOCA and HELB emergency procedures must be provided. Equipment qualification information in the form of summary sheets should be provided for all components of the display instrumentation exposed to harsh environments. Instrumentation which is not considered to be safety related but which is mentioned in the emergency procedure should appear on the list. For these instruments, (1) justification should be provided for not considering the instrument safety related and (2) assurance should be provided that its subsequent failure will not mislead the operator or adversely affect the mitigation of the consequences of the accident. The environmental qualification of post-accident sampling and monitoring and radiation monitoring equipment is closely related to the review of the TMI Lessons-Learned modifications and will be performed in conjunction with that review.

The licensee identified 275 items of equipment which were assessed by the staff.

3.2 Service Conditions

Commission Memorandum and Order CLI-80-21 requires that the DOR guidelines and the "For Comment" NUREG-0588 are to be used as the criteria for establishing the adequacy of the safety-related electrical equipment environmental qualification program. Three documents provide the option of establishing a bounding pressure and temperature condition based on plant-specific analysis identified in the licensee's Final Safety Analysis Report (FSAR) or based on generic profiles using the methods identified in these documents.

On this basis, the staff has assumed, unless otherwise noted, that the analysis for developing the environmental envelopes for Three Mile Island Unit 1, relative to the temperature, pressure, and the containment spray caustics, has been performed in accordance with the requirements stated above. The staff has reviewed the qualification documentation to ensure that the qualification specifications envelope the conditions established by the licensee. During this review, the staff assumed that for plants designed and equipped with an automatic containment spray system which satisfies the single-failure criterion, the main-steam-line-break (MSLB) environmental conditions are enveloped by the large-break-LOCA environmental conditions. The staff assumed, and requires the licensee to verify, that the containment spray system is not subjected to a disabling single-component failure and therefore satisfies the requirements of Section 4.2.1 of the DOR guidelines.

Equipment submergence has also been addressed where the possibility exists that flooding of equipment may result from HELBs.

3.3 Temperature, Pressure, and Humidity Conditions Inside Containment

The licensee has provided the results of accident analyses as follows:

	Max Temp (°F)	Max Press (psig)	Humidity (%)
0CA	275	50.6	100

The staff has concluded that the minimum temperature profile for equipment qualification purposes should include a margin to account for higher-than-average temperatures in the upper regions of the containment that can exist due to stratification, especially following a postulated MSLB. Use of the steam saturation temperature corresponding to the total building pressure (partial pressure of steam plus partial pressure of air) versus time will provide an acceptable margin for either a postulated LOCA or MSLB, whichever is controlling, as to potential adverse environmental effects on equipment.

The licensee's specified temperatu.e (service condition) of 275°F does not satisfy the above requirement. A saturation temperature corresponding to the peak profile (298°F peak temperature at 50.6 psig) should be used instead. The licensee should update his equipment summary tables to reflect this change. If there is any equipment that does not meet the staff position, the licensee must provide either justification that the equipment will perform its intended function under the specified conditions or propose corrective action.

3.4 Temperature, Pressure, and Humidity Conditions Outside Containment

The licensee has provided the temperature, pressure, humidity and applicable environment associated with an MSLB within the intermediate building.

The staff has verified that the parameters identified by the licensee for the MSLB are acceptable.

3.5 Submergence

The maximum submergence levels have been established and assessed by the licensee. Unless otherwise noted, the staff assumed for this review that the methodology employed by the licensee is in accordance with the appropriate criteria as established by Commission Memorandum and Order CLI-80-21.

The licensee's value for maximum submergence is 5.94 ft. The licensee identified Raychem heat shrink tubing and four Bailey Meter level transmitters as having the potential for becoming submerged after a postulated event. The work sheet for the Raychem heat shrink tubing indicates that this material is qualified for submergence. The licensee states that the four level transmitters are not required following a

large-break LOCA which results in the maximum flood level. The licensee states that flood levels associated with breaks where steam generator water level is needed will not subject the level transmitters to submergence. However, the staff does not agree with the licensee, because the flood level should be the same across the spectrum of postulated events. Therefore, the licensee should provide information that shows these level transmitters are qualified for submergence or take corrective action by either relocating them or replacing them with qualified level transmitters. Additionally, the licensee may justify an exemption for qualification of these components by providing the information discussed in Section 4.2 of this report.

Although not identified on the work sheets, the onsite inspection report indicates that Limitorque motor operators MU-V-2A and MU-V-2B in the make-up and purification system are below the calculated flood level. Therefore, before plant restart, the licensee should either verify that these motor operators are in fact not subject to submergence or provide documentation showing that the motor operators and associated cables are qualified for submergence. If qualification documentation does not exist, the licensee may provide an acceptable basis to exempt this equipment from qualification by providing the information discussed in Section 4.2 of this SER.

The onsite inspection of a very limited number of components indicated that the valve operators discussed above are below the calculated flood level. Because the submittal does not indicate the elevation of equipment, before plant restart the licensee should verify that, other than the equipment discussed above, no equipment has the potential for becoming submerged.

3.6 Chemical Spray

The licensee's FSAR value for the chemical concentration is 2270 ppm boron and sodium hydroxide (NaOH) to raise the pH to 9.5. Only the work sheet for Raychem heat shrink tubing provides enough information to show qualification for chemical spray. Therefore, for the purpose of this review, the effects of chemical spray will be considered unresolved. The staff will review the licensee's response when it is submitted and discuss the resolution in a supplemental report.

