ATTACHMENT II

GENERAL ELECTRIC COMPANY

PSM3D PLAN FOR QUALIFYING CLASS 1E DEVICES 1E81462

This generic plan i. intended to cover all PSM Class 1E Protective relays and auxiliary devices. Detailed instructions, based on the generic plan, cover individual relay models or devices which are subjected to Class 1E qualficiation. The format of this document follows the format of IEEE Standard 323-1974.

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PRODUCTION ENGINEERING

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PSM&D CLASS 1E QUALIFICATION PLAN

1. SCOPE

This document describes the PSM (Power Systems Management Business Department) plan for Class 1E Qualification in accordance with PSM interpretation of IEEE Standard 323-1974. The plan covers devices for use outside of the containment area.

2. PURPOSE

The purpose of this document is to describe a generic qualification plan applicable to all PSM devices. Detailed step-by-step instructions, based on the generic plan, will be written for individual relay models and auxiliary devices which are subject to Class 1E qualification.

In addition to meeting the requirements of IEEE 323, this plan is intended to meet applicable requirements of IEEE Standard 344, IEEE C37.98 (formerly IEEE Standard 501-1978) and Industry Standards ANSI/IEEE C37.90, UL 508 and UL 1059.

3. DEFINITIONS

The definitions of IEEE 323 apply to this plan.

4. INTRODUCTION

Type testing of selected devices will be used as the primary qualification method. Additional devices which can be shown to be similar to devices qualified by type testing with respect to factors such as application, construction and aging will be qualified by analysis.

A selected list of relays and auxiliary devices manufactured by PSM will be qualified. This list of devices, for which design revision control will be maintained, will be published by PSM Marketing. Design revision control is not included in this qualification plan but is covered by PSM Design Change Control Procedure No. 01-04-002.

5. PRINCIPLES OF QUALIFICATION

5.1 TYPE TESTING Type testing of aged devices will be performed on models selected from the PSM Qualification List. The devices are representative of generic types so that test results can be extended by analysis to qualify other similar devices.

5.2 OPERATING EXPERIENCE Operating experience may be used in combination with type testing and analysis but will not be employed as a primary qualification method.

5.3 QUALIFICATION BY ANALYSIS Qualification by analysis will consist of detailed comparisons of devices which are not scheduled for type testing or for which only partial type tests will be performed with similar devices for which qualification has already been established. Qualification by analysis will be designed to show that devices qualified by analysis are equivalent to those qualified by test from the standpoint of meeting Class 1E requirements.

5.4 COMBINED QUALIFICATION PSM devices may be qualified by type test, previous operating experience, analysis or any combination of these three methods.

5.5 ON-GOING QUALIFICATION Limited use may be made of on-going qualification where qualified life cannot be established equal to the anticipated installed life of the equipment. When this method is employed, it will be described and justified in the detailed qualification plan for the device.

6. QUALIFICATION PROCEDURES AND METHODS

6.1 IDENTIFICATION OF CLASS 1E DEVICES BEING QUALIFIED

The Class 1E list published by Marketing identifies the devices to be qualified by PSM.

6.2 PERFORMANCE SPECIFICATIONS

In keeping with a generic qualification plan, this plan is intended to cover performance characteristics, requirements and environments under normal, DBE (Design Basis Event) and post-DBE conditions for most out of containment applications.

When a particular application has performance specifications or environmental conditions more severe than those for which PSM devices have been qualified under this plan, one or more of the following steps may be taken:

(1) Reduce the qualified life of the device to a lower value consistent with the increased severity of the application.

(2) Perform Additional type tests and/or analysis to qualify the device to meet requirements for the increased severity of the application.

ANSI/IEEE C37.90 is the industry standard governing relay performance and specifications; it will be followed with respect to:

(1) Ratings

(2) Maximum design voltage and current

(3) Operating range, i.e., over and undervoltage operation

(4) Temperature rise of coils

(5) Dielectric (hi-pot) tests

(6) SWC (Surge Withstand Capability) test

(8) Operation in high and low temperature environments.

For characteristics such as resistance to radiation exposure, thermal aging, and seismic events which are not covered by Industry Standards, this plan is designed to establish qualified life in accordance with PSM understanding of expected service conditions and IEEE 323 requirements. For example, accelerated aging tests of non-metallic materials have been designed to produce thermal aging equivalent to 41 years of service life under the specified conditions.

6.3 TYPE TEST PROCEDURE

6.3.1 General The type test for each device tested shall be designed to establish the qualified life of the device with performance which meets or exceeds requirements of Industry Standare (ANSI C37.90). Where ANSI C37.90 does not apply, the tests shall be designed to meet or exceed specified service conditions.

