

PARTIAL REVIEW

Equipment Evaluation Report By the  
Office of Nuclear Reactor Regulation

For Yankee Atomic Electric Company  
Yankee Rowe Nuclear Power Station  
Docket No. 50-29

Environmental Qualification of Safety-Related  
Electrical Equipment

Dated: February 11, 1981

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(PARTIAL REVIEW)  
EQUIPMENT EVALUATION REPORT BY THE  
OFFICE OF NUCLEAR REACTOR REGULATION  
  
FOR YANKEE ATOMIC ELECTRIC COMPANY  
YANKEE ROWE NUCLEAR POWER STATION  
DOCKET No. 50-29  
ENVIRONMENTAL QUALIFICATION OF SAFETY-RELATED  
ELECTRICAL EQUIPMENT

### 3.0 STAFF EVALUATION

The staff's evaluation of the licensee's responses was accomplished by performing an on-site inspection of selected Class IE equipment and by examining the licensee's report for completeness and acceptability. The criteria described in the DOR Guidelines and NUREG-0588, in part, were used as a basis for the staff's evaluation of the adequacy of the Licensee's qualification program.

During the week of July 15, 1980, NRC and FRC representatives visited the Yankee Rowe plant site, inspected safety-related systems and equipment, identified and tabulated safety-related components through discussions with plant personnel, and conducted a general review of YAEC's submittal of June 5, 1980. The inspection verified proper installation of equipment, overall interface integrity, and manufacturers nameplate data. The manufacturer and model number from the nameplate data was compared to information given in the Licensee's submittal.

The following evaluation incorporates the YAEC submittal and the Franklin Research Center technical evaluation report (TER).

### 3.1 COMPLETENESS OF SAFETY-RELATED EQUIPMENT

In accordance with the DOR guidelines, the licensee was directed to establish a list of systems and display instrumentation needed to mitigate the consequences of a LOCA or HELB, inside or outside containment, and reach safe shutdown. The lists of safety-related systems and display instrumentation were developed from a review of plant safety analyses and emergency procedures. The display instrumentation selected includes parameters to monitor overall plant performance as well as to monitor performance of the systems on the list. The systems list was established on the basis of the functions that must be performed for mitigation of the consequences of a LOCA or HELB without regard to location of equipment relative to a potentially hostile environment. The staff has determined and verified that the systems considered by the licensee 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. In addition to the concerns identified below the staff's system review has not included those equipment items discussed in section 5.0 of this report. The systems and instrumentation list is contained in Appendix D.

The licensee submitted an extensive list of safety-related electrical equipment. This list was evaluated and identical components within a plant area exposed to the same environment were grouped; 25 item types

Equipment submergence has also been addressed where the possibility exists that flooding of equipment may result from high energy line breaks (HELB).

### 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
LOCA	245	33	100%
MSLB	360	33	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 temperature (service condition) of 245 F for LOCA does not satisfy the above requirement. This value was used only for equipment affected by LOCA conditions. A saturation temperature corresponding to the pressure profile (278 F peak temperature at 33 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.

The licensee's minimum HELB temperature profile for qualification purposes includes a margin at least as large as would result from the staff's recommendation and was used for only that equipment subjected to a HELB condition. Therefore we conclude that the specified temperature profile is acceptable.

#### 3.4 TEMPERATURE, PRESSURE AND HUMIDITY CONDITIONS OUTSIDE CONTAINMENT

The licensee has not provided the temperature, pressure, and humidity values associated with a HELB outside containment. The licensee has considered the containment to be basically the only "harsh" area in the plant, with all other areas (such as the Turbine, Primary Auxiliary, and Service Buildings) considered as "mild" areas. The licensee has used ambient temperature conditions in some areas outside containment. The staff considers saturation temperature at the peak pressure resulting from a HELB as the minimum level for acceptance. The licensee should update his 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 saturated conditions or propose corrective action.

