

3.10 QUALIFICATION OF SEISMIC CATEGORY I INSTRUMENTATION AND ELECTRICAL EQUIPMENT

The dynamic qualification criteria applicable to the seismic Category I instruments, electrical equipment, and their supports are provided in this section. The methods and procedures used to qualify them are also discussed. Seismic Category I instruments, equipment, and supporting structures are identified in Table 3.2-1.

3.10.1 DYNAMIC QUALIFICATION CRITERIA

The seismic Category I instruments and electrical equipment are designed to withstand the effects of the SSE defined in Section 3.7 and the hydrodynamic loads discussed in Section 3.9 and Appendix 3A.4 through 3A.7 without functional impairment.

The qualification discussion covered in the following sections is generally divided into two types of equipment: NSSS equipment and non-NSSS equipment.

The following design criteria and qualification procedures for NSSS equipment include the effects of both seismic and hydrodynamic loads. The non-NSSS equipment qualification discussions include only seismic design criteria and procedures. Refer to Appendix 3A.6.8 and 3A.7.1.7 for non-NSSS equipment subjected to hydrodynamic loads. Appendix 3A.6.7 and 3A.7.1.6 contain further discussion of NSSS equipment qualification.

There is a Risk Informed Categorization and Treatment Program at Limerick which is based on 10 CFR 50.69. This regulation provides an alternative approach for establishing requirements for treatment of SSCs using a risk-informed method of categorizing SSCs according to their safety significance. Specifically, for SSCs categorized as low safety significant, alternate treatment requirements may be implemented rather than treatments chosen by the seismic qualification program. Refer to Section 13.5.5 for further information.

3.10.1.1 Dynamic Loading Design Criteria (NSSS Equipment)

The criterion used in the design and subsequent qualification of all Class 1E instruments and electrical equipment supplied by GE is as follows: "The Class 1E equipment shall be capable of performing all safety-related functions during (1) normal plant operation, (2) anticipated transients, (3) DBAs, and (4) postaccident operation while being subjected to, and after the cessation of, the accelerations resulting from the SSE and hydrodynamic loads at the point of attachment of the equipment to the building or supporting structure."

The criteria for each of the devices used in the Class 1E systems depend on the use in a given system; for example, a relay in one system may have as its safety function to de-energize and open its contacts within a certain time, while in another system it must energize and close its contacts. Since GE supplies many devices for many applications, the approach taken was to test the device in the worst case configuration. In this way, the capability of protective action initiation and the proper operation of safety-related circuits is assured.

From the basic input ground motion data, a series of response curves at various structure elevations is developed after the building layout is completed. Standard requirement levels that meet or exceed the maximum expected unique plant information are included in the purchase specifications for seismic Category I equipment. Suppliers of equipment such as batteries and racks, instrument racks, control consoles, etc., are required to submit test data, operating

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experience and/or calculations to substantiate that their components, systems, etc will not suffer loss of function during or after dynamic loadings. The magnitude and frequency content of the loadings which each component will experience are determined by its specific location within the plant. All Class 1E equipment will be evaluated for the capability of performing its safety function during and after dynamic loading combinations given in Table 3.9-6.

3.10.1.2 Dynamic Loading Design Criteria (Non-NSSS Equipment)

The seismic Category I instruments and electrical equipment is the equipment that is designed to maintain its functional capability and/or to maintain the pressure boundary integrity during and after an SSE and at least 5 OBEs. (Refer to Appendix 3A.6.8 for criteria for equipment subjected to hydrodynamic loads.)

Seismic Category I equipment is designed to withstand the more severe of the following load combinations:

a. OBE Conditions:

The load combinations include gravity loads and operation loads (or LOCA loads, if applicable) including associated temperatures and pressures, combined with the seismic loading of an OBE.

Stresses in the structural steel portions may be increased to 125% of the allowable working stress limits accepted as good practice as set forth in the appropriate design standards; that is, AISC Manual of Steel Construction, ASME B&PV Code, ANSI B31.1 and B31.7 codes for pressure piping, or other equivalent industrial codes. The resulting deflections do not prevent continuous normal operation of the equipment during and after the seismic disturbance.

b. SSE Conditions:

The load combinations include gravity loads and operating loads (or LOCA loads, if applicable) including associated temperatures and pressures combined with the seismic loading of the SSE. Stresses in the structural portions may be increased to 150% of code allowable working stress limits but are not to exceed $0.9 F_y$ in bending, $0.85 F_y$ for tension, and $0.5 F_y$ in shear, where (F_y) equals the material yield stress at the design temperature. The resulting deflections will not prevent the operation of the equipment during and after the seismic disturbance.

The performance requirements of the seismic Category I items and their respective supports are structural as well as functional. Where applicable, the structural requirements are in accordance with AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings," adopted February 12, 1969, or similar codes applicable for other construction materials.

The structural requirements for electrical and instrumentation equipment and systems that are required to maintain pressure boundary integrity are in accordance with the ASME Section III.

3.10.2 METHODS AND PROCEDURES FOR QUALIFYING ELECTRICAL EQUIPMENT AND INSTRUMENTATION

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Seismic Category I instruments and electrical equipment are qualified according to the criteria discussed in Section 3.10.1 by the methods and procedures described in this section. The qualification methods and procedures are discussed in two parts: NSSS and non-NSSS equipment; both of which were re-assessed to SRP 3.10 Seismic Qualification Review Team (SQRT) requirements including IEEE 344-1975, and Reg. Guides 1.10 and 1.92. The SQRT re-assessment concluded that the seismic and dynamic qualification program meets the intent of IEEE 344-1975 and Reg. Guides 1.100 and 1.92.

3.10.2.1 Methods and Procedures for Qualifying NSSS Electrical Equipment and Instruments (Excluding Motors and Valve-Mounted Equipment)

3.10.2.1.1 Methods of Showing NSSS Equipment Compliance with IEEE 344 (1975) and Regulatory Guide 1.100

Originally, NSSS equipment were qualified to IEEE 344 (1971), which was the plant commitment, and as such did not demonstrate compliance with Regulatory Guide 1.100 and other SQRT criteria. However, a re-assessment of all NSSS equipment qualifications to NEDE-24788 "SQRT Technical Approach" ensures an adequate degree of equipment conformance to IEEE 344-1975 and Regulatory Guides 1.100 and 1.92 requirements which represents an acceptable basis for qualifying the equipment.

GE-supplied Class 1E equipment meets the requirement that the dynamic qualification should demonstrate the capability to perform the required function during and after the dynamic event. Both analysis and testing were used, but most equipment was tested. Analysis was primarily used to determine the adequacy of mechanical strength (mounting bolts, etc) after operating capability was established by testing.

a. Analysis

GE-supplied Class 1E equipment performing primarily a mechanical safety function (pressure boundary devices, etc) was analyzed, since the passive nature of its critical safety role usually made testing impractical. Analytical methods sanctioned by IEEE 344 (1971) were used in such cases and were re-evaluated to IEEE 334 (1975) criteria with satisfactory results. Table 3.10-1 shows which items were qualified by analysis.

b. Testing

GE-supplied Class 1E equipment having primarily an active electrical safety function was tested in compliance with IEEE 344 (1971), section 3.2 and were re-evaluated to IEEE 344 (1975) criteria with satisfactory results.

Available documentation verifies that the dynamic qualification of GE-supplied Class 1E equipment is in accordance with the requirements of IEEE 344 (1975).