3.7 Aging

Section 7 of the DOR guidelines does not require a qualified life to be established for all safety-related electrical equipment. However, the following actions are required:

- (1) Make a detailed comparison of existing equipment and the materials identified in Appendix C of the DOR guidelines. The first supplement to IEB-79-01B requires licensees to utilize the table in Appendix C and identify any additional materials as the result of their effort.
- (2) Establish an ongoing program to review surveillance and maintenance records to identify potential age-related degradations.
- (3) Establish component maintenance and replacement schedules which include considerations of aging characteristics of the installed components.

The licensee identified a number of equipment items for which a specified qualified life was established (for examples, 5 years, 15 years, or 40 years). In its assessment of these submittals, the starf did not review the adequacy of the methodology nor the basis used to arrive at these values; the staff has assumed that the established values are based on state-of-the-art technology and are acceptable.

For this review, however, the staff requires that the licensee submit supplemental information to verify and identify the degree of conformance to the above requirements. For equipment for which a materials evaluation has already been performed, items (2) and (3) above should be addressed. The response should include all the equipment identified as required to maintain functional operability in harsh environments.

The licensee indicated that this phase of the response is outstanding and that the review is in progress. The staff will review the licensee's response when it is submitted and discuss its evaluation in a supplemental report.

3.8 Radiation (Inside and Outside Containment)

The licensee has provided values for the radiation levels postulated to exist following a LOCA. The application and methodology employed to determine these values were presented to the licensee as part of the NRC staff criteria contained in the DOR guidelines, in NUREG-0588, and in the guidance provided in IEB-79-01B, Supplement 2. Therefore, for this review, the staff has assumed that, unless otherwise noted, the values provided have been determined in accordance with the prescribed criteria. The staff review determined that the values to which equipment was gualified enveloped the requirements identified by the licensee.

The value required by the licensee inside containment is an integrated dose of 2 x 10⁷ rads. The radiation service condition provided by the licensee is lower than provided in the DOR guidelines for gamma and beta radiation. The licensee is requested to either provide justification for using the lower service condition or use the service condition provided in the DOR guidelines for both gamma and beta radiation. If the former option is chosen, then the analysis--including the basis, assumptions, and a sample calculation--should be provided.

A required value outside containment of 3.4×10^6 rads has been used by the licensee to specify limiting radiation levels for the decay heat removal pumps in the auxiliary building. This value considers the radiation levels influenced by the source term methodology associated with post-LOCA recirculation fluid lines and is therefore acceptable.

For some equipment, the licensee has used a calculated integrated radiation dose at 1 hour after a LOCA as the required radiation environment. Without additional justification (as discussed in Section 4.2 of this SER), specifying these lower radiation levels is not acceptable and, therefore, radiation has been listed as a deficiency for these components. Radiation has also been identified as a deficiency if the list ree used other than the values listed in Appendix C of the DOR guidelines, up ass the Appendix C values also enveloped the specified value. In the January 30, 1981 submittal, the licensee does not provide a comparison of the radiation values given in Appendix C with those taken from other sources. Therefore, the licensee should verify that the radiation values used to show qualification of all components are at least as conservative as the values given for the various materials listed in Appendix C to the DOR guidelines.

4 QUALIFICATION OF EQUIPMENT

The following subsections present the staff's assessment, based on the licensee's submittal, of the qualification status of safety-related electrical equipment.

The staff has separated the safety-related equipment into three categories: (1) equipment requiring immediate corrective action, (2) equipment requiring additional qualification information and/or corrective action, and (3) equipment considered acceptable if the staff's concern identified in Section 3.7 is satisfactorily resolved.

In its assessment of the licensee's submittal, the NRC staff did not review the methodology employed to determine the values established by the licensee. However, in reviewing the data sheets, the staff made a determination as to the stated conditions presented by the licensee. Additionally, the staff has not completed its review of supporting documentation referenced by the licensee (for example, test reports). It is expected that when the review of test reports is complete, the environmental qualification data bank established by the staff will provide the means to cross reference each supporting document to the referencing licensee.

If supporting documents are found to be unacceptable, the licensee will be required to take additional corrective actions to either establish qualification or replace the item(s) of concern. This effort will begin in early 1981.

An appendix for each subsection of this report provides a list of equipment for which additional information and/or corrective action is required. Where appropriate, a reference is provided in the appendices to identify deficiencies. It should be noted, as in the Commission Memorandum and Order, that the deficiencies identified do not necessarily mean that equipment is unqualified. Dowever, they are cause for concern and may require further case-by-case evaluation.