6.3.1.1 TEST PLAN Detailed step-by-step test instructions will be written for each test for each device for which type tests are to be performed. The test plan shall include, but is not limited to, the following information:

(1) Description of device to be tested - this shall include type, model number and rating.

(2) Number of units to be tested - the number (quantity) of units to be tested shall be given and the tests to be performed on each unit shall be listed. In general, three units of each model will be tested.

(3) Mounting and Connection requirements - Devices shall be mounted and connected in a manner and position that simulate in-service installation to the extent that performance will be equal to performance in actual use. This requires that relays be supported or mounted in an upright level position, in a location free from excessive vibration. Relays must be tested in their cases (or a suitable test case) except where specific instructions are given to deviate from this practice. Special requirements for mounting to a rigid support structure apply to seismic testing so that no additional amplification will be introduced.

Instructions for electrical tests shall include wiring diagrams as needed to supplement written instructions and to assure that correct electrical connections are made.

(4) Aging simulation procedure - Protective Relays and Auxiliary Devices are composed of components having significant variety in materials, design and function. Each component must therefore be reviewed in terms of its materials, design, function and environment to identify potental aging mechanisms which could limit ability to perform required safety function(s). The most likely potential aging mechanisms for Protective Relays and Auxiliary Devices (and those which are therefore considered in this document) are:

(a) Operational Cycles
(b) Time/Temperature Effects
(c) Radiation

The time/temperature and radiation effects apply primarily to non-metallic materials and must also be considered for solid state components. The thermal aging and operational cycling may be accumulated on an incremental basis or a one time total basis.

(a) <u>Operational Cycles</u>

Relays or auxiliary devices will be subjected to operational cycles which simulate in-service operation and for a number of cycles in excess of the number specified during the qualified life of the device.

(b) Time/Temperature Effects

Where applicable, thermal aging conditions and qualified life values shall be established by use of the Arrhenius relationship (Ref. IEEE 101-1972, IEEE Guide for the Statistical Analysis of Thermal Life Test Data). Arrhenius time/temperature curves wi

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counted for in thermal aging tests. Temperature rise tests will be run to determine temperature rise as a function of input voltage or current and the resulting data will be used in establishing thermal aging test times and temperatures.

Acceleration factors and test conditions shall be conservatively chosen based on the time/temperature sensitivity of elements in the device. Selection of aging temperature depends upon the upper practical temperature limits of the materials involved, the desired aging time and the average in-service ambient air temperature of the device. For Protective Relays and Auxiliary devices, the in-service device ambient air temperature shall be taken as the average control room ambient air temperature. Typically, this is 25°C ± 15°C. The upper limit of 40°C will be used for designing thermal aging tests for PSM equipment.

Based on a target qualified life of 40 years, accelerated aging times shall be selected equivalent to at least 41 years of in-service life.

(c) Radiation

The integrated radiation dose for forty years service life outside the containment area is generally accepted as equal to or less than $1 \times 10^{+4}$ rads. To assure conservative test results, PSM devices will be subjected to $1 \times 10^{+5}$ rads.

(d) Other aging mechanisms are not considered detrimental to the life of the equipment for usual applications; these are:

1) Humidity -- Providing the Protective Relay and Auxiliary Device enclosure internal air temperatures exceed surrounding ambient air temperatures by 5°C minimum (Ref. IEEE 43-1974).

2) Contamination -- Based on expected application in nuclear power plants where ambient air quality is controlled to habitable levels.

3) Altitude -- when below 5,000 feet (Ref. ANSI/IEEE C37.90).

4) Vibration -- Seismic levels (both five OBE's and one SSE) to be addressed in seismic testing. There is no history evidencing sensitivity of this equipment to normal in-plant vibration levels.

(5) Service conditions to be simulated -- The test instructions must assure that expected service conditions are properly simulated. The test instructions should assure that operation is checked at the temperature extremes, -20°C and +55°C specified under SERVICE CONDITIONS in ANSI/IEEE C37.90, and as applicable, that relays operate over the range of operating voltages specified under RATINGS in ANSI/IEEE C37.90.

In addition to normal service conditions, seismic proof tests are required which cover postulated OBE and SSE events. These tests shall be run in accordance with IEEE 501-1978-IEEE STANDARD SEISMIC TESTING OF RELAYS.

(6) Performance and Environmental Variables -- The performance and environmental variables to be measured must be detemined for each device. As a minimum, the published performance characteristics will be checked. Typical characteristics for protective relays and devices are pickup and dropout voltage or current, and pickup and dropout times. The characteristics or variables measured should be selected to show that each tested device performs all of its essential functions in an acceptable manner.

Applicable environmental variables such as tmperature, input voltage and seismic vibration levels must be measured, recorded and identified with respect to performance data to which they apply.

