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C-E POWER SYSTEMS

Docket No.: STN-50-470F

January 29, 1982
LD-82-008

Mr. Darrell G. Eisenhut
Director for Licensing
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Response to EG&G and Staff Comments on Topical Report No. CENPD-255.

Dear Mr. Eisenhut:

Revision 2 to Topical Report CENPD-255, Qualification of Class 1E Electrical Equipment, was submitted on August 5, 1981 for staff review. Comments were provided by EG&G Idaho, Inc., your consultant, and were discussed in our meetings with the staff in Bethesda. Our draft responses to these comments have been provided over the past several weeks. Our formal responses, a revised section 3.11 to CESSAR-F and a copy of Revision 3 to Topical Report CENPD-255 are enclosed. Bound copies of the topical report, a CESSAR-F SAR amendment, and the sample environmental test report requested by the staff will be provided shortly.

If we can be of any additional assistance, please feel free to contact either myself or Mr. G. A. Davis of my staff at (203)688-1911, Extension 2803.

Very truly yours,

COMBUSTION ENGINEERING, INC.

A. E. Scherer
Director
Nuclear Licensing

AES:ctk

Attachments

cc: C. I. Grimes

E003
S1/1

ATTACHMENT 1

FORMAL RESPONSES TO EG&G COMMENTS

PAGES 1 thru 74

NOTE: EG&G comments were provided in a series of informal transmittals.

EG&G COMMENTS/C-E RESPONSE

Comment

1.0 INTRODUCTION

1.2 BACKGROUND INFORMATION

Add chemical spray to list of considerations.

Response

The term "Chemical Spray" will be incorporated as requested.

Comment

2.0 REFERENCES

Why are just the two reference listed here, and the rest relegated to Appendix E?

Response

All references indicated in Section 2.0 represent those references with which CENPD-255 is in full compliance.

All references indicated in Appendix E are utilized as appropriate on an equipment specific basis.

Comment

Section 3.2 Scope of Supply and Interface Requirements

How are appropriate interface requirements provided to the responsible party?

Response Please see the revised wording of Section 3.2.

Comment

Section 3.3.1 Aging

The listed information should include

1. Normal operating vibration (see IEEE 323-1974, 6.3.5)
2. Synergistic effect investigation (see NUREG 0588, Rev. 1, 4. (3)).

Response Please see the revised wording in Section 3.3.1.

Comment

Section 3.4 Environmental Conditions and Effects

Last Sentence

"The methods used to establish the environmental parameters for qualification are discussed in Section 5.2.2". This is a mis-statement all Section 5.2.2 does is state that a review will take place to evaluate the methodology used.

Response The last sentence in Section 3.4 has been deleted.

Comment

Section 3.4.1 Temperature

"Figure B-7 defines the qualification test profile for in-containment "Harsh environment" equipment. This profile is based upon saturation temperatures corresponding to the containment pressure profile. A saturation temperature of 290°F is calculated based upon a 60 psig maximum containment pressure. Per Reference 2.1, a 15°F and 6 psig margin is added that results in a 305°F and 66 psig steam/air qualification test condition."

This method of calculating qualification temperature is not allowed by IEEE 323-1974 or NUREG 0588. A qualification temperature profile based on the saturation temperature corresponding to maximum containment pressure is not an adequate profile. CESSAR FSAR, Figure 3.11A-1A reveals a peak temperature of 350°F for a period of 12 minutes into a DBE with an 8-hour expected temperature of 300°F. The FSAR curves must be enveloped with margin. NUREG 0588 and IEEE 323-1974 require bounding envelopes with margin, and in this case it is not done.

It is also noted that CESSAR FSAR, Figure 3.11A-1A (LOCA Temperature) is identical to Figure 3.11A-3 (MSLB Temperature). Is this correct?

Response

3.4.1 Temperature

Please see the revised section 3.4.1.1 of CENPD-255 for the description of harsh environment testing.

Comment

Section 3.4.1.1 Harsh Environment (Temperature)

Paragraph 4 - Explanation of the statement that HELB is not within the scope of this report is required. (e.g., HELB will be determined in many respects by non-NSSS systems. For this reason, all equipment not susceptible to LOCA are considered as mild environment equipment in this report. The plant specific SAR will have to evaluate all mild equipment herein for HELB effects.)

Response: Our response to your comment, "4.6.1 LOCATION" as addressed in our reply of Nov. 10, 1981 is an applicable response to this comment.

The methods and procedures used to define such environmental conditions are not within the scope of this report. These methods and procedures are an integral part of and are included in the equipment and system level design process and associated design documentation.

The following new wording was incorporated in 255 Par. 4.6.1

If it is determined that a particular piece of equipment is located in an area that exposes it to a defined (e.g. HELB, flooding or re-circulation fluids) environmental condition, then these conditions will be incorporated into the qualification program.

Comment

Section 3.4.2 Radiation

3.4.2.1 Harsh and Non-harsh Environment

"Equipment which is exposed to radiation above 10^4 Rads will be irradiated to its anticipated Total Integrated Dose (TID) prior to type testing unless determined by analysis that radiation does not effect its ability to perform its required function."

NUREG 0588, 2.1(2), requires that analysis be supported by partial type test data. Even equipment that is irradiated to less than 10^4 Rads cannot be qualified by analysis only. See staff resolution to Comment 37, NUREG 0588, Rev. 1.

"Equipment which will be exposed to radiation levels 10^4 Rads or below will be analyzed to determine whether low level radiation could impact its ability to perform its required function."

Response Please see the additional wording in Section 3.4.2.1.

Comment

Section 3.4.3 Vibration

In addition to the items listed here, NUREG 0588 4 (2) and IEEE 323-1974 6.3.5 require vibration to be considered and included in the aging program.

Response

The following wording was added to Section 3.4.3:

Where significant levels of continuous vibration are expected to exist during service, the effects of such vibrations, either externally or self-induced will be analyzed via surveillance, preventive maintenance, analysis, partial type testing, or any combination of the above.

Comment

Section 3.4.4 Pressure

"Equipment will be environmentally tested to these conditions prior to operation and performance requirements demonstrated during and after the test."

This is a confusing statement. It implies that separate testing of actual installed equipment will be the only pressure qualification testing done. This, of course, is not adequate per NUREG 0588, 2.3(1) and IEEE 323-1974, Section 6.3.2.

Response The phrase "Prior to Operation" has been deleted.

Comment

Section 3.4.5 Humidity

This section also confuses actual installed equipment with equipment undergoing type testing. See the above comment. The last sentence contradicts the first.

While sequential testing of humidity can be justified, it is difficult or impossible for most items.

Response The phrase "Prior to Operation" has been deleted.

Comment

Section 3.4.7 Dust

While this section is very adequate, consideration should be given to NRC Staff Resolution to Comment #65, NUREG 0588, Rev. 1, during future revisions of CENPD-255.

Response

A comparison review of Section 3.4.7 and the NRC Staff Resolution to Comment #65 indicate that CENPD-255 is in full compliance with 0588.

No change to CENPD-255 wording is required.

SECTION 4.0
EQUIPMENT REQUIRING QUALIFICATION

Comment

This section should include a description of the review process and the source documents used in the determination of which equipment require qualification. With this information, a customer can go through the same process for his specific plant in order to guarantee inclusion of all applicable equipment. (Section 3.2 suggests that there are components in NSSS systems which will not be C-E supplied and are, therefore, not in this section).

Response

The purpose of CENPD-255 is to describe in general the methods and procedures for qualifying Class IE electrical equipment. The methods and procedures used in the determination of which equipment requires qualification are part of and included in the equipment and system level design process and are not within the scope of CENPD-255. No change to CENPD-255 wording is required.

Comment

The abstract of this document (CENPD-255) and Section 1.1 suggest that the scope (Section 3.07) and the methods (Section 5.0?) may be referenced, but that the rest of the document is not designed for reference. If this is true, Section 4.0 should simply describe the procedures for searching source documents to determine component inclusion and then give the general discussion that is presently included.

Response

The purpose of the abstract and Section 1.1 is to reference the entire CENPD-255 document. No further changes to the wording in CENPD-255 are necessary.

Comment

If this section is to be referenced, all items that are in NSSS designed systems (even those which are not to be supplied by C-E) which will require environmental qualification should be listed. If these systems have undergone modification or evolution separate lists will be required for different generations or every plant. Source documents should be referenced to make the lists traceable.

At the conclusion of the above listing, several components could then be used for examples and detailed qualification plans could be developed. The present format for discussion of equipment is so general and "typical" that it defies use in plant specific applications.

Response

Sec. 4.0 3rd and 4th Par.

The equipment scope of CENPD-255 is clearly defined in the abstract and in Section 1.1 stating that the methods and procedures presented herein apply only to C-E supplied Class IE electrical equipment. The plant specific equipment listing is found in the applicants S.A.R. It is planned to present a plant specific equipment listing at the E.Q. Audit.

The qualification plans of Appendix "C" & "D" have been replaced with a set of plans having more detail as requested.

Comments

Section 4.0 General

It should be noted that the list of N.S.S.S. equipment requiring qualification is found in the CESSAR FSAR Section 3.11.

If the methods and procedures that are used in compiling this list is beyond the scope of 255 a note to that effect should be included.

Response

The methods and procedures for establishing the class 1E equipment list as found in CESSAR FSAR Par. 3.11 is beyond the scope of CENPD-255.

No further wording will be added to CENPD-255.

Comments

Section 4.0

Comment — It was agreed at the 10-20-81 meeting that a general statement of criteria for inclusion in that list would be added to this section. The general criteria that was mentioned is listed below.

Response — The following paragraph has been added to Section 4.0:

Equipment requiring qualification is that equipment and systems that are essential to emergency reactor shutdown, containment and isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential in preventing significant release of radioactive material to the environment.

Comment

4.2 Isolators

Three of the four isolators discussed are stated for use in "some" applications and no specific uses are given. This suggests the possibility that there might be uses or isolators that might not be presently covered and that might miss out on plant qualification programs.

Response The word "some" has been deleted from CENPD-255 Sections 4.2.1 and 4.2.3 and 4.2.4.

Comment

4.2.3 Process Signals

The statement "Isolation...may be accomplished by using devices that have no feedback effects on the input signals" suggests one of the following.

- The other three listed isolators allow feedback from non-Class 1E circuits.
- Some process signals may be subject to feedback from non-Class 1E circuits.

In cases where interface with non-Class 1E circuits could have adverse effects, the failure modes must be identified to show justification for this situation.

Response

Class 1E isolators used to provide isolation between 1E and Non 1E equipment are designed and qualified to ensure that faults in the Non 1E equipment do not degrade the safety function of the Class 1E equipment. No revision to CENPD-255 required.

4.2.3.1

Comment — How many abnormal conditions of 8 HR. duration can be expected during the life of the equipment?

Response — In general, equipment of this nature is designed to survive abnormal environmental conditions for 1% of its total expected life. The number of 8 hour, abnormal environmental condition excursions expected during the life of the equipment will need to be defined by a specific utility.

Comment

4.2.4 Digital Isolation Device Assembly

"The absence of these signals would not result in the failure of any Class 1E equipment to perform its intended safety function". Does this include post-accident monitoring?

Response

The digital isolation device assembly is not used with post-accident monitoring systems. No revision to CENPD-255 required.

Comment

4.3 Nuclear Service Valves and Auxiliary Equipment

Paragraph two provides a list of equipment that "will be addressed in the applicant's plant specific SAR". Does this mean that these items are BOP or that they simply didn't want to include them here?

Response This equipment is in the balance-of-plant scope of supply and is not in the scope of CENPD-255. No revision to CENPD-255 is required.

Comment

4.3.1 Electric Valve Motor Operators for Nuclear Service Valves

Does the loss of the heater in Figure 4-7 affect the operation of the MOVs? Can the heater fail in a manner that would disable the valve?

Response

The heater shown in Figure 4-7 has been deleted. The valve heaters are not connected or used when the valve is in operation.

Comment

4.6.1 Location

"Most equipment located outside of containment would only be subjected to a seismic event." What about HELB, flooding, and LOCA (recirc) effects?

Response Proposed new wording added to Sec. 4.6.1.

If it is determined that a particular piece of equipment is located in an area that exposes it to a defined environmental condition (e.g. HELB, flooding, or radiation due to recirculation fluids), then these conditions will be incorporated into the qualification program.

The methods and procedures used to define such environmental conditions are not within the scope of this report. These methods and procedures are an integral part of and included in the equipment and system level design process and associated design documentation. No change to CENPD-255 wording is required.

Comment

4.6.5 Equipment Categorization

There is no block on Table 5-2 for category.

Response

The equipment category will be defined in the note block of Table 5-2. No change to CENPD-255 required.

Comment

5.0 NUREG 0588 does not allow operating experience, analysis, or ongoing qualification without partial type testing in support of each qualification method. While this is clarified further in the section, a statement to that effect should be included here.

Response This concern is addressed in Section 5.1.

Comment

5.1.2 TYPE TEST METHODS

(Last paragraph)

"For long term testing (more than 1 hr.) monitoring at discrete intervals is performed with justification provided."

This contradicts Section 5.1.4 g, h and also the intent of NUREG 0588 2.2(9). See also staff resolution to comments on NUREG 0588 2.2(9). The intent is to allow periodic checking of function when testing proceeds "round the clock".

Response

The following wording has been added to Section 5.1.2:
For long term testing greater than one day, monitoring at discreet intervals is performed with justification provided.

Comment

Radiation

"(Excess margin will be equal to or greater than the uncertainty in measured dose)".

Does this mean

Applied Margin = 10% + uncertainty

It should be so stated.

Response

The following wording added to Section 5.1.3.

Applied margin = 10 percent of accident dose plus uncertainty of measuring device, if significant.

Comment

5.1.3 MARGIN

TEMPERATURE

See review of Section 3.4.1.1 for discussion of Figure B-7.

Response

The following wording has been added to Section 5.1.3:

As stated in Section 3.4.1.1, Figures B7A and B7B define the environmental test profiles for in-containment equipment. The combined MSLB/LOCA profile of Figure B-7A has a 15°F temperature and 6 psig pressure margin added which is illustrated with a dotted line.

The saturation profile of B-7B has saturation temperature and corresponding pressure values of 290°F and 60 psig (round off incorporated) and is based upon the following typical pre-LOCA in-containment environmental conditions:

A. Temperature: 120°F
B. Relative Humidity: 50%
C. Pressure (total, steam + air): 14.7 psia

A 15°F temperature and corresponding 15 psig saturation pressure margin were added to the saturation temperature and pressure values resulting in the environmental test profile illustrated by the dotted line in Figure B-7B.

For equipment located outside containment a 15°F temperature margin was also added to the appropriate environmental test profile, as illustrated in Figures B-8 through B-11.

Pressure: +10 percent of gauge but not more than 10 psi. Exception for saturation profile, (15 psig margin). See previous discussion on temperature margin.

Comment TIME

GENERAL COMMENT

C.E. is attempting to generalize a method for time margins of less than one hour. NUREG 0588 3. (4) specifically requires a 1 hour minimum margin. Staff resolution to industry comments on this section says, in part:

"There may be some designs where less restrictive margins may be justified and found acceptable on a case-by-case basis."

Response Please see the re-worded Time and Unusual Time paragraphs of Section 5.1.3.

Comment

SPECIFIC COMMENTS

Page 5-5, 2nd paragraph

"In addition to the above two trips the following trips are to be qualified to operate for the entire envelope defined by the curve of Figure 5-1: Low Pressurizer Pressure Trip, Low Steam Generator Level Trip, and Low Steam Generator ΔP (Low Reactor Coolant Flow) Trip."

No mention is made of how these parameter's times to trip are calculated, and how those times relate to the curve of Figure 5-1. Sound practice would indicate that their trip times are under those postulated in Figure 5-1, but it is not so stated.

A suspicion remains that the opposite might be true, and the assumption has been made that, for example, the Low Pressurizer Pressure Trip is not needed beyond the times shown in Figure 5-1 because either the High Containment Pressure trip or the Low Steam Generator Pressure trip will have already actuated.

Response

The Low Pressurizer Pressure Trip, the Low Steam Generator Level Trip and the Low Steam Generator ΔP (Low Flow) Trip are not required past the times shown in the Figure because either the High Containment Pressure Trip or the Low Steam Generator Pressure Trip will have actuated. For certain conditions the former three trips will take a very long time to actuate, while a reactor trip will already have taken place. The Low Steam Generator Pressure Trip for break areas above 3 ft^2 and High Containment Pressure Trip for break areas below 3 ft^2 form a practical bounding time to trip for all five trip functions.

