# EQUIPMENT QUALIFICATION DESIGN BASIS DOCUMENT

| Revision History | |
|---|---|
| Revision | Description |
| 15 | See attached Revision Description Sheet. |

| | | | |
|---|---|---|---|
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| Document Service Release by: | DC7 | Date: | 06/03/2020 |

| **EQSD-I R15 Revision Description** | |
|---|---|
| **EQSD-I Section** | **Change Made** |
| Table of contents | Updated Attachment C title to reflect changes. |
| 3.1.10.2 | Added statement in this PAOT to identify that exemptions from the 180-day PAOT licensing requirement are identified in Attachment C. |
| 3.1.13.6 | Revised section to provide administrative changes for clarification and additional information to explain why some profiles stop before too early (see QH-2019-827 wording changes & CR 110889). |
| 3.1.14.3 | Added information and reference to documents M-0Y005 and TSA 20419-000 for added sealing related information. Administrative change only. |
| 5.1 | Added clarification on what a service temperature is, acceptable use of average temperatures and need to consider hot spot area information as identified in QH-2019-1827. |
| 11.0 | To address changes needed in Attachment C needed to added references 133, 134, and 135 changes made per CP 20361. |
| | |
| **Attachment A revisions** | |
| 1411, 1412, 1508 & 1509 | Updated peak temperature for rooms 1412 and 1508 to correctly show that if the break is in these rooms the peak temperature will be 436F not 384.5F as was shown. Updated note “A” to add the following at the end “The compartment where the break does not occur has a peak temperature of 384.5°F.” to identify what the peak temperature of the MST compartment without the break would be (reference calculation AN-06-021). |
| | |
| **Attachment B revisions** | |
| N/A | None |
| | |
| **Attachment C revisions** | |
| Cover page | Updated Attachment C cover sheet to identify that it now has a Table C.1 and C.2 and updated information related to the section being part of the USAR by reference as was identified previously as part of CCP 014582. CP 20361 added Table C-2 and needed to make it clear Table C.1 and C.2 are both part of the USAR by reference. |
| Table | Made Exemptions From NUREG-0588 Qualification, Table C.1 to allow a separate place to identify exemptions from the POAT of 180 days (see CP 20361). |
| New Table | Added Table C.2 – Exemptions From 180 Day Post Accident Operating Time (PAOT) to provide location to identify any equipment that has a POAT time that has been justified as being less than 180 days, new items listed justified by CP 20361. |
| | |

TABLE OF CONTENTS:

**1.0 INTRODUCTION 5**
**1.1 Purpose 5**
**1.2 Scope 5**
**1.3 Purpose of EQ Design Bases Document 5**
**1.4 Historical Perspective of Equipment Qualification 5**
**1.5 EQ Program Model 7**
**2.0 EQ PROGRAM BASES 10**
**2.1 Regulatory Bases 10**
2.1.1 Electrical Equipment Qualification 10
2.1.2 Mechanical Equipment Qualification 10
**2.2 Design Bases 10**
2.2.1 Criteria for Selection of Equipment 10
2.2.2 Identification of Equipment 11
**2.3 Environmental Conditions 15**
2.3.1 Definition of Normal Environment 15
2.3.2 Harsh Environmental Conditions 16
2.3.2.1 Definition of Harsh Environment 16
2.3.2.2 Harsh vs. Mild Environmental Parameters 17
2.3.3 Inside Containment Environmental Conditions 19
2.3.3.1 Normal Conditions 19
2.3.3.2 Accident Conditions 19
2.3.4 Outside Containment Conditions 21
2.3.4.1 Auxiliary Building 22
2.3.4.2 Fuel Building 23
2.3.4.3 Diesel Generator Building 23
2.3.4.4 Control Building 24
2.3.4.5 All Other Site Areas 24
2.3.5 Mild Environment Equipment Qualification 24
**3.0 DESIGN VERIFICATION 26**
**3.1 Methodology for the Equipment Qualification of Electrical Equipment 26**
3.1.1 Thermal Aging 27
3.1.1.1 Arrhenius Methodology 27
3.1.1.2 Activation Energy 30
3.1.2 Radiation Aging 32
3.1.2.1 Normal Radiation 33
3.1.2.2 Accident Radiation 33
3.1.2.3 Beta Radiation Dose Qualification 33
3.1.2.4 Qualification by Analysis of Replacement Components 36
3.1.3 Cyclic and Mechanical Aging 36
3.1.3.1 Cycle Aging 36
3.1.3.2 Mechanical Aging 37
3.1.4 Qualified Life 39
3.1.5 Temperature 40
3.1.5.1 Post-DBA Temperature Qualification with Essential HVAC 40
3.1.5.2 Post-DBA Temperature Qualification without Essential HVAC 40
3.1.6 Pressure 41
3.1.7 Humidity 41
3.1.8 Chemical Spray 42

3.1.9 Submergence 42
3.1.10 Post-Accident Operating Time (PAOT) 44
3.1.10.1 Definition of Post-Accident Operating Time 44
3.1.10.2 Qualification for Post-Accident Operating Time 45
3.1.11 Equipment Performance Criteria 46
3.1.12 Voltage and Frequency Variations 47
3.1.14 Equipment Sealing and Moisture Exclusion 50
3.1.14.1 Moisture Effects on Equipment Performance 50
3.1.14.2 Environmental Test Configurations 50
3.1.14.3 Equipment Sealing Requirements 51
3.1.15 Dust 52
3.1.16 Synergisms 52
3.1.16.1 Test Sequence Effects 53
3.1.16.2 Dose Rate Effects 56
**4.0 EQ PROGRAM IMPLEMENTATION 56**
**4.1 EQ Maintenance Requirements 56**
**4.2 EQ Equipment Configuration Requirements 56**
**4.3 Replacement of EQ Equipment and Parts 57**
4.3.1 Equipment Specification 57
4.3.2 Equipment Procurement 57
4.3.3 "Like-for-like" Replacement 57
4.3.4 Design Changes 59
**5.0 TEMPERATURE MONITORING PROGRAM 58**
**5.1 Qualified Life Calculation Methodologies 58**
**5.2 Use of Actual Containment Temperatures Data Analysis 59**
**6.0 LUBRICATION CONTROL PROGRAM 62**
**6.1 Equipment Design and Lubrication 62**
**6.2 Equipment Qualification of Lubricants Used in EQ Equipment 62**
**6.3 Qualified Life of Lubricants 63**
**7.0 COMPLIANCE 64**
**7.1 Non-Conforming Conditions 64**
**7.2 Operability Determination 64**
**8.0 REVIEW OF REGULATORY, INDUSTRY AND VENDOR DOCUMENTATION 66**
**8.1 Regulatory Issues 66**
**8.2 Industry Operating Experience 66**
**8.3 Vendor Documentation 67**
**8.4 License Renewal 67**
**9.0 EQ PROGRAM DOCUMENTATION 69**
**9.1 Equipment Qualification Change Notice (EQCN) 69**
**9.2 Equipment Qualification Master List 70**
**9.3 Equipment Qualification Work Packages or Plant Qualification Evaluation 70**
**10.0 ABBREVIATIONS AND DEFINITIONS 72**
**10.1 Acronyms 72**
**10.2 Definitions 73**
**11.0 REFERENCES 76**
**Attachment A - Harsh Environments 82**
**Attachment B - Mild Environments 301**
**Attachment C – Exemptions From NUREG-0588 Qualification & PAOT 309**

# 1.0 INTRODUCTION

## 1.1 Purpose

The purpose of the Equipment Qualification (EQ) Program implemented at the Wolf Creek Generating Station (WCGS) is to provide reasonable assurance that certain safety-related (i.e., important to safety) and post-accident monitoring electrical equipment should function as designed during the design conditions postulated for plant normal and abnormal operation, design basis accidents, and the post-accident duration.

## 1.2 Scope

The scope of the WCGS EQ Program, as defined in Section 2, includes the environmental qualification of certain electrical equipment important to safety meeting Code of Federal Regulations Title 10 Part 50 Section 49 (10 CFR 50.49)[Ref.1] and its subordinate Regulatory Guide 1.89 Revision 1 by following NUREG 0588 as a Category 1 plant that is committed to IEEE 323-74 (Construction Permit issued after July 1, 1974). Westinghouse NSSS Class IE equipment includes IEEE 323a-1975, which is a supplement to IEEE 323-74 on aging.

The scope of the WCGS EQ Program does not include the Equipment qualification of equipment located in "mild" environments as discussed in Section 2.3.5.

Seismic qualification of safety-related electrical equipment is not considered part of the WCGS EQ Program.

The scope of the WCGS EQ Program does not include the Equipment qualification of mechanical equipment as discussed in Section 2.1.2.

## 1.3 Purpose of EQ Design Bases Document

The purpose of this document is to set forth in one place the bases and requirements for evaluating and maintaining the qualification of the plant equipment within the scope of the WCGS EQ Program. This manual is a controlled reference document. Control and maintenance of the EQ Design Bases Document is by WCGS Procedure AP 05G-004, “Equipment Qualification Summary Document” (Ref.8).

## 1.4 Historical Perspective of Equipment Qualification

Nuclear power plant equipment important to safety must be able to perform its safety functions throughout its installed life during both normal and accident conditions. This requirement, which is embodied in General Design Criteria 1 (Quality Standards and Records), Design Criteria 2 (Design bases for protection against natural phenomena), 4 (Environmental and Dynamic Effects Design Bases) of appendix A and Sections III (Design Control), XI (Test Control), and XVII (Quality Assurance Records) of Appendix B to 10 CFR 50 (Ref. 10), and 23 (Separation of protection and control system) is applicable to equipment located inside as well as outside containment (Ref. 3).

The NRC has used a variety of methods to ensure that these general requirements are met for electrical equipment important to safety. Prior to 1971, qualification was based on the fact that the electric components were of high industrial quality. For nuclear plants licensed to operate after 1971, qualification was judged on the basis of IEEE Standard 323-1971 (Ref. 7). For plants whose Safety Evaluation Reports for construction permits were issued subsequent to July 1, 1974, the NRC evaluated qualification based on Regulatory Guide 1.89, Revision 0 (Ref. 2), which endorses IEEE Standard 323-1974 (Ref. 13).

In November 1977, the Union of Concerned Scientists petitioned the NRC Commissioners to investigate and upgrade current standards for the environmental qualification of safety-related electrical equipment in operating plants.

Subsequently the NRC staff instituted the Systematic Evaluation Program (SEP) to determine the degree to which the older operating nuclear power plants deviated from current licensing criteria. The subject of electrical equipment environmental qualification was selected for evaluation as part of this program. Seismic qualification of equipment was to be addressed as a separate SEP topic. In December 1977, the NRC issued a generic letter to all SEP plant licensees (11 oldest Plants, e.g., Palisades, Oyster Creek, R. E. Ginna, Yankee Rowe, Haddam Neck, La Crosse and Zion) requesting that they initiate reviews to determine the adequacy of existing qualification documentation. Preliminary NRC review of licensee responses led to the preparation of NUREG-0458, an interim assessment of the environmental qualification of electrical equipment, which concluded, "no significant safety deficiencies requiring immediate action were identified." However, the NRC recommended that additional effort be devoted to examining the installation and environmental qualification documentation of specific electrical equipment in all operating reactors.

On May 31, 1978, the NRC Office of Inspection and Enforcement (IE) issued IE Circular 78-08, "Environmental Qualification of Safety-Related Electrical Equipment at Nuclear Power Plants," which required all licensees of operating plants (except those included in the SEP program) to examine their installed safety-related electrical equipment required to function under postulated accident conditions. Subsequently, on February 8, 1979, the NRC issued IE Bulletin 79-01, which was intended to raise IE Circular 78-08 to the level of a Bulletin (i.e., action requiring a licensee response). This Bulletin required a complete re-review of the environmental qualification of safety-related electrical equipment as described in IE Circular 78-08 by all plants with an Operating License. This did not include WCGS because the Wolf Creek OL was not issued until 06/04/1985.

The NRC review of the licensee responses to IE Bulletin 79-01 indicated certain documentation deficiencies within the scope of equipment addressed, definition of harsh environments, and adequacy of support documentation. It became apparent that generic criteria were needed for evaluating electrical equipment environmental qualification for both SEP and non-SEP operating plants. Therefore, during the second half of 1979, the Division of Operating Reactors (DOR) of the NRC issued internally a document entitled, "Guidelines for Evaluating Environmental Qualification of Class 1E Electrical Equipment in Operating Reactors." This document (referred to as the "DOR Guidelines") was prepared as a screening standard for all operating plants, including the SEP plants. At this point, the scope of the NRC qualification review criteria was expanded to include high-energy line breaks both inside and outside containment in addition to equipment aging and submergence. Like IE Bulletin 79-01, the “DOR Guidelines” did not apply to WCGS due to it not being an operating reactor.