(7) Test Equipment Requirements -- including accuracies will be determimed. The tests shall be monitored using equipment that provides resolution for detecting meaningful changes in the variables. The test equipment shall be calibrated against auditable calibration standards and shall have documentation to support such calibration.

(8) Test Sequence -- The environmental, operating and measurement sequence will be documented in step-by-step detail. An objective of the test plan is to run the test in specified order designed to be the most severe for the device being tested. In the absence of information to identify sequences that are more severe than the sequences described by paragraph 6.3.2 of IEEE 323, the sequence of IEEE 323 will be followed as a guide. Justification will be given for any variations from the sequence of IEEE 323.

Tests will be performed in the following sequence:

1) INSPECTION

Perform inspection to check the physical condition of the test units and to determine basic dimensions.

2) BASELINE DATA MEASUREMENT

Operate the test units under normal conditions to provide a data base for comparison with performance under more highly stressed conditions and for monitoring change of essential functions and characteristics. As applicable to each test unit check:

(a) Calibration
(b) Temperature rise at rated voltage or current.

The inspection points and calibration checks will be recorded throughout the test program for comparison with the initial inspection and Baseline Data Measurements.

3) EXTREMES OF PERFORMANCE AND CHARACTERISTICS

Test units shall be operated to applicable sections of ANSI/IEEE C37.90 as follows:

(a) Allowable variation from rated voltage for protective relays (Section 6.2).

(b) Range of operating voltage for auxiliary relays (Section 6.4)

(c) Test for operation at minimum voltage-auxiliary relays (Section 6.5)

(d) Limits of temperature rise for coils (Section 7.1)

(e) Dielectric Tests (Section 8)

(f) Surge Withstand Capability (Section 9)

(g) Each device shall be shown to be functionally operable at temperatures of -20°C and +55°C (Section 6).

(h) Each device shall be shown to be functionally operable at 95% relative humidity over the temperature range +4°C to +55°C.

4) AGING - Each device shall be subjected to an accelerated aging process which includes operational cycles, radiation exposure, and thermal aging.

(a) Operational Cycles - Where applicable, subject the test units to a 2,000 operation contact making test (Ref. ANSI/IEEE C37.90, Section 6.6). If specified in-service operations exceed 2,000, design a test for an equal or greater number of operational cycles than the number specified during the qualified life of the device.

(b) Radiation Exposure - Subject the test units to a gamma radiation exposure of $1 \times 10^{+5}$ rads.

(c) Thermal Aging - Subject each device to thermal aging in a high temperature environment for the equivalent of 41 years of service life. The time and temperature for accelerated thermal aging must be determined for each device based on thorough analysis of non-metallic materials properties for each device. If 41 years service life cannot be established, determine a lesser number of years for which the device can be qualified.

5) DESIGN BASIS EVENT - For protective and auxiliary devices, the simulated DBE is a seismic proof test run in accordance with IEEE C37.98 SEISMIC TESTING OF RELAYS.

6) POST DBE TESTS - Following the DBE seismic test, the test units will be tested to show that they are functionally operable at 49°C (120°F) and at 40°C (104°F) with 95% relative humidity. The initial dielectric test will be repeated at 75% of the initial hi-pot level.

A final inspection and calibration check will be made for comparison with the initial inspection and the Baseline Data Measurements.

7) POST TEST DISASSEMBLY - Upon completion of the test program, test units will be disassembled to the extent necessary for inspection of the status and condition of the test units.

(9) Performance Limits and Failure Definition --Results of each test will be reviewed and a determination will be made that the device either passed or failed the test. No single performance criterion applies to all tests or devices, but one or more of the following will be applied to each test and device:

a) Failure to meet requirements of applicable standards such as ANSI C37.90.

b) Change in characteristics exceeding twice published tolerances.

c) Inability to recalibrate to original standard calibration.

d) Loss of essential function.

e) Erroneous or false operation such as contact chatter, as defined in IEEE C37.98.

The primary considerations are ability of the device to perform its essential functions and freedom from false operations which could jeopardize Class 1E functions.

(10) Documentation (see Section 8)

(11) Conditions Peculiar to Specific Devices --Conditions peculiar to specific devices which are not covered by the preceding Items 1 through 10 of this generic test plan will be included in the detailed test plan for the device to which the conditions apply.

6.3.1.5 MARGIN

The following consideration is given to the eight factors listed in Section 6.3.1.5, MARGIN, of IEEE Standard 323-1974:

(1) TEMPERATURE - Average in service ambient air temperature is taken as 25°C. Thermal aging time and temperature to establish Qualified Life are based on a +15°C factor for a total 40°C continuous service ambient.

(2) PRESSURE - This item refers to gauge pressure and is not considered applicable to PSM devices.