The "UNUSUAL TIME" response of our November 25th transmittal will be inserted on page 5-5. This response states (in part) that unusual time margins of less than one hour will be included in the test envelope where it is determined that the addition of a one hour time margin to the required operability time would result in an overtest that is damaging to the equipment.

Comment

Page 5-6, 1st paragraph.

"Guidance provided to the operators will reflect the extent of qualification of equipment to help ensure that they are not mislead by false indications."

This reviewer doubts that this is an adequate response to the "not mislead an operator" requirement. In the example stated, an operator is asked to ignore Low Steam Generator Pressure, High Containment Pressure, Low Pressurizer Pressure, Low Steam Generator Level and Low Steam Generator ΔP approximately 10 minutes after a D.B.E.

Response

The Core Protection Calculator-Low DNBR Trip and the High Linear Power Trip will be the only trips qualified to the limited time interval described in this paragraph. The Low Steam Generator Pressure, High Containment Pressure, Low Pressurizer Pressure, Low Steam Generator Level and Low Steam Generator ΔP Trips will be qualified for the entire envelope defined by the curve of Figure 5-1.

Comment

5.1.4 d — Add a statement including radiation or a reference to 5.3.1 where this is amplified.

Response — The following wording has been added to Section 5.1.4d:

Section 5.3.1 provides additional discussion regarding the methods and procedures utilized if accelerated age conditioning is required.

Comment

5.1.4.f Add "including mechanical and self induced vibration as required".

Response The following wording has been added to Section 5.1.4.f:

Where it is determined that significant levels of external or internally induced vibration exist, qualification will be demonstrated based upon the methodology presented in Section 3.4.3.

Comment

Page 5-10 following h.

A note here on submergence testing should be required. See NUREG 0588 2.2(5).

Response

The following wording has been added to Section 5.1.4.h:

Submergence testing,if applicable,will be performed following seismic testing per the methodology of Section 3.4.8.

Comment

Page 5-10 4th Paragraph

Typo - Section 4.6.4 should read 4.6.5.

Response Corrected.

Comment

Page 5-11 i) Performance testing and/or monitoring of operability status during (5) and (7) will be performed to the extent practicable."

During (7), safety functions must be monitored.
See IEEE 323, 1974 6.3.2(7) and NUREG 0588 2.2(9).

Response It is understood that performance testing and/or monitoring of operability status during seismic and DBA testing are required if the equipment is required to perform its safety function during those events.
The reason the phrase "to the extent practicable" is included in note "i" was that only limited monitoring may be achievable because of the limited seismic test duration.

No change to CENPD-255 required.

Comment

Page 5-11 last paragraph

This addressment of Class 1E motors should use IEEE Std. 334-1974 as its basis. IEEE Std. 334-1974 recognized in NUREG 0588 as an acceptable daughter standard demonstrating compliance with IEEE Std. 323-1974. In addition, IEEE Std. 334 is endorsed by Regulatory Guide 1.40. It also is noted that IEEE Std. 334-1974 uses IEEE Std. 117-1974, IEEE Std. 275-1966 and IEEE Std. 112A-1964 as references.

Response IEEE 334-1974 has been added to this paragraph.

Comment

5.1.6 Environmental Test Profiles

See review of Section 3.4.1.1 for discussion of Figure B-7.

Response

The following wording has been added to Section 5.1.6:

5.1.6 Environmental Test Profiles

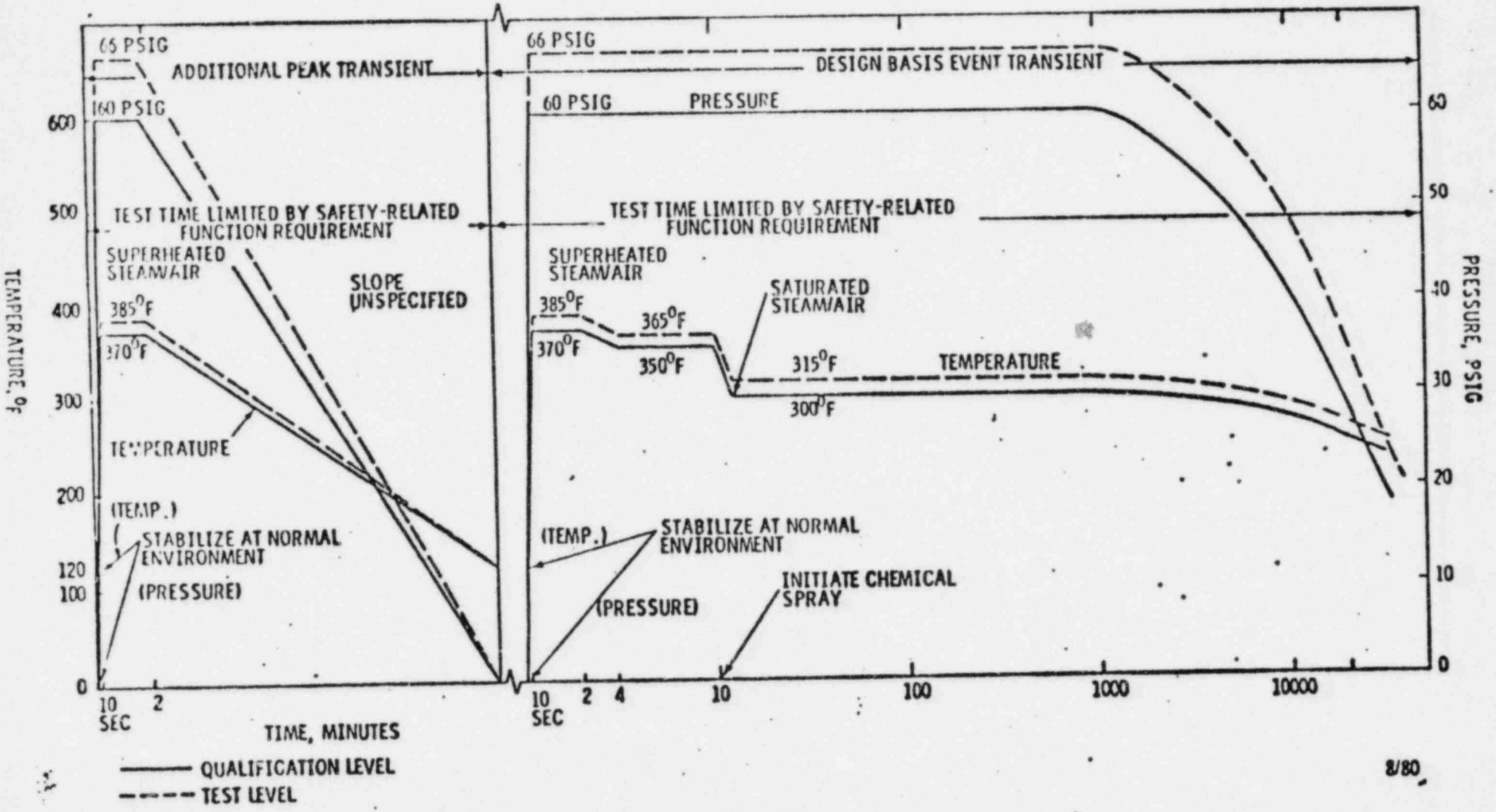
Typical test profiles for equipment which is required to perform a Class IE function during or after a design basis accident and which is located in the Containment Building are shown in Figure B-7A and B-7B. These profiles provide for margin requirments and include additional peak transients as required by IEEE Std. 323-1974, Section 6.3.1.5 and Appendix A. These profiles provide for establishing the design basis event peak transient environmental conditions, reducing to normal environmental conditions, then repeating the peak transient environmental conditions for the period of time over which the equipment is needed to perform its Class IE function. Equipment will be exercised or monitored for its Class IE function.

Typical test profiles for equipment located in non-harsh environments are provided in Appendix B, Tables B-8 through B-11. These profiles were developed based on normal and abnormal environmental conditions.

Equipment will be tested to the simultaneous temperature and humidity conditions for at least eight hours at the low and high temperature levels and at high humidity at normal temperatures.

Figure B-7A

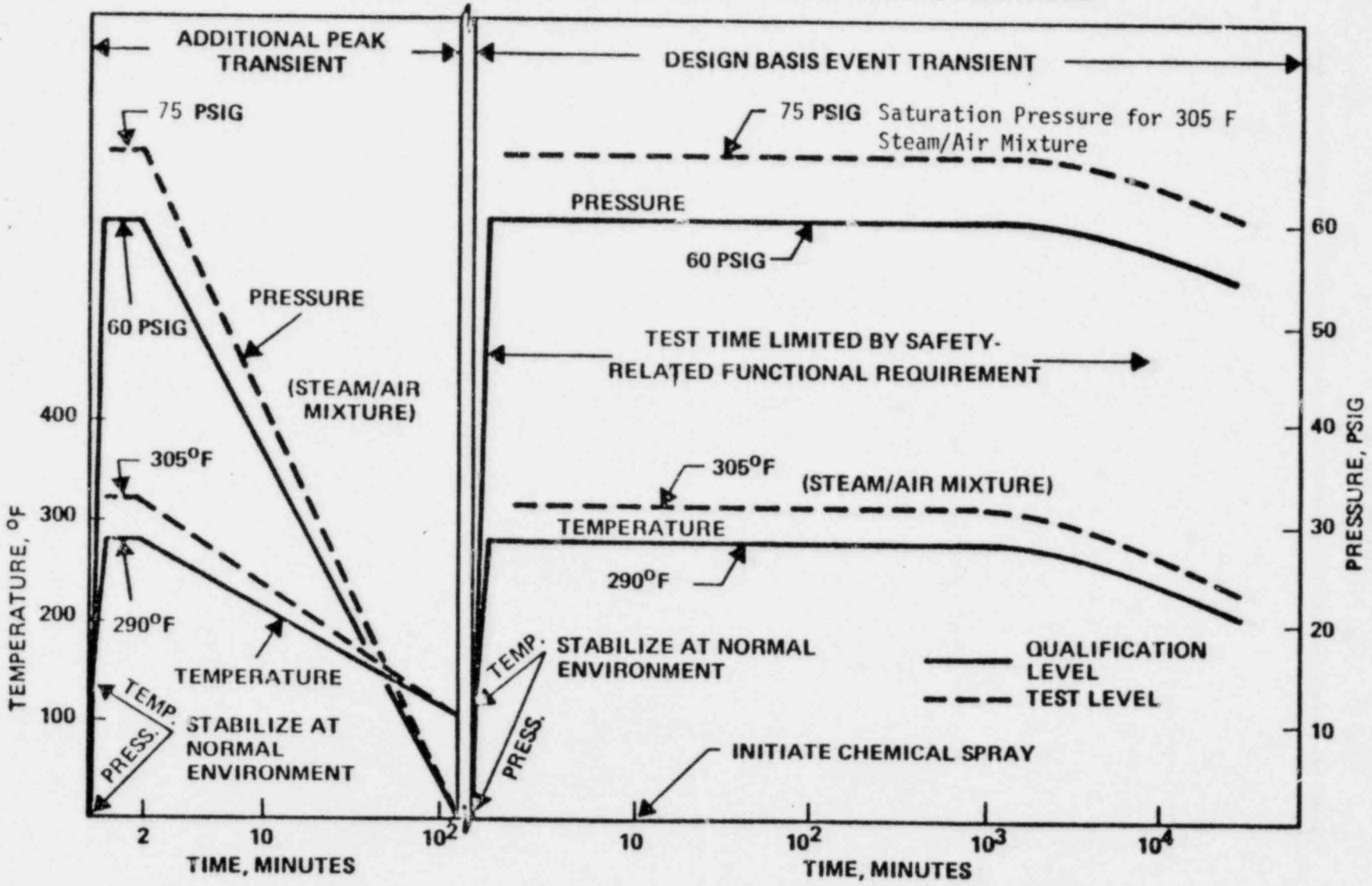
TYPICAL CONTAINMENT BUILDING ENVIRONMENTAL TEST PROFILE
FOR CATEGORY "A-1" AND "A-2" ENVIRONMENTAL CONDITIONS



8/80

Figure B-7B

TYPICAL CONTAINMENT BUILDING ENVIRONMENTAL TEST PROFILE
FOR CATEGORY "A-1", "A-2" AND "V-1" ENVIRONMENTAL CONDITIONS



Comment:
5.1.6 Environmental Test Profiles

Para. 2, Figures 8-8 through 11 (not Table)

Response: The word "Tables" will be deleted and the word "Figures" will inserted in the second paragraph of section 5.1.6 for consistentcy with the figures shown on Pages B25-B28 of Appendix B.

Comment

5.1.7 Acceptance Criteria

The first paragraph starts "Testing, and/or analysis...". This should be changed to read "Testing or testing and analysis..."

NUREG 0588 2.4 does not allow qualification by analysis without partial type testing to support that analysis.

Response This change has been made.

Comment

Page 5-18 last paragraph

Type - Section 9.2.1 should read Section 4.2.1.

Response This change has been made on Page 5-20.

Comment:

5.2.2 Environmental Conditions Calculations

Paragraph 2 should discuss all components in areas which could be influenced by ECCS fluids. Some components that are not part of the ECCS system might be affected.

Repsonse: The following wording has been added to paragraph 5.2.2:

Environmental Conditions Calculations

To ensure compliance with the requirements of Appendix A,B, and D of Reference 2.2 of CENPD-255, a review will be performed that evaluates the actual methods and codes used to calculate the environmental parameters for design basis events. Environmental condition verification is generally a joint activity between the customer, A/E and C-E.

Per the requirements of Section 1.4 (11) of Reference 2.2, components of the ECCS located outside containment will be qualified to withstand the radiation equivalent to that penetrating the containment and the circulating fluids passing through individual ECCS components. Equipment not associated with the ECCS but located in the same area will be addressed on a plant specific basis to meet the Radiation Qualification Requirements.

Comments

5.3.3 Surveillance/Preventative Maintenance

The last paragraph should include a statement that the data and evaluation from the S/PM program should become part of the central file either by inclusion in the equipment files or by reference.

Response: The last paragraph has been revised to reflect the above comment as shown in the paragraph below:

Data maintenance, storage in the central file and evaluation activities such as the surveillance/preventative maintenance program will be the responsibility of the utility.

It is not the scope CENPD-255 to define the methods, procedures or material to be incorporated in the Utilities Central File System. However, support will be provided to establish a Complete Central File.

Comment

6.1.4 Qualification Test Procedure

Section 6.1 references IEEE 323-1974 Section 8.0, which discusses documentation. Section 6.3.1.1 of IEEE 323 should be included as a reference for this Qualification Test Procedure section.

Response Section 6.3.1.1 of IEEE 323 has been included as reference in Section 6.1.

Comments

6.1.5 Qualification Test Report

The Qualification Test Report should also include test setup and test procedure (Reference 2.1, Section 8.3(4)(c) and (4)(d)).

It is almost essential for the persons actually preparing the Plans, Procedures and Reports in this section (6.0) to somehow be kept aware of the source documents (Reference 2.1 and 2.2) that support this section. This basic plan is very well thought out and should work well as long as the people involved are aware of the long-term documentation requirements and the importance of the "auditable" form requirement.

Response

The test setup and test procedure information are generally included in either the Qualification Plan or Qualification Procedure documents. Discussion of the test setup or testing procedures, other than verifying actual implementation of the planned approach, is normally not incorporated within the final test report, unless deviation from the planned approach is required.

Comments

7.0 QUALITY ASSURANCE
and
8.0 ADMINISTRATIVE PROCEDURES

One of these sections should include a discussion of turnover of information, from C-E to the customer, concerning maintenance of environmentally qualified equipment. This would involve, but is not limited to, the following:

1. Storage requirements prior to installation.
2. Handling and QA during installation.
3. Special installation requirements.
4. Baseline data required for on-going surveillance
5. Maintenance required to maintain the qualified status of the equipment.