3.10.2.1.2 Testing Procedures for Qualifying NSSS Electrical Equipment and Instruments (Excluding Motors and Valve-Mounted Equipment)

The test procedure requires that the device be mounted on the table of the vibration machine in a manner similar to how it is normally installed. The device is tested in the operating states as if it were performing its Class 1E functions and these states are monitored before, during, and after the test to assure proper function and absence of spurious function. In the example of a relay, both

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energized and de-energized states and normally open and normally closed contact configurations are tested if the relay is used in those configurations in its Class 1E functions.

The dynamic excitation is a single-frequency test in which the applied vibration is a sinusoidal table motion at a fixed peak acceleration and a discrete frequency at any given time. The vibratory excitation is applied in three orthogonal axes individually, with the axes chosen as those coincident with the most probable mounting configuration.

The first step is to search for resonances in each axis. This is done because resonances cause amplification of the input vibration and are the most likely cause of malfunction. The resonance search is usually run at low acceleration levels (0.2 g) to avoid damaging the test sample in case a severe resonance is encountered. The resonance search is run in accordance with IEEE 344; if the device is large enough, the vibrations are monitored by accelerometers placed at critical locations, from which resonances are determined by comparing the acceleration level with that at the table of the vibration machine. If the devices are either too small for an accelerometer, have their critical parts in an inaccessible location, or have critical parts that would be adversely affected by the mounting of an accelerometer, the vibrations are monitored at the closest location.

Following the frequency scan and resonance determination, the devices are tested to determine their malfunction limit. This test is a necessary adjunct to the assembly test, as shown later. The malfunction limit test is run at each resonant frequency as determined by the frequency scan. In this test, the acceleration level is gradually increased until either the device malfunctions or the limit of the vibration machine is reached. If no resonances are detected (as is usually the case), the device is considered to be rigid (all parts move in unison), and the malfunction limit is therefore independent of frequency. To achieve maximum acceleration from the vibration machine, rigid devices are malfunction tested at the upper test frequency because that allows the maximum acceleration to be obtained from deflection-limited machines.

The summary of the tests on the devices used in Class 1E applications given in Table 3.10-1 includes the "qualification" limit for each device tested.

The above procedures are required of purchased devices, as well as of those made by GE. Vendor test results are reviewed, and, if unacceptable, the tests are repeated either by GE or by the vendor. If the vendor tests are adequate, the device is considered qualified to the limits of the test.

3.10.2.1.3 Qualification of Valve-Mounted Equipment

The piping analysis establishes the response spectra, the power spectral density function or time history characteristics, and develops horizontal and vertical accelerations for the pipe-mounted equipment. Class 1E MOV actuators are qualified in accordance with IEEE 382 (1972).

The SRV, including the electrical components mounted on the valve, is subjected to a dynamic test. This testing is described in Sections 3.9.2.2a.2.14 and 3.9.3.1.13.

3.10.2.1.4 Qualification of NSSS Motors

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The seismic qualification of the ECCS motors is discussed in Section 3.9.2.2a.2.7 in conjunction with the ECCS pump and motor assembly. The seismic qualification of the SLCS pump motor is discussed in Section 3.9.2.2a.2.10 in conjunction with the SLC pump motor assembly.

3.10.2.2 Methods and Procedures for Qualifying Non-NSSS Instruments and Electrical Equipment

In regard to compliance with Regulatory Guide 1.100, the analysis and testing for the seismic qualification of non-NSSS Class 1E instruments and electrical equipment required to function during and after an SSE are in compliance with IEEE 344 (1971) for components purchased before issuance of IEEE 344 (1975) and are in compliance with IEEE 344 (1975) for components purchased after its issuance. In addition, all non-NSSS instruments and controls were re-evaluated to IEEE 344 (1975) and Reg. Guide 1.100 requirements (SQRT requirements) and found satisfactory.

Pipe-mounted instrumentation is qualified by analysis and/or testing to the acceleration levels allowed for piping systems. These levels include gravity and operation loading, as well as loading that is due to seismic excitation. Passive instruments that must only maintain mechanical and pressure boundary integrity are tested to the acceleration levels of the response spectra for the area in which they are to be installed.

Seismic Category I equipment is shown to be capable of withstanding the horizontal and vertical accelerations of five OBEs and one SSE by one of the following methods: dynamic analysis; dynamic testing; or a combination of dynamic analysis and testing. (Refer to Appendix 3A.7.1.7 for qualification methods for equipment subjected to hydrodynamic loads.)

3.10.2.2.1 Dynamic Analysis

For the analysis, equipment is idealized as a system of lumped masses and springs for which frequencies and mode shapes are determined for vibration in the vertical direction and two orthogonal horizontal directions. For each direction of vibration, the spectral accelerations per mode are obtained from the appropriate spectrum response curve corresponding to the location and damping of the equipment. Seismic loading in terms of inertia forces, moments, and shears is determined for each direction using the spectrum response method summing the absolute values per mode. If the orientation of the equipment is not designated, the horizontal seismic loading is taken as the maximum loading (worst case) obtained using each horizontal direction of vibration and the appropriate horizontal spectrum response curve(s). If the frequencies of all equipment modes (determined by either analysis or testing) are greater than the frequency of the appropriate spectrum response curve at which the acceleration is constant in the rigid (high frequency) range, the seismic loading consists of the static loading corresponding to that acceleration level.

If the equipment damping is unknown, the following values shall be used:

- a. OBE - ½% damping
- b. SSE - 1% damping

In lieu of determining the vibrational frequencies of equipment, the seismic loading of structurally simple equipment (that can be adequately represented as a single mass and spring) consists of a static load corresponding to 1.5 times the peak acceleration of the appropriate response spectrum curve. Total seismic loading consists of both the vertical seismic loading and the maximum horizontal seismic loading applied to the equipment simultaneously.

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Where equipment must meet IEEE 344 (1975), the dynamic analysis is in accordance with section 5 of IEEE 344 (1975). Equipment qualified by analysis to IEEE 344 (1971) were re-evaluated to IEEE 344 (1975) criteria and found satisfactory.

3.10.2.2.2 Dynamic Tests

In lieu of performing a dynamic analysis, seismic adequacy is established by providing dynamic test or previous dynamic environmental (performance) data that demonstrate that the equipment meets the seismic design criteria as defined in this section. The previous data include at least one of the following:

- a. Recent test data acquired from dynamic tests of equipment
- b. Dynamic test data from previously tested comparable equipment
- c. Performance data from equipment that, during normal operating conditions, is subjected to dynamic loads equal to or greater than those defined in this section

3.10.3 METHODS AND PROCEDURES OF ANALYSIS OR TESTING OF SUPPORTS OF ELECTRICAL EQUIPMENT AND INSTRUMENTATION

3.10.3.1 Dynamic Analysis Testing Procedures And Restraint Measures For NSSS Equipment Supports (Other Than Motors And Valve-Mounted Equipment)

Some GE-supplied Class 1E devices are qualified by analysis only (Table 3.10-1). Analysis is used for passive mechanical devices and sometimes is used in combination with testing for larger assemblies containing safeguard devices. For instance, a test may be run to determine if there are natural frequencies in the equipment within the critical frequency range. If the equipment is determined to be free of natural frequencies, then it is assumed to be rigid and a static analysis is performed. If the equipment has natural frequencies in the critical frequency range, then calculations of transmissibility are performed and responses to varying input accelerations are determined to see whether Class 1E devices mounted in the assembly would operate without malfunctioning. In general, the testing of Class 1E equipment is accomplished using the following procedure.