(3) RADIATION - Total integrated dose (out of containment) is taken as $1 \times 10^{+4}$ rads of gamma radiation. Testing is performed at $1 \times 10^{+5}$ rads.

(4) VOLTAGE - PSM voltage operated relays are designed to comply with voltage margins specified by Industry Standard ANSI/IEEE C37.90-1978. See this standard for Margins applicable to specific relay models.

(5) FREQUENCY - PSM AC rated relays are designed to operate at $\pm$5% of rated value unless otherwise specified.

(6) TIME - The requirement to establish qualified life doesn't specify a particular number of years. PSMRD uses 40 years as a goal and adds one year as a margin for a total of 41 years. If 41 years qualified life cannot be established, a lesser value is determined.

(7) ENVIRONMENTAL TRANSIENTS - Temperature transients associated with design basis events were not considered for the out-of-containment environments. However, relays are tested and shown to operate successfully at the high, +55°C, and low, -20°C, limits specified by Industry Standard ANSI/IEEE C37.90-1978. In addition, operation is checked in a 95 percent relative humidity environment.

(8) VIBRATION - Seismic fragility tests are run to determine seismic capability of each device rather than running seismic proof tests to demonstrate that a pre-established seismic level can be met.

7. SIMULATED SERVICE CONDITION TEST PROFILE

Test profile - not included since this section of IEEE Standard 323 refers to "in containment" conditions.

8. DOCUMENTATION

8.1 GENERAL The qualification documentation shall verify that each type of device is qualified for the specified service conditions and meets its specified performance requirements. The basis of qualification shall be explained to show the relationship of all facets of proof needed to support adequacy of the device. Data used to demonstrate the qualification of the device shall be pertinent to its function and organized in an auditable form.

8.2 DOCUMENTATION FILES A qualification file will be maintained. The file will contain a copy of the Type Test Data plus any applicable operating experience and analysis data.

8.3 TYPE TEST DATA The type test data shall contain:

(1) Idenftification of the specific feature(s) to be demonstrated by the test

(2) Test plan

(3) Report of test results. The report shall include:

(a) Objective
(b) Device tested
(c) Description of test facility (test setup) and instrumentation used, including calibration records reference.
(d) Test procedures
(e) Test data and accuracy (results)
(f) Summary, conclusions and recommendations
(g) Supporting data
(h) Approval, signature and date.

8.4 EXTRAPOLATION Where the test data or operating experience data have been extrapolated, the basis for the extrapolation shall be included.

GENERAL ELECTRIC CO.
RELAYS AND ACCESSORIES
SEISMIC CAPABILITY

The "SEISMIC CAPABILITY" ZPA levels are based on tests conducted in accordance with ANSI-C37.98-1978 Standard for Seismic Testing of Relays (formerly IEEE Std. 501). Relays and other devices have been placed on a shaker table and subjected to prescribed input motions to determine their seismic capability. Except where noted, all instantaneous and/or target/seal-in units are Hi-G high seismic units. The following comments describe the test methods used, and are extracted in part from IEEE 37.98.

(a) The SEISMIC CAPABILITY (FRAGILITY) LEVELS shown are based on tests conducted with biaxial multi-frequency broad-band frequencies applied to the shaker table as shown on page 3.

<u>Broad-Band Multi-Frequency Fragility Testing</u>

Repeatable multi-frequency input motions shall be used in fragility testing. It is the test's objective to produce an FRS (Fragility Response Spectrum) which envelopes the SRS (Standard Response Spectrum) shape using a biaxial input motion. The SRS shape (at 5% damping) is defined by four points:

Point A = 1.0 Hz and an acceleration equal to 25% of the ZPA. ZPA means <u>Z</u>ero <u>P</u>eriod <u>A</u>cceleration.

Point D = 4.0 Hz and 250% of the ZPA.

Point E = 16.0 Hz and 250% of the ZPA.

Point G = 33.0 Hz and a level equal to the ZPA.

The range of maximum amplification of acceleration, 4.0 to 16.0 Hz, has been designed to most realistically match the range of peak acceleration input to the relays or other devices by the equipment and panels on which they are mounted. Below 4.0 Hz, it is possible to encounter building frequencies to as low as 1.5 Hz. The resulting panel motions would probably be enveloped by the line AD since the amplification of panels at these low frequencies is small. Above 16 HZ, there are equipment and panel resonances, however, the seismic energy input in this range is generally reduced and, therefore, the motions would probably be enveloped by the line EG.

Where the fragility level is shown as 6G ZPA, it should be noted that this represents the table limit of the test facility used. This corresponds to 15G at the peak (Points D and E) of page 3.

Where an asterisk (*) appears opposite the ZPA values, this signified that the testing was done to an earlier draft of P-501 in which the peak (line D-E) spanned from 2.5 to 10 Hz. In those tests, the table limit was 4G ZPA, corresponding to 10G at the peak.