In December 1979, the NRC staff issued NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety-related Electrical Equipment," (Ref. 4) to promote a more orderly and systematic implementation of Environmental Qualification programs by the industry and to provide guidance to the NRC staff for its use in ongoing licensing reviews for new as well as for the older vintage plants not yet licensed for operation (i.e., near term operating license plants). NUREG-0588 established two (2) levels of environmental qualification criteria (i.e., Categories I and II) to be used as interim NRC positions with respect to acceptable qualification programs until "final" positions were established through the federal rule-making process. The Category II positions of NUREG-0588 are applicable to plants whose operating licenses were to be issued after May 23, 1980, whose Construction Permit SER is dated before July 1, 1974. The Category I positions are applicable to all licensees whose Construction Permit SER is dated July 1, 1974, or later (including WCGS).

The difference in the two (2) Categories assigned by NUREG-0588 reflects the revision of IEEE Standard 323, with Category II plants being committed, reviewed against, and licensed to the 1971 version (Ref. 7), while the Category I plants (including WCGS) were licensed to the 1974 version of the standard (Ref. 13).

On January 14, 1980, the NRC issued IE Bulletin 79-01B which included the "DOR Guidelines" as Enclosure 4 (Ref. 14). This Bulletin expanded the scope of IE Bulletin 79-01 and requested additional information on environmental qualification of safety-related electrical equipment at operating plants. Bulletin 79-01B cited the DOR Guidelines as the criteria to be used to evaluate the adequacy of safety-related electrical environmental qualification.

On May 23, 1980, the NRC issued Memorandum and Order CLI-80-21, specifying that licensees and applicants must meet the requirements set forth in the DOR Guidelines and NUREG-0588 regarding environmental qualification of safety-related electrical equipment in order to satisfy 10 CFR 50, Appendix A, General Design Criteria, Section I, Criterion 4. The Memorandum and Order established the DOR Guidelines and NUREG-0588 as acceptable interpretations of the General Design Criteria for an interim period until final rule making established the permanent positions.

Through the later part of 1980 and the first half of 1981, the NRC held regional meetings with licensees and interested parties, issued Supplements to IE Bulletin 79-01B, and issued SERs on environmental qualification of safety-related electrical equipment to all operating plants.

In July 1981, the NRC conducted extensive meetings with the nuclear industry to address concerns and questions regarding qualification of safety-related equipment. The NRC presented draft outlines of proposed programs concerning the environmental qualification of equipment located in "mild" environments, seismic and dynamic qualification, and environmental qualification of mechanical equipment. NUREG-0588, Revision 1 (Ref. 5), was issued which contains an additional Part II section that provides further guidance and interpretation of qualification criteria based on the NRC staff responses to questions raised by the industry and interested parties.

On January 7, 1982, the NRC approved the issuance of the proposed rule, "Environmental Qualification of Electric Equipment for Nuclear Power plants," for public comment. Proposed Revision 1 to Regulatory Guide 1.89, "Environmental qualification of Electric Equipment for Nuclear Power Plants," was issued for public comment in February 1982. This regulatory guide was issued to reflect current positions on Environmental Qualification and to provide guidelines for meeting the proposed rule.

The final rule, 10 CFR 50.49 (Ref. 1), was subsequently issued in April 1982 and published in the Federal Register on January 6, 1983. Revision 1 of Regulatory Guide 1.89 (Ref. 2) was issued in June 1984. Some significant features of the rule are:

- Requalification of electrical equipment in accordance with the rule was not required for equipment qualified or being qualified in accordance with the DOR Guidelines or NUREG-0588.
- It separated the issue of seismic and dynamic qualification from Equipment qualification such that the rule (10 CFR 50.49) only addresses environmental qualification.
- It deleted any requirements for the specific environmental qualification of equipment located in mild environments under the rule.
- It deleted requirements to address humidity effects during normal plant operation.

WCGS is required to meet 10 CFR 50.49 since the operating license was given on 9/3/1985.

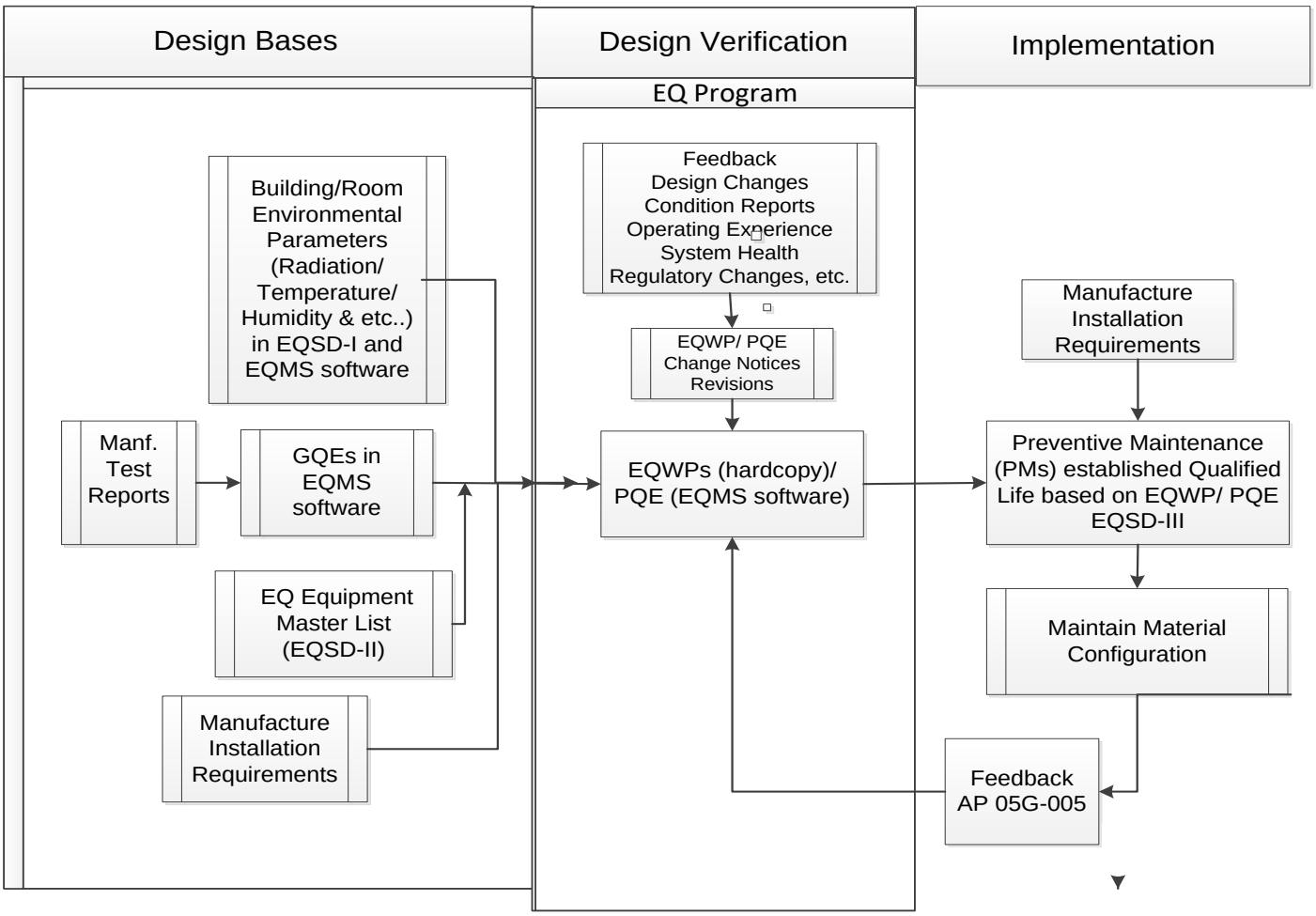
## 1.5 EQ Program Model

The WCGS EQ Program is a process that ensures the continued environmental qualification of equipment that must function during the design conditions postulated for normal and abnormal operation, design basis accidents and the post-accident duration.

The constituent parts of the EQ program include the program basis, the verification of equipment operability during exposure to plant environmental conditions, and the proper installation and maintenance of equipment in the plant.

### 1.5.1 EQ Program Model

The following figure displays the WCGS EQ Program Model:




The model consists of three distinct areas: Design Basis / Current Licensing Bases, Design Verification, and Implementation. The three areas are integrated to maintain the Equipment Qualification Work Packages (EQWPs)/Plant Equipment Evaluation (PQEs) as the auditable proof of qualification.

The Design Basis Area of the EQ program consists of identifying the equipment relied upon to remain functional during and following design basis events to ensure the three following condition are maintained:

- The integrity of the reactor coolant system boundary,
- The ability to shut down the reactor and maintain it in a safe shutdown condition,
- The capability to prevent or mitigate the consequences of accidents that could result in offsite radiological exposures.

Additionally, the Design Basis area of the EQ Program includes identifying the plant normal and design basis accident environmental conditions where all such equipment is located. Section 2.2 contains the basis for why qualification is required for certain equipment, as well as, the basis for exclusion of any equipment from the program.

Changes in equipment function or operating mode, substitutions of new models of equipment, and the addition of new equipment to the plant result in conditions that require a revision or verification of the EQWP/PQE. Changes to the environmental parameters such as revisions to accident analyses, rerouting or addition of high-energy lines, and changes in HVAC alignments and design may also result in revisions to the EQWP/PQE Files.

The EQWP/ PQE files provide the auditable documentation and evidence that equipment is qualified. The qualification process is based on the testing and or analysis of identical or similar equipment such that, the tested equipment performance becomes the model, or proof, of how the installed equipment is anticipated to behave when exposed to design basis accident environmental conditions. Emulation of the tested equipment's internal, external, and maintained configuration is necessary to enable the test to represent the plant-installed equipment. Products of the qualification verification process include installation, maintenance, and procurement requirements that must be implemented to ensure that the installed equipment meets the same standards as the equipment tested. The test results remain an accurate prediction of how the equipment should behave in the plant during accident conditions.

Implementation part of the EQ process is based on the proper equipment installation and maintenance, and the use of the correct parts and materials. This information is disseminated through the equipment maintenance and specification and procurement process (see Section 4.0).

### 1.5.2 Assignment of Responsibility

WCGS EQ procedures AP 05G-002 (Ref. 25) & AP 05G-004 (Ref. 8) describe the WCGS organizational responsibilities and interfaces that ensure that the qualification of WCGS Class 1E electrical equipment is established and maintained in accordance with the qualification documentation which provides the evidence that equipment should perform its safety function when exposed to design basis accident (LOCA/MSLB), or HELB environmental conditions.

# 2.0 EQ PROGRAM BASES

## 2.1 Regulatory Bases

### 2.1.1 Electrical Equipment Qualification

Equipment that is used to perform a necessary safety function must be capable of maintaining functional operability under all service conditions postulated to occur during its installed life for the time it is required to operate. This requirement, which is embodied in General Design Criteria 1, 2, 4, and 23 of Appendix A (Ref. 10) and Sections III, XI, and XVII of Appendix B to 10 CFR 50 (Ref. 11), is applicable to electrical equipment located inside as well as outside containment. The detailed requirements for demonstrating this capability for electrical equipment have been codified in 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants," (Ref. 1). Guidance relating to the methods and procedures for implementing the requirements of 10 CFR 50.49 are found in NUREG-0588, Revision 1, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment" (Ref. 5) and in USNRC Regulatory Guide 1.89, Revision 1 (Ref. 3). NUREG-0588 supplements IEEE Standard 323-1974 (Ref. 13), and various NRC Regulatory Guides and industry standards as stated therein.

The electrical equipment within the scope of the WCGS EQ Program is environmentally qualified in accordance with the requirements for Category I of NUREG-0588, Rev. 1, (Ref. 5) as supplemented by the requirements of 10 CFR 50.49 (Ref. 1).

### 2.1.2 Mechanical Equipment Qualification

10 CFR 50 Appendix A, General Design Criterion 4 requires, in part, that “...components important to safety shall be designed to accommodate the effects and be compatible with the environmental conditions associated with...postulated accidents, including loss-of-coolant accidents.” During the initial licensing of WCGS, mechanical equipment was included in the Equipment Qualification Program, which encompassed, at that time, *all* safety-related equipment.

