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POWER SYSTEMS

Docket No.: STN 50-470F

May 10, 1983
LD-83-045

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

Subject: Open Items 1 and 4, Revised Section 3.11 of CESSAR-F

Reference: Letter LD-82-063, A. E. Scherer to D. G. Eisenhut, dated July 1, 1982

Dear Mr. Eisenhut:

Section 3.11 of CESSAR-F, "Environmental Design of Mechanical and Electrical Equipment", describes the Combustion Engineering methodology for the environmental qualification of mechanical and electrical equipment required to mitigate the consequence of a design basis event or to attain a safe shutdown condition. Based on discussions with the NRC Staff reviewer and the reviewers of CENPD-255, "Class 1E Qualification", at EG&G Idaho, we have revised Section 3.11 to incorporate information necessary to resolve outstanding concerns. Our revised Section 3.11 is attached for Staff review.

The three areas of concern identified were (1) the treatment of radiation qualification below 10^4 rads, (2) the treatment of aging, and (3) distinction between sections that addressed electrical, mechanical or both types of equipment. The attached revision contains additional information to address, in more detail, our methodology for radiation qualification below 10^4 rads and aging. We have also clarified the section to reflect its applicability to both electrical and mechanical equipment.

In addition to addressing the issues raised in the resolution of Staff concerns with equipment qualification in general, the revision addresses concerns raised in the review of the Inadequate Core Cooling Instrumentation (ICCI), Open Item 4. Specifically, the Staff requested more information on the qualification of the ICCI. To resolve this concern, we have added the ICCI to Table 3.11B-2, "Class 1E Instrumentation Qualification Requirements". We believe that this change should resolve Open Item 4 of the CESSAR-F Safety Evaluation Report.

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The revised Section 3.11 will be incorporated into the text of CESSAR-F in an amendment. Revised sections have been highlighted by a vertical line and the letter "A" in the right-hand margin next to the lines being changed. This submittal has been prepared to expedite the resolution of Open Items 1 and 4. If you have any questions on the attached, please contact me 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:las
F72063
Attachment
cc: Gary Meyer (Project Manager / USNRC)

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) depend upon equipment location and function. Such equipment is qualified 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. Compatability of mechanical and electrical equipment with environmental conditions is provided within the following design criteria:

A. For operation under normal conditions the systems are designed and qualified to remain functional after exposures 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. 7

   2. Relative humidity ranges are given in Appendix 3.11A, Table 3.11A-1 thru 3.11A-14. 7

   3. Pressure ranges are given in Appendix 3.11A, Table 3.11A-1 thru 3.11A-14. 7

   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. 7

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. 7

   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. 7

   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. 7

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3.11.1 EQUIPMENT IDENTIFICATION AND ENVIRONMENTAL CONDITIONS

Appendix 3.11B lists and categorizes systems required to mitigate a DBE or to attain 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 Standard 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. 7

3.11.2.1 MECHANICAL AND ELECTRICAL Component Environmental Design and Qualification for Normal Operation A

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. 7

3.11.2.2 MECHANICAL AND ELECTRICAL Component Environmental Design and Qualification for Operation After a Design Basis Event A

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 Section 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 requirements 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 Sections 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 the Containment of Nuclear Power Plants. A descripiton 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). | 7

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. Environmental Qualification testing is not considered necessary for such components. | 7 | A

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AGING FOR HARSH AND NON-HARSH ENVIRONMENT EQUIPMENT

As stated in CENPD 255 Rev. 03 the aging portion of the qualification program is defined based upon whether or not equipment is located in a harsh or non-harsh environment. Equipment located in a harsh environment will undergo an aging analysis and an accelerated age conditioning program. Equipment located in a non-harsh environment will undergo an aging analysis that focuses on the identification of known aging mechanisms that significantly increase the equipments susceptibility to its design basis event (seismic event only for non-harsh environments). If no known significant aging mechanisms are found, a surveillance/preventive maintenance (S/PM) program will be developed to monitor for degradation trends that suggest increasing seismic susceptibility. If an aging mechanism is found that is known to significantly increase the equipments seismic susceptibility with time, that mechanism will be analyzed to determine whether an accelerated aging program or a periodic part replacement program is appropriate. A

RADIATION FOR HARSH AND NON-HARSH ENVIRONMENT EQUIPMENT

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.

Equipment which is exposed to radition 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. A

Equipment which will be exposed to radiation levels of 10^4 Rads or below will be analyzed to determine whether low level adiation could impact its ability to perform its required function. Where analysis supported by partial type test data cannot demonstrate proper operation at the required radiation levels, type testing will be performed. Additionally, Electronic Equipment exposed to low level radiation will be addressed by an Aging Analysis which focuses on the identification of semi-conductor (organic material) components that are considered to be age-sensitive in 40 years. For electronic components that are age-sensitive a surveillance/preventive maintenance program will be developed. CENPD 255 Rev. 03 outlines this methodology.

Mechanical/Electrical Equipment will be qualified to the typical radiation environments defined in Appendix 3.11A. If more than one type of radiation is significant, each type may be applied separately.

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

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 function 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

Equipment exposed to neutron radiation will be identified and neutron radiation levels defined. When actual neturon 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.

A

Paints/Radiation Effects

An analysis will be performed addressing paint exposure to beta and gamma radiation. Qualification of painted equipment will be by test if analysis indicates that the safety function of the equipment could be impaired by 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 tests 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. 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 typical environmental conditions and associated environmental test profiles are illustrated in Figures 3.11A-6A thru 3.11A-10. A

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 perform 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 boron 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 requirements under the environmental and operating conditions 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 (such 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. 7

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 will be 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.

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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 submergence 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 submergence is required, qualification will be demonstrated by type test and/or analysis supported by partial type test data. 7

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 requirements 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 adequacy.

REFERENCES

1. "Qualification of Combustion Engineering Class 1E Instrumentation", CENPD-255 Rev.03, Combustion Engineering, Inc., Windsor, Connecticut. |7

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 COMPONENTS

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APPENDIX 3.11A

TYPICAL ENVIRONMENTAL CONDITIONS AND TEST PROFILES FOR STRUCTURES AND COMPONENTS

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

Figure 3.11A-6 is an in-containment test profile that corresponds 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. Figure 3.11A-6A incorporates and illustrates required margin. For an explanation of the use of this profile see Section 3.4.1 of CENPD 255, Rev. 03. A 7

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

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

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 conditons outside containment (Environment Categories "D", "E", "F", "G", "H" and "I").

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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 represents a simulated environmental profile for equipment located inside containment, as appropriate (Environment Categories "A-1", "A-2" and "V-1"). A

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").

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3.11A.2 QUALIFICATION REQUIREMENTS (by Category)

Structures and components in each of the environmental qualification categories are designed and qualified in accordance with the following*: (The environmental conditions referred to are given in Table 3.11A-1).