Assemblies (i.e., control panels) containing devices that have had dynamic loading malfunction limits established are tested by mounting the assembly on the table of a vibration machine, in a manner similar to that in which it is to be mounted when in use, and vibration testing the assembly by running a low level resonance search. As with the devices, the assemblies are tested in the three major orthogonal axes. The resonance search is run in the same manner as described for devices. If resonances are present, the transmissibility between the input and the locations of each Class 1E device is determined by measuring the accelerations at each device location and calculating the magnification between it and the input. Once known, the transmissibilities could be used analytically to determine the response at any Class 1E device location for any given input. It is assumed that the transmissibilities are linear as a function of acceleration, even though they actually decrease as acceleration is increased; therefore, this is a conservative assumption. As long as the device input accelerations are determined to be below their malfunction limits, the assembly is considered a rigid body with a transmissibility equal to 1, so that a device mounted on it is limited directly by the assembly input acceleration.

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Since control panels and racks constitute the majority of seismic Category I electric assemblies supplied by GE, the qualification testing of these is discussed in more detail. There are basically four generic panel types: vertical board; instrument rack; local rack; and NEMA-12 enclosures. One or more of each type is tested using the above procedures.

Figures 3.10-1 through 3.10-4 illustrate the four basic panel types referenced above and show typical accelerometer locations. The status of the dynamic tests on the Class 1E panels supplied by GE for LGS is summarized in Table 3.10-2.

The full acceleration level tests described above disclose that most of the panel types have more than adequate mechanical strength and that a given panel design acceptability is just a function of its amplification factor and the malfunction levels of the devices mounted in it. Subsequent panels are therefore tested at lower acceleration levels, and the transmissibilities are measured to the various devices as described above. By dividing the devices' malfunction levels by the panel transmissibility between the device and the panel input, the panel qualification level can be determined. Several high level tests have been run on selected generic panel designs to assure the conservatism in using the transmissibility analysis described.

3.10.3.2 Non-NSSS Equipment Supports

Analyses or tests are performed for all supports of electrical equipment and instruments, such as switchgear, battery racks, instrument racks, control consoles, cabinets, and panels to ensure their structural capability to withstand seismic excitation.

The following bases are used in the seismic design and analysis of seismic Category I instrument tubing supports:

- a. All instrument tubing supports are qualified by analysis, using the response spectrum method described in Section 3.10.2.2.1.
- b. Analysis and design of seismic restraint measures for instrument tubing supports are based on combined limiting values for static load, span length, and computed seismic response.
- c. Maximum stress is limited to 90% of minimum yield stress.
- d. The seismic Category I instrument tubing systems are supported so that the allowable stresses permitted by ASME Section III are not exceeded when the tubing is subjected to the loads specified in Section 3.9 for Class 2 and 3 piping.

For field-mounted instruments, the following are applicable. (Refer to Appendix 3A.7.1.7 for instrument supports subjected to hydrodynamic loads.)

- a. The mounting structures for seismic Category I instruments have a fundamental frequency of 33 Hz or higher (rigid range), which corresponds to the maximum floor acceleration. Therefore the ZPA for the installation is applicable.
- b. The stress level in the mounting structure does not exceed the material allowable stress when the mounting structure is subjected to the maximum acceleration level for its location, in combination with other design loads.

3.10.4 OPERATING LICENSE REVIEW

3.10.4.1 NSSS Equipment

3.10.4.1.1 NSSS Control and Electrical Equipment (Other Than Motors and Valve-Mounted Equipment)

The qualification test plans and results for safety-related panels and control equipment within the NSSS scope of supply are maintained as follows:

- a. Proprietary documents will be maintained by GE in a centrally located, readily auditable, permanent file.
- b. Nonproprietary summary documents will be maintained by the licensee in a centrally located, readily auditable, permanent file.

If equipment fails to pass the tests, it is rejected. In some cases, equipment that fails one test is modified or repaired to meet the performance requirements and is retested. If the retested equipment passes the latter test, it may be used in a Class 1E application.

Table 3.10-1 lists the NSSS control devices by item number and vendor. The table also gives the corresponding acceleration levels for the devices used in Class 1E applications. The acceleration level shown in the right columns of Table 3.10-1 is the acceleration at which either the device malfunctioned or the limit of the vibration machine was reached.

3.10.4.1.2 NSSS Motors

Qualification test results for the ECCS motors are discussed in Section 3.9.2.2a.2.7 in conjunction with the ECCS pump and motor assembly. Qualification test results for the SLCS motor are discussed in Section 3.9.2.2a.2.10 in conjunction with the SLCS pump motor assembly.

3.10.4.1.3 Valve-Mounted Equipment

The SRVs, including the electrical components mounted on the valves, are subjected to dynamic tests. The results of these tests are discussed in Sections 3.9.2.2a.2.14 and 3.9.3.1.13, and are maintained in the same manner as discussed in Section 3.10.4.1.1.

3.10.4.2 Non-NSSS Equipment

A list of dynamic qualification packages for non-NSSS safety-related instruments and electrical equipment is given in Table 3.10-3. The qualification packages will be maintained by the licensee in a centrally located, readily auditable permanent file.

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Table 3.10-1

NSSS ESSENTIAL ELECTRICAL COMPONENTS AND INSTRUMENTS (CLASS 1E) *

DESCRIPTION				SEISMIC QUALIFICATION			
ITEM NO.	NAME	VENDOR	QUANTITY	OTHERS OF SAME TYPE IN SIMILAR AREA	SEISMIC QUALIFICATION ^(g)		
					F-B	S-S	V
<u>System Title - Reactor</u>							
B11-D193	Power range detector ⁽²⁾	GE	43	-	4.5	4.5	4.5
<u>System Title - Nuclear Boiler</u>							
B21-K613	Power supply	Elma Eng.	2	-	7.0	7.0	5.5
B21-N004	Temp. element & thermowell ⁽¹⁾	PYCO	14	-			
B21-N010	Temp. element	PYCO	19	N011-N014,N016,N017	5.0	5.0	5.0
B21-N027	Level transmitter	Rosemount	1	-	10.0	5.8	1.8
B21-N040	Temp. element (thermowell)	Rosemount	3	N057	S.A.	S.A.	S.A.
B21-N064	Temp. element & thermowell ⁽¹⁾	Calif. Alloy	1	-			
B21-N075	Press. transmitter	Rosemount	4	-	10.0	5.8	1.8
B21-N076	Press. transmitter	Rosemount	4	-	10.0	5.8	1.8
B21-N078	Press. transmitter	Rosemount	24	N090,N094	10.0	5.8	1.8
B21-N080	Level transmitter	Rosemount	38	N081,N085-N089, N091,N095,N097	10.0	5.8	1.8
B21-N402	Level transmitter	Rosemount	4	-	9.4	9.4	7.2
B21-N403	Press. transmitter	Rosemount	4	-	9.4	9.4	7.2
B21-N600	Temp. switch	Riley Inst.	18	N603,N605-N608	4.5	4.5	4.5
B21-N675	Press. indicator switch	Rosemount	86	N676,N678-N681,N684, N686-N695,N693A,E,B,F, N697	15.0	15.0	15.0
B21-N693	Trip unit	Rosemount	4	N698	15.0	15.0	15.0
B21-R005	Diff. press. indicator	Barton	1	-	5.0	10.0	10.0
<u>System Title - Reactor Recirculation</u>							
B32-N014	Flow transmitter	Rosemount	8	N024	10.0	5.8	1.8
B32-N015	Diff. press. transmitter	Rosemount	2	-	10.0	5.8	1.8
B32-N023	Temp. element	Rosemount	2	-	S.A.	S.A.	S.A.