The Mechanical EQ Program was deleted from the WCGS EQ Program by Revision 13 (USAR CR 00-001) to the USAR. This deletion was based on a study that concluded that the program provided no significant increase in plant safety and that WCGS has sufficient controls to ensure the continued compliance of mechanical equipment with GDC-4. Continued compliance with GDC 4 is accomplished by procurement engineering, which ensures that equipment and materials are properly certified and evaluated, and maintenance, which ensures that equipment is maintained in like-new condition so that there is ample margin in equipment condition to allow for degradation without loss of function.

## 2.2 Design Bases

### 2.2.1 Criteria for Selection of Equipment

The WCGS Equipment qualification program addresses all Electrical Equipment Important to Safety that is located in a potentially harsh environment. A harsh environment results from the occurrence of a design basis accident Lost of Coolant (LOCA), Main Steam line Break (MSLB) or a High Energy Line Break (HELB) as defined in Section 2.3. Electrical equipment important to safety which were considered for inclusion within the scope of the WCGS Equipment Qualification program include:

1. Safety-related (Class 1E) electrical equipment.
2. Non-safety-related electric equipment whose failure under postulated environmental conditions could prevent satisfactory accomplishment of safety functions by the safety-related equipment.
3. Instruments identified by USAR Appendix 7A, (Reference 6), “Comparison To Regulatory Guide 1.97.”

This appendix provides an evaluation of the instrumentation to assess plant and environment conditions following an accident. The plant instrumentation and features provided at WCGS have resulted from detailed design evaluations and reviews. Design features that enable the plant to be taken to cold shutdown while utilizing only safety-grade equipment are described in USAR Section 7.4, “Systems Required for Safe Shutdown”. Chapter 18.0 provides a comparison of the WCGS design to the requirements of NUREG-0737. This equipment is identified in EQSD-II, Table 1 and 2 (Reference 122), as NUREG-0737 instruments.

NUREG-0737, Clarification of TMI Action Plan Requirements; (Reference 97) is a letter from the NRC Director of the Division of Licensing, NRR, to licensees of operating power reactors and applicants for operating licenses forwarding post-TMI requirements which have been approved for implementation. USAR Chapter 18 is WCGS response to NUREG-0737.

| Summary of EQ Equipment Added by NUREG -0737 | | |
|---|---|---|
| NUREG-0737 Category | USAR Section | Description |
| II.B.1 | 18.2.1 | Post-Accident Reactor Coolant System Venting |
| II.B.3 | 18.2.3 | Post-Accident Sampling System |
| II.D.3 | 18.2.6 | Direct Indication of Relief and Safety Valve Position |
| II.E.1.2 | 18.2.8 | Auxiliary Feedwater Automatic Initiation and Flow Indication |
| II.F.1 | 18.2.12 | Accident Monitoring Instrumentation |
| II.F.2 | 18.2.13 | Instrumentation for Detection of Inadequate Core Cooling |

The criteria for the selection of the equipment in the WCGS Electrical Equipment Qualification (EEQ) Program is based on those systems and components required to achieve or support emergency reactor shutdown, containment isolation, reactor core cooling, containment heat removal, core residual heat removal and the prevention of significant release of radioactive material to the environment.

### 2.2.2 Identification of Equipment

In accordance with the requirements of 10 CFR 50.49 paragraph (d) (Reference 1), a review (Ref. 17) was performed of design documents to assure that all equipment important to safety [10 CFR 50.49 paragraphs (b)(1), (b)(2), (b)(3)] was identified. The equipment was selected in accordance with the guidance provided in Appendix E to Regulatory Guide 1.89, Revision 1 (Ref. 2).

Table 2-1 provides a list of safety-related systems required to perform or support the following functions:

- Emergency reactor shutdown
- Containment isolation
- Reactor core cooling
- Containment heat removal
- Core residual heat removal
- Prevention of significant release of radioactive material to the environment Support systems (e.g., electrical distribution, diesel generator, and essential chilled water systems)

Using the guidance provided in Regulatory Guide 1.89 (Refs. 2 & 3) and the requirements of 10 CFR 50.49 (Ref. 1), the systems listed in Table 2-1 were evaluated to identify all electrical equipment important to safety which is also located in a harsh environment.

All equipment identified for inclusion within the EQ Program is selected in accordance with the guidance provided in Appendix E to Regulatory Guide 1.89 (Ref. 3) and listed in the Equipment Qualification Master List, or EQML (see Section 9.2).

**Table 2-1**

**Safety-Related Systems Required to Perform Safety Functions**

| Safety Function | System |
| --- | --- |
| Emergency Reactor Shutdown | Main Steam System (AB)<br>Main Turbine System (AC)<br>Main Feedwater System (AE)<br>Reactor Coolant System (BB)<br>Safety Injection (EM)<br>Chemical and Volume Control (BG)<br>Accumulator Safety Injection System (EP)<br>Refueling Water Storage System (BN)<br>Reactor Protection System (SB)<br>Excore Neutron Monitoring System (SE)<br>Containment Cooling System (GN) |
| Containment Isolation | Main Steam System (AB)<br>Auxiliary Feedwater (AL)<br>Main Turbine System (AC)<br>Main Feedwater System (AE)<br>Reactor Coolant System (BB)<br>Safety Injection System (EM)<br>Chemical and Volume Control System (BG)<br>Refueling Water Storage System (BN)<br>Steam Generator Blowdown System (BN)<br>Essential Service Water System (EF)<br>Component Cooling Water System (EG)<br>Residual Heat Removal System (EJ)<br>Containment Spray System (EN)<br>Accumulator Safety Injection System (EP)<br>Containment Cooling System (GN)<br>Containment/Hydrogen Monitoring System (GS)<br>Liquid Radwaste System (HB)<br>Reactor Protection System (SB)<br>Ex-core Neutron Monitoring System (SE)<br>Floor and Equipment Drain System (JE) |
| Reactor Core Cooling | Reactor Coolant (RCS)<br>Safety Injection and Shutdown Cooling (SI)<br>Chemical and Volume Control System (BG)<br>Refueling Water Storage System (BN)<br>Essential Service Water System (EF)<br>Component Cooling Water System (EG)<br>Residual Heat Removal System (EJ)<br>Accumulator Safety Injection System (EP)<br>Emergency Fuel Oil System (JE)<br>Floor and Equipment Drain System (LF)<br>Reactor Protection System (SB)<br>Ex-core Neutron Monitoring System (SE) |

**Table 2-1**
**Safety-Related Systems Required to Perform Safety Functions**

| | |
| --- | --- |
| Containment Heat Removal | Refueling Water Storage System (BN)<br>Essential Service Water System (EF)<br>Component Cooling Water System (EG)<br>Residual Heat Removal System (EJ)<br>Containment Spray System (EN)<br>Containment Cooling System (GN)<br>Reactor Protection System (SB)<br>Safety Injection System (EM)<br>HVAC - Containment (HC) |
| Core Residual Heat Removal | Main Steam System (AB)<br>Auxiliary Feedwater (AL)<br>Main Feedwater System (AE)<br>Reactor Coolant System (BB)<br>Refueling Water Storage System (BN)<br>Essential Service Water System (EF)<br>Component Cooling Water System (EG)<br>Residual Heat Removal System (EJ)<br>Safety Injection System (EM)<br>Reactor Protection System (SB) |
| Prevention of Significant Release of Radioactive Material to the Environment | Reactor Cooling System (RC)<br>Safety Injection System (SI)<br>HVAC - Fuel Building (GG)<br>HVAC - Control Building (GK)<br>Containment/Hydrogen Monitoring System (GS)<br>Containment Purge System (GT) |

**Table 2-1 (continued)**

**Safety-Related Systems Required to Perform Safety Functions**

| | |
| --- | --- |
| Support Systems | Emergency Generating System (NE)<br>Load Sequencing and Shedding System (NF)<br>HVAC - Fuel Building (GG)<br>HVAC - Diesel Generator Building (GM)<br>HVAC - Auxiliary Building (GL)<br>Containment Cooling System (GN)<br>Miscellaneous Building HVAC (GF)<br>Non-Vital Instrument AC System (PN)<br>Diesel Generator System (KG)<br>Class 1E 4.16 kV Power (NB)<br>13.8 Kv Electrical System (PA)<br>Computer System (RJ)<br>Class 1E 480 V AC Electrical System (NG)<br>Class 1E 125 V DC Power (NK)<br>Class 1E Instrument AC Power (NN)<br>Essential Safety Features Actuation (SA)<br>Reactor Protection System (SB)<br>Ex-core Neutron Monitoring (SE)<br>Plant Annunciator System (RK)<br>Main Control Board System (RL)<br>Miscellaneous Panels (RP)<br>Primary Sampling System (SJ)<br>Process Radiation Monitoring System (SP)<br>Oily Waste System (LE)<br>Fire Protection System (KC) |

The list of systems is derived from Reference 17, Appendix B.

## 2.3 Environmental Conditions

Environmental qualification is the verification of design which demonstrates that equipment is capable of performing its safety function under the significant environmental stresses resulting from design basis accidents in order to avoid common cause failures [Reg. Guide 1.89 (Ref. 2, Section B)]. Design basis accidents are those events analyzed within the scope of the USAR, Chapter 15 (Ref. 6). However, significant environmental stresses may also result from events accounted for in the plant design process, which are analyzed, elsewhere in the USAR. Therefore, qualification must also address significant changes from normal environmental conditions that occur outside containment as a result of high energy line breaks (HELB) [NUREG-0588 (Refs. 4 & 5, Section 1.5)]." Changes in the environments over normal conditions, and the subsequent increased stresses applied to equipment, resulting from the initiation of design basis accidents LOCA, MSLB and HELBs, create "harsh" environments. Therefore, a harsh environment exists in any area of the plant affected by design basis accidents and HELBs where the environmental stressors exceed the equipment design or limits set forth in Section 2.3.1 of this manual. At WCGS, harsh environments only exist in the containment and auxiliary buildings (Ref. 17).

Mild environmental parameters are the range of conditions upon which equipment design is based and may not cause appreciable aging degradation of the equipment. Failures under mild environment conditions are not considered common mode failures and are typically random in nature [EPRI NP-1558 (Ref. 31)]. As defined in Section 2.3.5, equipment located in mild environment plant areas is not within the scope of the WCGS Equipment qualification program and therefore, not within the scope of this document.

The environmental parameters that occur during normal plant operation and postulated design basis accident conditions are provided for plant harsh environment areas (the containment building, auxiliary, Diesel and fuel buildings) in Attachment A of this document. The environmental parameters are given by Room number. Environmental parameters for other rooms of the plant may be found in Attachment B, USAR and Specification M-000.

### 2.3.1 Definition of Normal Environment

Normal plant environmental conditions are defined as those temperature, pressure, humidity and radiation conditions that occur during normal plant operation, including anticipated operational occurrences. Normal conditions are those for which the plant is designed.

Anticipated operational occurrences, or abnormal plant conditions, are those transient conditions of normal operation which are expected to occur one or more times during the life of the plant and include, but are not limited to, the loss of all offsite power and the concurrent loss of non-essential HVAC systems. This definition is consistent with that given in Appendix A of 10 CFR Part 50 (Ref. 10). In addition to those transient conditions, design basis accident conditions producing environmental stressors in areas not severe enough to be considered "Harsh," are considered abnormal plant conditions. Therefore, the normal plant temperature, pressure and humidity conditions for those areas with essential HVAC systems are defined for qualification purposes as the maximum, or most severe, normal plant design conditions (e.g., a room with essential ventilation may have a maximum normal design temperature of 104°F with and without offsite power).

For plant areas without essential ventilation systems, the environmental stresses associated with the loss of HVAC abnormal event are considered to be insignificant in their effects on equipment performance, particularly when compared to the environments resulting from LOCA, MSLB or HELB accident, for the following reasons:

1. The loss of HVAC events are of a very short duration compared to the 60 year plant life, and are therefore statistically insignificant;
2. The short duration of the loss of HVAC transient should not have a significant impact on the equipment thermal life,
3. The loss of HVAC events are easily mitigated such as by opening doors and using portable blowers; and
4. In most cases the thermal life calculated for qualified life purposes is based on the maximum, or most severe, normal plant design temperature assumed to occur for as long as the equipment is installed in the plant (see Sections 3.1.1 and 3.1.4).

Therefore, normal plant conditions in areas without essential ventilation are also defined for qualification purposes as the maximum, or most severe, normal plant design conditions.
In certain cases (e.g., the WCGS emergency diesel generator area), a normal environmental condition (e.g., temperature) should increase as an indirect result of a design basis accident (e.g., the normally inactive diesel generator sets are started in response to a design basis accident, thus increasing the heat load and ambient temperature in the area). However, these situations are not considered harsh environmental conditions since the equipment would see this change in its environment while operating, independent of whether or not a design basis accident had occurred. These operating conditions are accounted for in the design process (e.g., the diesel generator area normal design temperature is 122°F (Ref. 28) to account for the temperature rise associated with a running unit).