A-1 One time service during the condition specified for Category A-1, up to the point in time at which they are required to function, unless plant environmental control systems, physical separation, barriers, or other features make such design and qualification unnecessary.

Continuous service during the conditions specified for Category B.

A-2 One time service during the conditions specified for Category A-2, up to the point in time at which they are required to function, unless plant environmental control systems, physical separation, barriers or other features make such design and qualifications unnecessary.

Continuous service during conditions specified for Category B.

B. Continuous service during the conditions specified for Category B.

C. Continuous service during the conditions specified for Category C.

D. One time service during the conditions specified for Category D, up to the point in time at which they are required to function, unless plant environmental control systems, physical separation, barriers or other features make such design and qualification unnecessary.

Continuous service during the conditions specified for Category C.

E. One time service during the conditions specified for Category E, up to the point in time at which they are required to function, unless plant environmental control systems, physical separation, barriers or other features make such design and qualification unnecessary

Continuous service during the conditions specified for Category C.

F. One time service during the conditions specified for Category F, up to the point in time at which they are required to function, unless plant environmental control systems, physical separation, barriers or other features make such design and qualification unnecessary.

Continuous service during conditions specified for Category C.

G. One time service during the conditions specified for Category G, up to the point in time at which they are required to function, unless plant environmental control systems, physical separation, barriers or other features make such design and qualification unnecessary.

Continuous service during conditions specified for Category C.

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* Specific exemptions to these general requirements may be taken when justification is provided.

H. Short-term service (8 hours maximum duration for each event, total time not to exceed 1% of operating life) under conditions specified for Category H. Continuous service during conditions specified for Category J.

I. Continuous service under conditions specified for Category I.

J. Continuous service under conditions specified for Category J.

K. Continuous service under conditions specified for Category K.

TABLE 3.11A-1

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

ENVIRONMENTAL PARAMETERS	RANGE AND DURATION
TEMPERATURE, °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, 200 PPM HYDRAZINE AS N_2H_4 AND pH = 4 TO 10.

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A

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 3.11A-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'	

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NOTE 1 - 4400 PPM BORON AS H_3BO_3, 200 PPM HYDRAZINE AS N_2H_4 AND TO 10.

A

* S.H. ≡ SUPERHEATED

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)

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TABLE 3.11A-4

CATEGORY "C" ENVIRONMENTAL CONDITIONS

ENVIRONMENTAL PARAMETERS	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	

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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).

TABLE 3.11A-5

CATEGORY "D" ENVIRONMENTAL CONDITIONS

ENVIRONMENTAL PARAMETERS	RANGE OR MAXIMUM	DURATION
TEMPERATURE, °F	104-120	4 HR.
	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 99% RELATIVE HUMIDITY AT 120°F (DEWPOINT OF 116°F).

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

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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).

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TABLE 3.11A-7

CATEGORY "F" ENVIRONMENTAL CONDITIONS

ENVIRONMENTAL PARAMETERS	RANGE	DURATION
TEMPERATURE, °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	

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NOTE 1 - FOR UNCONTROLLED ACCESS AREAS 1×10^4 γ (TID) AND FOR CONTROLLED ACCESS AREAS 4×10^5 γ (TID).

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

TABLE 3.11A-8

CATEGORY "G" ENVIRONMENTAL CONDITIONS

ENVIRONMENTAL PARAMETERS	RANGE	DURATION
TEMPERATURE, °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	

7

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

TABLE 3.11A-9

CATEGORY "H" ENVIRONMENTAL CONDITIONS

ENVIRONMENTAL PARAMETERS	RANGE	DURATION
TEMPERATURE, °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	

7

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 - 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	

7

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

TABLE 3.11A-11

CATEGORY "J" ENVIRONMENTAL CONDITIONS

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

7

TABLE 3.11A-12

CATEGORY "K" ENVIRONMENTAL CONDITIONS
(OUTSIDE PLANT BUILDINGS)

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

7

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-14
CATEGORY "V-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.

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TABLE 3.11A-13
CATEGORY "V-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.

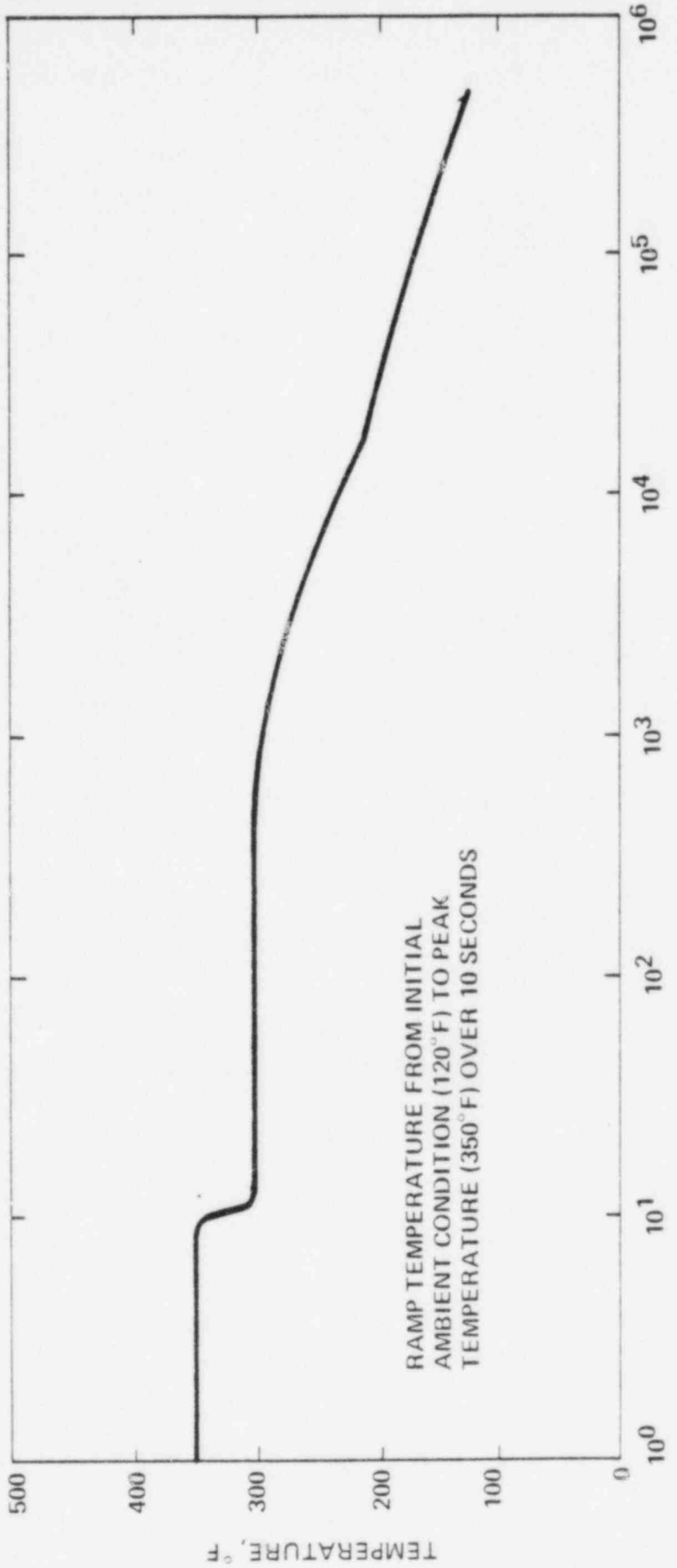
NOTE 2 - 4400 PPM BORON AS H_3BO_3, 200 PPM HYDRAZINE AS N_2H_4 AND P^H 4 TO 10.