4.1 Equipment Requiring Immediate Corrective Action

Appendix A identifies equipment (if any) in this category. The licensee was asked to review the facility's safety-related electrical equipment. The licensee's review of this equipment has identified six Limitorque motor operators requiring immediate corrective action; therefore, licensee event report (LER) 80-17 was submitted. The licensee states that these motor operators will either be qualified or replaced by the end of the first refueling after restart. The staff does not find this schedule acceptable and, therefore, the licensee must commit to either showing that these motor operators are qualified or replace them by June 30, 1982. For the four motor operators on the decay heat removal valves located outside containment, the licensee states that these valves will perform their intended function before they experience any post-LOCA radiation doses and that these valves will not have to be operated again. The staff agrees with the licensee's justification for interim operation for these four components. For the remaining two motor operators, which are located inside containment on the purge valves, the licensee states that the redundant valves outside containment are qualified. These two valves outside containment each have two solenoid valves. The staff has determined that the two solenoids on one of the purge valves are qualified, but finds that the two solenoids on the other valve are not fully qualified to post-LOCA radiation levels. However, the licensee indicates that these solenoid valves perform their safety function before they experience radiation levels that might degrade the materials in them. Therefore, the staff concludes that interim operation is also justified for these two valves inside containment and finds that no immediate corrective action is required before these six motor operators are replaced. In this review, the staff has not identified any additional safetyrelated electrical equipment which is not able to perform its intended safety function during the time in which it must operate.

4.2 Equipment Requiring Additional Information and/or Corrective Action

Appendix B identifies equipment in this category, including a tabulation of deficiencies. The deficiencies are noted by a letter relating to the legend (identified below), indicating that the information provided is not sufficient for the qualification parameter or condition.

Legend

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- temperature
- QT qualification time
- RT required time
- p pressure
- H humidity
- CS chemical spray
- A material-aging evaluation; replacement schedule; ongoing equipment surveillance
- S submergence
- M margin
 - HELB evaluation outside containment not completed
- OM qualification method
- RPN equipment relocation or replacement; adequate schedule not provided
- EXN exempted equipment justification inadequate
- SEN separate-effects qualification justification inadequate
- QI qualification information being developed
- RPS equipment relocation or replacement schedule provided

As noted in Section 4, these deficiencies do not necessarily mean that the equipment is unqualified. However, the deficiencies are cause for concern and require further case-by-case evaluation. The staff has determined that an acceptable basis to exempt equipment from qualification, in whole or part, can be established provided the following can be established and verified by the licensee:

- Equipment does not perform essential safety functions in the harsh environment, and equipment failure in the harsh environment will not impact safety-related functions or mislead an operator.
- (2a) Equipment performs its function before its exposure to the harsh environment, and the adequacy for the time margin provided is adequately justified, and
- (2b) Subsequent failure of the equipment as a result of the harsh environment does not degrade other safety functions or mislead the operator.
- (3) The safety-related function can be accomplished by some other designated equipment that has been adequately qualified and satisfies the singlefailure criterion.
- (4) Equipment will not be subjected to a harsh environment as a result of the postulated accident.

The licensee is, therefore, required to supplement the information presented by providing resolutions to the deficiencies identified; these resolutions should include a description of the corrective action, schedules for its completion (as applicable), and so forth. The staff will review the licensee's response, when it is submitted, and discuss the resolution in a supplemental report.

It should be noted that in cases where testing is being conducted, a condition may arise which results in a determination by the licensee that the equipment does not satisfy the qualification test requirements. For that equipment, the licensee will be required to provide the proposed corrective action, on a timely basis, to ensure that qualification can be established by June 30, 1982.

4.3 Equipment Considered Acceptable or Conditionally Acceptable

Based on the staff review of the licensee's submittal, the staff identified the equipment in Appendix C as (1) acceptable on the basis that the qualification program adequately enveloped the specific environmental plant parameters, or (2) conditionally acceptable subject to the satisfactory resolution of the staff concern identified in Section 3.7.

For the equipment identified as conditionally acceptable, the staff determined that the licensee did not clearly

- state that an equipment material evaluation was conducted to ensure that no known materials susceptible to degradation because of aging have been used,
- (2) establish an ongoing program to review the plant surveillance and maintenance records in order to identify equipment degradation which may be age related, and/or

(3) propose a maintenance program and replacement schedule for equipment identified in item 1 or equipment that is qualified for less than the life of the plant.

The licensee is, therefore, required to supplement the information presented for equipment in this category before full acceptance of this equipment can be established. The staff will review the licensee's response when it is submitted and discuss the resolution in a supplemental report.

5 DEFERRED REQUIREMENTS

IEB 79-01B, Supplement 3 has relaxed the time constraints for the submission of the information associated with cold shutdown equipment and TMI lessonslearned modifications. The staff has required that this information be provided by February 1, 1981. The staff will provide a supplemental safety evaluation addressing these concerns.

6 CONCLUSIONS

The staff has determined that the licensee's listing of safety-related systems and associated electrical equipment whose ability to function in a harsh environment following an accident is required to mitigate a LOCA or HELB is complete and acceptable, except as noted in Section 3 of this report. The staff has also determined that the environmental service conditions to be met by the electrical equipment in the harsh accident environment are appropriate, except as noted in Section 3 of this report. Outstanding information identified in Section 3 should be provided within 90 days of receipt of this SER.

The staff has reviewed the qualification of safet, related electrical equipment to the extent defined by this SER and, other than the Limitorque motor operators discussed in Section 4.1 of this SER, has found no outstanding items which would require immediate corrective action to ensure the safety of plant operation. However, the staff has determined that many items of safety-related electrical equipment identified by the licensee for this review do not have adequate documentation to ensure that they are capable of withstanding the harsh environmental service conditions. This review was based on a comparison of the qualification values with the specified environmental values required by the design, which were provided in the licensee's summary sheets.