* NOTE: Table for historical purposes only.

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Table 3.10-1 (Cont'd)

NSSS ESSENTIAL ELECTRICAL COMPONENTS AND INSTRUMENTS (CLASS 1E) *

DESCRIPTION				SEISMIC QUALIFICATION			
ITEM NO.	NAME	VENDOR	QUANTITY	OTHERS OF SAME TYPE IN SIMILAR AREA	SEISMIC QUALIFICATION ^(g)		
					F-B	S-S	V
<u>System Title - CRD HCU</u>							
C11-N012	Level transmitter	Gould	4	-	5.0	5.0	10.2
C11-N013	Level switch	Magnetrol	4	-	4.6	4.6	3.6
C11-N013 (E-H)	Level switch	Magnetrol	4	-	4.1	4.1	9.5
C11-N601	Level indicator switch	Rosemount	4	-	15.0	15.0	15.0
<u>System Title - Feedwater Control</u>							
C32-N003	Diff. press. transmitter	Rosemount	8	N004	10.0	5.8	1.8
C32-N005	Press. transmitter	Rosemount	2	N008	10.0	5.8	1.8
C32-N017	Level transmitter	Statham	1	-	10.0	5.8	1.8
<u>System Title - Standby Liquid</u>							
C41-N003	Temp. switch	Fenwell	1	-	S.A.	S.A.	S.A.
C41-N004	Press. transmitter	Rosemount	3	-	9.4	9.4	7.2
C41-N006	Temp. element ⁽¹⁾	Fenwell	1	-	-	-	-
C41-N010	Level transmitter	Gould	6	-	5.0	5.0	10.2
C41-N610	Level switch	GE	2	-	2.4	2.4	4.0
<u>System Title - Neutron Monitoring</u>							
C51-K002	Voltage preamplifier	GE	8	-	≥10.0	≥10.0	≥10.0
C51-K601	Intermediate range monitor	GE	8	-	8.5	8.5	8.5
C51-K605	Power range neutron monitor	GE	1	-	3.8	3.8	3.0
C51-N002	Detector	GE	8	-	S.A.	S.A.	S.A.
<u>System Title - Remote Shutdown</u>							
C61-K001	Sq Root converter	GE	1	-	9.0	9.0	13.0
C61-K002	Dc-ac inverter		1	-	5.0	3.0	8.5
C61-K005	Power supply	GE	2	K010	2.5	2.5	2.5
C61-N001	Flow transmitter	Rosemount	2	N010	10.0	5.8	1.8
C61-N006	Press. transmitter	Rosemount	1	-	10.0	5.8	1.8
C61-R001	Flow indicator controller	Bailey Meter	1	-	7.5	6.5	2.0

* NOTE: Table for historical purposes only.

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Table 3.10-1 (Cont'd)

NSSS ESSENTIAL ELECTRICAL COMPONENTS AND INSTRUMENTS (CLASS 1E) *

DESCRIPTION				SEISMIC QUALIFICATION			
ITEM NO.	NAME	VENDOR	QUANTITY	OTHERS OF SAME TYPE IN SIMILAR AREA	SEISMIC QUALIFICATION ⁽³⁾ (g)		
					F-B	S-S	V
<u>System Title - RPS</u>							
C71-N050	Press. transmitter	Rosemount	4	-	10.0	5.8	1.8
C71-N052	Press. transmitter	Rosemount	4	-	10.0	5.8	1.8
<u>System Title - PRMS</u>							
D12-K603	Radiation Monitor	GE	4	-	3.0	3.0	3.0
D12-K609	Indicator/trip unit	GE	8	K610	3.0	3.0	3.0
D12-N006	Detector (steam line)	GE	4	-	8.0	8.0	8.0
D12-N010	Detector (sensor & converter)	GE	8	N011	15.0	15.0	15.0
<u>System Title - RHR</u>							
E11-N001	Cond. element	Balsbaugh	2	-	S.A.	S.A.	S.A.
E11-N004	Temp. element	Calif Alloy	7	N005,N027,N032	S.A.	S.A.	S.A.
E11-N008	Level transmitter	Barton	2	-	9.1	10.6	6.0
E11-N009	Temp. element	Calif Alloy	6	N029,N030	5.0	5.0	5.0
E11-N013	Flow transmitter	Rosemount	7	N015, N060	10.0	5.8	1.8
E11-N026	Press. transmitter	Rosemount	7	N028,N053	10.0	5.8	1.8
E11-N052	Transmitter	Rosemount	8	N258	10.0	5.8	1.8
E11-N055	Press. transmitter	Rosemount	8	N056	10.0	5.8	1.8
E11-N057	Press. transmitter	Rosemount	1	-	10.0	5.8	1.8
E11-N600	Temp. switch	Riley Inst.	4	N601	4.5	4.5	4.5
E11-N652	Trip unit	Rosemount	29	N655, N656	15.0	15.0	15.0
<u>System Title - Core Spray</u>							
E21-K601	Dc-ac inverter		4	-	15.0	10.0	7.0
E21-K602	Power supply	Elma Eng.	8	-	7.0	7.0	5.5
E21-K605	Ac/dc power supply	GE/Sola	1	-	5.5	5.5	5.5
E21-N003	Flow transmitter	Rosemount	2	-	3.0	3.0	3.0
E21-N051	Diff. press. transmitter	Rosemount	2	-	10.0	5.8	1.8
E21-N054	Press. transmitter	Rosemount	2	-	10.0	5.8	1.8
E21-N055	Press. transmitter	Rosemount	4	-	10.0	5.8	1.8
E21-N056	Diff. press. transmitter	Rosemount	1	-	3.0	3.0	3.0
E21-N651	Trip unit	Rosemount	12	N655	15.0	15.0	15.0

* NOTE: Table for historical purposes only

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Table 3.10-1 (Cont'd)