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

* SH = SUPERHEATED

7

A



Amendment No. 7
March 31, 1982

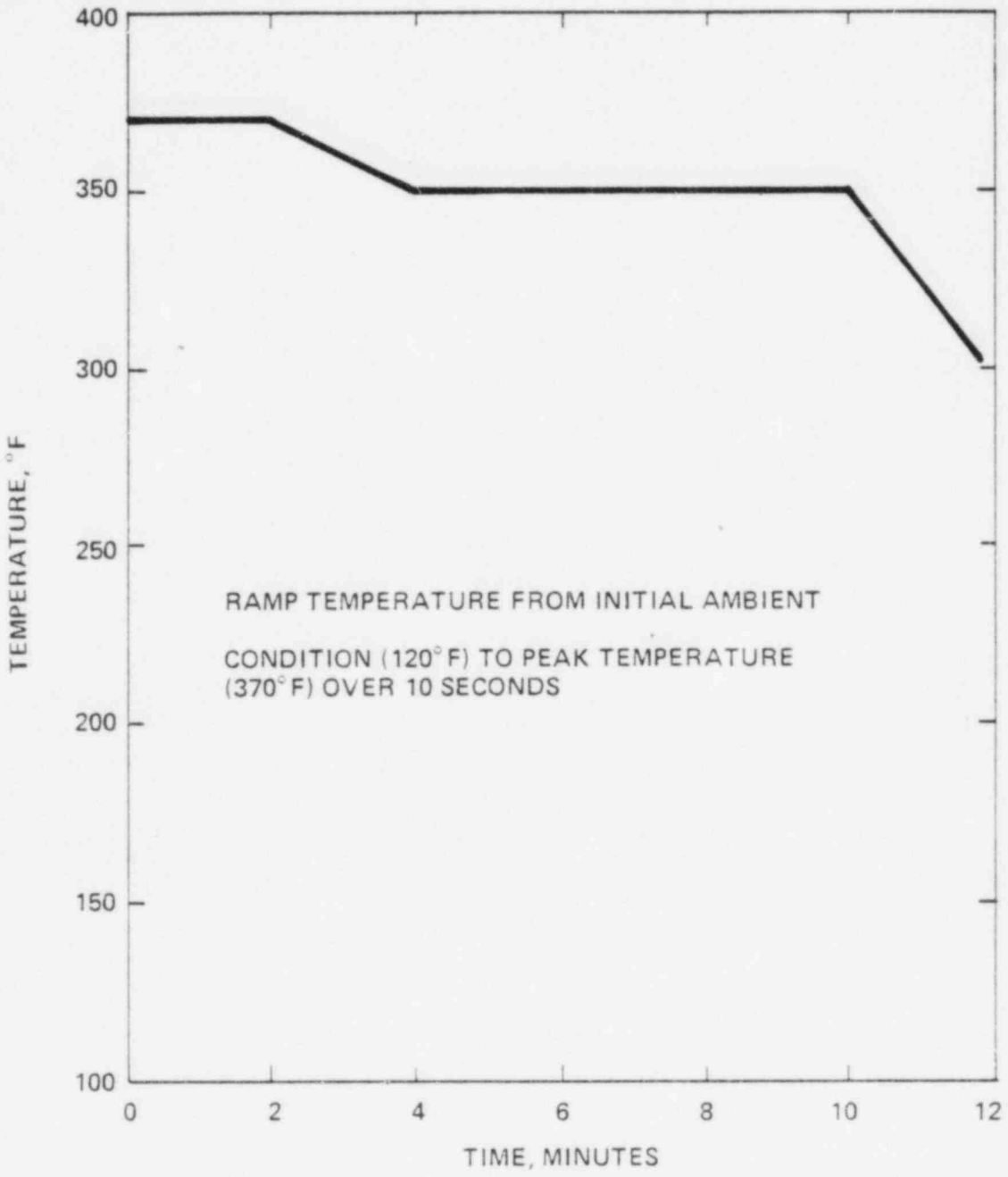
C-E SYSTEM 80	TYPICAL CONTAINMENT ATMOSPHERE TEMPERATURE CONDITION FOLLOWING LOCA	Figure 3.11A-1A