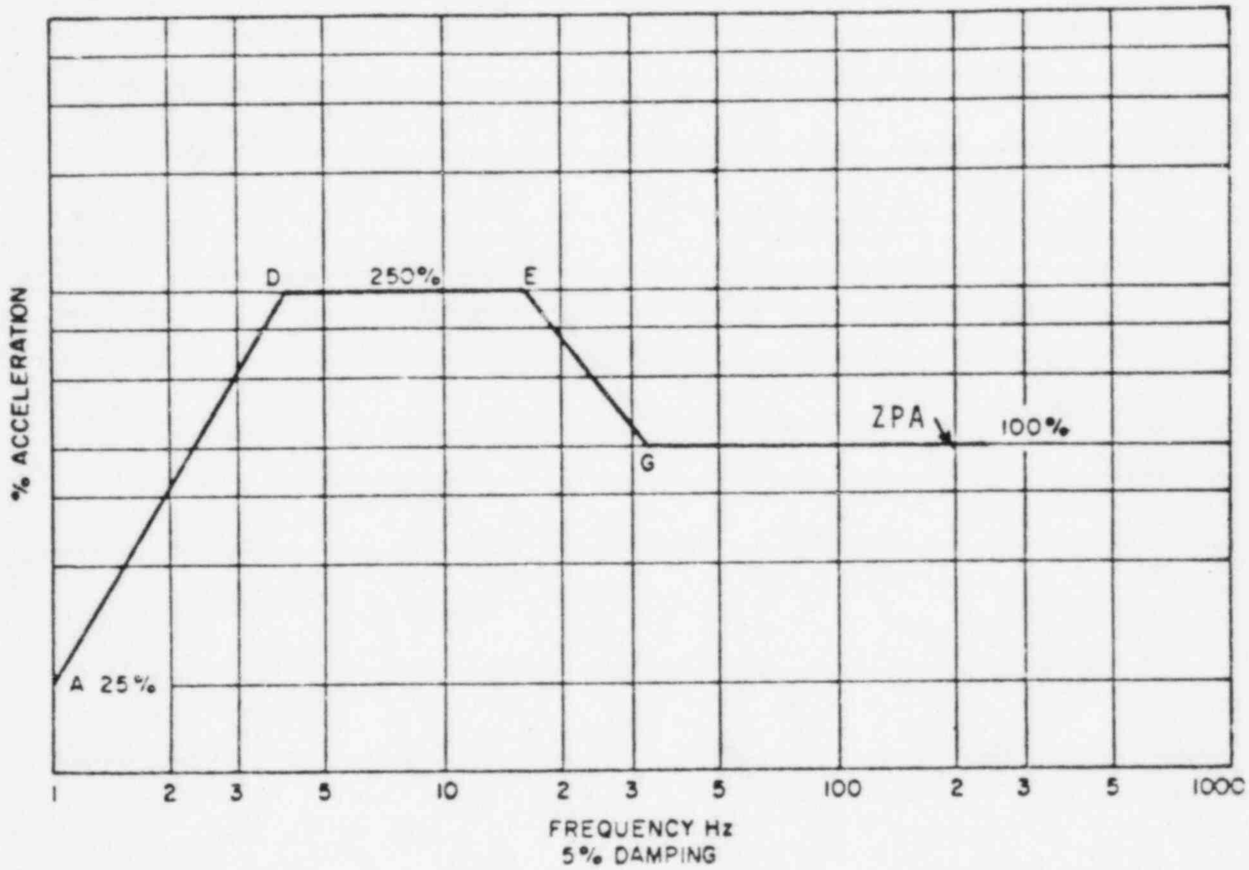
The notation "Test" is used to identify relays or other devices for which seismic capability was determined by fragility testing. Following such tests, other models of the same family were reviewed for electrical and mechanical commonality to the tested model. Such additional models are also listed with the notation "Analysis" in those cases in which the fragility level was conservatively judged to be equal to or higher than the tested model.

(b) Relays in the "non-operating" condition had tap settings, time dials, currents and/or voltages applied as specified in IEEE 37.98, Table 1. These currents/voltages are intended to simulate maximum load conditions or conservative settings.

(c) Relays in the "operating" condition had currents and/or voltages applied as specified in IEEE 37.98, Table 1. These are generally 200% of pickup.

(d) Relays have been tested using as failure criteria a two-millisecond contact discontinuity, i.e., a normally open (N.O.) contact closes for 2 ms or a normally closed (N.C.) contact opens for 2 ms.