## 2.3.2 Harsh Environmental Conditions

### 2.3.2.1 Definition of Harsh Environment

Environmental conditions anticipated to exist in areas, which would be directly affected by one of three Design Basis Accidents (DBA):

1. Loss of Coolant Accident (LOCA)
2. Main Steam Line Break (MSLB)/*Main Feed Line Break (MFLB)
3. High Energy Line Break (HELB)

* The MFLB is a break that is a subset of the MSLB accident that occurs between the feedwater lines and steam generators.

For radiation, a plant area is considered harsh for all nuclear power plant components with the exception of radiation sensitive semi-conductor devices (e.g. metal oxide semi-conductor or MOS) when the total integrated normal plus accident radiation dose exceeds 1.0E+4 rads [Reference 6, Page 3.11(B)-18].

Harsh plant conditions subject equipment to severe environmental stresses as compared to the range of conditions considered during the equipment design and specification process. Harsh environments may potentially result in common mode failures across redundant trains of equipment [Reg. Guide 1.89 (Reference 3, Section B)]. Harsh environmental conditions result in plant areas directly exposed to the effects of design basis accidents (e.g., LOCA, MSLB and HELBs). For plant areas wherein a design basis accident or HELB does not specifically occur, a harsh environment exists when the normal environmental plant conditions, as defined in Section 2.3.1 above, exceed the limits defined in Section 2.3.2.2 during or subsequent to a design basis accident or HELB. For example, areas outside containment may be subject to elevated radiation conditions, due to recirculating fluids, after a LOCA initiated inside containment.

### 2.3.2.2 Harsh vs. Mild Environmental Parameters

Definition of Mild Environment is an environment which does not exceed its anticipated abnormal condition or, as a result of an accident, the room environment remains below all of the following parameters: (References 17 and 83)

| | |
| --- | --- |
| Temperature | < 110 F |
| Pressure | < 16.1 psia |
| Radiation | < $10^3$ rads ($10^3$ to $10^4$ rads – with analysis) |
| Humidity | < 90% |

A. Temperature

As given in Section 2.3, normal plant environmental conditions are defined as those that occur during normal plant operation, including anticipated operational occurrences, such as a loss of room cooling in areas serviced by non-essential HVAC.

No credit was taken for cooling provided by non-safety related HVAC, because operation of these systems would reduce the severity of the environmental conditions.

The minimum temperature is not provided in the EQMS environments module as the minimum temperature is not used in the EQ program. To determine the minimum temperature use Specification M-000 (Reference 28) and/or the applicable equipment specification.

B. Pressure

A harsh pressure environment exists vs. mild, when a pressure is 1.0 psig above normal plant environmental conditions occurs as a direct result of a design basis accident; LOCA, MSLB or HELB. Atmospheric pressure is 14.7 psia.

Pressure excursions resulting from direct exposure to line break accidents (e.g., LOCA and HELBs) are indicative of steam releases such that the pressure gradient may force moisture (e.g., chemical spray and steam) inside equipment and enclosures.

C. Humidity

A harsh humidity environment exists when the relative humidity becomes 100% and condensing as a result of direct exposure to a saturated steam environment during a design basis accident or HELB.

Moisture concentration in air is not considered to significantly affect equipment performance. However, performance may be affected, when the conditions are such that the moisture condenses and forms water films and droplets on equipment, or condenses inside electrical enclosures, then accumulates in conduit low points as discussed in NRC Information Notices 89-63 and 84-57. The NRC identified the possibility of condensate accumulation resulting from a HELB in low points of conduits located in the auxiliary building and from LOCA or MSLB inside containment. At WCGS all class 1E terminal boxes supplied under E-028 have a drainage path shall be installed at bottom of the terminal box. (Reference 15). Conduit entering various electrical equipment and the openings for cable entry, from cable tray systems located above or below the equipment, shall be effectively sealed after cable pulling operations have been completed (Ref. 90, Section 3.17).

D. Chemical Spray

The initiation of chemical spray during a design basis accident (e.g., LOCA) results in a harsh environment in the containment building.

Water spray and chemical constituents may affect equipment performance initially through water ingress and during the post-accident period as a result of potentially corrosive interactions. The cooling effects of water spray on equipment may also result in an increase in the total condensation in enclosures as stated in Section 2.3.2.2.C. The duration of the chemical spray during a LOCA is approximately for 24 hours and the concentration range is between pH=4.0 and pH=11.0 per Reference 17, pages 6-4 & 6-5.

The normal spray pH during the injection phase is 9.5 to 10.5. The higher pH occurs early during the injection phase. As the level in the spray injection tank decreases, the head on the spray eductor decreases; accordingly, the pH level decreases in the spray. It is possible during the beginning of the recirculation phase to still be adding sodium hydroxide, via the eductors. During this short period (≤ 1 minute), it is possible to have an elevated pH = 11.0. Assuming a single failure in the spray system, this period could last up to 30 minutes. For the remainder of the recirculation phase (22 to 23 hours), the spray pH is 8.0 – 9.0 (Ref. 17, page 6-5).

A caustic spray with an upper limit of pH = 11.0 is used in the review; however, it is recognized that this event should only occur for a short period. A maximum boron concentration of 2500 ppm is utilized for the review (Ref. 6, Section 6.2.5.4 & Reference 41).

E. Submergence

Submergence of electrical equipment resulting from the occurrence of a design basis accident or HELB is considered a harsh environmental parameter. Qualification of electrical equipment to submergence is required by 10CFR50.49(e)(6). NRC Information Notices 89-63 and 84-57 clarify that possible submergence of electrical circuits includes those inside electrical enclosures located above plant flood levels. These circuits may become submerged post-accident due to moisture condensation (Section 2.3.2.2.C).

At WCGS each piece of equipment that was identified as being submerged was evaluated individually to determine if submerged operation for a particular accident was required for plant safety. All equipment that could be submerged was identified on the appropriate Equipment Evaluation Worksheet (EEW) (Ref. 17, page 6-8).

F. Radiation

A total (normal plus accident) integrated dose of less than $10^4$ rads should not hamper the strength or properties of most materials used. Hence, further Equipment qualification analyses and tests for such components, which should be exposed to less than $10^4$ rads are not necessary. For higher integrated doses, components are qualified either by qualification testing or by evaluating the materials of construction used in those components.

The effects of accident doses greater than $10^3$ rads were evaluated as appropriate (e.g., solid-state devices) [Reference 6, Page 3.11(B)-18)]. However, if the total integrated dose (normal plus accident radiation) determined for a specific piece of equipment is less than the radiation threshold due to shielding effects, or a short post-accident operating time, then this equipment would not be exposed to a harsh radiation environment even though it is located in a potentially harsh radiation area.

### 2.3.3 Inside Containment Environmental Conditions

The environmental parameters that occur during normal plant operation and postulated design basis accident conditions are provided for the containment building in Attachment A of this document. Instructions for the use of the Attachment A information are provided in the front of the Attachment.

#### 2.3.3.1 Normal Conditions

The environmental conditions occurring in the containment building during normal plant operation consist of ambient temperature, pressure and humidity and gamma radiation. Chemical spray initiates only during design basis accidents LOCA or MSLB (Ref. 6, Section 6.2.2.1.2.1) and flooding only occurs as a result of pipe breaks during accident conditions.

The containment building HVAC systems are designed to maintain the containment ambient air temperature between 50°F and 120°F during normal plant operation. These systems include the reactor cavity and control element drive mechanism cooling systems. The containment HVAC system cooling units are connected to engineered safety features (ESF) buses and are manually operated during postulated loss of offsite power occurrences to maintain ambient temperatures at, or below, 120°F. There are temperature indicators for all levels of the containment building in the control room [Ref. 6, Sections 3.11(B).1, Table 3.11(B)-1 and 9.4.6.1.2].

#### 2.3.3.2 Accident Conditions

The design basis accidents that determine the enveloping environmental conditions for in containment conditions are the loss of coolant accident (LOCA) and a main steam line break (MSLB). High-energy line breaks are also postulated in containment; however, the temperature, pressure, and humidity conditions resulting from these breaks are enveloped by the environmental conditions resulting from the MSLB or LOCA (Ref. 6, Section 6.2.1.4.4).

The peak containment accident temperature results from the worst case MSLB, while the peak accident pressure occurs during a LOCA. Chemical spray is initiated during either a LOCA or MSLB. The Containment Spray Pumps should automatically start upon receipt of a Containment Spray Actuation Signal (CSAS). CSAS is actuated by 27 psig inside Containment as sensed on 2 out of 4 containment atmosphere pressure transmitters, (Reference 95, M-10EN, “Containment Spray System”). The worst-case postulated flood level occurs during a LOCA per Attachment A of this document.

Section 6.2.1.4.4 of the WCGS USAR (Ref. 6), "Results of Postulated Feedwater Line Breaks Inside Containment," identifies the inside containment LOCA and MSLB temperature and pressure transient conditions to be used for equipment qualification.

The containment pressure and temperature response to a postulated LOCA are based on the results from the assumed Double-Ended Pipe Suction Guillotine (DEPSG) break with minimum safety injection and with the worst single failure being the loss of one emergency diesel (Ref. 6, Section 6.2.1.1.3)

The containment pressure and temperature response to a postulated MSLB has been analyzed, based on the developed GOTHIC model, for the 16 cases. The peak calculated containment pressure and temperature for each case is presented in Attachment A. The 0.40 $ft^2$ split break at hot-zero power with an additional MSIV failure (Case 16) and the full double-ended MSLB at the 102% power (Case 1), are found to result in the highest containment peak pressure and temperature, respectively (Reference 102, Section 3.0, Table 3-1). However, the temperature and pressure data presented in Reference 102 is only provided for 1400 seconds and not given for the entire 180 day post-accident period for which Equipment qualification must be demonstrated (see Section 3.10.1).

The accident radiation doses consist of gamma and beta radiation constituents determined for source distributions from nuclides suspended in the containment atmosphere, plated-out on containment and equipment surfaces, or mixed in the containment sump water. Equipment may receive a dose contribution from any or all of these sources. TID-14844 (Reference 130) is the process at WCGS which specified the release of fission products from the core to the reactor containment in the event of a postulated accident involving a "substantial meltdown of the core." Using the guidance of NUREG-0588, post-LOCA radiation environments were determined in all areas of the containment. The fission product release data used in this analysis were obtained from Westinghouse (Ref. 17, page 6-1). The isotopic inventory provided by Westinghouse (Ref. 17) was for an equilibrium cycle WCGS core. The data were calculated at the end of cycle life and, therefore, represent maximums suitable for post-accident evaluations. The current analysis bounds changes associated with Power Rerate 3565 MW thermal and the change from 12 to 18 month fuel cycle (Ref. 6, Section 3.11(B).1.2.2).

To determine the gamma dose rate inside the containment, the multi-group, three dimensional, point kernel code QAD-CG (Ref. 17, page 6-2) was used to take credit for all major internal structures. The containment was divided into regions, and the maximum dose rate within each region as a function of time was determined. These dose rates were assumed to apply to all equipment within that region. Each dose rate was numerically integrated to obtain the 180-day integrated dose for each region. The beta dose rate as a function of time was obtained assuming a semi-infinite cloud model. These dose rate values were also numerically integrated to obtain the 180-day beta doses for each region. The gamma plate-out was modeled using a cylinder with a height and radius equal to that of the containment. The dose rate was obtained at the center of the cylinder without taking credit for air attenuation. Beta dose rate contributions due to plate out were obtained assuming a contact dose rate.

Although WCGS is designed and has satisfactorily completed a review to a 1 percent cesium post-accident source term, the radiation levels obtained using a 50 percent cesium source term were utilized during the NUREG-0588 review. Due to the extreme conservatism in the equipment specifications, most components were qualified to this radiation level. The NRC has resolved GSI 187 (Reference 126); the staff concluded that there was no clear basis for backfitting the requirement to modify the design basis for equipment qualification to adopt the Alternative Source Term (AST). The additional Cesium contribution only becomes limiting after 30 days post-accident. If the PAOT of the equipment being qualified is less than 30 days, the source term with 1% cesium remains bounding. For equipment where the PAOT requirement is > 30days, the continued use of 1% cesium is consistent with the resolution of GSI-187. Plus as identified in section 3.1.13.3 radiation margins section and reference 109, the way WCGS calculations use the RELAP-EM program and 10 CFR 50 Appendix K, ECCS EVALUATION MODELS conservative assumptions result in estimates of between 20% and 80% fuel rods with cladding failure for a typical PWR. Thus, where the 50 percent cesium source term radiation is too severe, the equipment is evaluated against a 1 percent cesium source term (Ref. 6, Section 3.11(B).1.2.2).