Amendment No. 7
March 31, 1982

C-E System 80	TYPICAL CONTAINMENT ATMOSPHERE PRESSURE CONDITION FOLLOWING LOCA	Figure 3.11A-1B

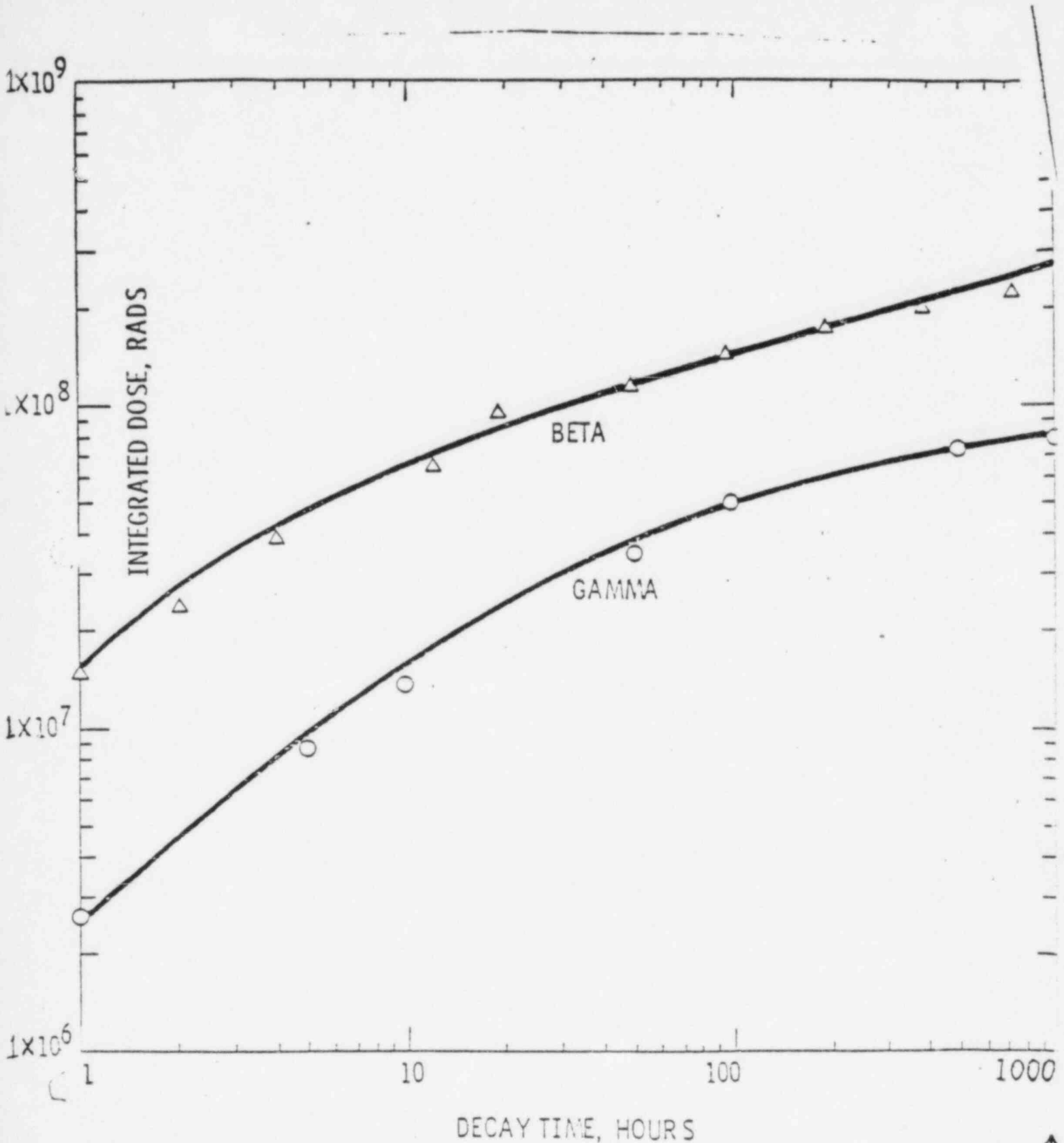
Amendment No. 7
March 31, 1982

C-E System 80	TYPICAL ANNULUS ATMOSPHERE TEMPERATURE CONDITION FOLLOWING LOCA/MSLB	Figure 3.11A-2



Amendment No. 7
March 31, 1982

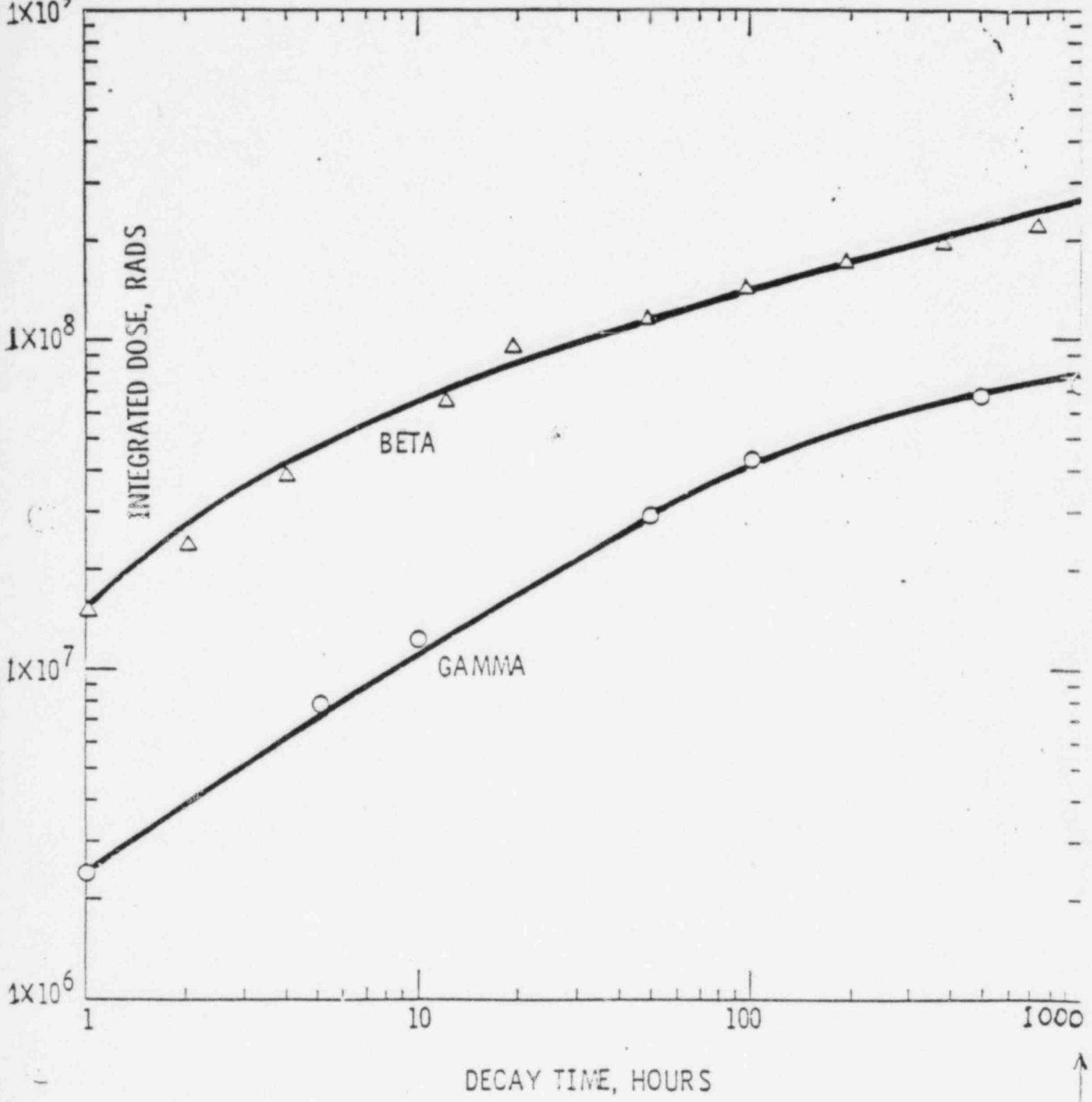
C-E System 80	TYPICAL CONTAINMENT ATMOSPHERE TEMPERATURE CONDITION FOLLOWING MSLB	Figure 3.11A-3