Subsection 4.2 identified deficiencies that must be resolved to establish the qualification of the equipment; the staff requires that the information lacking in this category be provided within 90 days of receipt of this SER. Within this period, the licensee should either provide documentation of the missing qualification information which demonstrates that such equipment meets the DOR guidelines or NUREG-0588 or commit to a corrective action (requalification, replacement, relocation, and so forth) consistent with the requirements to establish qualification by June 30, 1982. If the latter option is chosen, the licensee must provide justification for operation until such corrective action is complete.

Subsection 4.3 identified acceptance and conditional acceptance based on noted deficiencies. Where additional information is required, the licensee should

respond within 90 days of receipt of this SER by providing assurance that these concerns will be satisfactorily resolved by June 30, 1982.

The staff issued to the licensee Sections 3 and 4 of this report and requested, under the provisions of 10 CFR 50.54(f), that the licensee review the deficiencies enumerated and the ramifications thereof to determine whether safe operation of the facility would be impacted in consideration of the deficiencies. The licensee has completed a preliminary review of the identified deficiencies and has determined that, after due consideration of the deficiencies and their ramifications, continued safe operation would not be adversely affected.

Based on these considerations, the staff concludes that conformance with the above requirements and satisfactory completion of the corrective actions by June 30, 1982 will ensure compliance with the Commission Memorandum and Order of May 23, 1980. The staff further concludes that there is reasonable assurance of continued safe operation of this facility pending completion of these corrective actions. This conclusion is based on the following:

- that there are no outstanding items which would require immediate corrective action to assure safety of plant operation
- (2) some of the items found deficient have been or are being replaced or relocated, thus improving the facility's capability to function following a LOCA or HELB
- (3) the harsh environmental conditions for which this equipment must be qualified result from low-probability events; events which might reasonably be anticipated during this very limited period would lead to less demanding service conditions for this equipment.

APPENDIX A1

Equipment Requiring Immediate Corrective Action (Category 4.1)

LEGEND:

Designation for Deficiency

- R Radiation
- T Temperature
- QT Qualification time
- RT Required time
- P Pressure
- H Humidity
- CS Chemical spray
- A Material aging evaluation, replacement schedule, ongoing equipment surveillance
- S Submergence
- M Margin
- I HELB evaluation outside containment not completed
- QM Qualification method
- RPN Equipment relocation or replacement, adequate schedule not provided
- EXN Exempted equipment justification inadequate
- SEN Separate effects qualification justification inadequate
- QI Qualification information being developed
- RPS Equipment relocation or replacement schedule provided

Equipment Description	Manufacturer	Plant ID No.	Deficiency	
Motor Operator	Limitorque	DH-V-4A	R,A,RPN	
Motor Operator	Limitorque	DH-V-4B	R,A,RPN	
Motor Operator	Limitorque	DH-V-5A	R,A,RPN	
Motor Operator	Limitorque	DH-V-5B	R,A,RPN	
Motor Operator	Limitorque	AH-V-1B	CS,R,A,RPN	
Motor Operator	Limitorque	AH-V-1C	CS,R,A,RPN	

^TAcceptable justification for interim operation provided and, therefore, no immediate corrective action is required. These components are listed in this appendix only because the licensee identified them in an LER.

Equipment Description	Manufacturer	Plant ID No.	Deficiency
Pressure Tran er	Faxboro	SP6A-PT2	CS,A
Pressure Transmitter	Foxboro	SP6B-PT1	CS,A
Pressure Transmitter	Foxboro	SP6P - PT2	CS,A
Limit Switch	NAMCO	LSA/MSV-6	T,P,H,A,EXN
Limit Switch	NAMCO	LSB/MSV-6	T,P,H,A,EXN
Limit Switch	NAMCO	LSB/MSV-13A	T,P,H,A,EXN
Limit Switch	NAMCO	33/MSV-13A	T,P,H,A,EXN
Solenoid Valve	ASCO	SV/MSV-13A	T,P,H,A,EXN
Solenoid Valve	ASCO	SV/MSV-13B	T,P,H,A,EXN
Limit Switch	NAMCO	LSA/MSV-13B	T,P,H,A,EXN
Limit Switch	NAMCO	LSB/MSV-13B	T,P,H,A,EXN
Motor	Westinghouse	EF-P2A	QT,T,P,H,A
Motor	Westinghouse	EF-P2B	QT,T,P,H,A
Motor Operator	Limitorque	EF-V-1A	T,A
Motor Operator	Limitorque	EF-V-1B	T,A
Motor Operator	Limitorque	EF-V-2A	T,A
Motor Operator	Limitorque	EF-V-28	T,A
Pneumatic Converter	Bailey	EF-V-30A/Cont.	QT,T,P,H,R,A,RPN
Pneumatic Converter	Bailey	EFV-30B/Cont.	QT,T,P,H,R,A,RPN
Motor Operator	Limitorque	FW-V-5A	T,A
Motor Operator	Limitorque	FW-V-58	T,A
Motor Operator	Limitorque	FW-V-92A	T,A
Motor Operator	Limitorque	FW-V-928	T,A

APPENDIX B

Equipment Requiring Additional Information and/or Corrective Action (Category 4.2)

LEGEND:

Designation for Deficiency

- R Radiation
- T Temperature
- QT Qualification time
- RT Required time
- P Pressure
- H Humidity
- CS Chemical spray
- A Material aging evaluation, replacement schedule, ongoing equipment surveillance
- S Submergence
- M Margin
- I HELB evaluation outside containment not completed
- QM Qualification method
- RPN Equipment relocation or replacement, adequate schedule not provided
- EXN Exempted equipment justification inadequate
- SEN Separate effects qualification justification inadequate
- QI Qualification information being developed
- RPS Equipment relocation or replacement schedule provided