NSSS ESSENTIAL ELECTRICAL COMPONENTS AND INSTRUMENTS (CLASS 1E) *

DESCRIPTION				SEISMIC QUALIFICATION			
ITEM NO.	NAME	VENDOR	QUANTITY	OTHERS OF SAME TYPE IN SIMILAR AREA	SEISMIC QUALIFICATION ⁽³⁾		
					F-B	S-S	V
<u>System Title - MSIV-LCS</u>							
E32-K601	Power supply	Elma Eng.	2	K602	7.0	7.0	5.5
E32-N006	Flow meter	S&K Inst.	4	-	3.55	3.55	4.87
E32-N050	Press. transmitter	Rosemount	8	N055,N058,N060,N061	10.0	5.8	1.8
E32-N051	Press. transmitter	Rosemount	5	N056	10.0	5.8	1.8
E32-N053	Flow transmitter	S&K Inst.	4	-	3.0	3.0	2.0
E32-N054	Diff. press. transmitter	Rosemount	2	N059	3.0	3.0	3.0
E32-N600	Time delay switch	Eagle Signal	13	N601,N602,N604	2.5	2.5	2.5
E32-N650	Press. indicator switch	Rosemount	20	N651,N653-N661	15.0	15.0	15.0
E32-R601	Millivolt to current converter	Bailey Meter	4	-	8.0	8.0	8.0
E32-R653	Flow indicator	GE	14	R654-R656, R658-R661	18.0	18.0	7.0
<u>System Title - HPCI</u>							
E41-K600	Power supply	GE	1	-	5.5	5.5	5.5
E41-K601	Sq root converter	Bailey Meter	1	-	9.0	9.0	13.0
E41-K603	Dc-ac inverter		1	-	15.0	10.0	7.0
E41-N008	Flow transmitter	Rosemount	1	-	10.0	5.8	1.8
E41-N013	Press. transmitter	Rosemount	2	N052	10.0	5.8	1.8
E41-N014	Level switch	Robert Shaw	1	-	4.6	4.6	3.6
E41-N024	Temp. element	Calif. Alloy/ PYCO	15	N025,N028-N030	5.0	5.0	5.0
E41-N050	Press. transmitter	Rosemount	5	N055B, F, N056	10.0	5.8	1.8
E41-N051	Flow transmitter	Rosemount	3	N061	10.0	5.8	1.8
E41-N053	Press. transmitter	Rosemount	1	-	10.0	5.8	1.8
E41-N055 (D,H)	Press. transmitter	Rosemount	2	-	10.0	5.8	1.8
E41-N057	Press. transmitter	Rosemount	6	N058	10.0	5.8	1.8
E41-N062	Level transmitter	Gould	2	-	7.0	7.0	8.0
E41-N600	Temp. switch	Riley Inst.	13	N601-N603	4.5	4.5	4.5
E41-N650	Trip unit	Rosemount	23	N651-N653, N655-N662	15.0	15.0	15.0
E41-R600	Flow indicator controller	Bailey Meter	1	-	7.5	6.5	20.0
<u>System Title - RCIC</u>							
E51-K600	Power supply	GE	1	-	2.5	2.5	2.5
E51-K601	Sq root convertor	Bailey Meter	1	-	9.0	9.0	13.0
E51-K603	Dc-ac inverter		1	-	15.0	10.0	7.0
E51-N003	Flow transmitter	Rosemount	4	N051,N057	10.0	5.8	1.8
E51-N007	Press. transmitter	Rosemount	1	-	10.0	5.8	1.8

* NOTE: Table for historical purposes only

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Table 3.10-1 (Cont'd) *

DESCRIPTION				SEISMIC QUALIFICATION			
ITEM NO.	NAME	VENDOR	QUANTITY	OTHERS OF SAME TYPE IN SIMILAR AREA	SEISMIC QUALIFICATION ⁽³⁾ (g)		
					F-B	S-S	V
E51-N010	Level switch	Magnetrol	1	-	4.6	4.6	3.6
E51-N011	Temp. element	Calif. Alloy	15	N021-N023,N025	5.0	5.0	5.0
E51-N035	Level transmitter	Rosemount	2	-	3.0	3.0	3.0
E51-N050	Press. transmitter	Rosemount	2	N052	3.0	3.0	3.0
E51-N053	Press. transmitter	Rosemount	1	-	10.0	5.8	1.8
E51-N055	Press. transmitter	Rosemount	10	N056,N058	10.0	5.8	1.8
E51-N600	Temp. switch	Riley Inst.	11	N603	4.5	4.5	4.5
E51-N650	Press. indicator switch	Rosemount	21	N635,N651-N653,N655-N660	15.0	15.0	15.0
E51-R600	Flow indicator controller	Bailey Meter	1	-	7.5	6.5	20.0
<u>System Title - RWCU</u>							
G31-K602	Sq root converter	Bailey Meter	6	K603,K605	9.0	9.0	13.0
G31-K604	Five input summer	Bailey Meter	2	-	9.0	9.0	13.0
G31-N012	Flow transmitter	Rosemount	6	N036,N041	10.0	5.8	1.8
G31-N016	Temp. element	Calif Alloy	36	N022,N023	5.0	5.0	5.0
G31-N600	Temp. switch	Riley Inst.	24	N602	4.5	4.5	4.5
G31-N603	Diff. flow switch	Bailey Meter	2	-	7.5	8.5	20.0
G31-R616	Cycle timer	Eagle Signal	2	-	2.5	2.5	2.5
<hr/> ⁽¹⁾ Classified as pressure integrity or passive instrument ⁽²⁾ Qualified by analysis ⁽³⁾ S.A. = Stress Analysis							

* NOTE: Table for historical purposes only

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Table 3.10-2

SEISMIC QUALIFICATION TEST SUMMARY
NSSS SAFEGUARD CONTROL PANELS, LOCAL PANELS, AND RACKS

<u>PANEL</u>	<u>DESCRIPTION</u>	<u>TYPE</u>	<u>CLASS 1E EQUIPMENT DESCRIPTION</u>	<u>COMMENTS</u>
H12-P601	Reactor and containment cooling and isolation	Vertical board	Control switches, GE/MAC instruments, recorders	Seismic test complete
H12-P602	Reactor water cleanup and recirculation control	Bench board	Control switches	Qualification by similarity ⁽¹⁾
H12-P603	Reactor control	Bench board	Switches (range, push button, control)	Seismic test complete
H12-P606	Radiation monitor instrument Panel A	Instrument rack	Startup neutron monitoring electronics, radiation monitor trips units	Qualification by similarity
H12-P608	Power range neutron monitor	Instrument rack	APRM electronics, RBM electronics, Two-Out-Of-Four Logic Modules, power supplies, isolators, interface panels	Seismic test complete
H12-P609	Reactor protection system Division 1 & 2 logic	Vertical board	Relays, contactor, temperature monitor, trip units, switches, power supply	Seismic test complete
H12-P611	Reactor protection system Division 3 & 4 logic	Vertical board	Relays, contactor, temperature monitor, trip units, switches, power supply	Qualification by similarity
H12-P613	NSSS process instrument	Vertical board	Relays, trip limits, power supply	Qualification by similarity
H12-P614	NSSS temperature recorder	Vertical board	Relays	Seismic test complete
H12-P617	Division 1 RHR relay	Vertical board	Relays, trip units	Qualification by similarity
H12-P618	Division 2 RHR relay	Vertical board	Relays trip units, switches, power supply	Seismic test complete
H12-P620	HPCI relay	Vertical board	Relays, temperature monitor, switches	Seismic test complete

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Table 3.10-2 (Cont'd)

<u>PANEL</u>	<u>DESCRIPTION</u>	<u>TYPE</u>	<u>CLASS 1E EQUIPMENT DESCRIPTION</u>	<u>COMMENTS</u>
H12-P621	RCIC relay	Vertical board	Relays, temperature monitor, switches	Qualification by similarity
H12-P622	Inboard valve relay	Vertical board	Relays	Qualification by similarity
H12-P623	Outboard valve relay	Vertical board	Relays	Qualification by similarity
H12-P626	ADS	Vertical board	Switches, indicators	Qualification by similarity
H12-P628	Prompt relief trip and ADS Division 1 relay	Vertical board	Relays, control switches	Qualification by similarity
H12-P631	ADS Division 3 relay	Vertical board	Relays, control switches	Qualification by similarity
H12-P633	Radiation monitor instrument Panel B	Instrument rack	Startup neutron monitoring electronics, radiation monitor trip units	Qualification by similarity
H12-P640	Division 3 RHR relay	Vertical board	Control switches, trip units, relays, temp. monitors, power supply	Qualification by similarity
H12-P641	Division 4 RHR relay	Vertical board	Control switches, trip units, temperature monitors, power supply	Qualification by similarity
H12-P647	HPCI	Vertical board	Controller, switches, power supply	Qualification by similarity
H12-P648	RCIC	Vertical board	Switches, power supply	Qualification by similarity
H12-P661	Safeguard systems A,B,C,D	Vertical board	Switches (non-NSSS supply)	Seismic test complete