Amendment No. 7
March 31, 1982

C-E System 80	TYPICAL INTEGRATED DOSE IN SPHERICAL CONTAINMENT FOLLOWING LOCA	Figure 3.11A-4A

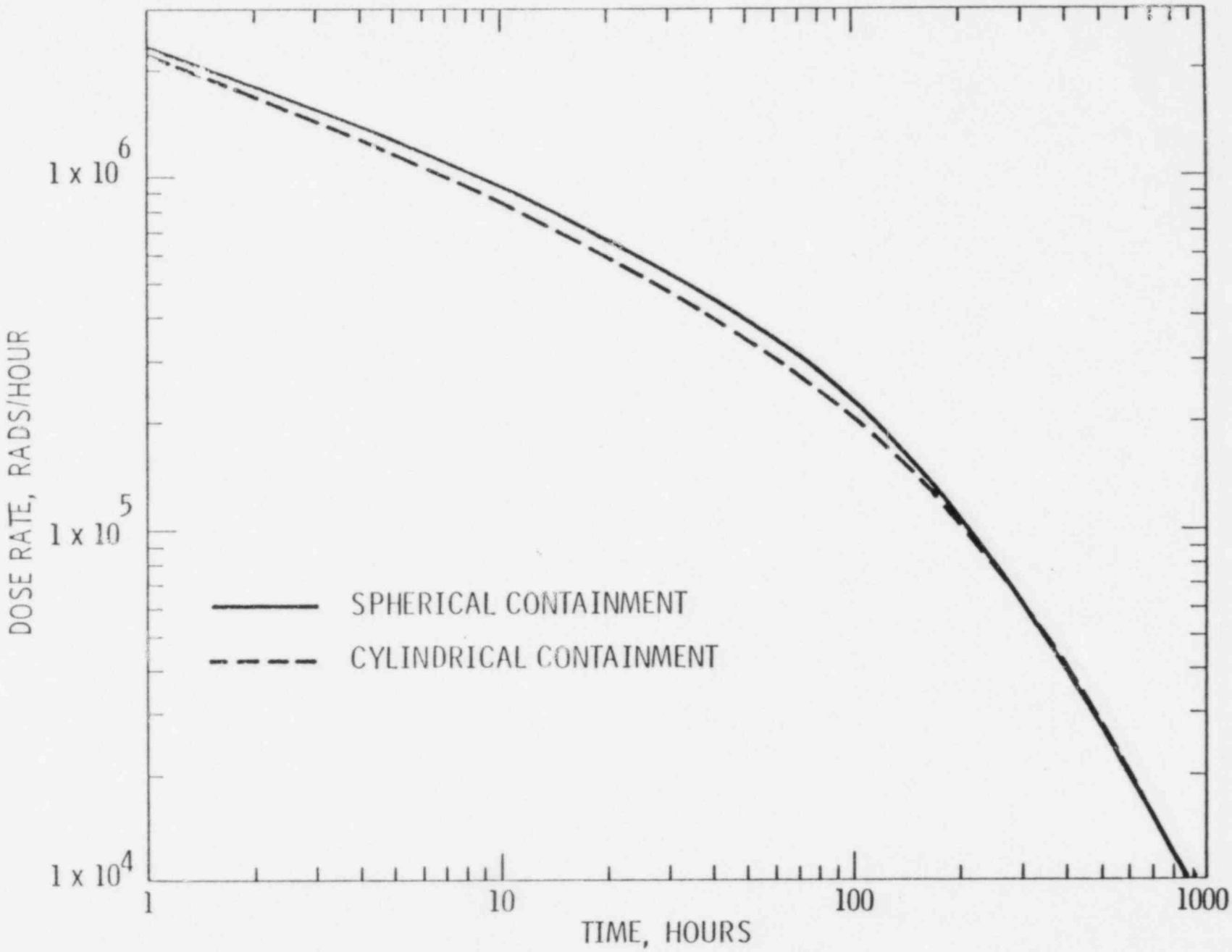
NSW. FIG.



Amendment No. 7
March 31, 1982

C-E System 80	TYPICAL INTEGRATED DOSE IN CYLINDRICAL CONTAINMENT FOLLOWING LOCA	Figure 3.11A-48

NEW FIG.