Response

1. Storage requirements prior to installation:
   The revised wording has been added to ageing Section 5.3.1.
2. Handling and QA during installation of equipment are defined and accomplished by the utility and/or the architect engineer and are beyond the scope of CENPD-255.
3. Special installations (if any) are equipment specific and are addressed in installation drawings, equipment specifications and technical manuals and are beyond the scope of CENPD-255.
4. Baseline data (as defined in the aging analysis) for on-going surveillance of equipment is equipment specific and will be defined in the appropriate equipment qualification documentation and is beyond the scope of CENPD-255.
5. The manner and frequency of maintenance for qualified equipment is equipment specific and will be defined in the appropriate equipment specifications and specific qualification documentation.

Comment

APPENDIX A

TYPICAL CLASS IE ELECTRICAL EQUIPMENT AND DATA LISTING

This appendix should include all equipment that is listed in Section 4.0 and is shown in Figures 4-1 through 4-11. There should also be a direct correspondence between the component or module names used on this appendix and those given in Section 4.0. Frequently, the name given in the appendix cannot be found in Section 4.0. Examples of problems follow.

1. Section 4.1.4 on the CEA Position Indication system does not mention disconnects. Figure 4-4 shows a refueling disconnect panel. Table A-1 lists a CEA P.I. connector.

2. Section 4.1.2 on the NI system mentions signal processing drawers. Table A-1 lists an NI Signal Processor. Figure 4-2 shows Log Power and Linear Power Safety Channels.

3. The SSCCS, SSAS, and SSM are on Table A-1, but cannot be found in Section 4.0 or on Figures 4-1 to 4-11.

4. The isolators from Sections 4.2.1 and 4.2.3 are not on Table A-1.

5. The penetrations, cable, and junction boxes of Section 4.1.1 through 4.1.4 are not on Table A-1.

6. Due to problems with nomenclature (for examples see 1 and 2 above) it is difficult to locate items in 4.1.5 through 4.1.9 on Table A-1.

There also seems to be discrepancies with the Environmental Condition and Environmental Equipment Categories.

Both the NI Detector and Cable and the NI Pre-amp are in Condition Category (CC) "A2" (in containment, subject to MSLB) but the Detector and Cable are Equipment Category (EC) "1" (harsh, must function) and the pre-amp is EC "4" (non-harsh). The same thing occurs for the CEA P.I. Cable (A2, 1) and the connector (A2, 4).

Comment

APPENDIX A

The SPLA and pressure switch are both CC 'C' but the SPLA is EC '1' (harsh) and the Pressure Switch is EC '4' (non-harsh).

Due to the lack of correlation and the above inaccuracies, it is hard to see this appendix as a guide or as a sample. A smaller exact sample would be more effective.

Response

Appendix A, typical Class IE electrical equipment and data listing was revised to correct the inaccurancies and provide correlation between Appendix A, Section 4 and Figures 4-1 through 4-11.

Appendix A

Comment

A-1 Purpose

It is assumed by the reviewer that those components shown on figures 4-1 thru 4-11 and not noted in table A-1 are B.O.P. A note to that effect should be added here.

Response

Principal components of systems as shown on Figures 4-1 thru 4-11 are listed on Table 4-11 as revised to reflect the material in paragraphs 4.1.1 thru 4.4 and Figures 4-1 thru 4-11. Revised Table A-1 is attached to this response for your convenience. No further change to wording in 255 is necessary.

Comment

Table A-1

Nuclear Instrumentation System

Pre amp + filter shown on fig 4-2 to be inside containment, environmental cond. Category "A-2" but environ. equip category "4" the two are incompatible.

Response

Table A-1 was revised to reflect the correct category for the nuclear instrumentation system pre-amplifier and filter.

TABLE A-1

CLASS IE ELECTRICAL EQUIPMENT AND DATA LISTING

SYSTEM	MODULE OR COMPONENT	(12) (7) (1) (15) OPERATING REQUIREMENTS LOCA	MSLB	SEIS	SSD	(2) (15) LOCATION	(3) (15) ENVIR.COND. CATEGORY	(14) (15) ENVIR.EQUIP. CATEGORY	INTERFACE	NOTES REF. 255 PAR
Process Instrumentation Contained in Varied Systems	Process Dectors Signal Converter Panel Mounted Recorder Panel Mounted Indicator Isolation Device	Varies by Location and Design				Varies by Design Application	Varies by Design Application	Varies by Design Application		4.1.1
Nuclear Instrmentation System	Fission Chamber Detectors & Cable	x(8)	x	x		CB(4)	A2	1	(11)	4.1.2
	Pre-Amplifier & Filter	x(8)	x	x		CB(5)	A2	1	(11)	4.1.2
	Signal Processor for Log Power & Linear Power Safety Channels	x(8)	x	x		CR	H	4	(9) (10) (11)	4.1.2
Reactor Coolant Pump Speed Sensing System	Proximity Probe for Shaft Speed		x	x		CB(6)	A2	1	(11)	4.1.3
	Extension Cable		x	x		CB(6)	A2	1	(11)	4.1.3
	Pulse Transmitter		x	x		CB(5)	A2	1	(11)	4.1.3
	Signal Processor		x	x		CR	H	4	(9) (10) (11)	4.1.3
CEA Position Indicating System	Reed Switch Assy.& Cable		x	x		CB(4)	A2	1	(11)	4.1.4
	Refueling Disconnect Panel		x	x		CB(4)	A2	1	(11)	4.1.4
	Isolator		x	x		CR	H	4	(9) (10) (11)	
Plant Protection System Cabinet	Reactor Protection System	x	x	x	x	CR-AB	H	4	(9) (10) (11)	4.1.5
	Engineered Safety Features Actuation System	x	x	x	x	CR-AB	H	4	(9) (10) (11)	4.1.5
ESFAS Aux. Relay Cabinet	ESFAS Actuation Circuitry			x	x	CR	H	4		4.1.6

TABLE A-1

CLASS IE ELECTRICAL EQUIPMENT AND DATA LISTING

SYSTEM	MODULE OR COMPONENT	(12) (7) (1) (15) OPERATING REQUIREMENTS LOCA	MSLB	SEIS	SSD	(2) (15) LOCATION	(3) (15) ENVIR.COND. CATEGORY	(14) (15) ENVIR.EQUIP. CATEGORY	INTERFACE	NOTES REF. 255 PAR
DNDR/LPD Calculator System	CPC I/O Modules			x		CR	H	4		4.1.7
	CPC CPU and Memory			x		CR	H	4		4.1.7
	CEAC CPU and Memory			x		CR	H	4		4.1.7
	Signal Isolators			x		CR	H	4		
Supplementry Protection System	SPS Pressure XMTR.			x		CB(5)	B	1	(9)(10)(11)	4.1.8
	SPS Indicator			x		CR	H	4		4.1.8
	Supplementary Protection System Logic Assy.(SPLA)			x		CR	H	4	(9)(10)(11)	4.1.8
Remote Input Sub-System	RIS Isolation			x		CR	H	4		4.2.1
Various Systems	Digital Isolation Device Assy.	x	x	x	x	CR	H	4	(9)(10)(11)	4.2.4
Nuclear Service Valves in Various Systems as SIS, SCS, CSS, & CVCS	Electric Valve Motor Operators	x	x	x	x	CB,OC	V-1, V-2	1	(10)	4.3.1
	Electric Solenoid Process System Valves	x	x	x	x	CB,OC	V-1, V-2	1	(10)	4.3.2
	Electric Solenoid Operator Pneumatic Pilot Valves	x	x	x	x	CB,OC	V-1, V-2	1	(10)	4.3.3
	Electric Limit Switch for Open/Close Position Indicator	x	x	x	x	CB,OC	V-1, V-2	1	(10)	4.3.4

TABLE A-1

CLASS IE ELECTRICAL EQUIPMENT AND DATA LISTING

SYSTEM	MODULE OR COMPONENT	(12) (7) (1) (15) OPERATING REQUIREMENTS LOCA	MSLB	SEIS	SSD	(2) (15) LOCATION	(3) (15) ENVIR.COND. CATEGORY	(14) (15) ENVIR.EQUIP CATEGORY	INTERFACE	NOTES REF. 255 PAR
Nuclear Service Pump Motors in Various Systems CVSC, IRS, CSS & ECCS	High Pressure Safety Injection Pump	x	x	x		AB	D	1	(10) (13)	4.4.1
	Low Pressure Safety Injection Pump	x	x	x	x	AB	D	1	(10)	4.4.2
	Containment Spray Pump Motor	x	x	x		AB	D	1	(10)	4.4.3
	Charging Pump Motor		x	x	x	AB	D	1	(10) (13)	4.4.4
	Chemical Spray Addition Pump Motor	x		x		AB	D	1	(10)	4.4.5

Table A-1

Nuclear Instrumentation System

Pre amp + filter shown on fig 4-2 to be inside containment, environmental cond. Category "A-2" but environ. equip category "4" the two are incompatable.

Response

Table A-1 was revised to reflect the correct category for the nuclear instrumentation system pre-amplifier and filter.

Comment

Appendix B

B.2 Summary

Our initial comment is still not answered. Either change the paragraph or supply the figures that were used to define the 10 tables.

Response

The summary paragraph has been revised to reflect the initial EG&G comment, and to clarify that the ten tables were not derived from the Figures B-1 through B-6. Please see the following page for the proposed new wording.

Comment

APPENDIX B

TYPICAL ENVIRONMENTAL CONDITIONS AND TEST PROFILES

B.2 Summary

Paragraph 2 states that Table B-1 through B-14 are derived from Figures B-1 through B-6. With the exception of Figure B-3, all of these figures are inside containment. This means that 10 tables derived from it include radiation, pressure, humidity and spray for at least three different outside containment environments.

B.3 Environmental Conditions

An equipment location description that is more definitive than just inside or outside containment (out-of-doors, in the auxiliary building, control room, etc.) is required to make this section usable and understandable. This might also make it possible to coordinate the four normals with the eight abnormals.

1. Response

The purpose of Appendix "B" is to define Typical environmental conditions and associated environmental test profiles. Tables B-1 through B-14 were developed for the purpose of defining a limited set of clearly established environmental conditions that could be associated with specific equipment and/or locations. Appendix A correlates generic pieces of equipment with its corresponding environmental category designator.

Environmental conditions, as found in the Tables of Appendix B cannot be defined by location other than inside or outside containment because of the differences in plant design. As an example the environment of an auxiliary building at one plant may be different than that of another. Defining this would defeat the purpose of a generic qualification program document.

Comment

The two worst-case valve categories are confusing. They are not found in CESSAR-F, Section 3.11 and the reason for making special categories here is not shown.

2. Response

This comment is addressed in the revision of CESSAR-F Section 3.11.

Comment

Table B-2. This table is for MSLB inside containment but, for the pressure profile, references Figure B-2, which is LOCA pressure.

3. Response

Table B-2 has been revised, see attached sheet on following page. The MSLB pressure profile is to be same as LOCA pressure profile Figure B-2.

TABLE B-2

CATEGORY "A-2" ENVIRONMENTAL CONDITIONS
(MSLB: IN-CONTAINMENT)

ENVIRONMENTAL PARAMETERS	RANGE	DURATION
TEMPERATURE, °F	FIGURE B-4	0-12 MIN.
	FIGURE B-1 (AFTER 12 MIN.)	
PRESSURE, PSIG	SAME AS LOCA PROFILE FIGURE B-2	
HUMIDITY	SH STEAM/AIR MIXTURE	0-12 MIN.
	SAT. STEAM/AIR MIXTURE (AFTER 12 MIN.)	
RADIATION RADS	$4.5 \times 10^4 \gamma$ (TID)	
CHEMICALS	NOTE '1'	

NOTE 1 - 4400 PPM BORON AS H_3BO_3, 50-100 PPM HYDRAZINE AS N_2H_4 AND $_pH_4$ TO 10.

B.2 Summary

Our initial comment is still not answered. Either change the paragraph or supply the figures that were used to define the 10 tables.

Response

The summary paragraph has been revised to reflect the initial EG&G comment, and to clarify that the ten tables were not derived from the Figures B-1 through B-6.

Comment

Tables B-3 and B-4 - CESSAR-F. Table 3.11 B-2 is used as a reference even though it is not listed in Section 2.0. It should either be referenced in Section 2.0 or duplicated in this appendix.

Tables B-5 and B-6. The low-end temperature goes down to 55°F. CESSAR Table 3.11A-1 uses 60°F as a minimum.

Table B-10. The specified radiation dose is less than 10^3 Rads. CESSAR Table 3.11A-1 gives 10^4 Rads.

Figure B-1. This figure shows a 200° elbow at about 44 hours. CESSAR Figure 3.11A-1A shows this elbow at about 264 hours.

Figure B-4. This figure has a peak of 370°F. CESSAR Figure 3.11A-3 does not show a 370°F maximum. (This CESSAR figure is a duplicate of CESSAR Figure 3.11A-1A).

Figure B-6. This figure shows about one-half of Figure 3.11A-5 CESSAR values.

Response

Please see previous response to Appendix B.

This comment will be addressed in the revision of Section 3.11.

Comment

Tables B-5 through B-8. The note on these tables giving an eight-hour limit is confusing. Does it mean that plant shutdown is initiated after eight hours outside the normal band or that operating studies show that for the 50-year life less than eight hours are expected outside the normal band. For Table B-5, the eight and 24 hour specifications do not coordinate.

Response

The eight hour period was selected on the basis of engineering judgement as a reasonably conservative period for the plant operators to (1) recognize that actual conditions in the non-harsh environments have exceeded their normal values and to (2) restore those environments to within normal limits. Purchasers of these components will be informed that the period of assured operability in the abnormal environment conditions is 8 hours (based on testing) and that off-normal procedures should contain provisions for appropriate actions should it not be possible to restore normal environmental conditions within 8 hours.

Comment

Table B-5 B-8

Is this response going to be included in the text? It should be.

Also the number of expected abnormal incidents per year or over the lifetime of the equipment and how this relates to mild environment qualification should be mentioned.

Response

The eight hour explanation for Tables B-5 through B-8 has been included in Appendix B Par. B.2 "Summary Text."

Please see the response for Paragraph 4.2.3.1 for the response to the second paragraph above.

Comment

Figure B-7. This typical test profile is intended to envelope equipment in environments shown in Figures B-1 through B-6. The maximum test temperature is 305°F, which is to include 15°F for margin. The maximum temperature shown in Figure B-1 through B-6 is 370°F. This indicates that a test temperature including a 15°F margin would be at 385°F. The reviewer assumes that 290°F (the test temperature without margin) was derived as the saturation temperature for 60 psig. The reviewer also assumes that this was done in accordance with IEEE 323-1974, Section 6.3.1.5(1). This method was incorrect since this IEEE section applies to margin only, and then only in the case where saturated steam is to be used. In this case, the in-containment humidity is specified as superheated steam, which then forces a high temperature than saturation unless the higher pressure (to meet saturation for the required temperature) is used.

Response

See Section 3.4.1 write-up. Figure B-7 has been replaced with Figures B-7A and B-7B.

Response to verbal question on thermal equivalence methods.

Discussion of Thermal Equivalence

For Main Steam Line Break (MSLB) thermodynamic conditions C-E plans to qualify instrumentation in the following manner:

1) A spectrum of MSLB break areas will be analyzed. The conservatively calculated mass/energy (m/e) release to the containment from thhe affected SG will be modelled following the NRC approved methods of Appendix A of NUREG 0588. The SGNIII computer code will be used to determine the m/e release as a function of break size. CESSARF generic NSSS enveloping data will be used for this analysis.

2) The containment pressure/temperature (p/t) thermodynamic response to the m/e data will be conservatively determined for each case of 1) above. The NRC approved methods of Appendix B, part 1, NUREG 0588 will be used. Credit will be taken for the safety grade containment sprays in this analysis. The spray delay time and the spray rate will be conservatively modelled; these conservatisms are in addition to those required in Appendix B, Part 1, of NUREG 0588. C-E's NRC approved containment code (CONTRANS) will be used for the analysis. As appropriate, either plant specific data or enveloping data will be used for this analysis.

3) Each component to be tested will be modelled to conservatively determine its time dependent temperature. The containment p/t time dependent response for each MSLB area case will be used as a forcing function for this analysis. The heat transfer coefficients and the mode of heat transfer will be conservatively modelled using the NRC approved methods of Appendix B, part 2, NUREG 0588. A subroutine imbedded in the CONTRANS code will be used to rigorously solve the heat conduction equation for each component. The result of this calculation will be the time dependent surface temperature (Ts) of each component for each MSLB break area. The highest value of Ts (Txmax) will be used in determining the adequacy of a given thermal environmental qualification test profile; see (4), below.