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Table 3.10-2 (Cont'd)

<u>PANEL</u>	<u>DESCRIPTION</u>	<u>TYPE</u>	<u>CLASS 1E EQUIPMENT DESCRIPTION</u>	<u>COMMENTS</u>
H12-P787	Termination cabinet	Cabinet	Cables	Qualification by similarity
H12-P788	Termination cabinet	Cabinet	Cables	Qualification by similarity
H12-P789	Termination cabinet	Cabinet	Cables	Qualification by similarity
H12-P790	Termination cabinet	Cabinet	Cables	Qualification by similarity
H12-P791	Termination cabinet	2 Bay cabinet	Cables	Qualification by similarity
H12-P792	Termination cabinet	2 bay cabinet	Cables	Qualification by similarity
H12-P793	Termination cabinet	2 bay cabinet	Cables	Qualification by similarity
H23-P001	Core spray system, Panel A	Local panel	Pressure transmitters	Seismic test complete
H23-P002	Reactor water cleanup	Local panel	Pressure transmitters, indicators, temperature control	Seismic test complete
H23-P004	Reactor vessel level & pressure, Panel A	Local panel	Pressure transmitters and indicators, level indicator, switches	Qualification by similarity
H23-P005	Reactor vessel level & pressure, Panel B	Local panel	Pressure transmitters	Qualification by similarity
H23-P006	Recirc pump, Panel A	Local panel	Pressure transmitters	Qualification by similarity
H23-P009	Jet pump, Panel A	Local panel	Pressure transmitters	Seismic test complete
H23-P010	Jet pump, Panel B	Local panel	Pressure transmitters	Qualification by similarity
H23-P014	HPCI system, Panel B	Local panel	Pressure transmitters, indicators	Qualification by similarity
H23-P015	Main steam flow, Panel B	Local panel	Pressure transmitters	Qualification by similarity
H23-P016	HPCI leak detection, Panel A	Local panel	Pressure transmitters	Qualification by similarity
H23-P017	RCIC, Panel A	Local panel	Pressure transmitters	Qualification by similarity
H23-P018	RHR System, Panel A	Local panel	Pressure transmitters	Qualification by similarity

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Table 3.10-2 (Cont'd)

<u>PANEL</u>	<u>DESCRIPTION</u>	<u>TYPE</u>	<u>CLASS 1E EQUIPMENT DESCRIPTION</u>	<u>COMMENTS</u>
H23-P019	CS system, Panel B	Local panel	Pressure transmitters	Qualification by similarity
H23-P022	Recirc pump, Panel B	Local panel	Pressure transmitters	Qualification by similarity
H23-P025	Main steam flow, Panel D	Local panel	Pressure transmitters	Qualification by similarity
H23-P026	Reactor vessel level & pressure, Panel D	Local panel	Pressure transmitters	Qualification by similarity
H23-P027	Reactor vessel level & pressure, Panel C	Local panel	Switches, pressure transmitters	Qualification by similarity
H23-P030	SRM & IRM preamp A-D	NEMA - 12 enclosure	SRM-IRM preamplifiers	Seismic test complete
H23-P031	SRM & IRM preamp A-D	NEMA - 12 enclosure	SRM-IRM preamplifiers	Qualification by similarity
H23-P032	SRM & IRM preamp A-D	NEMA - 12 enclosure	SRM-IRM preamplifiers	Qualification by similarity
H23-P033	SRM & IRM preamp A-D	NEMA - 12 enclosure	SRM-IRM preamplifiers	Qualification by similarity
H23-P034	HPCI system, Panel A	Local panel	Pressure transmitters	Qualification by similarity
H23-P035	RCIC leak detection, Panel A	Local panel	Pressure transmitters	Qualification by similarity
H23-P036	HPCI leak detection, Panel B	Local panel	Pressure transmitters	Qualification by similarity
H23-P037	RCIC system, Panel B	Local panel	Pressure transmitters	Qualification by similarity
H23-P038	RCIC leak detection, Panel B	Local panel	Pressure transmitters	Qualification by similarity
H23-P041	Main steam flow, Panel C	Local panel	Pressure transmitters	Qualification by similarity
H23-P042	Main steam flow, Panel D	Local panel	Pressure transmitters	Qualification by similarity
H23-P073	MSIV LCS Division 1	Local panel	Pressure transmitters	Qualification by similarity
H23-P074	MSIV LCS Division 2	Local panel	Pressure transmitters	Qualification by similarity
H23-P075	RHR A/ADS, Panel A	Local panel	Pressure transmitters, indicators	Qualification by similarity

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Table 3.10-2 (Cont'd)

<u>PANEL</u>	<u>DESCRIPTION</u>	<u>TYPE</u>	<u>CLASS 1E EQUIPMENT DESCRIPTION</u>	<u>COMMENTS</u>
H23-P076	RHR B/ADS, Panel C	Local panel	Pressure transmitters, indicators	Qualification by similarity
H23-P077	RHR C/ADS, Panel A	Local panel	Pressure transmitters, indicators	Qualification by similarity
H23-P078	RHR D/ADS, Panel C	Local panel	Pressure transmitters, indicators	Qualification by similarity
C61-P001	Remote shutdown	Local panel	Switches, square root converter, power supply	Qualification by similarity

⁽¹⁾ Qualification by similarity - Panel is structurally similar and in some cases identical to a panel that was tested.

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Table 3.10-3

DYNAMIC QUALIFICATION TEST SUMMARY
NON-NSSS SAFETY-RELATED INSTRUMENTS AND ELECTRICAL EQUIPMENT

<u>ITEM NUMBER</u>	<u>EQUIPMENT DESCRIPTION</u>	<u>SUPPLIER</u>	<u>DYNAMIC QUALIFICATION PACKAGE NO.</u>
8031-E-7	Medium-voltage metal clad switchgear (4.16 kV)	Brown Boveri	D-14
8031-E-7	4.16 kV ATWS switchgear	Brown Boveri	D-167
8031-E-8B	4 kV Induction motors	GE	D-2 D-3
8031-E-10	Load centers	Brown Boveri	D-15
8031-E-11	480 V motor control centers	Cutler-Hammer	D-12 D-16
8031-E-11	Lighting panels	Cutler-Hammer	D-46
8031-E-13	Batteries and racks	C&D Batteries Div.	D-17 D-143
8031-E-14	250 V dc motor control centers	Westinghouse	D-18
8031-E-16	Dc distribution panels & fuse boxes	B-K Electrical Products Div.	D-13 D-19 D-70
8031-E-17	Battery chargers	C&D Batteries Div.	D-20
8031-E-33D	Heat tracing panels	Thermon	D-26
8031-E-37	Ac power dry-type transformers	Square D	D-45
8031-E-40	Primary containment electrical penetrations	Conax Corp.	D-27
8031-E-51	In-line plug connectors	Litton	D-44