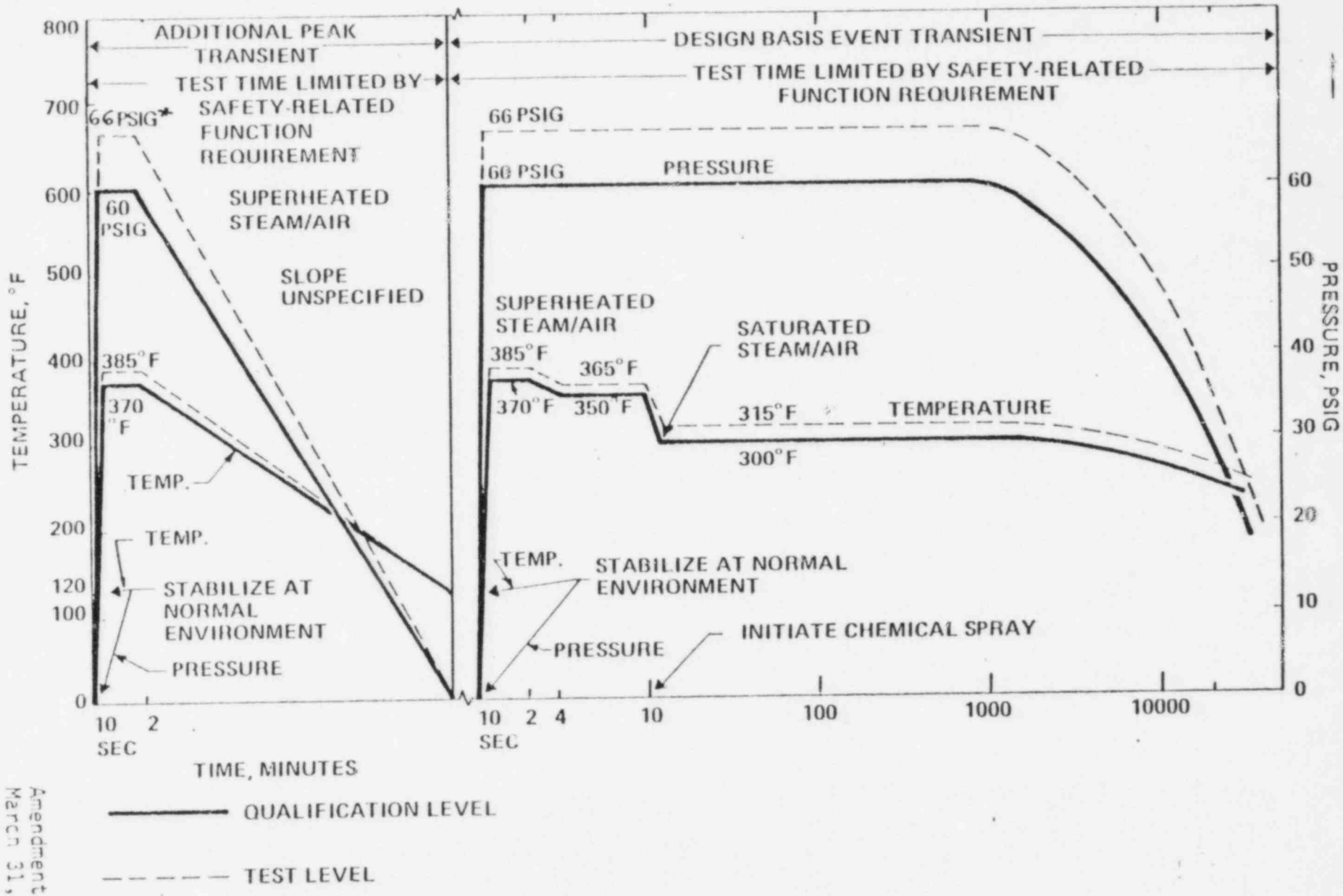
C-E

TOTAL DOSE RATE FOLLOWING LOCA FOR A POINT AT CENTER OF CONTAINMENT

Figure 3.11A-5

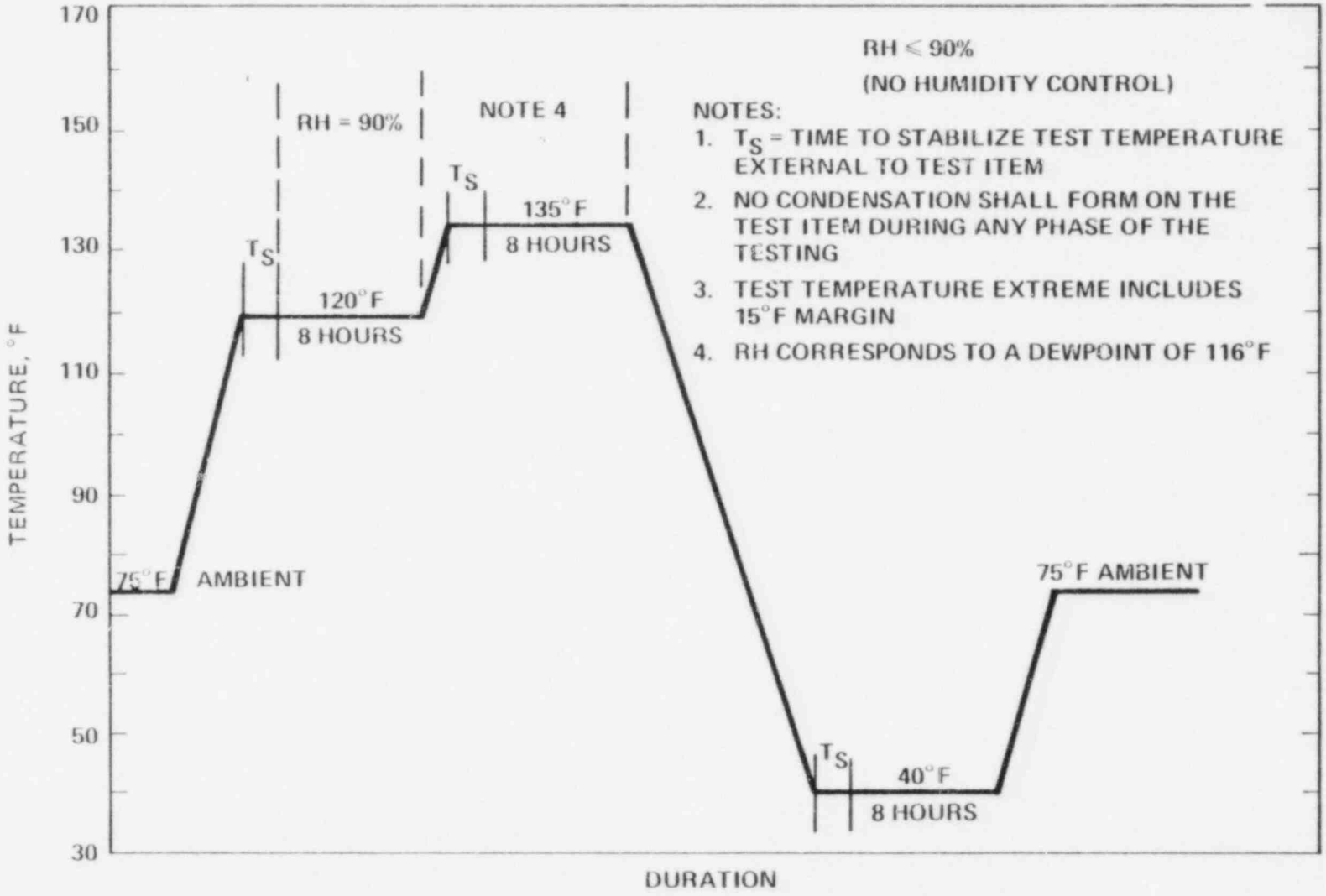
C-E

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



Amendment No. 7
March 31, 1982

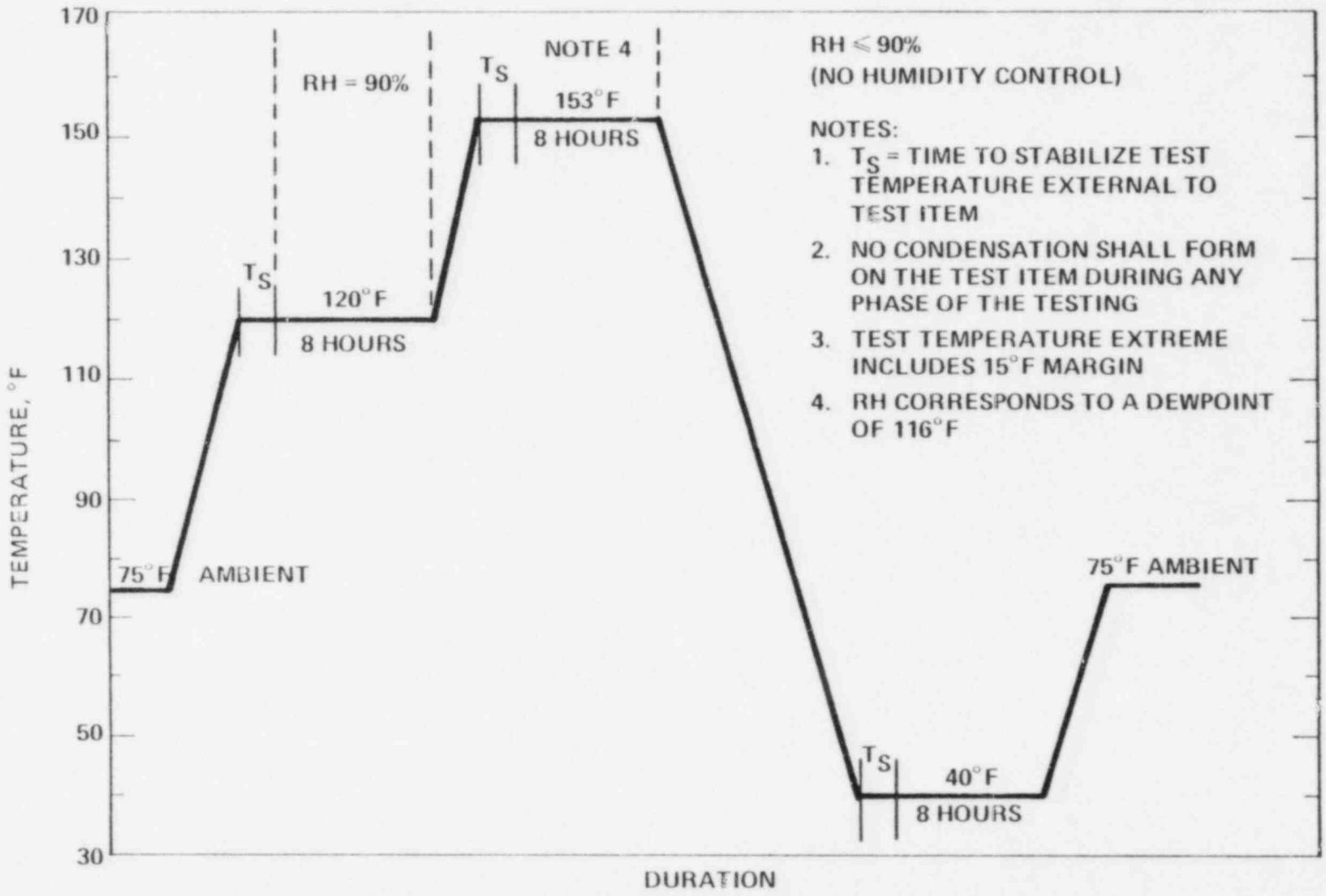
Figure 3.11A-6



TYPICAL ENVIRONMENTAL TEST PROFILE FOR CATEGORY "C" ENVIRONMENTAL CONDITIONS