#### 3.5 SUBMERGENCE

The maximum submergence levels have been established and assessed by the licensee. The staff assumed for this review, unless, otherwise noted, that the methodology employed by the licensee is in accordance with the appropriate criteria as established by the Commission Memorandum and Order (CLI-80-21), dated May 23, 1980. The licensee's value for maximum submergence is 11.1 feet (elev. 1057 feet). The licensee has not identified any equipment items below this level.

### 3.6 Chemical Spray

The methodology and guidance for developing chemical spray criteria was provided by the DOR Guidelines and NUREG-0588. The Yankee Rowe plant is not equipped with a containment spray system, therefore, the chemical spray parameter is not applicable for this review.

### 3.7 AGING

The DOR Guidelines, section 7, does not require a qualified life to be established for all safety related electrical equipment, however, the following actions are required:

1. Detailed comparison of existing equipment to the materials identified in Appendix C of the DOR guidelines. The first supplement to IEB-79-01B requires the licensees to utilize the table and identify any additional materials as a 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.

For this review the staff requires that the licensee submit supplemental information to verify and identify their degree of conformance to the above requirements. The response should be inclusive of all the equipment identified as required to maintain their functional operability in harsh environments.

The staff will review the licensee's response, when submitted, and report its evaluation in a supplemental report.

### 3.8 RADIATION (INSIDE AND OUTSIDE CONTAINMENT)

The licensee has provided values for radiation levels postulated to exist following a LOCA event. The application and methodology employed to determine these values have been presented to the licensee as part of the NRC staff criteria contained in the DOR Guidelines, NUREG-0588 and the guidance provided in IEB-79-01B, Supplement 2. The staff's review assessed that the values to which equipment was qualified, enveloped the requirements identified by the licensee. The values established by the licensee were obtained through Engineering Analysis, YAEC No. YR-ADH-80-6, "Radiation dose calculations," (Re: Licensee REF. 2.22). RAD levels were stated on the applicable equipment data sheets. The radiation service condition provided by the licensee is the order of  $2.4 \times 10^6$  to  $2 \times 10^7$  RADS and is lower than provided in the DOR Guidelines for the Gamma and Beta radiation. The licensee is requested to either provide justification



for using lower service conditions or use the service conditions provided in the DOR Guidelines for both Gamma and Beta radiation. If the former option is chosen then the analysis including the basis and assumptions used in the analysis and a sample calculation should be provided. A required value outside containment of  $2.3 \times 10^6$  RADS has been used by the licensee to specify limiting radiation levels within the RHR pump room of the auxiliary building. This value appears to consider the radiation levels influenced by the source term methodology associated with Post-LOCA recirculation fluid lines and is therefore acceptable.

#### 4.0 QUALIFICATION OF EQUIPMENT

The following subsections are the staff's assessment, based on the licensee's submittal, and the Franklin TER 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 conditioned only on the satisfactory resolution of the staff's concern identified in Section 3.7.

The NRC staff in its assessment of the licensee's submittal and the TER did not review the methodology employed to determine the values established by the licensee. However, in reviewing the TER a determination was made by the staff as to the stated conditions presented by the licensee. Additionally, the detailed review of supporting documentation referenced by the licensee (e.g., test reports) has been completed by FRC.



The environmental qualification data bank to be established by the staff will provide the means to cross reference each supporting document to the referencing licensee.

Where supporting documents were 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. An appendix for each subsection is attached which provides a list of equipment which requires additional information and/or corrective action. 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. However, they are cause for concern and may require further case-by-case evaluations.

#### 4.1 EQUIPMENT REQUIRING IMMEDIATE CORRECTIVE ACTION

#### 4.2 EQUIPMENT REQUIRING ADDITIONAL INFORMATION AND/OR CORRECTIVE ACTION

Appendix B identifies equipment in this category, including the tabulation of their deficiencies. The deficiencies are noted by a letter relating to the legend, identified below, indicating that insufficient information has been provided for the qualification parameter or condition.