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Table 3.10-3 (Cont'd)

<u>ITEM NUMBER</u>	<u>EQUIPMENT DESCRIPTION</u>	<u>SUPPLIER</u>	<u>DYNAMIC QUALIFICATION PACKAGE NO.</u>
8031-M-66	HVAC control instruments	Various	D-144
8031-M-66	HVAC flow switches	FCI	D-155
8031-M-66	HVAC RTDs	Minco	D-156
8031-M-66	HVAC panel-mounted instruments	Various	D-159
8031-M-66	HVAC humidity transmitter/sensor	American Instruments	D-160
8031-M-66	HVAC solenoid valves	ASCO	D-161
8031-M-66	HVAC flow elements	Annubar	D-163
8031-M-66	HVAC flow element air stations	Air Monitor	D-164
8031-M-66	Duct-mounted RTDs	Minco	D-182
8031-M-66	HVAC ITE time delay relay	Brown Boveri	D-211
8031-M-203	Radiation monitors, consisting of:	General Atomic	
	Item 1: Control room radiation monitors (4 each)		D-196
	Item 2: Control room emergency fresh air radiation monitors (2 each)		D-196
	Item 3: Primary containment post-LOCA radiation monitors (4 each)		D-58
8031-M-203	Single pen strip-chart recorders	General Atomic	D-200

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Table 3.10-3 (Cont'd)

<u>ITEM NUMBER</u>	<u>EQUIPMENT DESCRIPTION</u>	<u>SUPPLIER</u>	<u>DYNAMIC QUALIFICATION PACKAGE NO.</u>
8031-M-203	Radiation monitoring control pen	General Atomic	D-201
8031-M-203	Communication and isolation devices	General Atomic	D-203
8031-M-206	Electronic transmitters	Rosemount	D-1
8031-M-212A	Flow elements venturi	BIF	D-214
8031-M-224	Pressure switches	Mercoird Corp.	D-28 D-49
8031-M-230	Differential pressure instruments	ITT-Barton	D-51 D-52
8031-M-231	Excess flow check valves	Marotta	D-134
8031-M-235	Containment gas sampling and analyzing system	Comsip-Delphi	D-59
8031-M-238	Atmospheric chlorine detectors	Nuclear Logistics Inc.	D-185
8031-M241	Nuclear pressure regulators	Target Rock Corp.	D-72
8031-M-242	Nuclear butterfly control valves	Fisher Controls	D-60
8031-M-243	Quality assured pressure gauges	Dresser Industries	D-32 D-53
8031-M-245	Quality assured solenoid valves	Target Rock Corp.	D-54
8031-M-245C	Solenoid valves	Valcor	D-212
8031-M-250A	Nuclear control valves	Masoneilan	D-56
8031-M-253	Wide range accident monitoring system	General Atomic	D-210

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Table 3.10-3 (Cont'd)

<u>ITEM NUMBER</u>	<u>EQUIPMENT DESCRIPTION</u>	<u>SUPPLIER</u>	<u>DYNAMIC QUALIFICATION PACKAGE NO.</u>
8031-M-263	Suppression pool temperature monitoring system	WestronicsSimmonds-precision	D-178
8031-M-266	Class 1E pressure switches	ITT-Barton	D-180
8031-M-267	Class 1E RTDs	Weed	D-179

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3.11 ENVIRONMENTAL DESIGN OF ELECTRICAL EQUIPMENT

This description provides a summary of the information addressed and substantiated in the separate Environmental Qualification Report (Section 1.1). The EQR identifies and documents the licensee's program for the environmental qualification of safety-related electric equipment installed in the LGS, in accordance with 10CFR50.49.

3.11.1 ENVIRONMENTAL DESIGN CRITERIA FOR ELECTRICAL EQUIPMENT

All safety-related equipment must be capable of performing its safety function and/or remaining in a safe mode under all conditions postulated to occur during its installed life. This requirement is embodied in GDC 1, 2, 4, and 23 of 10CFR50, Appendix A, in Criterion III and Criterion XI of 10CFR50, Appendix B, 10CFR50.55a(h), which incorporates by reference IEEE 279 (1971), "Criteria for Protection Systems for Nuclear Power Generating Stations," and in 10CFR50.49.

The NRC has issued definitive criteria in NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment", which contains the following criteria:

- a. Category I, for plants whose construction permit SERs were issued after July 1, 1974, incorporates and supplements IEEE 323 (1974).
- b. Category II, for plants whose construction permit SERs were issued before July 1, 1974, incorporates and supplements IEEE 323 (1971) unless the operating license applicant's record indicates that IEEE 323 (1974) is to be used, in which case Category I criteria are applicable.

The LGS construction permit SER was issued in June 1974, therefore, NUREG-0588 Category II criteria are applicable.

In February 1980 and June 1982, the NRC requested that the licensee perform a review of their environmental qualification program for safety-related equipment to identify the degree to which the program complied with the regulatory criteria. The EQR has been developed to provide detailed information on the LGS EQ program. The following sections provide a summary of the information contained in the EQR including mild environment qualification.

There is a Risk Informed Categorization and Treatment Program at Limerick which is based on 10 CFR 50.69. This regulation provides an alternative approach for establishing requirements for treatment of SSCs using a risk-informed method of categorizing SSCs according to their safety significance. Specifically, for SSCs categorized as low safety significant, alternate treatment requirements may be implemented rather than treatments chosen by the environmental qualification program. Refer to Section 13.5.5 for further information.

3.11.2 EQUIPMENT REQUIRING ENVIRONMENTAL QUALIFICATION

The list of equipment that is included in the environmental qualification program was established by considering those systems which are required to mitigate the consequences of a LOCA or HELB. This list also includes certain postaccident monitoring equipment. This list specifically includes the equipment 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.

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Subsequent to identifying the equipment requiring qualification, equipment locations are identified using design drawings and are verified, where practicable, by field inspection. Equipment locations are identified by architectural room numbers with defined boundaries.

3.11.3 ENVIRONMENTAL SERVICE CONDITIONS

Environmental conditions have been determined for normal, abnormal, and accident conditions.

All areas inside containment and rooms containing high energy lines or post-LOCA recirculatory fluid lines outside of containment are considered to be harsh environments.

3.11.3.1 Environmental Conditions During Normal Plant Operation

Redundant plant HVAC systems are designed to maintain the temperature and humidity within the normal limits which are shown in the EQR. Section 9.4 describes the HVAC system.

The TID for normal operation for 40 years of equipment life have been calculated assuming a 100% load factor and rated power. The doses are based on the design radiation source terms of the radiation sources within each plant area.

Aging effects on all equipment are considered in the qualification program to conform to the requirements of section 4 of NUREG-0588. Components susceptible to aging effects are identified, and refurbishment and/or replacement is incorporated into the LGS Preventive Maintenance/Surveillance Program. Known susceptibility to aging degradation, results of inspections and manufacturer's recommendations are factored into the Maintenance/Surveillance Program.

Effects of known normal vibratory loads on equipment are considered in the EQ program when significant.

3.11.3.2 Accident Environmental Conditions

Operability duration requirements have been determined based on the length of time the equipment must maintain its ability to perform its safety function.

The primary containment time-dependent pressure and temperature profiles for the spectrum of postulated LOCAs and main steam line breaks have been generated using NRC approved methodology.