Figure 3.11A-7

Amendment No. 7
March 31, 1982



C - E POWER

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

Figure 3.11A-8

Amendment No. 7
March 31, 1982

C-E SYSTEM 80

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

Figure 3.11A-9

Amendment No. 7
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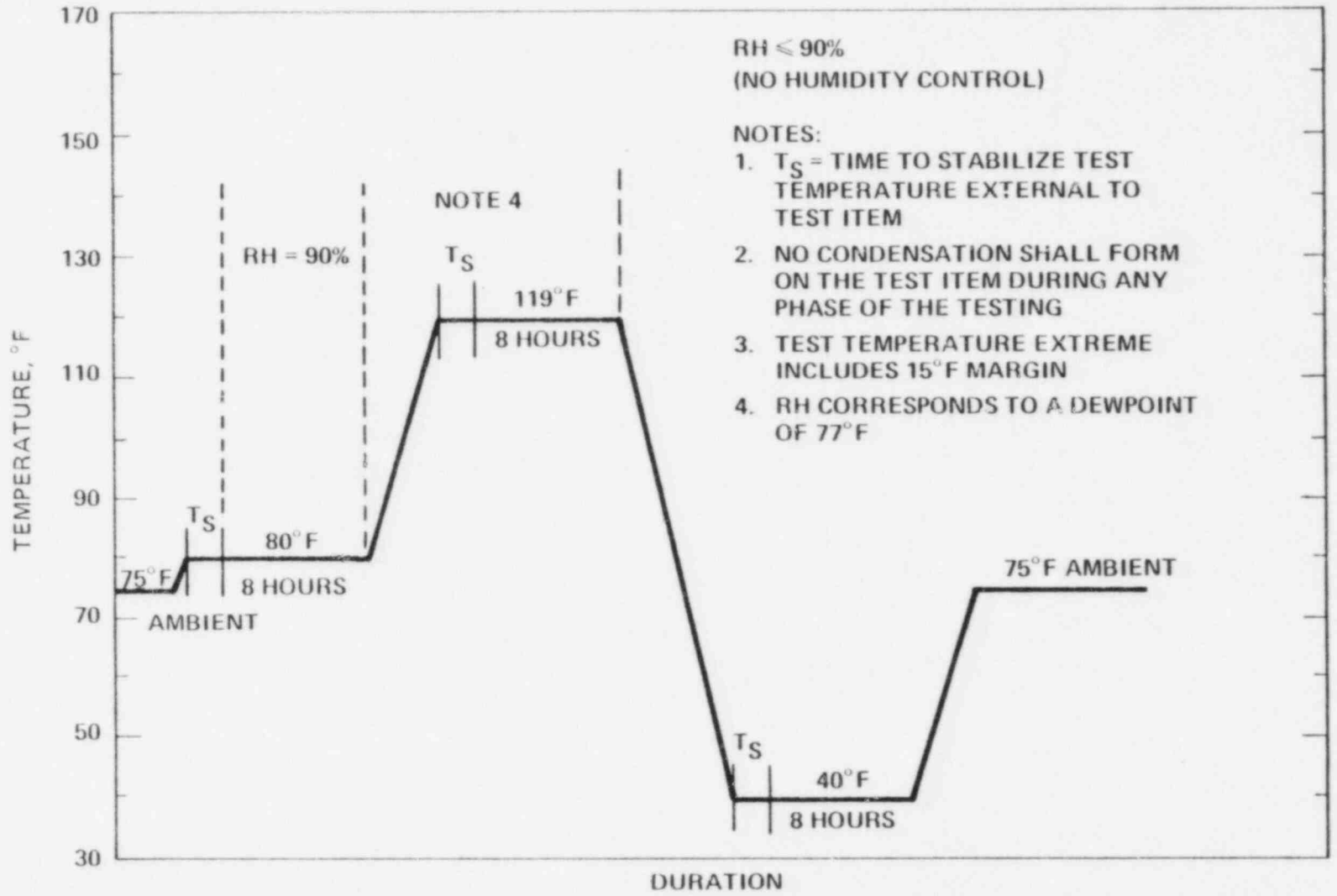