4) C-E will test each component in a thermal environment (See (5), (6) and (7) below) which will heat the surface of the component to at least TSmax as defined in 3) above. Verification that the surface of the component has been heated to at least TSmax will be accomplished either by:

a) a conservative calculation which will minimize the heat flux to the component using the test profile as a forcing function, or

b) thermocouple measurements at the surface of the component, or

c) "soaking" the component in a saturated steam/air environment for at least 10 minutes.

5) C-E's experience with 1) through 4) above shows that most components are sufficiently massive such that the values of LOCA seldom exceed 290°F. 290°F has been chosen since it is conservatively representative of containment saturated steam/air conditions following a TSmax;this temperature and its associated pressure are shown in Figure 1. C-E will use this thermal profile for LOCA and MSLB related testing only where it can be demonstrated (using the methods described in 1 through 4 above) that this profile heats the component surface to at least TSmax.

6) If there are components for which testing via Figure 1 does not heat the component surface to at least TSmax, then these components will be tested in a harsher environment which will heat the component surface to at least TSmax.

7) There may be components which are only credited for safety analysis calculations for selected ranges of MSLB areas; for MSLB break areas outside the selected range, these components are not credited in safety analyses. For these components, TSmax will be determined by considering only the appropriate MSLB break area range. These components will be tested with a suitable environmental testing profile which will heat the surface of each component to att least TS max as determined by the narrower range of MSLB areas.

Comment

GENERAL OBSERVATION
APPENDIX "C" + "D"

While these Appendices are intended to be qualification plans, they are very general and inadequate to show an acceptable qualification program.

If an actual age conditioning report, a qualification test procedure, a qualification test report and a qualification data summary and evaluation package were to be made a part of CENPD-255, a much better example of how to qualify equipment would be achieved.

Response

As addressed in Paragraph C.1 Purpose ,the attached Qualification Plans are only outlines of plans to be used and should not represent detailed vendor prepared qualification plans.

The Age Conditioning Report; Qualification Test Procedure; Qualification Test Report and Summary are plant and equipment specific in nature and will be made available for E.Q. audit by the NRC.

No further change to CENPD-255 wording is necessary.

Comment

Appendix C

2nd Paragraph Pge 4/21 " for equipment inside containment LOCA".

Change LOCA to LOCA/MSLB

Response

Revised LOCA to LOCA/MSLB in 2nd Paragraph Page 4/21. See Section 1.0 of Appendix C for additional wording.

Comment

Appendix "C"

REF. 3.2 IEEE 323-1974 is IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations

Response

The correct IEEE Reference will be added to Reference 3.2 Appendix C.

Comment
4.1.2

No mention here of MSLB, yet App. A, CENPD 255 states that it is required for MSLB. Operability time is shown in Table 1 to be 70 min.

Response

See Section 4.0 in Appendix C for revised wording.

Comment

Appendix "C"

Page 14 of 21.

Is 70 min. the required operating time and does it include margin?

70 min. chem. spray duration incompatable with Figure 3, Chem. spray duration missing for pulse transmitter.

Response

10 minutes is the required operating time of Reactor Speed Sensing System during the MSLB. An additional 60 minutes is added to the 10 minute operational time to meet the 1 hr. margin Criteria.

Duration of Chemical Spray was changed to 60 min. to be compatible with Fig. 3 in Appendix C.

The 60 minute duration for Chemical Spray was added to the Table 1 Qualification Parameters for the Pulse Transmitter.

Please see the revised Table 1 of Appendix "C".

Comment 4.2.4

Appendix "C"
Which profiles in Ref. 3.4?

Response

The profiles B-7A and B-11, and Figures in Appendix "B" shall be added to 4.2.4 wording.

Comment 4.2.3

Appendix "D"

Specify which profile in Reference 3.3, what the appropriate voltage and frequency variations are, and what functional capabilities will be monitored.

Response

The profile as shown in Reference 3.3 Appendix "B" Figure B-10 is the applicable profile and is shown on Figure 3 in this Appendix.

The appropriate voltage and frequency variations and monitored functional capabilities are not within the scope of 255 as a Generic Document. However, the above information is furnished in test vendor qualification plans, test reports and specific design specifications.

Please see the revised Section 4.2.3 of Appendix "D".

Comment

Section 4.2.5.2

It is assumed that information supplied here will be used to simulate equipment on the R.S.P. Is this true?

Will accelerometer data at the point of attachment be compared with the seismic test data of the simulated equipment to establish its adequacy for this application?

Response

This information is to be used for determining dummy loads for actual equipment simulation during seismic testing.

The accelerometer data from the simulated equipment is compared to the actual equipment accelerometer data from its Generic Module curve to insure that seismic integrity is maintained.

Specific seismic information will be addressed by seismic test plans and reports as furnished to meet Qualification Criteria.

Please see Revised Section 4.2.5.2 of Appendix "D".

Comment
Section 4.2.2

Appendix "D"

A list showing what equipment in the R.S.P. is tested with the panel, what is qualified eslewhere, and where it is qualified, should be listed here.

Response

An equipment list for the remote shutdown panel is not within the scope of 255 "Appendix D". The above information is furnished by the Test Vendor Qualificaiton Plan, Test Reports and Design Specifications. This plan is intended to outline major areas of qualification to be completed and not intended to provide specific qualificaiton details.

No further change to wording in 255 is necessary.

ATTACHMENT 2

REVISED SECTION 3.11 TO CESSAR-F

3.11 ENVIRONMENTAL DESIGN OF MECHANICAL AND ELECTRICAL EQUIPMENT

The design criteria with respect to environmental effects on the electrical and mechanical equipment of the Reactor Protective System and the Engineered Safety Features System to ensure acceptable performance in all environments (normal and accident in harsh and non-harsh environment) depend upon equipment location and function. Such equipment is designed to meet its performance requirements under the environmental and operating conditions in which it will be required to function and for the length of time for which its function is required. As far as practical, equipment for these systems is located outside the Containment Building or other areas where adverse environmental conditions could exist. Compatibility of mechanical and electrical equipment with environmental condition is provided within the following design critera:

A. For operation under normal conditions the systems are designed to remain functional after exposure within the following ranges of environmental conditions:

1. Design temperatures maintained at the equipment location during normal operation by the ventilating and cooling system described in Section 9.4. Temperature ranges are given in Appendix 3.11A, Table 3.11A-1 thru 3.11A-14.

2. Relative humidity ranges are given in Appendix 3.11A, Table 3.11A-1 thru 3.11A-14.

3. Pressure ranges are given in Appendix 3.11A, Table 3.11A-1 thru 3.11A-14.

4. Maximum expected integrated radiation exposures for 40 years at the equipment location during normal operation are given in Appendix 3.11A, Table 3.11A-1 thru 3.11A-14.

B. In addition to the normal operation environmental requirements given in listing A above, the mechanical and electrical components required to mitigate the consequences of a design basis event (DBE) or to attain a safe shutdown of the reactor are designed to remain functional after exposure to the environmental conditions anticipated following the specific DBE which they are intended to mitigate. Anticipated environmental conditions and requirements are listed below.

1. The temperature, pressure, and humidity ranges following the design bases accidents such as the loss of coolant accident (LOCA), the main steam line break (MSLB), control element assembly ejection, or feedwater line break (FWLB), "Worst Case" combined (LOCA & MSLB) are indicated in Appendix 3.11A.

2. The time integrated post accident radiation doses are indicated in Appendix 3.11A. Equipment will be designed for the types and levels of radiation associated with normal operation plus the radiation associated with the limiting design basis accident (DBA). If more than one type of radiation is significant each type may be considered separately.

3.11.1 EQUIPMENT IDENTIFICATION AND ENVIRONMENTAL CONDITIONS

Appendix 3.11B lists and categorizes systems required to mitigate a DBE or to obtain a safe shutdown. Specific equipment and components for each system are discussed in the appropriate section of the safety analysis report as referenced in appendix 3.11B. The major component categories, such as motor-operated valves, pump motors, instrumentation and pressure boundary equipment in each system, and the location of the components by area are also provided.

3.11.2 QUALIFICATION TESTS AND ANALYSES

Qualification tests and analyses performed in accordance with the methodologies defined in CENPD 255 Rev. 03 on NSSS instrumentation and electrical equipment (including pump and valve motors and electrical accessories) fulfill the requirements of IEEE Standrd 323-1974, and "Category 1" of NUREG 0588. For mechanical equipment, environmental qualification is based on Engineering, Evaluation, and Material Selection where sufficiently reliable data is available.

3.11.2.1 Component Environmental Design and Qualification for Normal Operation

Equipment listed in Appendix 3.11B is designed for 40 years of continuous operation in the temperature, pressure, humidity, and radiation environment that exists at the equipment location during normal operation, assuming proper routine preventive maintenance is performed, such as periodic replacement of seals and packing.

Appendix 3.11A provides the ranges of the design temperatures, pressure, and humidities, as well as the exposures to chemical spray and radiation for each area in which safety-related equipment listed in Appendix 3.11B is located.

3.11.2.2 Component Environmental Design and Qualification for Operation After a Design Basis Event in Harsh and Non Harsh Environments

Equipment listed in Appendix 3.11B is designed to remain functional in the temperature, pressure, humidity, and chemical spray environment conditions that exist at the equipment location after the design basis LOCA. This equipment is also designed for the maximum calculated integrated radiation exposure after the design basis LOCA, as discussed in 3.11.5. The temperature, pressure, and humidity environment inside the containment after a LOCA is discussed in detail in Section 6.2.1.3. The containment spray characteristics are given in Section

6.2.2.1. The integrated post-accident radiation dose for those areas at which equipment is located is given in Appendix 3.11A. The temperature, pressure, and humidity environment inside the containment after a MSLB is discussed in detail in Section 6.2.1.4.

The requirement of the General Design Criteria, Appendix A to 10CFR50, are met as follows:

- Criterion 1 - Quality Standards and Records, refer to Section 3.1.1.
- Criterion 4 - Environmental and Missile Design Basis, refer to Subsection 3.1.4.
- Criterion 23 - Protection System Failure Modes, refer to Section 3.1.19.
- Criterion 50 - Containment Design Basis, refer to Section 3.1.43 and 6.2.1.

The requirements of the Quality Assurance Criterion III, Appendix B to 10CFR50 are met as discussed in the Design and Procurement Q.A. Program (See Chapter 17).

The recommendations contained in the documents discussed below, listings A through D, and other applicable Regulatory Guides and Standards have also been utilized.

A. Regulatory Guide 1.30, Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment.

B. Regulatory Guide 1.73, Qualification Tests of Electric Valve Operators Installed Inside and Containment of Nuclear Power Plants. A description of the tests and analysis by which active NSSS valves are qualified is provided in Section 3.9.2.2.

C. The qualification methods and documentation requirements of IEEE Standard 323-1974, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations and "Category 1" of NUREG 0588, are discussed in CENPD-255 Rev. 3 (Reference 1).

D. Pressure boundary components inside the containment are designed for the appropriate temperature and pressure environment in accordance with the applicable code to which the component is constructed.

Qualification testing is not considered necessary for such components.

RADIATION IN HARSH AND NON-HARSH ENVIRONMENT

Electrical Equipment will be designed for the types and levels of radiation associated with normal operation plus the radiation associated with the limiting Design Basis Accident (DBA). These levels are defined in Appendix 3.11A. If more than one type of radiation is significiant, each type may be applied separately.

Electrical Equipment which is exposed to radiation above 10^4 Rads will be irradiated to its anticipated Total Integrated Dose (TID) prior to type testing unless determined by analysis that radiation does not effect its ability to perform its required function. Where the application of the accident dose is planned during DBA testing, it need not be included during the aging process.

Electrical Equipment which will be exposed to radiation levels 10^4 Rads or below will be analyzed to be determined whether low level radiation could impact its ability to perform its required function.

Electrical Equipment will be qualified to the typical radiation environments defined in Appendix 3.11A, as required.

Gamma

Cobalt-60 is considered an acceptable gamma radiation source. Other sources may be found acceptable, and will be justified. Electrical Equipment will be tested to typical gamma radiation levels defined in Appendix 3.11A.

Beta

Electrical Equipment exposed to beta radiation will be identified and an analysis will be performed to determine if the operability of the equipment is affected by beta radiation ionization and heating effects. Qualification will be performed by test unless analysis demonstrates that the safety functiuon will not be degraded by Beta exposure. Equipment will be tested and/or analyzed to the beta radiation levels defined in Appendix 3.11A. Where testing is recommended, gamma equivalent radiation source will be used.

Neutron

Electrical Equipment exposed to neutron radiation will be identified and neutron radiation levels defined. When actual neutron dose qualification testing is not performed, an equivalent gamma radiation dose will be used for qualification testing to simulate neutron exposure. The basis for establishing an equivalent gamma radiation dose will be provided.

Paints/Radiation Effects

Electrical Equipment; an analysis will be performed addressing paint exposure to beta and gamma radiation, if required. Qualification of painted equipment will be by test if analysis indicates that the safety function of the equipment could be impaired by paint failure due to radiation.

Chemical Spray

After a postulated accident, such as the LOCA or MSLB, components located in the Containment Building may be exposed to a chemical spray from a solution used to remove iodine from the containment building atmosphere. Equipment will be environmentally tested to these conditions and performance requirements demonstrated during and after the test. The most severe spray composition will be determined by single failure analysis of the spray system. Corrosion effects due to long term exposure will be addressed, as appropriate.

Where qualification for chemical spray environment is required, the simulated spray will be initiated at the time shown in Appendix 3.11A.

Typical values of chemical spray composition, concentration and pH are defined in Appendix 3.11A, Tables 3.11A-1, 3.11A-2 and 3.11A-13.

3.11.3 QUALIFICATION TEST RESULTS

3.11.3.1 NSSS Instrumentation and Electrical Equipment

Qualification testing and analyses of NSSS Instrumentation and Electrical Equipment are discussed in Reference 1.

3.11.3.2 NSSS Mechanical Equipment

Qualification test results and analyses of NSSS Mechanical Equipment are provided in Section 3.9.2.2.

3.11.4 CLASS 1E INSTRUMENTATION LOSS OF VENTILATION EFFECTS

Loss of ventilation is discussed in the Applicant's SAR. Interface criteria are presented in Chapter 7.

Class 1E equipment which is located in the control room or similar areas includes the following:

Plant Protection System Cabinet (PPS)

Auxiliary Relay Cabinet (ARC)

Auxiliary Protective Cabinet (APC)

Main Control Panels

Process Instrument Cabinet

Other instrumentation, such as process transmitters and signal converters and the reactor trip switchgear system circuit breakers, are located in the Auxiliary Building or Containment Building. Equipment in these areas is qualified for the maximum expected temperature, radiation, humidity, and pressure under which the equipment is expected to operate.

The following are the normal and abnormal environmental conditions for which C-E Class 1E safety-related equipment is qualified to operate according to the service location of the equipment and the expected environmental condition.

Appendix 3.11A, Tables 3.11A-1 thru 3.11A-14 which define typical environmental conditions and associated environmental test profiles are defined in Figures 3.11A-6A thru 3.11A-10.

3.11.5 CHEMICAL SPRAY, RADIATION, HUMIDITY, DUST, SUBMERGENCE, AND POWERSUPPLY VOLTAGE AND FREQUENCY VARIATION

3.11.5.1 Chemical Environment

Engineered Safety Feature Systems are designed to peform their safety-related functions in the temperature, pressure, and humidity conditions described in Section 3.11.1 and Sections 6.2 and 6.3. In addition, components of ESF systems inside the containment are designed to perform their safety-related

functions in the presence of the existing chemical environment, resulting from the boric acid and hydrazine solutions recirculated through the Safety Injection System (SIS) and Containment Spray Systems (CSS). The SIS is designed for both the maximum and long-term boric concentration and pH. These chemical environment conditions are given in Appendix 3.11A.

3.11.5.2 Radiation Environment

The components in the Engineered Safety Feature and Reactor Protection Systems are designed to meet their performance requriements under the environmental and operating conditins in which they will be required to function and for the length of time for which their function is required. The components are designed to ensure acceptable performance under normal operational radiation exposure in addition to the single most adverse post accident environment. The normal operational exposures are based on the design source terms provided in Section 11.1 and Section 12.2. Radiation environments for those components for which the most adverse accident conditions are post LOCA are based on the source term assumptions consistent with Regulatory Guides 1.4 and 1.7. Radiation environments for those components for which the most adverse accident condition is other than the LOCA (wuch as the main steam line break, feedwater line break or CEA ejection) are based on conservative estimates of the fuel assembly gas gap activities and maximum Reactor Coolant specific activities as discussed in Section 11.1.