### 2.3.4 Outside Containment Conditions

The environmental parameters that occur during normal plant operation and postulated design basis accident conditions are provided for the auxiliary building, Diesel building, control building and the fuel building in Attachment A of this document. Instructions for the use of the Attachment A information are provided at the beginning of the Attachment.

A break is considered to be a HELB if the pressure is 275 psig or more and/ or the temperature is 200F or more, plus this is the normal existing conditions. Reference 29, sheet 15 identifies that based on the line size, fluid pressure and temperature condition a determination was made of which lines were the worst case lines to be used for HELB analysis for a particular room.

In the NUREG-0588 review (USAR 3.11(B).1.2.3), the equipment qualification temperature and pressure environments for postulated MSLBs and HELBs outside the containment were determined based on a conservative model as summarized below:

a. Room pressure and temperature profiles were generated to determine the worst local environments.
b. No credit was taken for cooling by non-Class 1E HVAC.
c. The only mechanism considered for temperature dissipation was a conservative model of heat transfer to passive heat sinks.
d. Conservative break isolation times were used.

As identified in USAR 3B.2.2, all high and moderate energy lines whose failure could reduce the functioning of a safe shutdown component to an unacceptable safety level are evaluated for pipe breaks or cracks. Thrust forces, jet impingement forces, and environmental effects are considered. Section 3.6 provides a description of the location and types of breaks and the forcing functions that are considered for analyzing pipe breaks. Evaluation of environmental effects of moderate energy pipe cracks (MEC) has been made based on the characteristics of the flow from the postulated cracks, but not as a part of the NUREG-0588 review. The locations of the cracks are discussed in USAR Section 3.6.2.1. The evaluations include the effects of spraying or wetting safe shutdown equipment and the effect of flooding from the worst-case pipe crack in each room or general area. Additional HELB and MEC analysis is provided in USAR Tables 3.6-4 and 3B-1 (pipe break analysis section).

NRC Information Notice 89-63: “Possible Submergence of Electrical Circuits Located above Flooding Level Because of Water Intrusion and Lack of Drainage”. This IE Notice was evaluated by Nuclear Plant Engineering and found no significant engineering concern. Much of the equipment has vapor and dust seals, other equipment is provided with moisture drainage paths; design features include potting compounds or seal connectors (See Section 2.3.2.2.C).

NRC Information Notice 83-41: “Actuation of Fire Suppression System Causing Inoperability of Safety-Related Equipment”. At WCGS the power block Fire Protection System (FPS) components in safety-related equipment areas utilize proven components and have been selected to minimize the risks of inadvertent operation. Drip-proof safety-related pump motors and electrical equipment are used, when feasible, to minimize the possibility of damage should firefighting operations be required. Wet-pipe sprinkler systems are not used in electric motor-driven safety-related pump rooms and electrical equipment rooms. Extinguishing materials used in the FPS are compatible with the equipment in the areas served to avoid damage to the equipment in the event of a break in the system. Adequate drainage is provided in the areas where sprinkler or water spray systems are used.

Standpipes, which service safety-related equipment, are located outside the boundary of the equipment room, where possible, so that an inadvertent pipe failure does not create a flooding condition in the vicinity of the safety-related equipment. Manual valves are provided to isolate the failed standpipe. The safety-related equipment located in the basement of the auxiliary building is enclosed by watertight doors and walls to prevent a flooding condition within the equipment room. Standpipes in the control building are routed in the stairwells, where possible, to preclude pipe failures, creating a flooding condition in the vicinity of the safety-related equipment. Floor drains have been provided throughout the control building to preclude flooding at any elevation due to a failure or if water is required to extinguish a fire (Ref. 6, Section 9.5.1.2.1).

Additionally, this condition has no adverse effect on the EQ equipment since simultaneous actuation of Fire Protection system during HELB would actually aid in suppression of environmental effects of the accident thus making MSLB/HELB without actuation of FP system the most limiting event.

NUREG 0800, Standard Review Plan section 3.11 (Ref. 12) states that all EQ equipment must be capable of performing their design safety functions under all environmental conditions which may result from any normal or abnormal mode of plant operation, design basis events, post-design basis events, and containment tests.

### 2.3.4.1 Auxiliary Building

A. Normal conditions

The environmental conditions occurring in the auxiliary building during normal plant operation consist of ambient temperature, pressure and humidity and gamma radiation.

The auxiliary building normal or essential HVAC systems maintain ambient air temperature below design conditions during normal plant operation. The equipment rooms, access control areas, the mechanical and electrical penetration areas, and the remainder of the auxiliary building are served by a normal HVAC system per Reference 6, Section 9.4.3.

B. Accident Conditions

The design basis accidents that determine the harsh environmental conditions in the auxiliary building are various high energy line breaks (HELB), and the LOCA that occurs in containment. The HELBs create increases in the temperature, pressure, and humidity environments of many of the auxiliary building areas. The LOCA result in increased radiation doses. For the feedwater lines (HELB), only breaks outside the containment were considered. Both types of breaks, i.e., double-ended guillotine and slot breaks, were analyzed (Ref. 6, Section 3.6.2.2.1.4).

The HELB temperature profiles for each area of the auxiliary building affected by the auxiliary steam and letdown line breaks are provided in Attachment A.

Post-LOCA, areas of the auxiliary building should experience increased radiation doses resulting from shine through the containment wall and from recirculating fluids. Airborne radiation doses due to leakage from the containment are present in areas of the auxiliary building.

### 2.3.4.2 Fuel Building

A. Normal Conditions

The environmental conditions occurring in the fuel building during normal plant operation consist of ambient temperature (60ºF/122ºF), pressure and humidity and gamma radiation.

The fuel building normal HVAC system maintains ambient air temperature below design conditions during normal plant operation and provides the required ventilation to maintain the level of airborne radioactivity below permissible limits (Ref. 6, Section 9.4.2.2).

B. Accident Conditions

There are two design basis accidents that affect environmental parameters in the fuel building. These accidents are: a fuel handling accident and a HELB concurrent with a LOOP and single failure of one train (Ref. 6, Section 9.4.2.1.1). The fuel handling accident, equipment in the fuel building, such as ventilation system, would not be exposed to radiation levels higher than $10^3$ rads.

The original Equipment Qualification program review for compliance to NUREG 0588 indicated that all harsh environments caused by LOCA, HELB or MSLB are located in the containment building and auxiliary building (Ref. 17, page 1-1)

### 2.3.4.3 Diesel Generator Building

A. Normal Conditions

The environmental conditions occurring in the diesel generator building consist of ambient temperature, pressure and humidity.

The diesel generator HVAC system maintains ambient air temperature below design conditions during normal plant operation. Design normal temperature conditions for the diesel generator control room are 50°F to 122°F. Design normal temperature conditions for the diesel generator area are 50°F to 122°F based on the temperatures expected as a result of diesel generator operation. The diesel generator HVAC system cooling units are connected to ESF buses and are manually operated during postulated loss of offsite power occurrences to maintain ambient temperatures at, or below, normal design limits. There are temperature indicators for the areas supplied with essential HVAC systems in the control room [Ref. 6, Sections 3.11(B).4 and 9.4.7]. However, the original equipment qualification program review for compliance to NUREG 0588 indicated that all harsh environments caused by LOCA, HELB or MSLB are located in the containment building and auxiliary building (Ref. 17, page 1-1).

B. Accident Conditions

During design basis accidents, the HVAC system maintains the diesel generator control room and area within normal design ambient temperature, pressure and humidity conditions (Ref. 6, Section 9.4.7). Therefore, the environmental conditions do not increase above normal design conditions as a result of design basis accidents.

#### 2.3.4.4 Control Building

A. Normal Conditions

The environmental conditions occurring in the control building during normal plant operation consist of ambient temperature, pressure and humidity conditions.

The control building essential and normal HVAC systems maintain ambient temperature below design conditions during normal plant operation. Both HVAC systems, essential and normal, are provided for the control room, computer room, ESF switchgear, ESF equipment rooms, and battery rooms. The essential HVAC system cooling units are connected to ESF buses and are manually operated during postulated loss of offsite power occurrences to maintain ambient temperatures at, or below, normal design limits. There are temperature indicators for the areas supplied with essential HVAC systems in the control room [Ref. 6, Sections 3.11(B).4 and 9.4.1].

During the normal environment the following anticipated operational occurrences or abnormal conditions can occur. During a loss of offsite power, when Class 1E equipment is powered by the emergency diesels, Class 1E room temperatures may reach 92°F, due to the possibility of the fan running slower because of variation in the diesel generator frequency/voltage. With a single nonfunctional SGK05A or SGK05B unit concurrent with accident condition (LOCA) heat loading as well as a high enough ambient temperature, the room temperature may reach 104°F.

B. Accident Conditions

During design basis accidents, the essential HVAC system maintains the essential areas within normal design ambient temperature, pressure and humidity conditions (Ref. 6, Section 9.4.1). Therefore, the environmental conditions do not increase above normal design conditions as a result of design basis accidents.

#### 2.3.4.5 All Other Site Areas

There are no other site areas that contain safety-related equipment that is required to mitigate the consequences of design basis accidents that would also be exposed to increased environmental conditions as a result of these accidents.

### 2.3.5 Mild Environment Equipment Qualification

The specific environmental qualification of equipment located in mild environment plant areas is not required under 10 CFR 50.49 [Ref. 1, paragraph (c)].

Mild environmental parameters are the range of conditions upon which equipment design is based. Failures under mild environment conditions are not considered common mode failures and are typically random in nature (Ref. 31).

This definition is consistent with the Mild Environment definition given in 10 CFR 50.49 [Ref. 1, para. (c)], which states that:

"A mild environment is an environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences."

The requirements outlined in the NUREG 0800 Standard Review Plan (SRP), Section 3.11 (Ref. 12) for establishing environmental qualification of electrical and mechanical equipment located in a mild environment are as follows:

1. "Design/Purchase" specifications that contain a description of the functional requirements for specific environmental zones during normal and abnormal conditions are required to demonstrate qualification.

2. A well-supported maintenance/surveillance program with data and records reviewed at least every 18 months to ensure qualified life has not suffered degradation.

3. A good preventive maintenance program.

Per Generic Letter 82-09, "Environmental Qualification of Safety-Related Electrical Equipment," for existing equipment located in mild environments, equipment qualification can be adequately demonstrated and maintained by the use of the following three programs:

1. A periodic maintenance, inspection, and/or replacement program based on sound engineering practice and recommendations of the equipment manufacturer which is updated as required by the results of an equipment surveillance program;

2. A periodic testing program to verify operability of safety-related equipment within its performance specification requirements (system level testing of the type typically required by the plant technical specifications may be used);

3. An equipment surveillance program that includes periodic inspections, analysis of equipment and component failures, and a review of the results of preventive maintenance and periodic testing programs.

The generic letter also states "for replacement and new equipment, the licensee must also establish and document the environmental design basis for the equipment locations. The purchase specification must reflect those design basis environmental conditions that are bounding for all applicable equipment locations."

# 3.0 DESIGN VERIFICATION

## 3.1 Methodology for the Equipment Qualification of Electrical Equipment

Electrical equipment qualification is in accordance with the criteria, requirements, and guidance provided in Title 10 Part 50 Section 49 of the Code of Federal Regulations (10 CFR 50.49) (Reference 1), NUREG-0588, Category I (Reference 4&5), Regulatory Guide 1.89, Revision 1 (Reference 3) and NUREG 0881 – Supplement 4, (Reference 98). Qualification methodology is in accordance with IEEE Standard 323-1974 (Reference 13) as implemented by Regulatory Guide 1.89 and associated daughter standards as outlined by licensing commitments contained in the WCGS UFSAR, Section 3.11(B) and Section 3.11(N), (Reference 6).

Other IEEE standards and qualification criteria were used in conjunction with IEEE 323-74 to qualify certain equipment. These are discussed below:

1. Continuous-duty motors used inside the containment are type tested under simulated LOCA conditions. IEEE 334-1974, "Standard for Type Tests of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations," is used. Insofar as practicable, auxiliary equipment which is part of the installed motor assembly is likewise qualified in accordance with IEEE 334, under simulated design basis event conditions.
2. Motor-operated valves used inside the containment are type tested in accordance with IEEE 382-1972 (ANSI N41.6), "Trial-Use Guide for Type Test of Class I Electric Valve Operators for Nuclear Power Generating Stations."
3. Type tests for each type of cable to assure acceptability for use in the containment post-accident environment are performed in accordance with IEEE 383-1974, "Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations."
4. Electrical containment penetrations are tested in accordance with IEEE 317-1976, "Electric Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations."