MULTI-FREQUENCY BROAD-BAND STANDARD RESPONSE SPECTRUM SHAPE



THIS CURVE APPEARS AS FIGURE 1 IN ANSI-C37.98-1978

QUALIFIED LIFE

GENERAL

The "Qualified Life" evaluation of relays is derived from a test program based on PSMBD's interpretation of IEEE 323-1974 (IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations). As this standard is generic in nature, the program outlined below follows closely the IEEE Standard but has been arranged to be more compatible with relays.

PSMBD TEST PROGRAM FOR CLASS 1E QUALIFICATION

A. CALIBRATION OF RELAYS

The operating points of essential characteristics of each relay model are checked to ensure conformance with factory standard calibration. The results are recorded to document initial characteristics and to monitor any change of these characteristics during the test program.

After each test of the Qualification Test Program, the relay is operated at normal ambient temperature and its essential characteristics are rechecked and documented. Changes are detected by comparison with the original results.

B. PASS/FAIL CRITERIA

Results of each step of the test program are monitored, documented and a determination made that the relay either passed or failed the test. No single performance criterion applies to all of the tests but one or more of the following failure criteria is applied to each test:

1. Failure to meet ANSI C37.90 (ANSI/IEEE C37.90-1978) or other applicable standards such as UL.
2. A change in characteristics exceeding pre-established tolerances.
3. Inability to calibrate to original standard calibration.
4. Loss of function.
5. Unacceptable (depends on relay appliacation) difference in operating time during seismic testing compared to operating time when no vibration is applied.

C. ANSI/IEEE C37.90

Depending upon the characteristics of the relay being qualified, all applicable portions of ANSI C37.90, as shown by the following list, are included in the test program:

C. ANSI/IEEE C37.90 (Cont'd)

1. Usual Service Conditions
2. Operating Range
3. Contact Rating
4. Temperature Rise of Coils
5. Dielectric
6. Surge Withstand Capability

1. USUAL SERVICE CONDITIONS

Demonstrates operation at the extremes of temperature defined by ANSI C37.90 for "USUAL SERVICE CONDITIONS."

2. OPERATING RANGE

These tests are designed to demonstrate compliance with operating range requirements of ANSI C37.90.

3. CONTACT RATING

This test is derived from the Make and Carry Ratings for Tripping Contacts Test defined in ANSI C37.90. It also provides operational aging of the test relays.

Relay contacts are operated to make and carry a simulated power circuit breaker trip coil load (current is interrupted by independent means). The contact duty cycle is 200 milliseconds on and 30 seconds off for a total of 2,000 make operations.

4. TEMPERATURE RISE OF COILS:

These tests are designed to:

a. Demonstrate compliance with ANSI C37.90 limits of temperature rise for coils for "USUAL SERVICE CONDITIONS."

b. Provide information needed for selecting time-temperature values for the thermal aging test.

c. Temperature Rise Inside Case: These tests are run concurrently with the coil temperature rise tests and provide similar information for evaluating temperature capability of non-metallic material.

5. DIELECTRIC (HI-POT CONFORMANCE)

Demonstrate conformance to ANSI C37.90 requirements.

6. SWC-SURGE WITHSTAND CAPABILITY.

ANSI C37.90 SWC tests are applicable to and are performed only on static relays and on electromechanical relays which employ solid state components.

D. SIX DAY 95% RELATIVE HUMIDITY TEST

This test is not based on an industry standard but is designed to demonstrate operational capability of the relays while exposed to extreme humidity conditions. This test may be changed as more data becomes available.

Set temperature and humidity controls for 40°F and 95% relative humidity and allow temperature and humidity to stabilize.

Maintain selected temperature and humidity for 24 hours.

Monitor essential functions for proper operation in the temperature/humidity environment and record appropriate data.

Repeat at 20°F intervals up to 140°F.

E. INTEGRATED 10^5 RADS GAMMA RADIATION DOSE

Subject the test relays to an integrated radiation exposure of 1×10^5 rads of gamma radiation at a rate of 0.5×10^5 rads per hours.

There is no established industry standard for the radiation test. The 1×10^5 rad value was selected to provide exposure greater than an estimated 1×10^4 rads from 41 years of normal out-of-containment environment.

F. THERMAL AGING

Designed to establish qualified life at an accelerated rate based on Arrhenius data of thermally limiting non-metallic material(s).

a. Subject the relay to an elevated temperature for a period of time designed to produce thermal aging equivalent to the desired qualified life.

b. The operating temperature is considered to be 40°C. This temperature is the upper limit of anticipated service conditions for an average service temperature of 30°C with allowable excursions from 10°C to 40°C.

G. SEISMIC TEST (IEEE C37.98-1978)

1. Subject the device to five operations per IEEE C37.98 paragraph 5.2.3 at 0.5 times the seismic capability level determined under test conditons (operated or non-operated) in seismic tests of new relays.