HUMIDITY

Equipment not subjected to steam environments during DBE testing will be environmentally tested to short term high humidity levels prior to operation and performance requirements demonstrated during and after the test. Equipment that is subjected to steam environments will be subjected to the appropriate test profiles in Appendix 3.11A.

DUST

Dust environments will be considered when establishing service conditions and qualification requirements. The potential effects of dust exposure will be evaluated relative to effects upon equipment safety function performance.

Where dust could have a degrading effect on equipment safety function performance, it will be addressed in the qualification program through the development of a maintenance program and/or an upgrading of equipment interface requirements.

SUBMERGENCE

Equipment locations and operability requirements will be reviewed to establish whether or not specific equipment could be subject to submergency during its required operating time. Flood levels both inside and outside containment will be reviewed and potential impacts on equipment qualification appropriately addressed. Where operability during submergency is required, qualification will be demonstrated by type test and/or analysis supported by partial type test data.

Power Supply Voltage and Frequency Variation

Power supply voltage and frequency variation is addressed in several areas throughout the equipment design and verification process. During the design process interface requriements dictate the acceptable range of power supply variation. Equipment specifications incorporate these interface requirements into the design to ensure acceptable operation within the defined range of power supply voltage and frequency variation. Upon equipment fabrication and completion, design verification tests are performed to demonstrate design adequency.

REFERENCES

1. "Qualification of Combustion Engineering Class 1E Instrumentation", CENPD-255 Rev. 3, Combustion Engineering, Inc., Windsor, Connecticut.

2. Griess, J. C. and Bacarella, A. L., "Design Considerations of Reactor Containment Spray Solutions", CRNL-TM-2412, Part III, Oak Ridge National Laboratory, Oak Ridge, Tennessee, December, 1969.

3. Kircher, J. F. and Bowman, R. E., "Effects of Radiation on Materials and Components", Van Nostrand Reinhold, New York, 1964.

APPENDIX 3.11A

TYPICAL ENVIRONMENTAL CONDITIONS AND TEST PROFILES

FOR

STRUCTURES AND COMPNENTS

APPENDIX 3.11A

TYPICAL ENVIRONMENTAL CONDITIONS AND TEST PROFILES

FOR

STRUCTURES AND COMPONENTS

This appendix defines the generic environmental qualification requirements for CESSAR scope structures and components. The requirements are given in categories which combine various locations and conditions of design for environmental qualification purposes.

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3.11A-1 DEFINITION OF ENVIRONMENTAL CONDITIONS AND PROFILES

The purpose of this appendix is to define typical environmental conditions and associated environmental test profiles.

SUMMARY

Figures 3.11A-1A through 3.11A-5 provide typical post accident environmental conditions. These figures are not "test" profiles and therefore do not include margin.

Tables 3.11A-1 through 3.11A-14 provide a series of tables titled "Category "XX"" Environmental Conditions". These tables were developed for the purpose of defining a limited set of clearly established environmental conditions that could be associated with specific equipment and/or locations. Appendix 3.11A utilizes and illustrates this approach by correlating a generic piece of equipment with its corresponding environmental category designator.

These tables do not define actual test conditions or parameters and therefore do not include margin.

Figure 3.11A-6A and 3.11A-6B are the in-containment test profiles that correspond to the post accident environmental conditions defined in Figures 3.11A-1A through 3.11A-5 and Tables 3.11A-1, 3.11A-2 and 3.11A-13. Both Figure 3.11A-6A and 3.11A-6B incorporate and illustrate required margin. For an explanation of the use of these profiles see Section 3.4.1 of CENPD 255, Rev. 03.

Figures 3.11A-7 through 3.11A-10 are test profiles for equipment located outside containment. These test profiles also incorporate margin.

The test profiles included herein represent "typical" examples of qualification test profiles and are not intended to represent the complete set of all test profiles utilized.

ENVIRONMENTAL CONDITIONS

A. Tables 3.11A-11 and 3.11A-2 list typical parameters for design basis accident conditions inside containment (Environmental Categories "A-1" and "A-2").

B. Table 3.11A-3 lists typical parameters for normal environmental conditions inside containment (Environment Category "B").

C. Tables 3.11A-4, 3.11A-11 and 3.11A-12 list typical parameters for normal environment conditions outside containment (Environment Categories "C", "J" and "K").

D. Tables 3.11A-5 through 3.11A-10 list typical parameters for abnormal environment conditions outside containment (Environment Categories "D", "E", "F", "G", "H" and "I").

E. Table 3.11A-13 lists typical "Worst Case" parameters for valves inside containment (Environment Category V-1).

F. Table 3.11A-14 lists typical "Worst Case" parameters for valves outside containment (Environment Category V-2).

G. Figures 3.11A-1A through 3.11A-5 provide profiles for typical post accident environment conditions.

H. Figures 3.11A-6A and 3.11A-6B represent simulated environmental profiles for equipment located inside containment, as appropriate (Environment Categories "A-1", "A-2" and "V-1").

I. Figures 3.11A-7 and 3.11A-8 represent simulated environmental conditions for equipment located outside containment, as appropriate (Environment Category "C").

J. Figures 3.11A-9 and 3.11A-10 will be used to simulate environment conditions for equipment located outside containment, as appropriate (Environment Categories "H" and "J").

TABLE 3.11A-1

CATEGORY "A-1" ENVIRONMENTAL CONDITIONS
(LOCA: IN-CONTAINMENT)

ENVIRONMENTAL PARAMETERS	RANGE AND DURATION
TEMPERATURE, ^{o}F	FIGURE 3.11A-1A
PRESSURE, PSIG	FIGURE 3.11A-1B
HUMIDITY	SUPERHEATED STEAM/ AIR MIXTURE
RADIATION, RADS	FIGURES 3.11A-4 AND 3.11A-5
CHEMICALS	NOTE '1'

NOTE 1 - 4400 PPM BORON AS H_3BO_3, 50-100 PPM HYDRAZINE AS N_2H_4 AND PH_4 TO 10.

TABLE 3.11A-2

CATEGORY "A-2" ENVIRONMENTAL CONDITIONS
(MSLB: IN-CONTAINMENT)

ENVIRONMENTAL PARAMETERS	RANGE	DURATION
TEMPERATURE, °F	FIGURE 3.11A-3	0-12 MIN.
	FIGURE 3.11-1A (AFTER 12 MIN.)	
PRESSURE, PSIG	SAME AS LOCA PROFILE FIGURE 3.11A-1B	
HUMIDITY	SH STEAM/AIR MIXTURE	0-12 MIN.
	SAT. STEAM/AIR MIXTURE (AFTER 12 MIN.)	
RADIATION, RADS	4.5×10^4 γ (TID)	
CHEMICALS	NOTE '1'	

NOTE 1 - 4400 PPM BORON AS H_3BO_3, 50-100 PPM HYDRAZINE AS N_2H_4 AND $P^{H}4$ TO 10.

TABLE 3.11A-3

CATEGORY "B" ENVIRONMENTAL CONDITIONS
(NORMAL: IN-CONTAINMENT)

ENVIRONMENTAL PARAMETERS	RANGE	DURATION
TEMPERATURE, °F	55 TO 122	CONTINUOUS
PRESSURE, PSIG	0-5	CONTINUOUS
HUMIDITY, %	20-90	CONTINUOUS
RADIATION, RADS (TID)	NOTE '1'	
CHEMICALS	NOT APPLICABLE	

NOTE 1 - DOSE VARIES WITH COMPONENT (SEE CESSAR-F, TABLE 3.11B-2)

TABLE 3.11A-4

CATEGORY "C" ENVIRONMENTAL CONDITIONS

ENVIRONMENTAL PARAMETER	RANGE	DURATION
TEMPERATURE, °F	55 TO 104	CONTINUOUS
PRESSURE, PSIG	0	CONTINUOUS
HUMIDITY, %	20-90 NOTE '1'	CONTINUOUS
RADIATION, RADS (TID)	NOTE '2'	
CHEMICALS	NOT APPLICABLE	

NOTE 1 - AT OR ABOVE 80°F, THE MOISTURE CONTENT IS THAT WHICH PRODUCES 90% RELATIVE HUMIDITY AT 80°F (DEWPOINT OF 77°F).

NOTE 2 - DOSE VARIES WITH COMPONENT (SEE CESSAR-F, TABLE 3.11B-2).

CATEGORY "D" ENVIRONMENTAL CONDITIONS

ENVIRONMENTAL PARAMETERS	RANGE OR MAXIMUM	DURATION
	104-150	4 HR.
TEMPERAUTRE, °F	104 TO 55	AFTER 4 HR.
PRESSURE, PSIG	0	ALL DURATION
HUMIDITY, %	20-90 NOTE '1'	NOTE '2'
RADIATION, RADS	4×10^6 γ (TID)	
CHEMICALS	NOT APPLICABLE	

NOTE 1 - AT OR ABOVE 80°F, THE MOISTURE CONTENT IS THAT WHICH PRODUCES 90% RELATIVE HUMIDITY AT 80°F (DEWPOINT OF 77°F). AT OR ABOVE 120°F, THE MOISTURE CONTENT IS THAT WHICH PRODUCES 90% RELATIVE HUMIDITY AT 120°F (DEWPOINT OF 116°F).

NOTE 2 - LIMITED TO 3 HOURS OUTSIDE THE NORMAL RANGE OF CATEGORY "C" UNLESS OTHERWISE SPECIFIED.

TABLE 3.11A-6

CATEGORY "E" ENVIRONMENTAL CONDITIONS

ENVIRONMENTAL PARAMETERS	RANGE OR MAXIMUM	DURATION
TEMPERATURE, °F	55 TO 330	0 - 3 MIN.
	104-55	AFTER 3 MIN.
PRESSURE, PSIG	3	0-3 MIN.
	0	AFTER 3 MIN.
HUMIDITY, %	100	0-3 MIN.
	NOTE '2'	AFTER 3 MIN. (NOTE '1')
RADIATION, RADS	$<10^3$ (TID)	
CHEMICALS	NOT APPLICABLE	

NOTE 1 - LIMITED TO 8 HOURS OUTSIDE THE NORMAL RANGE OF CATEGORY "C" UNLESS OTHERWISE SPECIFIED.

NOTE 2 - AT OR ABOVE 80°F, THE MOISTURE CONTENT IS THAT WHICH PRODUCES 90% RELATIVE HUMIDITY AT 80°F (DEWPOINT OF 77°F).

TABLE 3.11A-7

CATEGORY "F" ENVIRONMENTAL CONDITIONS

ENVIRONMENTAL PARAMETERS	RANGE	DURATION
TEMPERATURE, ^{o}F	FIGURE 3.11A-2 (NOTE '2')	
PRESSURE, PSIG	0	ALL DURATION
HUMIDITY	SAT. STEAM/AIR MIXTURE	NOTE '2'
RADIATION, RADS	NOTE '1'	
CHEMICALS	NOT APPLICABLE	

NOTE 1 - FOR UNCONTROLLED ACCESS AREAS 1×10^{4} γ (TID) AND FOR CONTROLLED ACCESS AREAS 4×10^{6} γ (TID).

NOTE 2 - LIMITED TO 8 HOURS OUTSIDE THE NORMAL RANGE OF CATEGORY "C" UNLESS OTHERWISE SPECIFIED.

TABLE 3.11A-3

CATEGORY "G" ENVIRONMENTAL CONDITIONS

ENVIRONMENTAL PARAMETERS	RANGE	DURATION
TEMPERATURE, ^{o}F	FIGURE 3.11A-2 (NOTE '1')	
PRESSURE, PSIG	0	ALL DURATION
HUMIDITY	SAT. STEAM/AIR MIXTURE	NOTE '1'
RADIATION, RADS	3.1×10^{4} γ (TID)	
CHEMICALS	NOT APPLICABLE	

NOTE 1 - LIMITED TO 8 HOURS OUTSIDE THE NORMAL RANGE OF CATEGORY "C" UNLESS OTHERWISE SPECIFIED.

TABLE 5.1.1A-9

CATEGORY "H" ENVIRONMENTAL CONDITIONS

ENVIRONMENTAL PARAMETERS	RANGE	DURATION
TEMPERATURE, ^{o}F	55 TO 104	NOTE '2'
PRESSURE, PSIG	0	ALL DURATION
HUMIDITY, %	20-90 NOTE '1'	NOTE '2'
RADIATION, RADS	$<10^3$ (TID)	
CHEMICALS	NOT APPLICABLE	

NOTE 1 - AT OR ABOVE $80^{o}F$, THE MOISTURE CONTENT IS THAT WHICH PRODUCES 90% RELATIVE HUMIDITY AT $80^{o}F$ (DEWPOINT OF $77^{o}F$).

NOTE 2 - LIMITED TO 8 HOURS OUTSIDE THE NORMAL RANGE OF CATEGORY "J" UNLESS OTHERWISE SPECIFIED.

TABLE 3.11A-10

CATEGORY "I" ENVIRONMENTAL CONDITIONS

(OUTSIDE PLANT BUILDINGS)

ENVIRONMENTAL PARAMETERS	RANGE	DURATION
TEMPERATURE, °F	-30 TO 122	NOTE '1'
PRESSURE, PSIG	0	ALL DURATION
HUMIDITY, %	100	NOTE '1'
RADIATION, RADS	$<10^3$ (TID)	
CHEMICALS	NOT APPLICABLE	

NOTE 1 - LIMITED TO 8 HOURS OUTSIDE THE NORMAL RANGE OF CATEGORY "K" UNLESS OTHERWISE SPECIFIED.

TABLE 3.11A-11

CATEGORY "J" ENVIRONMENTAL CONDITIONS

PARAMETERS	RANGE	DURATION
TEMPERATURE, ^{o}F	65 TO 85	CONTINUOUS
PRESSURE, PSIG	0	CONTINUOUS
HUMIDITY, %	40-60	CONTINUOUS
RADIATION, RADS	$<10^3$ (TID)	
CHEMICALS	NOT APPLICABLE	

TABLE 3.11A-12

CATEGORY "K" ENVIRONMENTAL CONDITIONS (OUTSIDE PLANT BUILDINGS)

ENVIRONMENTAL PARAMETERS	RANGE	DURATION
TEMPERATURE, ^{o}F	-30 TO 120	CONTINUOUS
PRESSURE, PSIG	0	CONTINUOUS
HUMIDITY, %	20-90 NOTE '1'	CONTINUOUS
RADIATION, RADS	$<10^3$ (TID)	
CHEMICALS	NOT APPLICABLE	

NOTE 1 - AT OR ABOVE 80°F, THE MOISTURE CONTENT IS THAT WHICH PRODUCES 90% RELATIVE HUMIDITY AT 80°F (DEWPOINT OF 77°F). AT OR ABOVE 120°F, THE MOISTURE CONTENT IS THAT WHICH PRODUCES 90% RELATIVE HUMIDITY AT 120°F (DEWPOINT OF 116°F).

TABLE 3.11A-13
CATEGORY "Y-1" ENVIRONMENTAL CONDITIONS
(WORST CASE: IN-CONTAINMENT): NOTE 3

ENVIRONMENTAL PARAMETERS		RANGE	DURATION
TEMPERATURE, °F	NORMAL	60 - 122	CONTINUOUS
	LOCA	FIGURE 3.11A-1A	
	MSLB	FIGURE 3.11A-3	0-12 MIN.
		FIGURE 3.11A-1A	AFTER 12 MIN.
PRESSURE, PSIG	NORMAL	0-5	CONTINUOUS
	LOCA	FIGURE 3.11A-1B	
	MSLB	FIGURE 3.11A-1B	
HUMIDITY, %	NORMAL	NOTE '1'	
	LOCA	SAT. STEAM/AIR MIXTURE	ALL DURATION
	MSLB	SH. STEAM/AIR MIXTURE	0-12 MIN.
		SAT. STEAM/AIR MIXTURE	AFTER 12 MIN.
RADIATION, RADS		1×10^8 (TID)	
CHEMICALS		NOTE '2'	

NOTE 1 - 95% RELATIVE HUMIDITY (RH) AT 60 TO 80°F. FOR 80°F TO MAXIMUM TEMPERATURE FIXED MOISTURE CONTENT IS EQUIVALENT TO 95% RH AT 80°F

NOTE 2 - 4400 PPM BORON AS H_3BO_3, 50-100 PPM HYDRAZINE AS N_2H_4 AND P^H 4 TO 10.