Equipment Description		Manufacturer	Plant ID No.	Deficiency	
Pressure	Switch	Static-O-Ring	PS-600	QT,CS,R,A,EXN,QM	
Pressure	Switch	Static-O-Ring	PS-601	QT,CS,R,A,EXN,QM	
Pressure	Switch	Static-O-Ring	PS-602	QT,CS,R,A,EXN,QM	
Pressure	Switch	Static-O-Ring	PS-603	QT,CS,R,A,EXN,QM	
Pressure	Switch	Static-O-Ring	PS-604	QT,CS,R,A,EXN,QM	
Pressure	Switch	Static-O-Ring	PS-605	QT,CS,R,A,EXN,QM	
Pressure	Switch	Static-O-Ring	PS-606	QT,CS,R,A,EXN,QM	
Pressure	Switch	Static-O-Ring	PS-607	QT,CS,R,A,EXN,QM	
Pressure	Transmitter	Foxboro	SP6A-PT1	CS,A	

Equipment Description	Manufacturer	Plant ID No.	Deficiency
Limit Switch	NAMCO	LSB/MUV-26	R,A
Solenoid Valve	ASCO	SV/MUV-26	R,A,EXN
Pressure Switch	Square D	P\$480A	R,A
Pressure Switch	Square D	P\$480B	R,A
Pressure Switch	Square D	P\$480C	R,A
Motor Operator	Limitorque	MU-V-2A	CS,A,S
Motor Operator	Limitorque	MU-V-2B	CS,A,S
Limit Switch	NAMCO	LSA/MUV-3	R,A
Limit Switch	NAMCO	LSB/MUV-3	R,A
Solenoid Valve	ASCO	SV/MUV-3	R,A,EXN
Solenoid Valve	Ross	SV/MUV-18	R,A
Limit Switch	NAMCO	LSA/MUV-18	R,A
Limit Switch	NAMCO	LSB/MUV-18	R,A
Limit Switch	NAMCO	LSA/MUV-20	R,A
Limit Switch	NAMCO	LSB/MUV-20	R,A
Solenoid Valve	Ross	SV/MUV-20	R,A
Motor Operator	Limitorque	MU-V-25	CS,A
Limit Switch	NAMCO	LSA/MUV-26	R,A
Motor Operator	Limitorque	DH-V-1	CS,A
Motor Operator	Limitorque	DH-V-2	CS,A
Limit Switch	NAMCO	LSA/AHV-1A	R,A
Limit Switch	NAMCO	LSB/AHV-1A	R,A
Solenoid Valve	ASCO	SV/AHV-1A1	R,A,EXN

Equipment Description	Manufacturer	Plant ID No.	Deficiency
Solenoid Valve	ASCO	SV/AHV-1A2	R,A,EXN
Motor Operator	Limitorque	CA-V-1	CS,A
Solenoid Valve	ASCO	SV/CAV-2	R,A,EXN
Limit Switch	NAMCO	LSA/CAV-2	R,A
Limit Switch	NAMCO	LSB/CAV-2	R,A
Motor Operator	Limitorque	CA-V-3	CS,A
Motor Operator	Limitorque	CA-V-4A	CS,A
Motor Operator	Limitorque	CA-V-4B	CS,A
Motor Operator	Limitorque	CA-V-13	CS,A
Limit Switch	Micro Switch	LSA/CAV-189	CS,A
Limit Switch	Micro Switch	LSB/CAV-189	CS,A
Solenoid Valve	ASCO	SV/CAV-189	R,A, EXN
Motor Operator	Limitorque	IC-V-2	CS,A
Solenoid Valve	ASCO	20/ICV-3	R,A, EXN
Limit Switch	NAMCO	33/ICV-3	R,A
Limit Switch	NAMCO	LSB/ICV-3	R,A
Motor Operator	Limitorque	RB-V-7	QT,T,P,H,R,A,RPN
Motor Operator	Limitorque	WDG-V-3	CS,A
Solenoid Valve	ASCO	SV/WDG-V4	R,A
Limit Switch	Micro Switch	LSA/WDG-V4	R,A
Limit Switch	Micro Switch	LSB/WDG-V4	R,A
Motor Operator	Limitorque	WDL-V-303	CS.A