G. SEIMSIC TEST (IEEE C37.98-1978) (Cont'd)

2. Subject the relay to one operation in each of four directions per IEEE C37.98 at the full capability level as determined in seismic tests of new relays.

8. POST DBE

a. Subject to 49°C for eight hours

b. Subject to 40°C at 95% relative humidity for 120 hours.

c. Dielectric (hi-pot) at 75% of initial hi-pot level

d. Final characteristics check and visual examination.

QUALIFIED LIFE

GENERAL

The "Qualified Life" evaluation of switches is derived from a test program based on PSMBD's interpretation of IEEE 323-1974 (IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations). As this standard is generic in nature, the program outlined below follows closely the IEEE Standard but has been arranged to be more compatible with switches.

PSMBD TEST PROGRAM FOR CLASS 1E QUALIFICATION

A. MONITORING CONDITION OF DEVICE

The original condition of each switch and its contacts is checked by inspection, measurements and operation to assure conformance with factory standards. The results are recorded to document the original condition and for monitoring changes during the test program. The initial checks are repeated throughout the test program and changes are detected by comparison with the original results.

B. PASS/FAIL CRITERIA

Results of each step of the test program are monitored, documented and a determination made that the device either passed or failed the test. No single performance criterion applies to all of the tests but one or more of the following failure criteria is applied to each test:

1. Failure to meet ANSI C37.90 (ANSI/IEEE C37.90-1978) or other applicable standards such as UL.
2. Dielectric breakdown.
3. Electrical circuit failure.
4. Mechanical failure of a part or material.
5. Loss of function, e.g., a contact fails to transfer.

C. QUALIFICATION TESTS

Where specific standards or specifications are not applicable, performance criteria are based on ability to meet or exceed published data and on consideration of material properties under "USUAL SERVICE CONDITIONS," defined by ANSI C37.90.

1. CONTACT TEMPERATURE RISE

a. Demonstrate that temperature rise is consistent with material properties when current equal to the continuous current rating of the contacts is passed through the contacts and terminals of the switch.

1. CONTACT TEMPERATURE RISE (Cont'd)

   b. Provide information needed for selecting time-temperature values for the thermal aging test.

2. DIELECTRIC (HI-POT CONFORMANCE)

   Demonstrate conformance to ANSI C37.90 requirements.

3. CONTACT RATING

   This test is derived from the Make and Carry Ratings for Tripping Contacts Test defined in ANSI C37.90.

   Switch contacts are operated to make and carry a simulated power circuit breaker trip coil load (current is interrupted by independent means). The contact duty cycle is 200 milliseconds on and 30 seconds off for a total of 2,000 make operations.

4. OPERATIONAL AGING

   This test is designed to demonstrate capability of the switch to perform a number of operations equal to or exceeding the expected number of operations it will be required to perform during its qualified life. The test is designed to simulate service conditions as nearly as possible.

5. TEMPERATURE AND HUMIDITY EXPOSURE

   These tests are not based on an industry standard but are designed to demonstrate that the switch is not damaged by exposure to extremes of temperature and humidity. These tests may be changed as more data becomes available. Switch operation under simulated service conditions in the specified environment may be included in the test.

   a. Subject the switch to the extremes of temperature defined by ANSI C37.90 for "USUAL SERVICE CONDITIONS" for a minimum of three hours at each temperature.

   b. Set temperature and humidity controls for 40°F and 95% relative humidity and allow temperature and humidity to stabilize.

      Maintain selected temperature and humidity for 24 hours.

      Repeat at 20°F intervals up to 140°F.

6. INTEGRATED 10^5 RADS GAMMA RADIATION DOSE

   Subject the test switches to an integrated radiation exposure of 1×10^5 rads of gamma radiation at a rate of 0.5×10^5 rads per hours.

6. INTEGRATED 10^5 RADS GAMMA RADIATION DOSE (Cont'd)

There is no established industry standard for the radiation test. The 1×10^5 rad value was selected to provide exposure greater than an estimated 1×10^4 rads from 41 years of normal out-of-containment environment.

7. THERMAL AGING

Designed to establish qualified life at an accelerated rate based on Arrhenius data of thermally limiting non-metallic material(s).

a. Subject the device to an elevated temperature for a period of time designed to produce thermal aging equivalent to the desired qualified life.

b. The operating temperature is considered to be 40°C. This temperature is the upper limit of anticipated service conditions for an average service temperature of 30°C with allowable excursions from 10°C to 40°C.

8. SEISMIC TEST (IEEE C37.98-1978)

a. Subject the test units to five operations per IEEE C37.98 paragraph 5.2.3 at 0.5 times the full capability level as determined in seismic tests of new switches.

b. Subject the test units to one operation in each of four directions per IEEE C37.98 at the full capability level as determined in seismic tests of new switches.