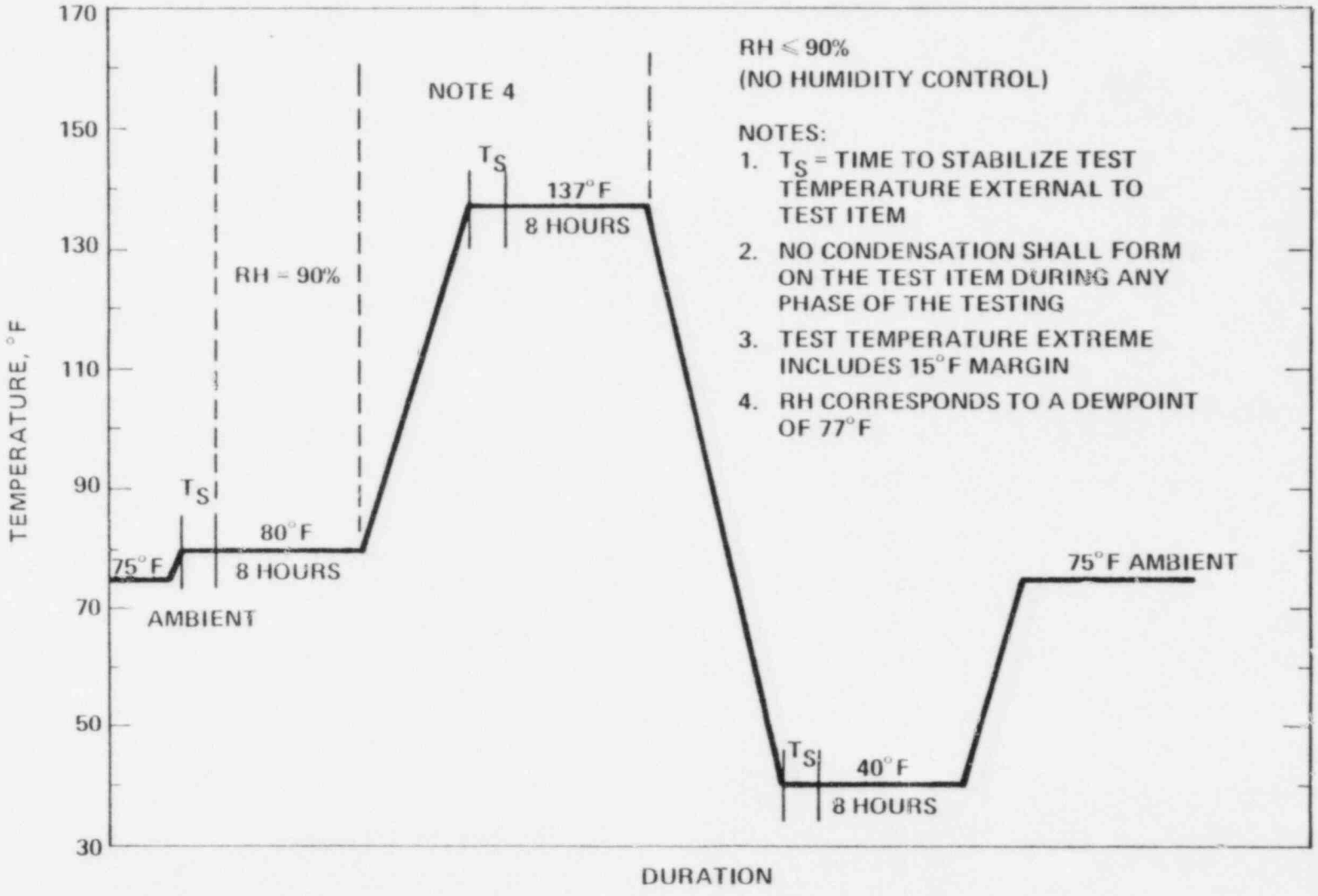

TYPICAL INSIDE CABINET ENVIRONMENTAL TEST PROFILE FOR CATEGORIES "H" AND "J" ENVIRONMENTAL CONDITIONS

Figure 3-11A-10

C - E

Amendment No. 7
March 31, 1982

TABLE 3.11B-2 (Cont'd.) (Sheet 10 of 12)

CLASS 1E INSTRUMENTATION QUALIFICATION REQUIREMENTS

					ENVIRONMENT (1) (2)		RADIATION DOSE		
							RADS		
COMPONENT	PARAMETER	MODULE	DESIGNATION	LOCATION	NORMAL	ACCIDENT	40 YRS	ACCIDENT	OPERATING TIME, MIN
NI Safety	Power Channel	Indicator	JI-001 A, B, C, D	CR/MCB	H	H	Bkgrd	Negligible	N/A (5)
NI Safety	Power Channel	Recorder	JR-001A	CR/MCB	H	H	Bkgrd	Negligible	N/A (5)
Charging	Flow	Indicator	FI-212	CR/MCB	H	H	Bkgrd	Negligible	N/A (5)
Charging	Pressure	Indicator	PI-212	CR/MCB	H	H	Bkgrd	Negligible	N/A (5)
Reactor Drain Tank	Pressure	Transmitter	PT-268	CB/SS	B	A1, A2	2.0×10^6	Negligible	N/A (5)
Steam Generator	Level	Indicator	LI-1113, 1123 A-1, B-1	CR/RSP	H	H	Bkgrd	Negligible	N/A (5)
Steam Generator	Pressure	Indicator	PI-1113, 1123 A-1, B-1	CR/RSP	H	H	Bkgrd	Negligible	N/A (5)
SPS	Logic	Assembly	CHNL A, B, C, D	AB	C	C	Bkgrd	Negligible	N/A (5)
Inadequate Core Cooling Equipment	Display	Plasma Display Unit & Power Supply	N/A	CR	H	H	Bkgrd		
	N/A	Page Control Module	N/A	CR	H	H	Bkgrd		
	N/A	Heater Controller Chassis	N/A	CR	H	H	Bkgrd		A
	Temperature	Core Exit Thermocouple	N/A	CB	B	Note (7) A1, A2	(5.1×10^6 (8) (9))		
	Temperature	Heated Junction Thermocouple	N/A	CB	B	Note (7) A1, A2	(8.5×10^6 (8) (10))		

CLASS 1E INSTRUMENTATION QUALIFICATION REQUIREMENTS

Notes

(1) See Table 3.11A-1 for definition of environmental categories.

(2) Equipment located within a cabinet will be qualified allowing for temperature increase inside cabinet.

(3) 55 - 250°F.

(4) Only required to improve reliability of reactor trip.

(5) N/A - Not applicable. Environment not affected by accident.

(6) Process Protective Cabinet contains all other Class 1E devices in process instrumentation systems between transmitters and indicators such as signal processors, power supplies, isolators and interlocks.

(7) Post Accident Conditions; equipment is designed to survive the accident condition and to perform its intended function through the post accident period.

(8) Ex-Vessel Portion of the instrument.

(9) Instrument Design life of 6 years.

(10) Instrument Design life of 10 years.

A