NOTE 3 - COMBINED "WORST CASE" CONDITION FOR NORMAL/LOCA/MSLB ENVIRONMENTS.

TABLE 3.11A-14

CATEGORY "Y-2" ENVIRONMENTAL CONDITIONS
(WORST CASE: OUTSIDE CONTAINMENT): NOTE 2

ENVIRONMENTAL PARAMETERS		RANGE	DURATION
TEMPERATURE, °F	NORMAL	60-104	CONTINUOUS
	LOCA	FIGURE 3.11A-2	
	MSLB	60-330	0-3 MIN.
		FIGURE 3.11A-2	AFTER 3 MIN.
PRESSURE, PSIG	NORMAL	0	CONTINUOUS
	LOCA	0	ALL DURATION
	MSLB	3	0-3 MIN.
		0	AFTER 3 MIN.
HUMIDITY, %	NORMAL	NOTE '1'	
	LOCA	SAT. STEAM/AIR MIXTURE	ALL DURATION
	MSLB	SAT. STEAM/AIR MIXTURE	ALL DURATION
RADIATION, RADS		5×10^7 (TID)	
CHEMICALS		NOT APPLICABLE	

NOTE 1 - 95% RELATIVE HUMIDITY (RH) AT 60 TO 80°F. FOR 80°F TO MAXIMUM TEMPERATURE FIXED MOISTURE CONTENT IS EQUIVALENT TO 95% RH AT 80°F.

NOTE 2 - COMBINED "WORST CASE" CONDITION FOR NORMAL/LOCA/MSLB ENVIRONMENTS.