Aging assessment is the evaluation of appropriate information for determining the effects of aging on the current and future ability of equipment to function as designed under all service conditions. The aging evaluation addresses the effects of significant aging mechanisms through operating experience, testing, analysis, in-service surveillance, condition monitoring, and maintenance activities, as noted in IEEE Std 323-1974, (Reference 13).

Types of aging include thermal, radiation, wear (e.g., mechanical and electrical cycling), and vibration. Types of aging can further be categorized as:

1. Operational Stresses - Operational stresses include surge voltages, mechanical, and electrical cycling, and self-heating; these parameters are factored into the aging evaluation as applicable.
2. External Stresses - External stresses include radiation, non-seismic vibration, and thermal; these parameters are factored into the aging evaluation as applicable. Because earthquakes fall under the category of design basis events, seismic stresses are not considered external stresses.
3. Synergism - In accordance with Regulatory Guide 1.89, if synergistic effects have been identified prior to the initiation of qualification, they should be accounted for in the qualification program. Synergistic effects known at this time are dose and dose rate effects resulting from different sequences of applying radiation and elevated temperature.

The following sections provide the acceptable methods and guidance used in evaluating WCGS qualification documentation to determine if the documentation demonstrates that electrical equipment should perform as required when exposed to normal and postulated accident harsh environmental conditions.

### 3.1.1 Thermal Aging

Thermal aging is the deterioration of equipment due to its exposure to normal plant temperatures over extended periods of time. The thermal life of equipment is the time the equipment can be installed in the plant such that it should retain sufficient capacity to perform its required safety function during design basis accident conditions. Thermal aging effects are one of several elements considered when establishing the Qualified Life (QL) of equipment (Refer to Section 3.1.4 for a discussion of qualified life).

Thermal aging only affects organic materials. The rigid structure and relatively high melting points of inorganic materials such as metals, minerals, and ceramics demonstrate that they should be unaffected by the range of normal temperature conditions postulated to occur at WCGS. Therefore, the thermal life of equipment is based on the degradation of its organic parts.

At WCGS, the desired thermal life for equipment is 60 year plant design life (40 original + 20 extension) at the maximum normal ambient temperature to which the equipment should be exposed. However, a 60-year thermal life may not always be achieved due to aging data limitations and the variations in degradation rates of the materials used in equipment construction. In these cases, it is acceptable to determine a thermal life of less than 60 years, or to define periodic maintenance to replace age sensitive parts within a device.

#### 3.1.1.1 Arrhenius Methodology

IEEE 101, Guide for the Statistical Analysis of Thermal Life Test Data (Reference 35) establishes a method by which the thermal aging of equipment can be simulated by an accelerated test process, which exposes the equipment to a temperature higher than the normal plant temperature for a specified time period. The mathematical model identified in section 1.2 (Reference 35) is the Arrhenius Equation. In Regulatory Guide 1.89 R/1 (Reference 3) the NRC endorsed IEEE 323-74 (Reference 13) and the IEEE 323-74 version introduced the concept of aging (section 6.3.3) and qualified life (section 5.3). Section 5.3, qualification by analysis, states that "Qualified life shall be determined by the time dependent effects of the environmental influences by quantitatively demonstrating that the performance characteristics of the equipment meet or exceed the design specifications of the equipment after a design basis event, proceeded by a time period during which the equipment is subjected to its normal design environment. The maximum time period of normal environment for which the quantitative analysis is valid shall be the maximum life for which the equipment can be qualified by analysis. Section 6.3.3, aging, with respect to the use of a regression line references IEEE 101-1972 as a basis for selecting aging time and temperature. 10CFR50 GDC-4, IEEE 279 and IEEE 323-74 established the foundation for Equipment Qualification and IEEE 323-74 through reference to IEEE 101 brings the Arrhenius method to the Nuclear Industry by NRC acceptance of IEEE 323-74 by Regulatory Guide 1.89.

Additional IEEE standards related to thermal life and analysis are:

- ANSI/IEEE Std 1-2000, IEEE Standard General Principles for Temperature Limits in the Rating of Electrical Equipment and for the Evaluation of Electrical insulation (Reference 110)
- ANSI/IEEE Std 98-2016, IEEE Standard for the Preparation of Test Procedures for the Thermal Evaluation of Solid Electrical Insulation Materials (Reference 111)
- ANSI/IEEE Std 99-2007, IEEE Recommended Practice for the Preparation of Test Procedures for the Thermal Evaluation of Insulation Systems for Electrical Equipment (Reference 112)
- ANSI/IEEE Std 117-2015, IEEE Standard Test Procedure for the Evaluation of Systems of Insulating Materials for Random Wound AC Electric Machinery (Reference 113)
- ANSI/IEEE Std 1776-2008, IEEE Recommended Practice for Thermal Evaluation of Unsealed or Sealed Insulation System for AC Electric Machinery Employing Form-Wound Pre-Insulated Stator Coils for Machines Rated 15,000V and Below (Reference 114)
- ANSI/IEEE Std 434-2006, IEEE Guide for Functional Evaluation of Insulation Systems for Large High-Voltage Machines (Reference 115)

- ANSI/IEEE Std 930-2004, IEEE Guide for Statistical Analysis of Electrical Insulation Breakdown Data (Reference 116)
- IEEE Transaction Paper EI-13 No 4, a 1978 paper by E.L. Brancato presents an excellent historical review of insulation aging up to the beginning of the "qualification age" – Brancato was another insulation aging pioneer (Reference 117)
- UL 746B, first edition issued in 1975, "Standard for Polymeric Materials – Long Term Property Evaluations" follows the basic principles of IEEE Stds 1, 98, 99 and 101 to determine the Relative Thermal Index of materials. This is a source for activation energy information and addresses the 90 degree C cable rating (Reference 118)
- IEEE 1205-2014, IEEE Guide for Assessing, Monitoring, and Mitigating Aging Effects on Electrical Equipment Used in Nuclear Power Generating Stations and Other Nuclear Facilities (Reference 127)

As stated, the mathematical model supported by the NRC for the correlation of the time of exposure to the higher test temperature to an equivalent time at the normal plant temperature is the Arrhenius methodology. As described in EPRI 1021067, Plant Support Engineering: Nuclear Power Plant Equipment Qualification Reference Manual, (Reference 33).

The Arrhenius equation provides a method of equating thermal aging data to the equivalent duration at temperatures other than the aging temperature. EPRI 1021067 (Reference 33) identifies the following Arrhenius equation most suited to this analysis:

$$t_s = t_a \, e^{N(1/Ts - 1/Ta)/k}$$

(Equation 3.1)

Where:

ts = service time being simulated (same unit as aging time )

ta = accelerated aging time

e = exponential function

N = activation energy (eV)

Ts = service temperature (Kelvin)

Ta = aging temperature (Kelvin)

k = Boltzmann's constant = 8.617 E-5 eV/K

The Arrhenius equation can be used to establish any of the four time or temperature parameters (i.e., ts, ta, Ts, or Ta ) when the other three are specified.

Based on reference 13, section 6.5.3 the qualified life shall be based upon the known limits of extrapolation of the time dependent environmental effects if an accelerated aging test was used to determine the mathematical model. Extrapolation is an analytical technique which may be used to augment testing. However, in order to be considered valid for qualifying Class 1E equipment certain guidelines must be considered in order to use it for analysis.

1) Failure modes: The modes of failure produced under intensified or accelerated -environmental or other influences shall be the same as those predicted under the required service conditions. If not, the intensity of the accelerating variable shall be reduced until failure modes and mechanisms produced are consistent with those known or predicted for required service conditions.
2) Characterization of Effects: The life (or other attribute) being extrapolated shall be characterized as a function of the environmental variable to provide a basis to forecast changes of the equipment performance with time (or other domain).
3) Extrapolation Basis: To establish the basis for extrapolation, equipment or components shall be subjected to a comparable environment for a time or level necessary to justify the extrapolation of the test results to the total time or level to be qualified.

Neither IEEE 323 nor IEEE 101 state any known limits of extrapolation for the Arrhenius methodology. However, extrapolation of the model to stress levels significantly beyond the established data range may introduce large statistical uncertainties in any aging prediction. Additional quality standards to IEEE 323-1974 and nuclear industry EPRI reports do indicate that extrapolating beyond the extrapolation limits could invalidate the results of the Arrhenius methodology.

Linear Interpolation of the test points can be done in excel by doing the following:

1) First load all values in excel spread sheet two column table.
2) Go to <insert Tab> select <Scatter <scatter with only markers>
3) Right click on one of the points.
4) Select <add trendline>
5) Select in the "Trend Options" tab the following:
   - Linear
   - Automatic
   - Display Equation on chart
   - Display R-squared value on chart (identified % accurate)

Note one can include layers (multiple lines) by selecting in the chart tools tab <design>

The thermal life of equipment is based on the temperature the equipment is exposed to during normal plant operating conditions, and is a constituent of qualified life (see Section 3.1.4). This temperature is not only a function of ambient air conditions but may also be a function of the type of equipment, its construction and operating mode and its location.

Specifically, the normal plant temperature (Ts) used as input in the Arrhenius Equation must consider the following:

1. Self-Heating Effects of Energized Equipment and Circuits where the normal equipment temperature is a function of the ambient temperature and the heat rise resulting from the equipment's energized state. Examples where self-heating effects are considered include normally energized motors, solenoid valves, relays, transformers, and terminations and cable used in power applications.

   Equipment that is intermittently cycled, or normally de-energized, is not energized for a sufficient duration to experience any significant temperature rise due to internal self-heating. Therefore, its aging life should only be a function of the normal ambient temperature environment. Examples include, motor operated valves where the motor only operates when the valve changes position, control cable and de-energized solenoid valves.
   Equipment that is energized, but used in low current instrumentation and control circuit applications (e.g., transmitters, switches, instrument and control cable, radiation monitors, etc.), should not experience any significant self-heating as the low amperage (i.e., milliamps for instrumentation circuits and 1 or 2 amps for control circuits) is insufficient to result in any significant internal heating. Therefore, the aging life of this equipment is only a function of the normal ambient temperature environment.

   In most cases at WCGS, the thermal life of terminations and cable used in normally energized power circuits is determined based on an assumed temperature of 90°C (194°F), which is the manufacturer's rated design conductor temperature as stated in the cable specifications. The use of 90°C conservatively accounts for any conductor self-heating effects that may be present during normal plant conditions.

Per EPRI Report 1003057, Plant Support Engineering License Renewal Electrical Handbook (Reference 75), in lieu of using a 90°C conductor temperature, the operating temperature of power cable installed in conduit can be calculated in accordance with IPCEA P-46-426, Cable Ampacities at AEIC Temperatures (Reference 93).

If an upper bounding temperature increase is desired to apply to a thermal life analysis for all power cables regardless of actual load, then a value of 72°C (162°F) can be applied to all cables installed in a room ambient of 40°C (104°F), provided that the circuit was properly designed and the correct cable size was properly selected from the ampacity tables in IPCEA P-46-426. That is, the maximum temperature increase caused by ohmic heating in power cable application (in a 40°C ambient) should be 32°C; consequently, the maximum cable insulation temperature should be 72°C (162°F). In addition, when compensating for a higher ambient temperature (such as 50°C [122°F] ambient), factors in the calculations and tables counteract each other resulting in the same maximum cable insulation temperature of 72°C (162°F).

For cable specifically purchased for use in high temperature applications [e.g., with a rated design conductor temperature of 200°C (392°F)], the thermal life is either determined based on its rated design conductor temperature, or based on the calculated cable loading.

2. Process Fluid Temperature and "hot spots" where the location of the equipment (e.g., in, on, or near hot fluid piping) is such that materials and parts susceptible to thermal aging degradation are exposed to temperatures in excess of the external ambient environment temperature. Examples include, solenoid valves used in process sampling lines, RTDs, accelerometers and limit switches mounted on MSIVs.

#### 3.1.1.2 Activation Energy

The Activation Energy is an empirical constant unique to a material. It is a measure of the minimum energy required to initiate a chemical reaction in a material that causes a measured property to change and may vary based on the property selected (e.g., elongation and compression set). The Activation Energy determines the way in which the rate of the reaction varies with temperature. Note that, on a semi-log plot, the rate of reaction is relatively constant or linear within a very limited temperature range.