Equipment Description	Manufacturer	Plant ID No.	Deficiency
Limit Switch	NAMCO	LSA/WDLV-304	R,A
Limit Switch	NAMCO	LSB/WDLV-304	R,A
Solenoid Valve	ASCO	SV/WDL-V304	R,A
Limit Switch	NAMCO	LSA/WDL-V534	R,A
Limit Switch	NAMCO	LSB/WDL-V534	R,A
Solenoid Valve	ASCO	SV/WDL-V534	R,A,EXN
Limit Switch	NAMCO	LSA/WDL-V535	R,A
Limit Switch	NAMCO	LSB/WDL-V535	R,A
Solenoid Valve	ASCO	SV/WDL-V535	R,A,EXN
Pressure Transmitter	Rosemount	RC3A-PT1	CS,R,A,EXN
Pressure Transmitter	Rosemount	RC3A-PT2	CS,R,A,EXN
Pressure Transmitter	Rosemount	%C3B-PT1	CS, R, A, EXN
Pressure Transmitter	Rosemount	RC3B-PT2	CS, R, A, EXN
Temp. Transmitter	Rosemount	RC4A-TE2	CS, A, EXN
Temp. Transmitter	Rosemount	RC4A-TE3	CS, A, EXN
Temp. Transmitter	Rosemount	RC4B-TE2	CS,A,EXN
Temp. Transmitter	Rosemount	RC4B-TE3	CS,A,EXN
Pressure Switch	Static-O-Ring	PS-672	R_A
Pressure Switch	Static-O-Ring	PS-673	R,A
Pressure Switch	Static-O-Ring	PS-674	R,A
Pressure Switch	Static-O-Ring	PS-675	R,A,EXN
Pressure Switch	Square D	PS-283	R,A
Pressure Switch	Square D	PS-284	R,A
Pressure Switch	Square D	PS-286	R,A
Pressure Switch	Square D	PS-287	R,A

Equipment Description	Manufacturer	Plant ID No.	Deficiency
Pressure Switch	Square D	PS-289	R,A
Pressure Switch	Square D	PS-290	R,A
Pressure Transmitter	Foxboro	RC3A-PT3	CS,A
Pressure Transmitter	Foxboro	RC3A-PT4	CS,A
Pressure Transmitter	Foxboro	RC3B-PT3	CS,A
Fan Motor	GE	AH-E-1A	CS,A
Fan Motor	GE	AH-E-18	CS,A
Fan Motor	GE	AH-E-1C	CS,A
Motor Operator	Limitorque	CF-V-1A	CS, R, A, EXN
Motor Operator	Limitorque	CF = V=18	CS,R,A,EXN
Motor Operator	Limitorque	CF-V-2A	CS,M,A
Motor Operator	Limitorque	CF-V-28	CS,M,A
Motor Operator	Limitorque	CF-V-3A	CS,A
Motor Operator	Limitorque	CF-V-3B	CS,A
Limit Switch	Micro Swtich	LSA/CFV-19A	R,A
Limit Switch	Micro Swtich	LSB/CFV-19A	R,A
Limit Switch	Micro Swtich	LSA/CFV-19B	R,A
Limit Switch	Micro Swtich	LSA/CFV-19B	R,A
Solenoid Valve	ASCO	20/CF-V19A	R,A
Solenoid Valve	ASCO	20/CF-V19B	R,A
Limit Switch	Micro Switch	LSA/CFV-20A	R,A
Limit Switch	Micro Switch	LSB/CFV-20A	R,A
Limit Switch	Micro Switch	LSA/CFV-20B	R,A
Limit Swtich	Micro Switch	LSB/CFV-20B	R,A
Solenoid Valve	ASCO	SV/CF-V20A	R.A

APPENDIX B (continued)

Equipment	Manufantunan	Direct TO No.	Definiter	
Description	Manufacturer	Plant ID NO.	Deficiency	
Solenoid Valve	ASCO	SV/CF-V20B	R,A	
Motor Operator	Limitorque	NS-V-35	CS,R,A	
Level Transmitter	Bailey Meter	SP1A-LT2	CS,A,S	
Level Transmitter	Bailey Meter	SP1B-LT2	CS,A,S	
Level Transmitter	Bailey Meter	SP1A-LT4	CS,A,S	
Level Transmitter	Bailey Meter	SP1B-LT4	CS,A,S	
Level Transmitter	Bailey Meter	RC1-LT1	CS,A	
Level Transmitter	Bailey Meter	RC1-LT2	CS,A	
Level Transmitter	Bailey Meter	RC1-LT3	CS,A	
Temp. Transmitter	Rosemount	RUSA-TE1	CS,A,EXN	
Temp. Transmitter	Rosemount	RC5A-TE2	CS,A,EXN	
Temp. Transmitter	Rosemount	RC5A-TE3	CS,A,EXN	
Temp. Transmitter	Rosemount	RC5A-TE4	CS,A,EXN	
Temp. Transmitter	Rosemount	RC5B-TE1	CS,A,EXN	
Temp. Transmitter	Rosemount	RC5B-TE2	CS,A,EXN	
Temp. Transmitter	Rosemount	RC5B-TE3	CS,A,EXN	
Temp. Transmitter	Rosemount	RC5B-TE4	CS,A,EXN	
Terminal Block	States Co.	Various Model No. NT	CS,R,A	
Electrical Penetration Assembly	GE	Various Model No. F01	CS,A,EXN	
Instrument Cable	Anaconda	Various	CS,A	
Power & Control Cable	Kerite	Various	CS,A	
Valve Control Center	ITE, Gould	1A-ES-VLV CC	QT,T,P,H,R,A	
Valve Control Center	ITE, Gould	18-ES-VLV CC	QT,T,P,H,R,A	
Valve Control Center	ITE, Gould	1C-ES-VLV CC	QT,T,P,H,R,A	