Figure 3.11A-1A

TYPICAL CONTAINMENT ATMOSPHERE TEMPERATURE CONDITION FOLLOWING LOCA

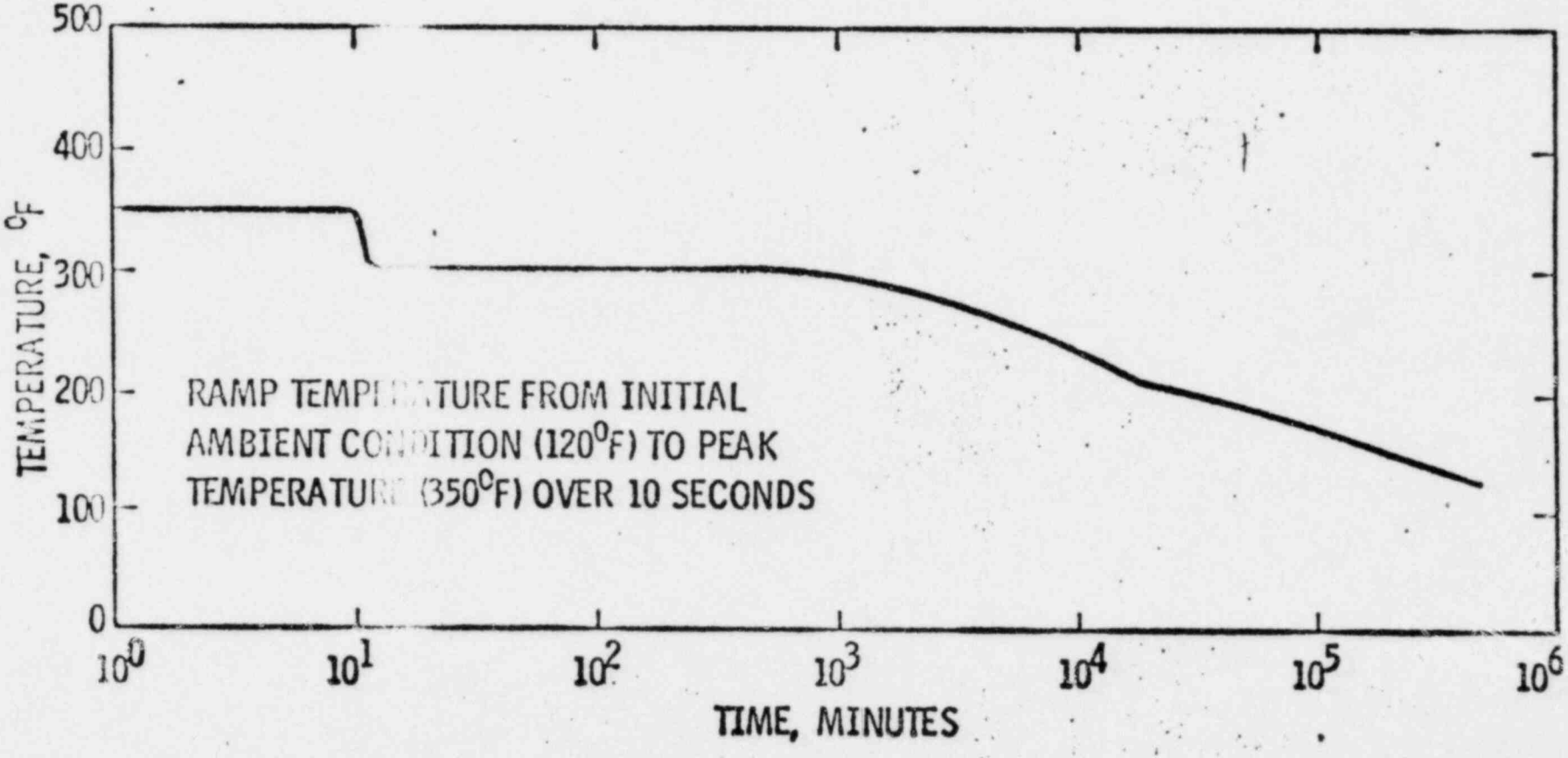


FIGURE 3.11A-1B

TYPICAL CONTAINMENT ATMOSPHERE PRESSURE CONDITION FOLLOWING LOCA

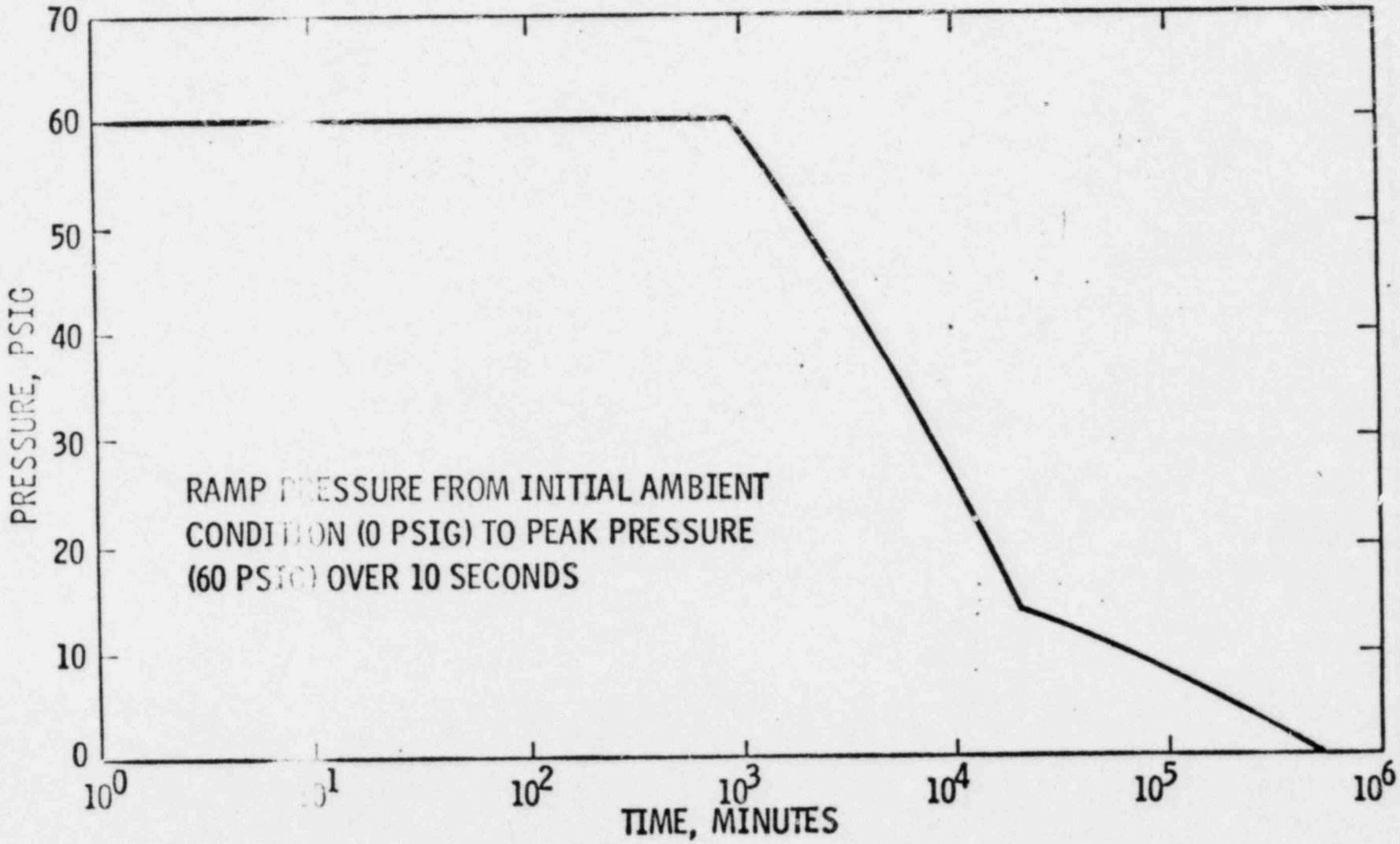


FIGURE 3.11A-2

TYPICAL ANNULUS ATMOSPHERE TEMPERATURE CONDITION
FOLLOWING LOCA/MSLB

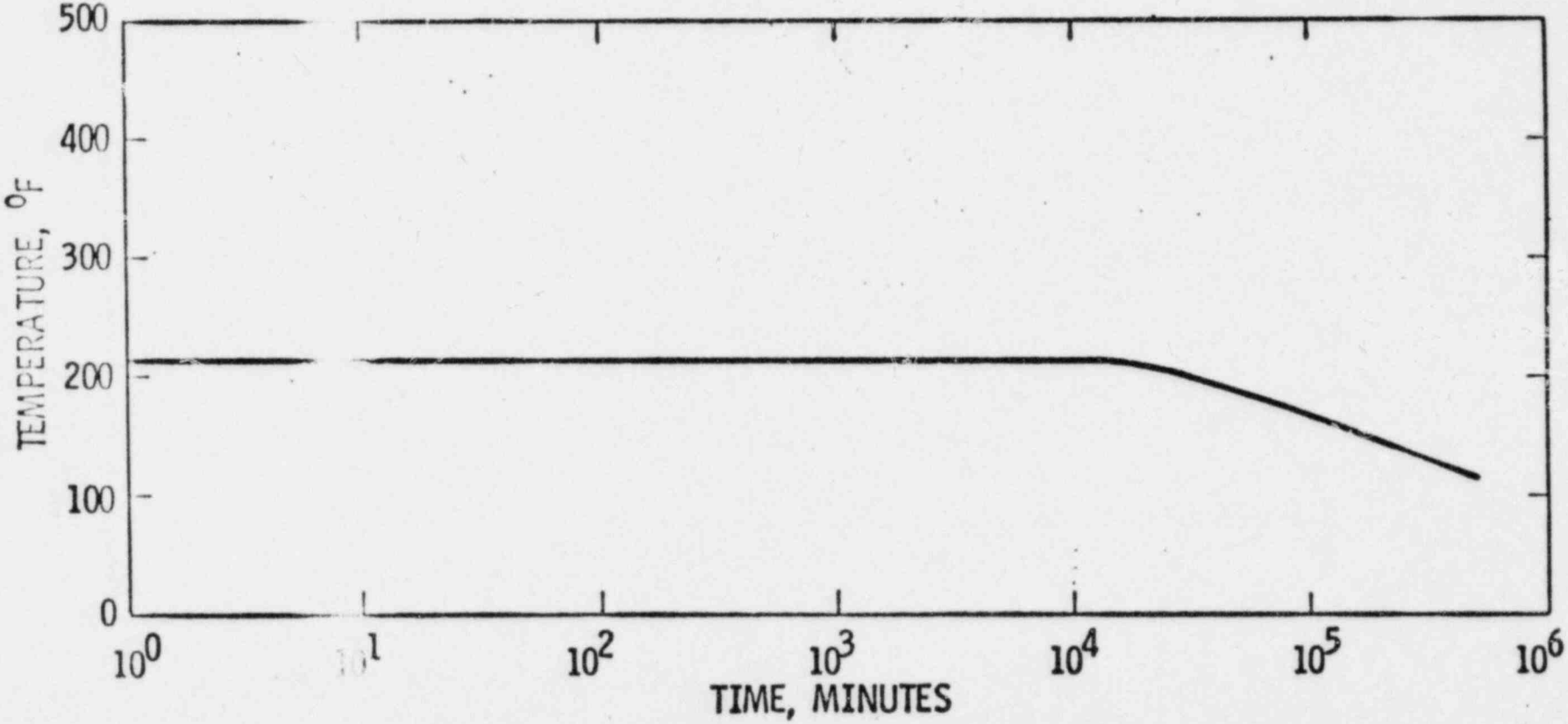


FIGURE 3.11A-3

TYPICAL CONTAINMENT ATMOSPHERE TEMPERATURE CONDITION FOLLOWING MSLB

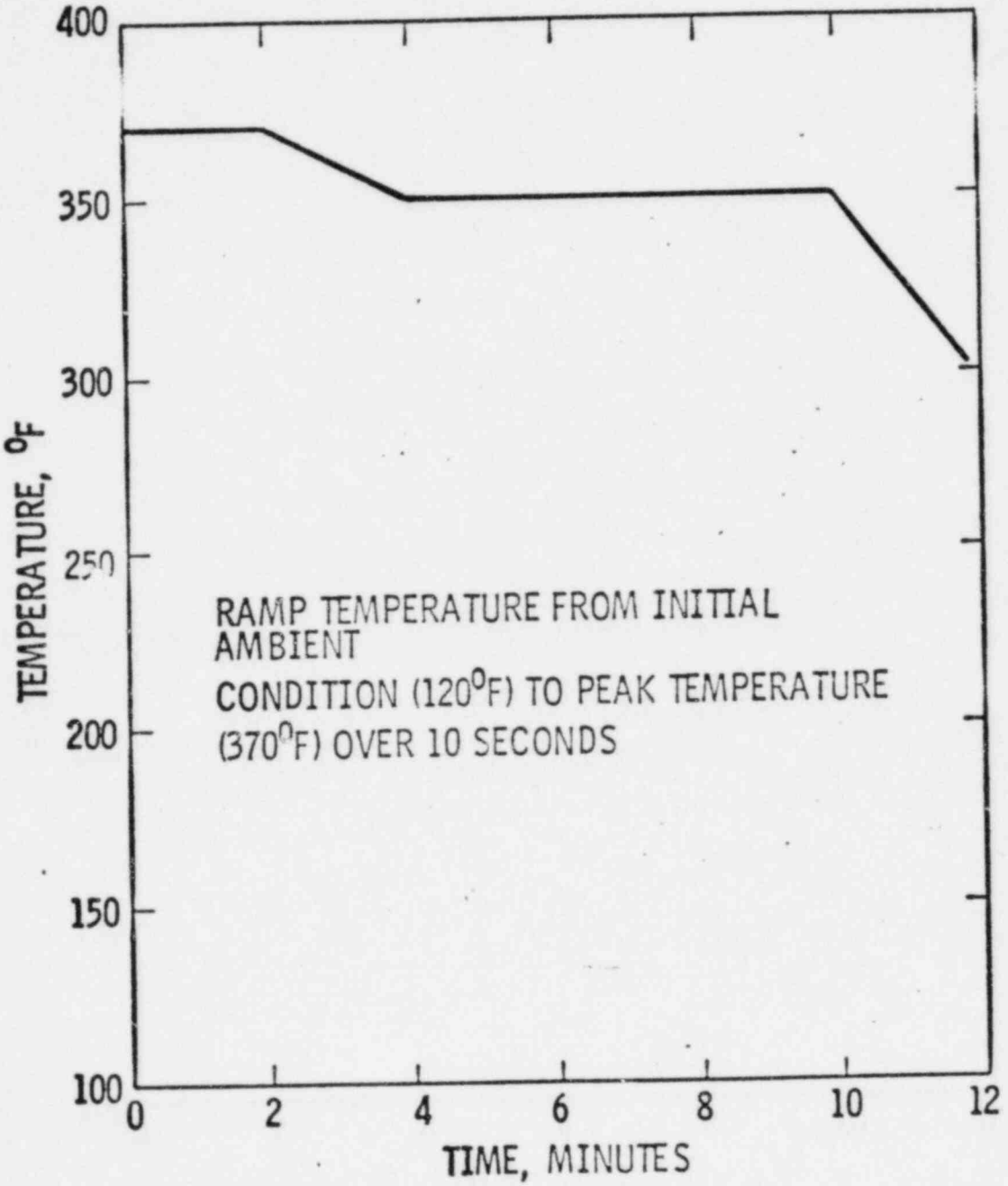


FIGURE 3.11A-4

TYPICAL CONTAINMENT RADIATION DOSE FOLLOWING LOCA

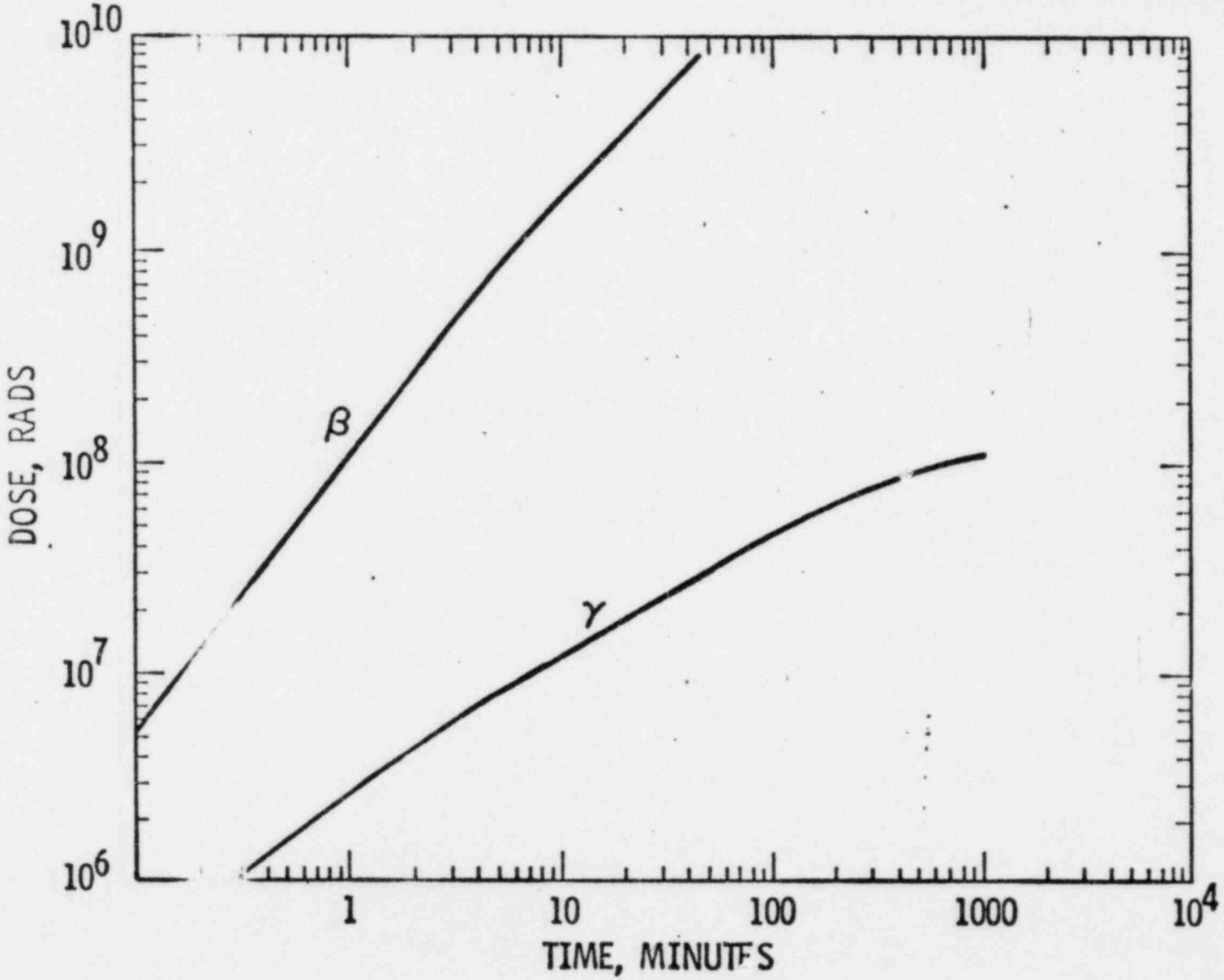


FIGURE 3.11A-5

TYPICAL CONTAINMENT GAMMA DOSE RATE FOLLOWING LOCA

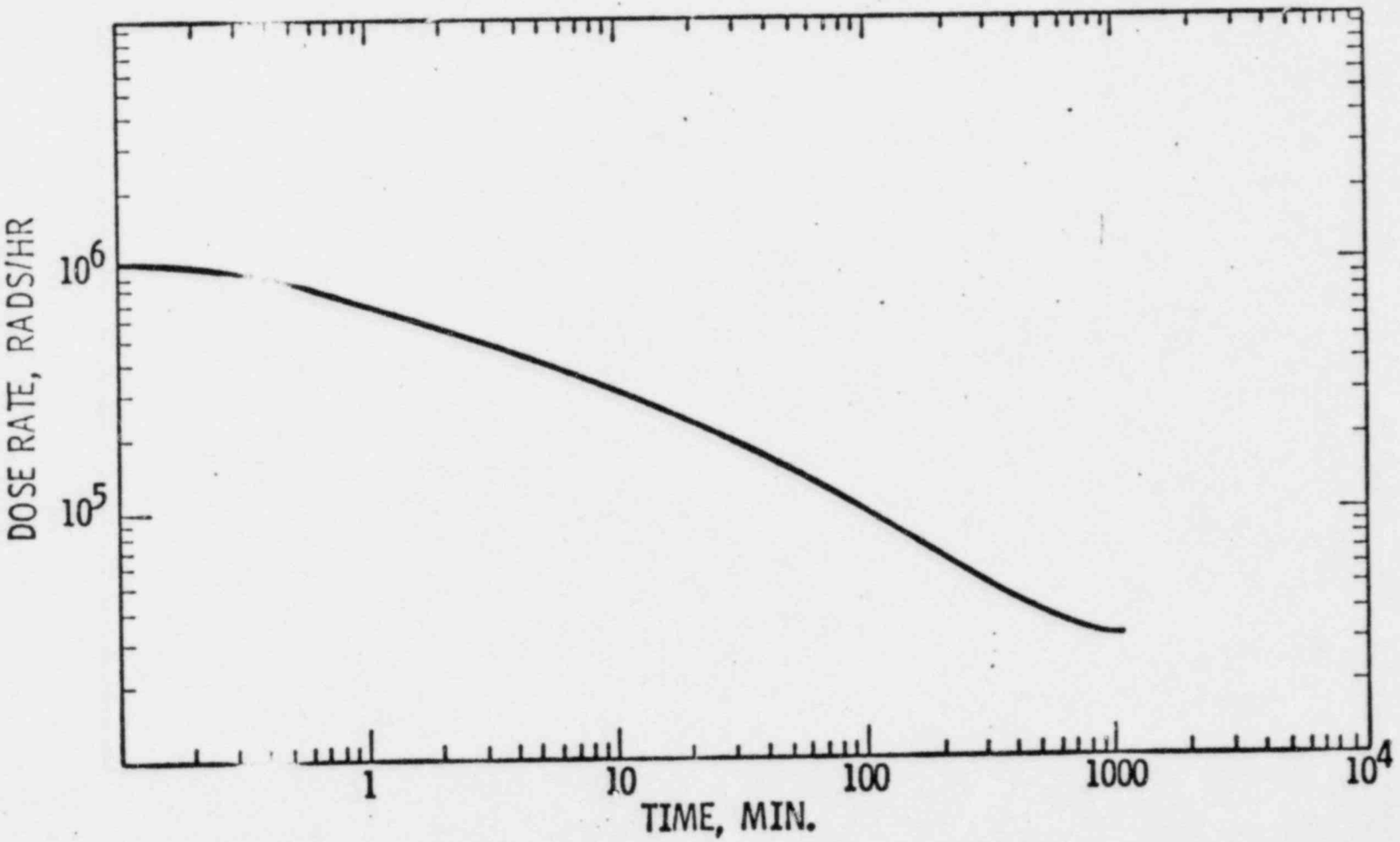


FIGURE 3.11A-6A

TYPICAL CONTAINMENT BUILDING ENVIRONMENTAL TEST PROFILE