When the thermal life of equipment is determined by the Arrhenius method, the activation energy is determined for each organic material of construction from manufacturer's data and industry reports. The activation energy for various materials is provided in EPRI 1021067, Appendix G (Reference 33) and many other references such as EPRI Report NP-1558.

Select an activation energy based on the data most representative of the material, material property, and temperature range of interest. In many cases, the activation energy is stated in the test report. This value should be used and justified unless there is specific knowledge that it is not the most conservative value.

There are also cases when a vendor approved test report provides an activation energy without any additional basis, or it may be for an entire device without any individual part breakdown. Further clarification from either the vendor, test laboratory, or both, may also not be possible in cases where the vendor and/or test laboratory is out of business. In such cases, it is recognized that use of the test report identified activation energy is acceptable, with the caveat that the engineer should use sound engineering judgment when selecting the activation energy.

For example, EPRI Report No. 1021067, “Plant Support Engineering: Nuclear Power Plant Equipment Qualification Reference Manual”, page 4-12, identifies a 0.5 eV activation energy as conservative; therefore, any value below this should be researched further. Similarly, EPRI Report No. NP-1558 (Reference 31), “A Review of Equipment Aging Theory and Technology,” page B-1, provides a histogram of activation energies, with very few identified above 2.0 eV; therefore, any activation energy above that value should be researched further. Another potential research item is when a test report activation energy for a specific material is very different from other activation energies for the same generic material; although this case is not anticipated to occur as most material databases provide a wide range of values for activation energy. An example of this case would be if it is known that a query of a generic material provides all activation energies as below 1.0 eV, and the test report for the same generic material uses a value of 3.5 eV. In any of the above cases, further research could include industry surveys, use of EPRI documents, and use of industry databases, to provide further support for the vendor value.

The activation energy values should always be conservatively selected. For equipment containing more than one material, it is conservative practice to use the lowest material activation energy as a basis for equipment thermal aging calculations, using the following four guidelines aid in proper activation energy selection:

1. The activation energy is based on the specific compound used in the equipment.
2. The activation energy is based on the most relevant material property and property endpoint. Compression set is the most appropriate property for gaskets and O-rings. Elongation-at-break is applicable for cables because electrical failure has been found to correlate closely with cracking of cable insulation in low voltage applications.
3. Potential nonlinearities and data extrapolation should be minimized by using activation energy values based on material test data obtained within the temperature range of interest.
4. The activation energy should exhibit a good fit to the Arrhenius relationship. IEEE Std. 101-1987(R2004) (Reference 35) provides guidance for determining Arrhenius coefficients.

When precise activation energy for the application is not available, the following approaches may be used:

1. An activation energy is selected based on the most representative of the material, material property, and temperature range of interest. Apply a factor of conservatism, such as decreasing the activation energy by a few percent or reducing the resulting QL by a percentage.
2. When similarity is difficult to determine and a number of reference activation energies are available for a generically similar material, select the lowest published value.
3. When little information is available, conservative activation energy is selected that represents the lower bound of available data for most materials and properties (e.g., 0.75 eV).
4. Activation energies are available from such sources as vendor Equipment qualification reports, as well as EPRI 1021067 (Reference 33) and EPRI NP-1558 (Reference 31) and:
   - RCMT System 1000 website (https://system1000.rcmt.com/System1000/default.aspx)
   - EQDB website - Thermal Degradation Screen.

It is imperative that the activation energy selected for each organic material and/or for the overall equipment be based on a physical property and endpoint, which is appropriate for the material application, critical safety function, or failure mode. For example, selecting an activation energy based on 40% loss of dielectric strength would not be appropriate for an O-ring. An O-ring's critical parameter would be compressive set. It is also important to select an activation energy based on the proper endpoint. For example, selecting an activation energy based on dielectric failure for cable insulation would not be valid. Most available activation energies are developed from tests based on IEEE Standard 101-1987.

Discussion on Restrictions and Limitations

1. If the device is not repairable (i.e., component parts are not replaceable, or routinely replaced at WCGS), then the thermal life of the material with the shortest thermal life becomes the thermal life for the entire parent device. For example, ASCO solenoid valves are not repairable because ASCO does not sell replacement parts; therefore, the life of the valve is the shortest life calculated for any organic materials of construction. The activation energy value should be the lowest for all materials used in the device that have a critical function.
2. If certain organic parts are replaced, then the life of the device is the lowest life determined for any part that is not replaced. That is, the life of the entire device is equal to the time period when the whole device must be replaced. The activation energy value for replacement parts would determine the replacement interval for those parts. The lowest activation energy value for the remaining materials would determine the qualified life of the whole device.
3. If certain organic parts do not contribute to the safety function of a device, they may be eliminated from the determination of the device's life. For example, a coil in a solenoid valve that de-energizes to complete its safety function need not be considered since the failure of the coil (i.e., shorts to ground) should not prevent the valve from reaching its safe position via spring pressure.
4. Per EPRI 1021067 - Equipment Qualification Reference Manual, Reference 33, Pages E-5 through E-8, thermo-gravimetric analysis (TGA) should only be used in cases where the test has applicability to the failure mechanism under consideration. The TGA activation energy value represents a correlation of weight loss and time with temperatures that are generally greater than 572°F (300°C). Weight loss is rarely the preferred property of concern for equipment aging applications so activation energy values based on TGA should be avoided.

In some cases, the activation energy may be found for an entire device that represents the unique construction materials and configuration of the device. The thermal life of this device is then determined based on this activation energy. Examples include the use of 0.78 eV for certain transmitters and 3.9 eV for Conax ECSAs and feedthroughs.

Rearranging the Arrhenius equation to solve for the activation energy the vendor supplied long term thermal aging Arrhenius plot data points can be used in the following equation:

$$Ea = KB \ln (t1/t2)/ (1/T1 - 1/T2)$$

Where:

| | |
|---|---|
| T2 = Higher Aging temperature. (Kelvin) (K) | T1 = Lowest Aging Temperature. (Kelvin) (K) |
| t2 = Time to failure at T2 temperature (hours). | t1 = Time to failure at T1 temperature (hours). |
| Ea = Activation Energy of material | |
| KB = 0.00008617 eV/K (Boltzmann's Constant) | |

### 3.1.2 Radiation Aging

Radiation aging concerns the degradation of organic materials when exposed to radiation doses during normal plant operating conditions and during design basis accidents. Like thermal aging, long term radiation exposure degrades the mechanical and electrical properties of organic materials. Although very intense and long term exposure can degrade certain inorganic materials, these materials should not be affected by the radiation doses and dose rates postulated to occur over the 60 year plant design life (40 original + 20 extension) plus a design basis accident [EPRI-2129 (Reference 16)]. Therefore, radiation qualification concerns only the behavior of organic materials.

The type and intensity of radiation experienced by equipment is a function of location and equipment configuration. For example, equipment located in containment should be exposed to both gamma and beta radiation during certain accident conditions. Also, equipment that is completely enclosed, or shielded, from the environment may experience a decreased radiation dose because of the inability of beta radiation to penetrate certain materials.

The radiation environment for qualification of the electrical equipment should be based on the normal radiation expected over the installed life of the equipment plus that associated with the most severe design basis accident (accident radiation) or following which the equipment must be functional. The accident-related environmental conditions should be assumed to occur at the end of the installed life of the equipment. Reference Reg. Guide 1.89, (Reference 3).

Acceptable methodologies for demonstrating the qualification of electrical equipment exposed to radiation environments is provided as follows:

### 3.1.2.1 Normal Radiation

Normal plant radiation environments consist of the total integrated gamma radiation dose applied to equipment over a 60-year period. Radiation dose values for plant harsh environmental areas are provided by Room number in Attachment A of this document.

Irradiation of equipment during the environmental test process is performed prior to design basis accident testing to cause equipment material degradation comparable to that received during normal plant operation. Per Regulatory Guide 1.89 (Reference 3), Cobalt-60 or Cesium-137 are acceptable gamma radiation sources to simulate plant environmental conditions. The use of another source type during the test process must be justified.

Qualification requires that the test radiation dose be equal to, or exceed, the postulated plant normal total integrated 60 year radiation dose. If the tested dose is less than the plant required dose, then the qualified life of the equipment must consider whether the reduced test dose results in any restrictions with respect to the duration that the equipment can be installed in the plant and still retain sufficient ability to perform its safety function when exposed to any subsequent design basis accidents (See Section 3.1.4).

### 3.1.2.2 Accident Radiation

Design basis accident radiation environments consist of the total integrated radiation dose applied to equipment for the duration of the accident and post-accident period for which the equipment must perform its safety function. Radiation exposure during accident conditions is due to gamma and/or beta radiation based upon plant location. Acceptable qualification requires that the test radiation dose be equal to, or exceed, the postulated plant accident total integrated radiation dose within the margin requirements provided in Section 3.1.13.

Per Regulatory Guide 1.89 (Reference 3), acceptable testing for accident radiation dose consists of the exposure of equipment to a Cobalt-60 or Cesium-137 source. The use of another source type during the test process must be justified.

As a test simplification, and because the effects of radiation exposure are essentially cumulative, the normal and accident radiation doses are normally combined and the equipment is irradiated to the total 60 year plus accident dose requirement prior to exposure to design basis accident conditions.

### 3.1.2.3 Beta Radiation Dose Qualification

Equipment shall be qualified to total integrated accident radiation dose that accounts for the beta and gamma radiation doses for the equipment installed inside containment. The equipment installed outside containment will not be exposed to beta radiation.

As allowed by NRC staff guidance [NUREG-0588 (Reference 5), DOR Guidelines (Reference 14) and R.G. 1.89 (Reference 3)], significant reductions in the beta dose can be determined based on localized shielding (i.e. component and/or structural shielding) such that the sensitive portions of the component or equipment are not exposed to significant beta radiation dose rates or that the effects of beta radiation, including heating and secondary radiation (e.g. Bremsstrahlung effect), have no deleterious effects on component performance. Therefore, the qualification of equipment is only required to be demonstrated for the actual radiation dose to which the sensitive portions of the equipment should actually be exposed. If the total worst case beta radiation dose to the equipment is less than ten percent of the total gamma dose to which the equipment has been

qualified (i.e., if plant beta dose < 10% of gamma test dose), qualification to the gamma dose alone is sufficient to demonstrate qualification for the WCGS accident radiation environment [Regulatory Guide 1.89, Revision 1, paragraph C.2.c(6)] (Reference 3).

Equipment located in the containment building is installed in sealed or unsealed enclosures. Cable is jacketed and located in cable trays or conduits. Unjacketed cable may be present; however, it is always contained in sealed or unsealed enclosures (i.e., junction boxes or component enclosures), specifically where terminations are present. The beta dose to which the sensitive portions of components or equipment may be exposed can be reduced as a function of the amount of shielding provided by internal structures and equipment enclosures.

The following subsections address typical containment equipment configurations and how each provides a degree of shielding that results in a reduced beta radiation dose exposure. The beta dose reductions are based on the worst case airborne and plateout accident beta doses occurring inside containment, (Attachment A of this document).

1. Cable

   A. For cable in trays, a reduction of one half of the postulated total beta dose is appropriate based on the localized shielding provided by the other cables in the tray and the tray itself [NUREG-0588, paragraph 1.4(9) (Reference 5)]. This 50% reduction is also applied to cable in conduit. Therefore, cable routed in trays and in conduit need only be qualified to a total beta radiation dose of 8.9E+7 rads, which is a reduction of the worst case containment total integrated accident beta dose of 1.78E+8 rads by one half.

   B. The WCGS cable design itself can also provide shielding with the jacket and insulation. Beta dose may be further reduced by a factor of 10 with 30 mils of cable jacket and/or insulation surface. An additional 40 mils of jacket and insulation (total of 70 mils), results in another reduction factor of 10 in beta dose [DOR Guidelines, Section 4.1.2 (Reference 14)]. This reduction in beta dose based on the jacket and insulation thickness is called the **"Sacrificial Layer"** concept. Therefore, for cable located in containment, the total integrated accident beta radiation dose of 1.78E+8 rads may be reduced by "sacrificing" layers of the jacket and insulation so that the remaining cable insulation need only be qualified to the reduced dose. Note that the remaining insulation thickness not "sacrificed" must be equal to or greater than the insulation thickness of the tested cable specimen. This technique may be used in addition to the 50% reduction of dose concept described in A, above.