Temperature and pressure conditions resulting from a HELB outside containment have been determined using plant specific profiles. These profiles bound accident environments caused by other events. Sections 3.6 and 9.4 describe the analyses used in generating these profiles. Additional information is contained in the EQR.

Post-LOCA radiation doses inside primary and secondary containments were calculated in accordance with NUREG-0737, item II.B.2. The source terms are consistent with those specified in NUREG-0588 and NUREG-0737. Additional information is contained in Section 1.13.

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Dynamic qualification of equipment due to seismic and hydrodynamic loads from SRV and LOCA is addressed in Section 3.10 and Appendix 3A.7.1.7.

The potential for submergence of equipment inside and outside containment is identified. Identified equipment is either qualified for submergence or analyzed to ensure both that it completes its function prior to submergence and that failure after submergence is acceptable. If these conditions cannot be met, the equipment will be relocated above flood level.

LGS has the capability of water spray actuation to mitigate the effects of a LOCA. Although no credit for spray actuation has been taken in determining temperature/pressure conditions inside containment, equipment inside containment is evaluated for the effects of spray.

Synergistic effects, where known, are considered. Specifically, where a supplier has identified synergisms or where the licensee is aware of synergistic effects for a particular component, it has been addressed. Appropriate documentation is included in the qualification file.

Margins appropriate to account for unquantified uncertainties in the effects of production variations and/or inaccuracies in test instruments are included in the qualification program.

3.11.4 QUALIFICATION TESTING AND ANALYSIS OF EQUIPMENT

All qualification testing and analysis of safety-related electrical equipment is performed according to the appropriate NUREG-0588 guidelines. Sequential testing and analysis or a combination thereof is performed for all electrical equipment. Analyses, performed on a case-by-case basis, have been conducted using approved methodologies to provide adequate justification.

3.11.5 METHODOLOGY FOR EVALUATING ENVIRONMENTAL QUALIFICATION TO SERVICE CONDITIONS

A comparison of environmental qualification to equipment service conditions is performed for all equipment located in harsh environmental zones. The equipment is evaluated for the 40 year normal environment and accident environments resulting from the spectrum of LOCAs and HELBs inside and outside containment. A point-by-point comparison is made between service condition parameters and qualified levels.

In addition, reviews and analyses were completed to ensure that the equipment tested was either identical or similar to the installed plant equipment.

3.11.6 MAINTENANCE/SURVEILLANCE PROGRAM

A Maintenance/Surveillance Program has been developed to encompass vendor prescribed maintenance procedures and periodic inspections of equipment to ensure that degradation is not occurring sooner than predicted. The program requires replacement of subcomponents (e.g., seals, gaskets, etc) at predetermined intervals to maintain the designated life. In addition, the program encompasses procedures to ensure that the environment is maintained relatively clean to avoid the possible adverse effects of dust.

3.11.7 REPLACEMENT PARTS PROGRAM

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Safety-related equipment and spare and replacement parts are being ordered to meet or exceed the original specifications. For replacement parts being procured from the original specification and which are identical to the originally supplied equipment, a certificate of conformance is considered sufficient documentation to support qualification. However, if identical replacement parts are not available, environmental qualification for the new replacement parts will be demonstrated.

3.11.8 MILD ENVIRONMENT QUALIFICATION

Mild environment qualification is not included in the EQ program. A mild environment is an environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences.

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3.12 CONTROL OF HEAVY LOADS

3.12.1 Introduction/Licensing Background

Site Licensing documentation is discussed in Section 1.12 (Subsection A-36) of the LGS UFSAR. Section 1.12 states "requirements for heavy loads, NUREG-0612, were addressed in the initial operating license review." Section 1.12 mentions a submittal dated August 13, 1984, which includes Bechtel Revision 3 of the LGS Overhead Handling Systems Review Final Report. Limerick Generating Station, Limerick Units 1 and 2, Overhead Handling Systems Review Final Report, Bechtel Revision 6/PECO Revision 1 (SDOC M-038-00008), August 1989 is incorporated in the LGS UFSAR as reference 9.1-1. The report summarizes the site correspondence to and from the NRC with respect to GL 81-07 and GL 85-11. Licensee submittal dated May 10, 1996, in response to NRC Bulletin 96-02 determines that at the time, NUREG-0612, Phase I commitments were being effectively implemented at LGS.

3.12.2 Safety Basis

UFSAR Section 1.12 (Subsection A-36) provides documentation of the site's compliance with Phase I of NUREG-0612 and Overhead Handling Systems Review Final Report (Reference 9.1-1) provides documentation that the site utilizes a single failure proof crane for RPVH/specified lifts and performed load drop analysis that demonstrates the fuel in the RPV will not be damaged and by providing electrical or mechanical interlocks on the crane to prevent travel of crane over spent fuel pool.

3.12.3 Scope of Heavy Load Handling Systems

The scope of load handling systems is documented in tabular form in M-038-00008 (Reference 9.1-1).

3.12.4 Control of Heavy Loads Program

3.12.4.1 Commitments in Response to NUREG-0612, Phase I Elements

The station is committed to NUREG-0612, Phase I elements as summarized in section 1.12 (Subsection A-36) of the LGS UFSAR. Detailed information is documented in M-038-00008 (Reference 9.1-1).

3.12.4.2 Reactor Pressure Vessel Head (RPVH) Lifting Procedures

The LGS UFSAR documents a single failure proof crane to be utilized to perform RPV head lifts in UFSAR Section 9.1.5 and is also documented further in reference 9.1- 1 (SDOC M-038-00008). In addition, the strong back/carousel used as a special lifting device for this evolution is single failure proof per UFSAR Section 9.1.4.2.5.8.

This safety basis (single failure proof lift for RPVH) is reflected in procedures M-041-200 (Reactor Pressure Vessel Disassembly) and M-041-400 (Reactor Pressure Vessel Reassembly).

3.12.4.3 Single Failure Proof Cranes for Spent Fuel Casks

LGS UFSAR

The spent fuel cask will be equipped with lifting lugs and yoke(s) which are single failure proof and compatible with the single failure proof reactor enclosure crane and main hook, thus precluding a cask-drop due to a single failure (UFSAR section 15.7.5). Refer to Section 9.1.5 for a description of the reactor enclosure crane and the interlocks that prevent moving the crane over the fuel pool in the absence of specific action by the crane operator to allow such movement.

3.12.5 Safety Evaluation

The basis for the site's conclusion that the existing heavy loads program is compliant with the NUREG-0612, Phase 1 requirements is documented in UFSAR Section 1.12 under the heading of "Implementation and Status Summary." This section states, "the requirements for heavy loads, NUREG-0612, were addressed in the initial operating license submittal and Unit I Operating License NPF-27 License Condition 2.C(19)." This demonstrates that the LGS heavy loads program is compliant with the appropriate regulations, codes, and standards.

Reference 9.1 1 documents, that in the event of postulated load drops, the consequences are acceptable, as demonstrated by load drop analyses. Restrictions on load height, weight, medium under the load and safe paths are reflected in plant procedures.

Reference 9.1-1 documents that when using single failure proof cranes or equivalent to perform heavy loads lifts, the risk of a load drop is extremely unlikely and acceptably low.

Detailed review of load handling systems as documented in Reference 9.1-1 (SDOC M-038-00008) provides sufficient documentation (along with controls required by station rigging procedures) that heavy load lifts are done safely.