Equipment Description	Manufacturer	Plant ID No.	Deficiency	
Conax Connectors	Conax	Rosemount Connectors PL-14-B2	QT,T,P,H,CS,R,A	
Conax Connectors	Conax	Bailey Connectors TG-14-2	CS,R,A	
Conax Connectors	Conax	Bailey Connectors PL-16-B4	CS,R,A	
Solenoid	ASCO	SV/EF-V-8A	T,P,H,A,EXN	
Solenoid	ASCO	SV/EF-V-88	T,P,H,A,EXN	
Solenoid	ASCO	SV/EF-V-8C	T,P,H,A,EXN	
Diff. Press. Transmitter	Barton	FI-S-77	QT,T,P,H,R,A	
Diff. Press Transmitter	Barton	FI-S-78	QT,T,P,H,R,A	
Diff. Press Transmitter	Barton	FI-79	QT,T,P,H,R,A	
Solenoid Valve	ASCO	SV3 & SV4 FW-V-16A	T,P,H,A,EXN	
Solenoid Valve	ASCO	SV3 & SV4 FW-V-168	î,P,H,A,EXN	
Solenoid ∀alve	ASCO	SV3 & SV4 FW-V-17A	T,P,H,A,EXN	
Solenoid Valve	ASCO	SV1 & SV2 FW-V-17B	Г,Р,Н,А	
Solenoid Valve	ASCO	SV3 & SV4 FW-V-178	T,P,H,A,EXN	

APPENDIX C

Equipment Considered Acceptable or Conditionally Acceptable (Category 4.3)

LEGEND:

Designation for Deficiency

- R Radiation
- T Temperature
- QT Qualification time
- RT Required time
- P Pressure
- H Humidity
- CS Chemical spray
- A Material aging evaluation, replacement schedule, ongoing equipment surveillance
- S Submergence
- M Margin
- I HELB evaluation outside containment not completed
- QM Qualification method
- RPN Equipment relocation or replacement, adequate schedule not provided
- EXN Exempted equipment justification inadequate
- SEN Separate effects qualification justification inadequate
- QI Qualification information being developed
- RPS Equipment relocation or replacement schedule provided

Equipment Description	Manufacturer	Plant ID No.	Deficiency
Pump Motor	Westinghouse	MU-PIA	A
Pump Motor	Westinghouse	MU-P16	А
Pump Motor	Westinghouse	MU-P1C	А
Pump Motor	GE	MU-P2A	А
Pump Motor	GE	MU-P2B	A
Pump Motor	GE	MU-P2C	A
Pump Motor	GE	MU-P3A	А
Pump Motor	32	MU-P3B	А
Pump Motor	GE	MU-P3C	A

Equipment Description	Manufacturer	Plant ID No.	Deficiency
Motor Operator	Limitorque	MU-∀-36	A
Motor Operator	Limitorque	MU-V-37	A
Pump Motor	Westinghouse	MU-P4A	A
Pump Motor	Westinghouse	MU-P4B	A
Pump Motor	Westinghouse	MU-P4C	A
Motor Operator	Limitorque	MU-V-12	A
Motor Operator	Limitorque	MU-V-14A	A
Motor Operator	Limitorque	MU-V-148	A
Motor Operator	Limitorque	MU-V-16A	A
Motor Operator	Limitorque	MU~V-168	A
Motor Operator	Limitorque	MU-V-16C	A
Motor Operator	Limitorque	MU-V-16D	A
Pump Motor	Westinghouse	DH- PIA	A
Pump Motor	Westinghouse	DH-P1B	A
Motor Operator	Limitorque	DH-V-3	А
Motor Operator	Limitorque	DH-V-6A	A
Motor Operator	Limitorque	DH-V-6B	A
Motor Operator	Limitorque	DH-V-7A	A
Motor Operator	Limitorque	DH-V-7B	A
Pump Motor	Westinghouse	DC-P1A	А
Pump Motor	Westinghouse	DC-P1B	A
Solenoid Valve	ASCO	SV/DCV-19A	A
Limit Switch	NAMCO	LSA/DCV-19A	A
Limit Switch	NAMCO	LSB/DCV-19A	A
Solenoid Valve	ASCO	SV/DCV-198	A

Equipment Description	Manufacturer	Plant ID No.	Deficiency
Lisit Swtich	NAMCO	LSA/DCV-19B	A
Limit Swtich	NAMCO	LSB/DCV-19B	A
Limit Swtich	NAMCO	LSA/AHV-1D	A
Limit Swtich	NAMCO	LSB/AHV-1D	А
Solenoid Valve	ASCO	SV/AHV-101	A
Solenoid Valve	ASCO	SV/AHV-102	А
Limit Switch	NAMCO	LSA/CAV-5A	A
Limit Switch	NAMCO	LSB/CAV-5A	A
Solenoid Valve	ASCO	SV/CAV-5A	A
Limit Switch	NAMCO	LSA/CAV-5B	А
Limit Switch	NAMCO	LSB/CAV-58	A
Solenoid Valve	ASCO	SV/CAV-5B	A
Limit Switch	NAMCO	LSA/CMV-1	A
Limit Switch	NAMCO	LSB/CMV-1	A
Solenoid Valve	ASCO	SV/CMV-1	А
Limit Switch	NAMCO	LSA/CMV-2	А
Limit Switch	NAMCO	LSB/CMV-2	А
Solenoid Valve	ASCO	SV/CMV-2	А
Limit Switch	NAMCO	LSA/CMV-3	А
Limit Switch	NAMCO	LSB/CMV-3	А
Solenoid Valve	ASCO	SV/CMV-3	А
Limit Switch	NAMCO	LSA/CMV-4	А
Limit Switch	NAMCO	LSB/CMV-4	А
Solenoid Valve	ASCO	SV/CMV-4	A
Solenoid Valve	ASCO	20/ICV-4	A