FOR CATEGORY "A-1","A-2"AND "V-1" ENVIRONMENTAL CONDITIONS

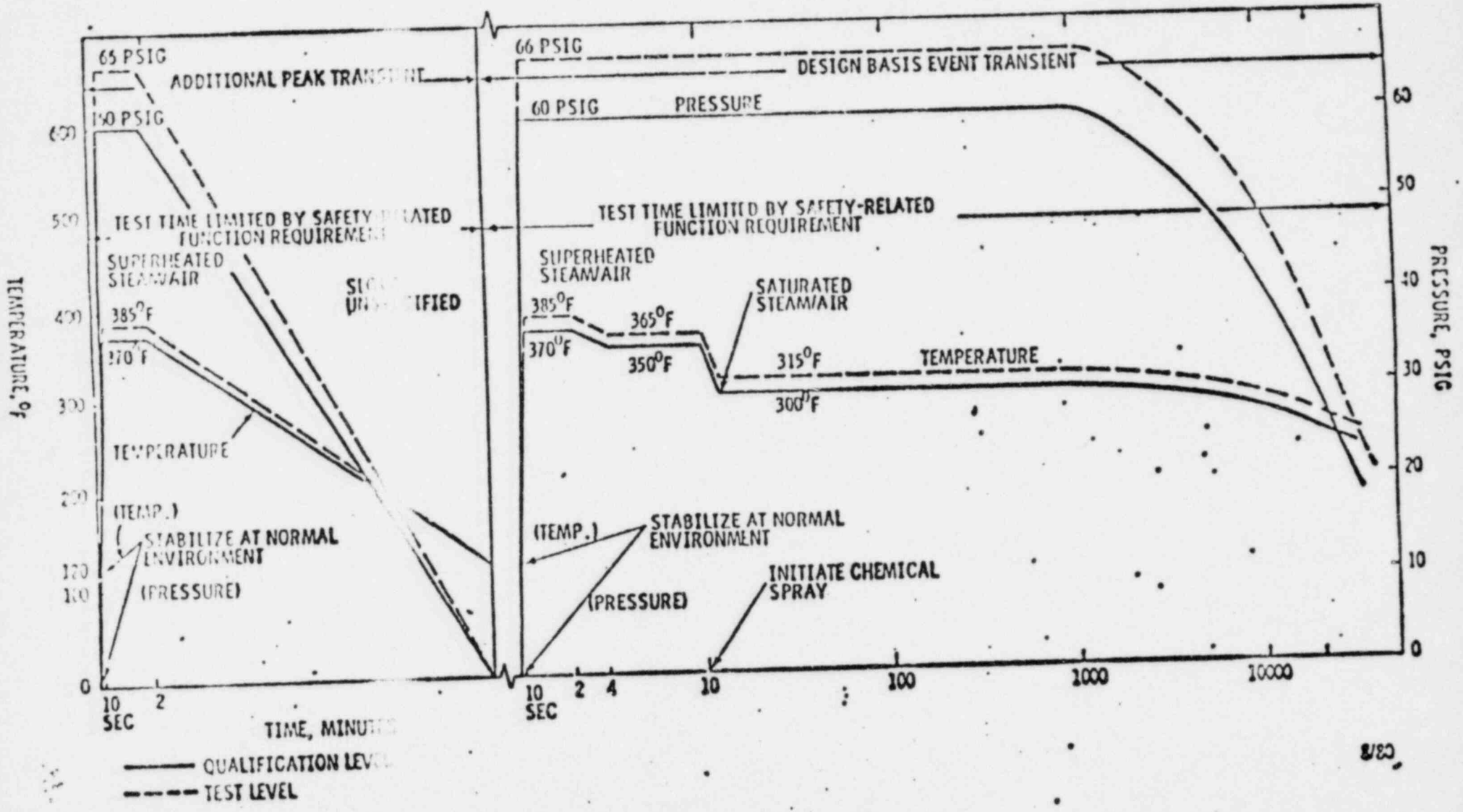


FIGURE 3.11A-6B

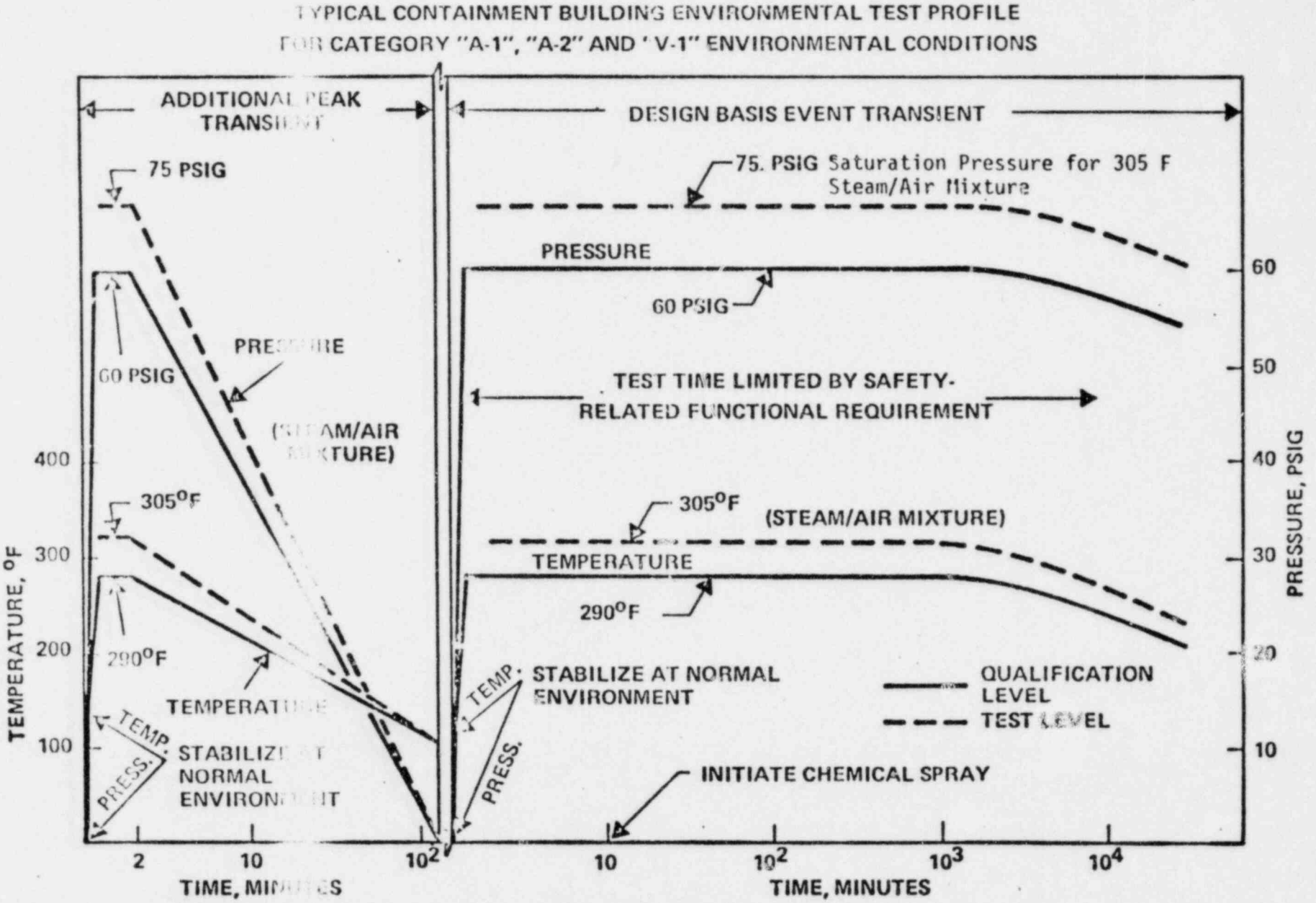


FIGURE 3.11A-7

TYPICAL ENVIRONMENTAL TEST PROFILE FOR CATEGORY "C" ENVIRONMENTAL CONDITIONS

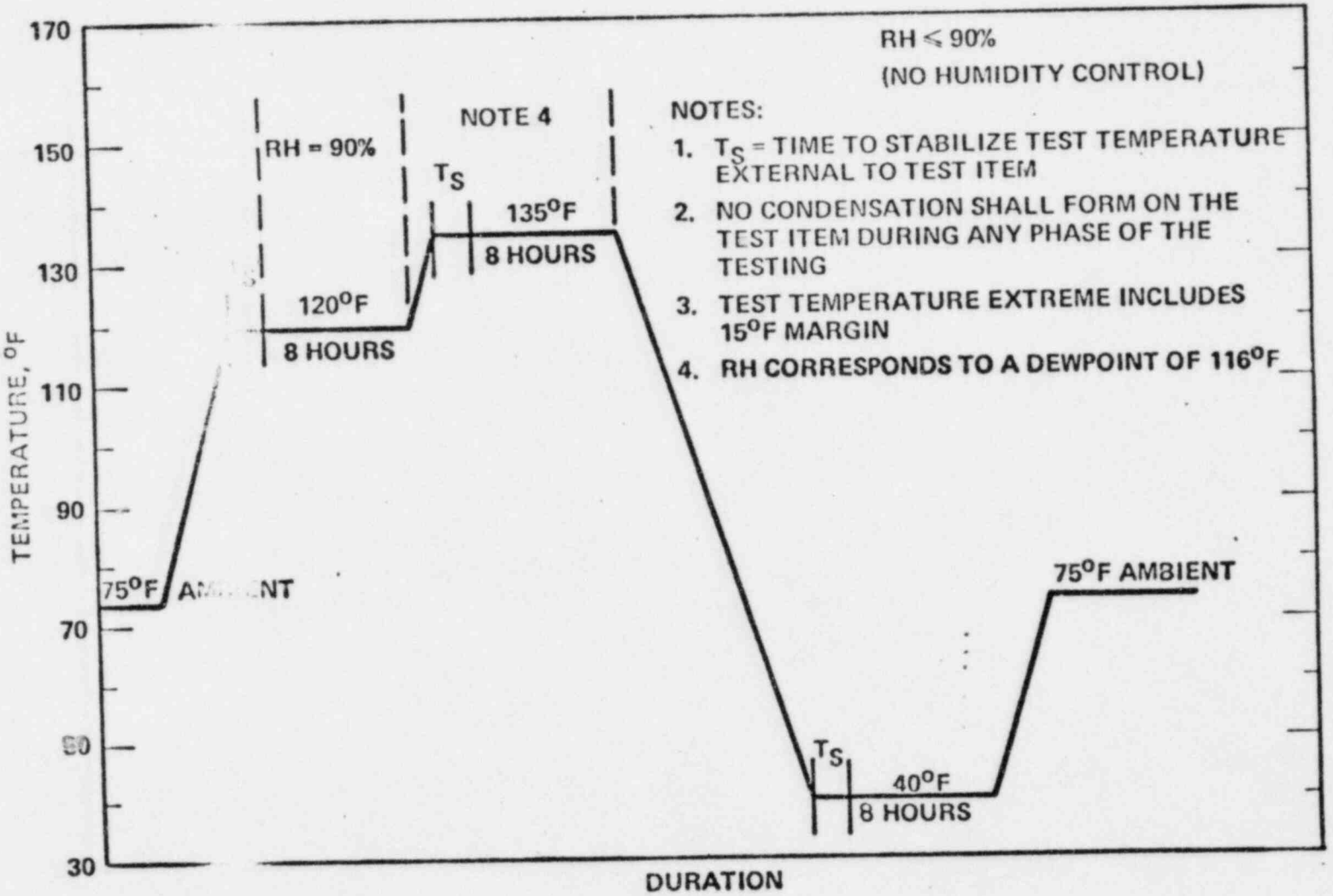


FIGURE 3.11A-8

TYPICAL INSIDE CABINET ENVIRONMENTAL TEST PROFILE FOR CATEGORY "C"
ENVIRONMENTAL CONDITIONS

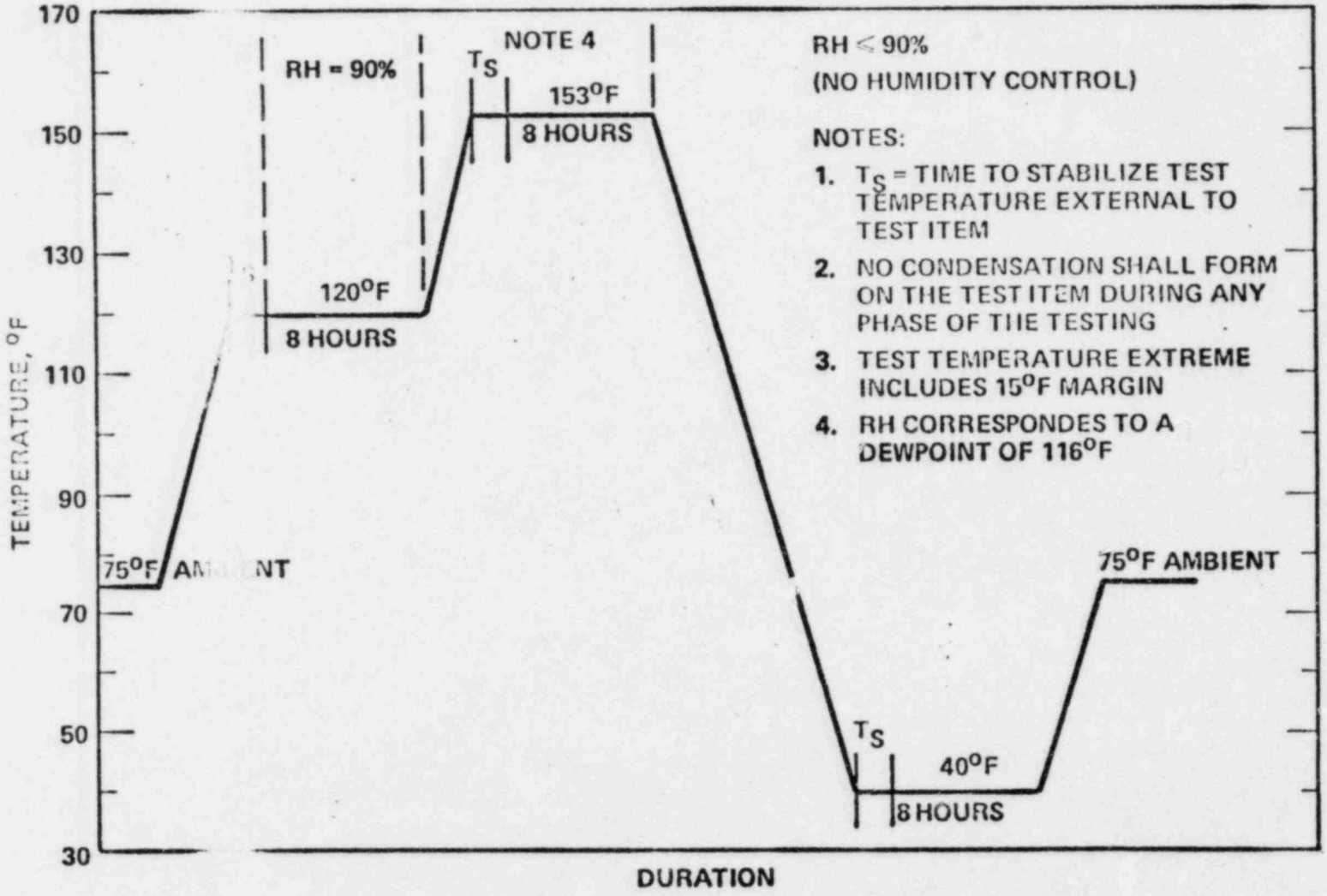


FIGURE 3.11A-9

TYPICAL ENVIRONMENTAL TEST PROFILE FOR CATEGORIES "H" AND "J"
ENVIRONMENTAL CONDITIONS

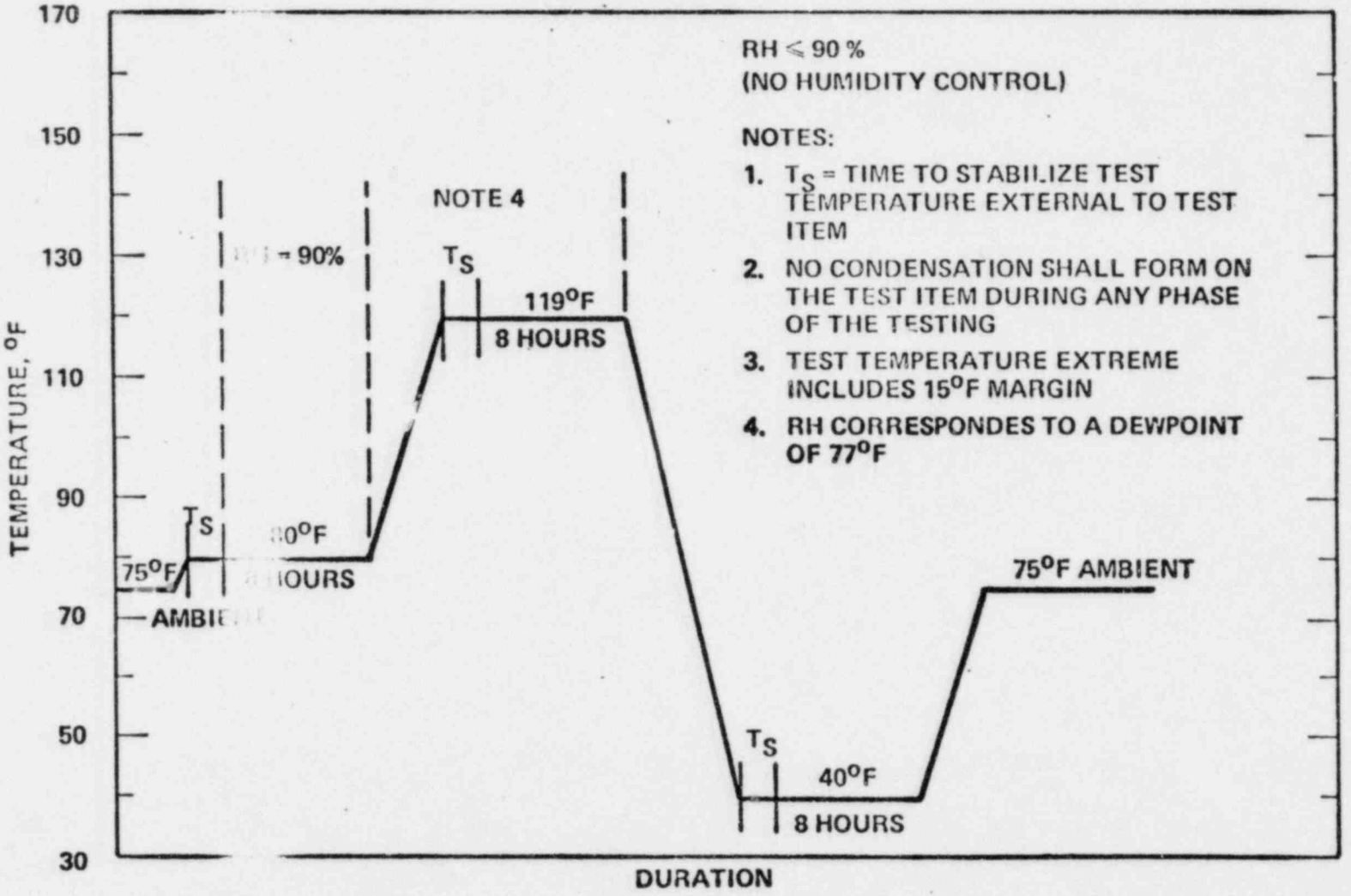
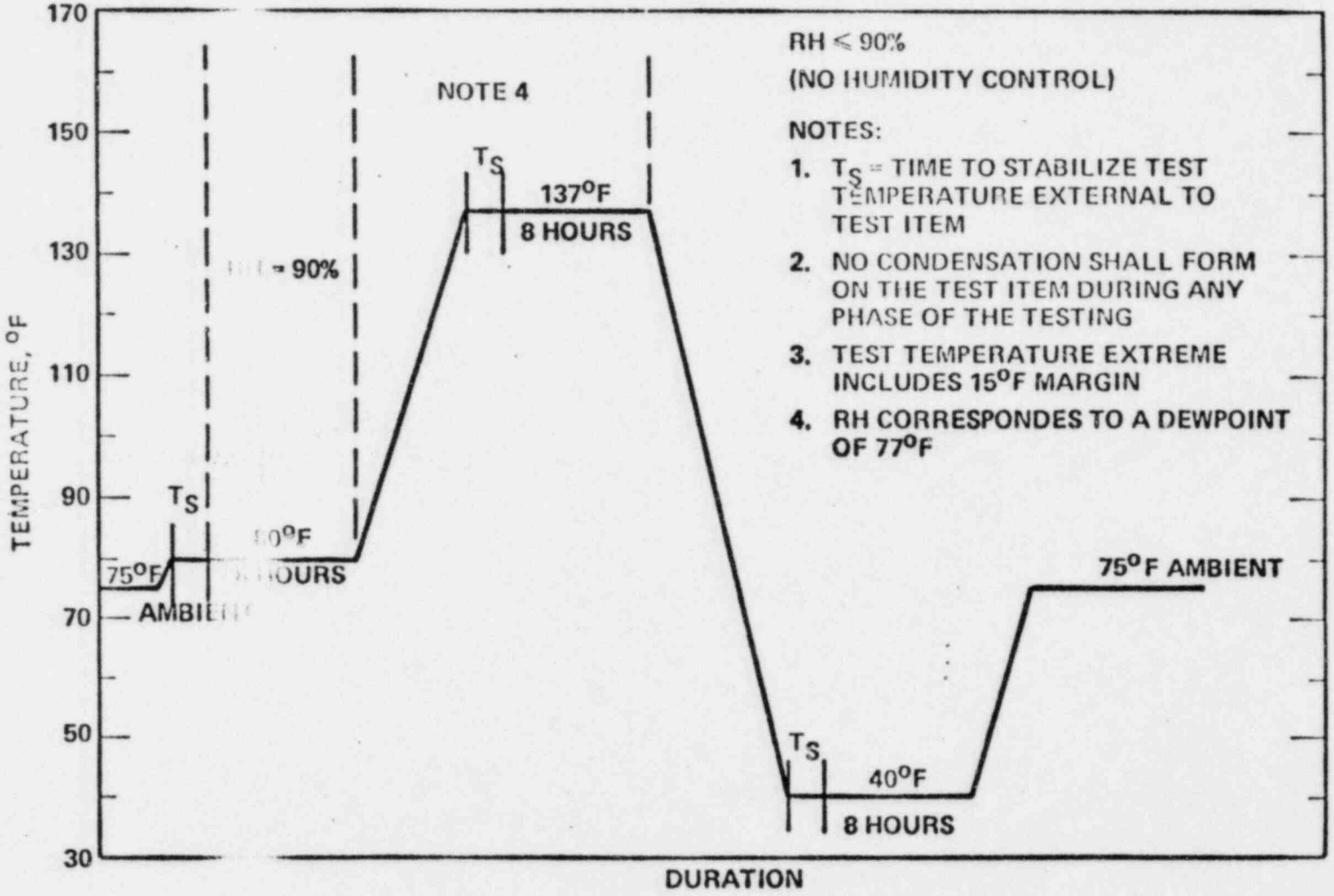


FIGURE 3.11A-10

TYPICAL INSIDE CABINET ENVIRONMENTAL TEST PROFILE FOR CATEGORIES "H" AND "J" ENVIRONMENTAL CONDITIONS



ATTACHMENT 3

REVISION 3 TO CENPD-255

QUALIFICATION OF CLASS IE EQUIPMENT