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.

As noted in Section 4.0, these deficiencies do not necessarily mean that the equipment is unqualified. However, they are cause for concern and require further case-by-case evaluations. 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 licensees:

- (1) Equipment does not provide essential safety functions in the harsh environment and failure of it in the harsh environment will not impact safety related functions or mislead an operator.
- (2a) Equipment performs its function prior to 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 single failure criteria.
- (4) Equipment not subjected to a harsh environment as a result of the postulated accident.

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

It should be noted that where testing is presently 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 their proposed corrective action, on a timely basis, to assure that qualification can be established by June 30, 1982.

#### 4.3 EQUIPMENT CONSIDERED ACCEPTABLE OR CONDITIONALLY ACCEPTABLE

Based on the staff's review of the licensee's submittal and the TER 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:

- (1) state that a material evaluation on their equipment was conducted to assure that no known materials susceptible to degradation due to aging have been used in their equipment.
- (2) establish an ongoing program to review the surveillance and maintenance records of their plant 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 submitted, and report on the resolution in a supplemental report.

#### 5.0 DEFERRED REQUIREMENTS

IE Bulletin 79-01B, Supplement 3 has relaxed the time constraints for the submission of the information associated with cold shutdown equipment and TMI Lessons Learned modifications. To permit a uniform program schedule the SEP plant reviews have been amended. The staff required that this information be provided by February 1, 1981. The staff will provide a supplemental evaluation addressing these concerns.

APPENDIX B

List of Equipment in Section 4.2, Equipment Requiring  
Additional Information And/Or Corrective Action

NOTE: (R) Licensee has committed  
to replace equipment

LEGEND:  
DESIGNATION FOR Deficiency

- |   |  |
|---|--|
| R - Radiation   | M - Margin   |
| T - Temperature   | I - HELB Evaluation Outside<br>Containment Not Completed                     |
| QT - Qualification Time   | QM - Qualification Method  |
| RT - Required Time  | RPN - Equipment Relocation or Replacement,<br>Adequate Schedule Not Provided |
| P - Pressure  | EXN - Exempted Equipment Justification<br>Inadequate                         |
| H - Humidity  | SEN - Separate Effects Qualification<br>Justification Inadequate             |
| CS - Chemical Spray   | QI - Qualification Information Being<br>Developed                            |
| A - Material Aging Evaluation,<br>Replacement schedule, Ongoing<br>Equipment Surveillance | RPS - Equipment Relocation or Replacement<br>Schedule Provided               |
| S - Submergence   |  |

TER Item No.	Equipment Description	Manufacturer	Model/ Type	Deficiency
AR1	Motor	Westinghouse	72Y51238	QI,QM,A
SI9	MOV	Limitorque	SMA-2	QI,A
SC1	MOV	Limitorque	SMA-1	QI,A
J18	Terminal Block	Westinghouse	542247	QI,A,QM,R
J19	Electrical Penetration	Chicago Bridge & Iron	UNK	QI,A,QM,QT,R
FW4	Transmitter	Fischer & Porter	13D-2495- JBNS	QI,QM,QT,M
(R) HV1	Solenoid	Atkomatic	32861-CV	QI
MC10	Thermocouples	Thermo-Electric	UNK	QI,A
SI6	Pressure Switch	Static-O-Ring	7828-100	QI,R,M
MC4	Transmitter	Rosemount	1152	RPN

APPENDIX C

List of Equipment in Section 4.3  
Equipment Considered acceptable or Conditionally Acceptable