9. POST DBE

a. Subject to 49°C for eight hours

b. Subject to 40°C at 95% relative humidity for 120 hours.

c. Dielectric (hi-pot) at 75% of initial hi-pot level

d. Final characteristics check and visual examination.

GENERAL

The "Qualified Life" evaluation of accessory devices is derived from a test program based on PSMBD's interpretation of IEEE 323-1974 (IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations). As this standard is generic in nature, the program outlined below follows closely the IEEE Standard but has been arranged to be more compatible with accessory devices.

PSMBD TEST PROGRAM FOR CLASS 1E QUALIFICATION

A. MONITORING CONDITION OF DEVICE

The original condition of each device is checked by inspection, measurements and/or operation to assure conformance with factory standards. The results are recorded to document the original condition and for monitoring changes during the test program. The initial checks are repeated throughout the test program and changes are detected by comparison with the original results.

B. PASS/FAIL CRITERIA

Results of each step of the test program are monitored, documented and a determination made that the device either passed or failed the test. No single performance criterion applies to all of the tests but one or more of the following failure criteria is applied to each test:

1. Failure to meet ANSI C37.90 (ANSI/IEEE C37.90-1978) or other applicable standards such as UL, for example, failure of a terminal board connector to properly hold and secure an electrical conductor.

2. A change in characteristics exceeding pre-established tolerances.

3. Electrical, mechanical or materials failure.

4. Loss of function, e.g., an indicating lamp failure.

C. QUALIFICATION TESTS

Where specific standards or specifications are not applicable, performance criteria are based on ability to meet or exceed published data and on consideration of material properties under "USUAL SERVICE CONDITIONS" defined by ANSI C37.90.

1. TEMPERATURE RISE

This test is designed to:

a. Demonstrate that temperature rise is consistent with material properties of the device.

b. Provide information needed for selecting time-temperature values for the thermal aging test.

c. Demonstrate conformance to standards where applicable to a specific device.

Applicable standards for terminal boards are:

1) UL Standard 486 WIRE CONNECTORS AND SOLDERING LUGS.

2) UL Standard 1059 TERMINAL BLOCKS.

2. DIELECTRIC (HI-POT)

This test is designed to demonstrate conformance to standards where applicable to a specific device.

UL Standard 1059 applies to terminal boards.

3. FUNCTIONAL TESTS

These tests are designed to demonstrate conformance to standards where applicable to a specific device and/or to published performance or rating information.

UL Standard 486 applies to Terminal Board Secureness Test and to Terminal Board Pullout Test.

4. TEMPERATURE AND HUMIDITY EXPOSURE

These tests are not based on an industry standard but are designed to demonstrate that the device is not damaged by exposure to extremes of temperature and humidity. These tests may be changed as more data becomes available. Operation in the specified environments may be included in the test if applicable to a particular device.

a. Subject the device to the extremes of temperature defined by ANSI C37.90 for "USUAL SERVICE CONDITIONS" for a minimum of three hours at each temperature.

4. TEMPERATURE AND HUMIDITY EXPOSURE (CONTD.)

b. Set temperature and humidity controls for 40°F and 95% RH and allow temperature and humidity to stabilize.

Maintain selected temperature and humidity for 24 hours.

Repeat at 20°F intervals up to 140°F.

5. INTEGRATED 10^5 RADS GAMMA RADIATION DOSE

Subject the test devices to an integrated radiation exposure of 1×10^5 rads of gamma radiation at a rate of 0.5×10^5 rads per hour.

There is no established industry standard for the radiation test. The 1×10^5 rad value was selected to provide exposure greater than an estimated 1×10^4 rads from 40 years of normal out-of-containment environment.

6. THERMAL AGING

Designed to establish qualified life at an accelerated rate based on Arrhenius data of thermally limiting non-metallic material(s).

a. Subject the device to an elevated temperature for a period of time designed to produce thermal aging equivalent to the desired qualified life.

b. The operating temperature is considered to be 40°C. This temperature is the upper limit of anticipated service conditions for an average service temperature of 30°C with allowable excursions from 10°C to 40°C.

7. SEISMIC TEST (IEEE C37.98-1978)

a. Subject the device to five operations per IEEE C37.98 at 0.5 times the full capability level as determined in seismic tests of new devices. This should be done in any one plane.

b. Subject the device to one operation in each plane per IEEE C37.98 at the full capability level as determined in seismic tests of new devices.

8. POST DBE

a. Subject to 49°C for 8 hours.

b. Subject to 40°C at 95% R.H. for 120 hours.

c. Dielectric (hi-pot) at 75% of initial hi-pot level.

d. Final characteristics check and visual examination.