Équipment Description	Manufacturer	Plant ID No.	Deficiency
Limit Switch	NAMCO	33/ICV-4	A
Limit Switch	NAMCO	LSB/ICV-4	A
Limit Switch	NAMCO	33/ICV-6	A
Limit Switch	NAMCO	LSB/ICV-6	A
Solenoid Valve	ASCO	SV/ICV-6	A
Motor Operator	Limitorque	RB-V-2	A
Pump Motor	Westinghouse	BS-P1A	A
Pump Motor	Westinghouse	BS-P1B	A
Motor Operator	Limitorque	BS-V-1A	A
Motor Operator	Limitorque	BS-V-1B	A
Motor Operator	Limitorque	BS-V-2A	A
Motor Operator	Limitorque	BS-V-2B	A
Motro Operator	Limitorque	BS-V-3A	A
Motor Operator	Limitorque	BS-V-3B	A
Neutron Detector	Westinghouse	NI-5	Exempt
Neutron Detector	Westinghouse	NI-6	Exempt
Neutron Detector	Westinghouse	NI-7	Exempt
Neutron Detector	Westinghouse	NI-8	Exempt
Pressure Transmitter	Foxboro	PT-282	A
Pressure Transmitter	Foxboro	PT-285	A
Pressure Transmitter	Foxboro	PT-288	A
Motor Operator	Limitorque	RR-V-3A	A
Motor Operator	Limitorque	RR-V-3B	А
Motor Operator	Limitorque	RR-V-3C	А
Motor Operator	Limitorque	RR-V-4A	A
Motor Operator	Limitorque	RR-V-4B	A

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Equipment Description	Manufacturer	Plant ID No.	Deficiency
Motor Operator	Limitorque	RR-V-4C	A
Motor Operator	Limitorque	RR-V-4D	A
Pump Motor	Westinghouse	NS-P1A	A
Pump Motor	Westinghouse	NS-P1B	A
Pump Motor	Westinghouse	NS-P1C	А
Motor Operator	Limitorque	NS-V-4	А
Motor Operator	Limitorque	NS-V-15	A
Motor Operator	Limitorque	NS-V-32	А
Limit Switch	NAMCO	LSA/NSV-52A	А
Limit Switch	NAMCO	LSB/NSV-52A	А
Solenoid Valve	ASCO	SV/NSV-52A	A
Limit Switch	NAMCO	LSA/NSV-52B	A
Limit Switch	NAMCO	LSB/NSV-52B	А
Solenoid Valve	ASCO	SV/NSV-52B	A
Limit Switch	NAMCO	LSA/NSV-52C	4
Limit Switch	NAMCO	LSB/NSV-52C	A
Solenoid Valve	ASCO	SV/NSV-52C	А
Limit Switch	NAMCO	LSA/NSV-53A	А
Limit Switch	NAMCO	LSB/NSV-53A	А
Solenoid Valve	ASCO	SV/NSV-53A	А
Limit Switch	NAMCO	LSA/NSV-53B	А
Limit Switch	NAMCO	LSB/NSV-53B	А
Solenoid Valve	ASCO	SV/NSV-53B	А
Limit Switch	NAMCO	LSA/NSV-53C	А
Limit Switch	NAMCO	LSB/NSV-53C	A

Description	Manufacturer	Plant ID No.	Deficiency
Solenoid Valve	ASCO	SV/NSV-53C	А
Heat Shrink Tubing	Raychem	None; Model No. Thermofit	A
Solenoid Valve	ASCO	SV1 & SV2 FW-V-16A	А
Solenoid Valve	ASCO	SV1 & SV2 FW-V-16B	A
Solenoid Valve	ASCO	SV1 & SV2	A

APPENDIX D

Safety-Related Systems List¹ (Category 4.4)

Function	System
Emergency Reactor Shutdown	Reactor Protection Engineered Safeguards Actuation Make-up and Purification
Containment Isolation	Make-up and Purification Feedwater Decay Heat Removal Sampling Main Feedwater Main Steam Reactor Building Spray Reactor Building Isolation ²
Reactor Core Cooling	Make-up and Purfication (HPI) Decay Heat Removal (LPI) Core Flood Tanks
Containment Heat Removal	Reactor Building Spray Reactor Building Air Recirculation and Cooling Containment Sump Recirculation
Core Residual Heat Removal	Decay Heat Removal Decay Heat Closed Loop Cooling Nuclear Services Closed Cooling Water Nuclear Services River Water Main Steam Main Feedwater Emergency Feedwater Power Operated Relief Valves ³

¹The NRC staff recognized that there are differences in nomenclature of systems because of plant vintage and engineering design; consequently, some systems performing identical or similar functions may have different names. In those instances it was necessary to verify the system(s) function with the responsible IE regional reviewer and/or the licensee. ²Includes other isolation valves in systems not listed above.

³To be covered as part of TMI-2 lessons learned.

Function	System	
Prevention of Significant Release of Radioactive Material to Environment	Reactor Building Spray (Iodine Removal) Containment Combustible Gas Control ³ Containment Radiation Monitoring Containment Radiation Sampling ³	
Supporting Systems	Emergency Power Safety Equipment Area Ventilation Control Room Habitability (HVAC)	