Legend: A - Material Aging Evaluation

TER Item No.	Equipment Description	Manufacturer	Model/ Type	Deficiency
AM2	Transmitter	Rosemount	1153A	A
AM3	Transmitter	Rosemount	1153A	A
J23	Cables	Rockbestos	UNK	A
J24	Cable	Rockbestos	FIREWALL III	A
J25	Cable	Continental Wire & Cable	UNK	A
MC3	Transmitter	Rosemount	1153GA9	A
PR1	Transmitter	Rosemount	1153GA9	A
J20	Cables	General Cable	UNK	A
J32	Cable	Collyer Cable	UNK	A
J33	Cable	Okonite	UNK	A
J34	Cable	General Cable	UNK	A
SI8A	MOV	Limitorque	SMB-1	A
SI8B	MOV	Limitorque	SMB-00	A
SI8C	MOV	Limitorque	SMB-000	A
J17	Cable	Manhattan	UNK	
J21	Cable	Simplex Wire & Cable	UNK	
J22	Cable	Simplex Wire & Cable	UNK	



## APPENDIX D

Plant Safety-Related Systems  
and Display Instrumentation

## A. Safe Shutdown Systems

System	Term	Function
Reactor Protection Trip System*	S	Trips reactor when predetermined setpoints are exceeded
Reactor Coolant System	L	Transfers heat from the reactor vessel to the steam generator.
Charging System*	L	Provides reactor makeup water during cooldown/long-term chemical control.
Shutdown Cooling System†	L	Long-term heat removal capability
Auxiliary Feedwater System*	I/L	Provides steam generator makeup water for decay heat removal and plant cooldown.
Component Cooling System	L	Removes heat from the RHR heat exchangers/transfers to the service water system.
Service Water System	L	Transfers heat from the component cooling heat exchangers to the river, lake, or other heat sink.
Radiation Monitoring System*	L	Self-explanatory
Sampling System*	L	Self-explanatory
Emergency Diesel AC Power System*	S/I	Emergency electrical power source for vital equipment.
125-V dc Power Supply Systems*	L	Provides backup power to certain vital equipment and circuits.
Emergency Power Distribution System*	L	Electrical power the various electrical equipment.

\*Systems which function both for safe shutdown and also for accident mitigation.

†System required for cold shutdown only.

(S) Short Term	Less than 24 hours
(I) Intermediate Term	Up to 30 days
(L) Long Term	30 days plus

APPENDIX D, Continued

B. Accident Mitigating Systems

System	Term	Function
Safeguards Activation System	S	Initiates safeguards system operations
Containment Isolation System	L	Isolates containment penetrations in case of accidents.
Steam Line Isolation System	S	Automatically isolate the main steam lines in case of line break.
Feedwater Isolation System	S	Isolates feedwater lines in case of line break.
Safety Injection and Accumulators	S/I	Provides cooling water to the core post-accident.
Recirculating Fan System/Hydrogen Control System	I	Post-LOCA containment heat removal and hydrogen control.
Pressurizer Pressure Relief	I	Power operated relief valves for relief of RCS pressure.

APPENDIX D, Continued

C. Accident Mitigation and Safety Shutdown Instruments  
(LOCA, MSLB, FWLB)

Pressurizer Level	I
Pressurizer Pressure	L
RCS Pressure	L
RCS Temperature	L
Containment Pressure**	I
Steam Generator Level	L
Sump Level**	L
Auxiliary Feedwater System Flow	L
DWST	I
SI Tank Level**	S

\*\*Instruments required only for accident mitigation purposes.

of equipment were identified and assessed by the staff. In reviewing the licensee's Oct. 31, 1980 submittal certain inconsistencies or apparent omissions have been identified by FRC which should be resolved. (Re: Appendix D of the TER).

### 3.2 Service Conditions

The Commission Memorandum and Order (CLI-80-21), dated May 23, 1980 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. These documents provide the option of establishing a bounding pressure and temperature condition based on plant specific analysis identified in the licensees 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 Yankee Rowe relative to the temperature, pressure, and the containment spray caustics, have been performed in accordance with the above stated requirements for this review the staff 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 environmental conditions are enveloped by the large break LOCA environmental conditions. The staff assumed and requires that the licensee verifies, that the containment spray system is not subjected to a disabling single component failure and therefore satisfies the DOR Guideline requirements of Section 4.2.1.