      All WCGS instrument, power and control cables in the containment building use jackets. Jackets and cable insulation are environmentally tested as a system. During some of the LOCA tests, the cable jackets may crack. In addition, some jacket cracking may be expected in the plant since the 60-year life of cable is, in some cases, based only on the insulation system and the jacket may have a thermal life of less than 60 years. However, the localized cracking which could potentially result due to normal aging or accident exposure would only expose a minute part of the inner insulation, due to the geometry of the configuration, and would therefore not negate the overall shielding provided by the jacket. Therefore, the existence of cable jacketing and its ability to stay on the cable during environmental testing provides a basis for beta radiation attenuation.

      **EXAMPLE:**
      Given a cable with a 30 mil jacket located in a tray or conduit in the containment building, the following beta dose reduction is expected:

      Worst case WCGS six month beta dose = 1.78E+8 rads 1/2 of dose (i.e., 50% reduction) to account for trays and conduit = 8.9E+7 rads Reduction by a factor of 10 for 30 mil jacket = 8.9E+6 rads

If this cable had been tested to a gamma dose of 2.00E+8 rads, the beta dose to the insulation of this cable is less than 10% of the total tested integrated gamma dose [i.e., 8.9E+6 rads < 2.00E+7 rads (10% of 2.00E+8 rads)] and qualification to the postulated accident gamma dose alone is sufficient to qualify the cable for the worst case beta and gamma radiation environment.

C. There are two (2) cases for cable where a reduction in beta dose due to shielding from a conduit or cable tray cannot be applied:

CASE 1 - Applies for a length of cable not installed in a cable tray or a conduit.

In this case, the 50% beta dose reduction based on the shielding provided by a tray or conduit cannot be applied. However, the "sacrificial layer " concept may be applied to the jacket and insulation (see B. above). Note that the remaining insulation thickness not "sacrificed" must be equal to or greater than the insulation thickness of the tested cable specimen.

CASE 2 - Applies to tested cable where the jacket, or parts of the jacket, falls off the cable during testing

In cases where the jacket, or parts of the jacket, have fallen off the cable test specimen(s), the jacket provides no shielding and the "sacrificial layer" concept applies only to the remaining cable insulation (see B. above). Note that the remaining insulation thickness not "sacrificed" must be equal to or greater than the insulation thickness of the tested cable specimen.

2. Enclosed Equipment

The equipment in the Containment Building that may be exposed to the effects of beta radiation is located in sealed or unsealed metal enclosures (e.g., rigid and flexible conduits, equipment housings, Limitorque limit switch compartments, and junction boxes). In either the sealed or unsealed state, the enclosures provide direct shielding that prevents, or limits, beta radiation penetration.

A. Sealed Enclosures

Consider minimum thickness for metal enclosures for WCGS equipment located in a harsh environment is 16 gauge (0.062 inches).

Beta radiation has a very short penetration range and is effectively stopped by a 0.5 mm (0.0196 inch) metal plate [EPRI NP-2129, p. 2-4 Radiation Effects on Organic Materials in Nuclear Plants (Reference 16)]. Therefore, the plant sealed equipment enclosures should effectively prevent the penetration of beta radiation.

Though the incident beta dose should be stopped, secondary ionizing radiation, called the Bremsstrahlung effect, should be present. The secondary ionizing radiation is defined in EPRI NP-2129, (Reference 16, p. 2-4) and is calculated as a percentage of the beta radiation dose to which the outside of the equipment is exposed as follows:

Bremsstrahlung beta = E x Z / 800

Using iron as a representative base material for the containment metal enclosures, iron has a Z value of 26.

Solving for Bremsstrahlung beta, where:

E = Beta energy in MeV (typically 1.0 is assumed)

Z = Atomic number of the absorbing medium (i.e., enclosure material). For Iron, Z = 26

Therefore,

(1.0) x (26) / 800 = 0.0325 or 3.25 percent

Therefore, the secondary (Bremsstrahlung) radiation available to effect the equipment inside a metal WCGS containment enclosure is 3.25 percent of the 1.78E+8 (1.50E+8 rads airborne beta + 2.81E+7 plate-out beta) rads worst case beta radiation dose, which equals 5.78E+6 rads. If the 5.78E+6 rads value is less than 10 percent of the total gamma radiation dose to which the equipment or component has been qualified (i.e., tested), qualification to this gamma dose alone demonstrates that the equipment or component is qualified for the postulated accident radiation environment (see 2nd paragraph of section 3.1.2.3). Therefore, if equipment located in a sealed enclosure has been tested to a gamma dose that is equal to or greater than 1.0E+8 rads, see WCGS Specification E-028, Appendix A, section 1.4(Ref. 18) [1.0E+8 * 10% = 1.0E+7 rads, or 10% of a test dose of 1.0E+7 rads], then the effects of Bremsstrahlung secondary ionizing radiation need not be considered in the qualification evaluation process, 5.78E+6 rads < 1.0E+7 rads.

B. Unsealed Enclosures

For unsealed enclosures, the total beta shielding effects should be as discussed above for the sealed enclosures, except consideration must be given to the potential entry of airborne beta emitting particles.

Unsealed enclosures can be defined as equipment enclosures and housings that only differ from sealed enclosures in that covers may not have gaskets, weep/drain holes may be present at the low point, and conduit entrances may be unsealed. Therefore, pathways exist where airborne beta radiation emitting particles may enter the enclosure. However, the equipment located inside the enclosure should not be exposed to the effects of the full postulated beta radiation dose because of the shielding provided by the enclosure itself and the surrounding containment structures and equipment.

The beta contribution to the equipment inside the enclosure is only due to airborne iodine source term introduced into the enclosure during the initial pressurization from the accident. Plate-out would not accrue within the device internals or equipment enclosures

#### 3.1.2.4 Qualification by Analysis of Replacement Components

The UFSAR allows qualification of equipment to harsh environment due to radiation either by qualification testing or by evaluation of the materials used. Reliable accumulated data on radiation effects such as that contained in EPRI Report NP-2129, "Radiation Effects on Organic Materials in Nuclear Plants," (Reference 16) and EPRI 1021067, Appendix G, “Material Thermal and Radiation Data (Reference 33) are used to analyze the dose effects on particular materials. Equipment Qualification tests and analyses are responsive to Regulatory Guides 1.30, 1.40, 1.63, 1.73, 1.89, and 1.131, as described in USAR Appendix 3A.

### 3.1.3 Cyclic and Mechanical Aging

#### 3.1.3.1 Cycle Aging

Cycle aging is evaluated for electro-mechanical equipment only. Electro-mechanical equipment is equipment that has moving parts. Examples include switches, relays, valve operators, solenoid valves, etc.

In cases where cycle aging is potentially an aging mechanism, the equipment must be cycled during testing to at least the number of operations postulated to occur over the equipment's installed plant life, including, the operations postulated during design basis accident conditions.

The basis for plant operational cycles may be derived from system design documents, equipment specifications, or predicted based on current operational histories that are then projected over the equipment's installed life.

In general, equipment that has been subjected to a rigorous cycle aging program (e.g., NAMCO switches are operated in excess of 100,000 cycles, which is equivalent to about 4 cycles a day for 60 years) without failure is considered to be insensitive to these aging effects, and a comparison

of tested to plant cycles is not required. Addressing the number of plant equipment cycles is also not necessary for equipment that is the subject of normal periodic preventive maintenance and surveillance activities which monitor and trend equipment performance such that the operational effects of cycle aging and wear would be detected prior to equipment failure (e.g., motor operated valve actuators).

Qualification evaluations shall provide adequate justification for not comparing the estimated number of equipment plant cycles to the cycles completed during testing (i.e., either the equipment is not sensitive to cyclic aging, is maintained such that wear aging is monitored, or the number of plant and test cycles is compared).

### 3.1.3.2 Mechanical Aging

Mechanical aging mechanisms that may affect equipment performance include the effects of aging caused by the continuous operation of equipment, such as bearing wear in motors, and non-seismic vibration aging.

1. Bearing Wear

   Bearing wear is a function of equipment operational modes (e.g., continuously running versus normally in standby) and the condition of the bearing lubricant. Given a properly lubricated bearing, fatigue is the primary failure mode. Therefore, the life of an individual bearing is defined as the total number of revolutions or hours at a given speed at which a bearing runs before the first evidence of fatigue develops, EPRI 1021067, (Reference 33)

   The Anti-Friction Bearing Manufacturers Association (AFBMA) provides bearing life calculations and data based on tests of roller and sleeve bearings (References 19 and 20).

   Within these standards is defined the bearing Rated Life ($L_{10}$) which is the life that 90% of a group of identical bearings should complete or exceed before the first evidence of fatigue develops. In bearing industry terminology, the terms Minimum Life and $L_{10}$ Life are also used to mean Rated Life.

   Examples of bearing lives for common equipment given in Mark's Standard Handbook for Mechanical Engineers, Section 8, Table 8.5.1 Design-Life Guide, (Reference 40), are:

| Application | Bearing Rated Life (Hours) |
| --- | --- |
| Industrial Electric Motors | 20,000 to 30,000 |
| Industrial Fans | 8,000 to 15,000 |
| Pumps | 40,000 to 60,000 |
| Blowers | 20,000 to 30,000 |

   At WCGS, bearing life shall be based on the equipment manufacturers' and AFBMA recommendations with consideration for the plant specific equipment operational requirements, which is consistent with the position given in IEEE Standard 334-1974, for the type testing of Class 1E Motors (Reference 21).

   Life values for sleeve/journal bearings assume that the lubricant used remains in good condition (See Section 6.0 of this manual for lubrication requirements). Bearing life values assume that the equipment is subject to periodic preventive maintenance and surveillance testing, which monitors equipment performance such that wear aging degradation would be detected. Replacement intervals for sleeve/journal bearings are based on the observation of wear during maintenance checks, IEEE Std. 334 (Reference 21).

2. Vibration (Non-Seismic) Aging

   Qualification in accordance with the guidance of IEEE Standard 323-1974 (Reference 13) requires that significant aging mechanisms be identified and addressed by equipment type (e.g., motor and solenoid valve). The aging mechanisms include naturally occurring vibration that is a function of equipment type and design. For example, self-induced vibration may be experienced by a running motor, or an energized solenoid valve; however, this vibration should not be present in an energized cable.

   Non-seismic vibration can also be caused by the operation of adjacent equipment, process fluid dynamics (e.g., pipe motion), or building vibration due to non-seismic causes. The mounting of equipment to rigid structures and its structural isolation from adjacent equipment preclude the need to address this type of vibration within the scope of the WCGS Equipment Qualification program.

   For equipment where vibration is potentially an aging mechanism, it is subjected to mechanical vibration aging prior to design basis accident testing in the test sequence given in Section 6.3.2 of the IEEE Standard 323-1974 standard. This vibration testing includes seismic vibration in accordance with IEEE Standard 344-1975 (Reference 23) and the effects of naturally occurring vibration. This naturally occurring vibration is accounted for by operating the equipment during testing in a manner similar to how it should be operated when installed in the plant, including cycling and periods of continuous operation. These same effects are also accounted for during design basis accident testing by operating and cycling the equipment. Therefore, qualification for the effects of vibration aging is accounted for during the seismic and operational stress testing (e.g., cycling) applied within the test sequence recommended in IEEE Standard 323-1974, or appropriate specific equipment daughter standards, and is not addressed as a separate aging mechanism in the WCGS electrical equipment qualification program.

3. Wear Associated With Making And Breaking Connectors

   Connectors and cable (or wire) splices involve the electrical interconnection and insulation of interfaces between separate electrical conductors and are used with practically every type of Class 1E equipment. Connectors and cable splices typically also provide a sealing function to prevent moisture, steam, or water from compromising the insulation function and electrical integrity of the affected electrical circuit.

   The mechanical wear cycle for a connector is a mate-demate cycle, EQ consideration is the effect on the sealing surfaces of the connector. As an example the seal on an EGS Grayboot connector is created between the outside rubber surface of the plug and the inside rubber surface of the receptacle. This makes inspection of the receptacle sealing surface difficult. Thus, cycling as part of qualification testing is relied upon to demonstrate wear resistance. In the EQ testing done by EGS, the connectors were cycled at least 140 times prior to being subjected to postulated Design Basis Accident test conditions.

Other connectors in the EQ Program at WCNOC are those associated with the heated-junction and core exit thermocouples. Two different connector designs are used and cycling as part of qualification testing ranged from 5 to 50 mate-demate cycles depending on whether they would be taken apart only for trouble-shooting or for disassembly of the reactor each refueling outage. However, unlike the Grayboot connectors, these connectors have grafoil gaskets, which are easily inspected for flaws each mate-demate cycle, or copper crush rings that are replaced every mate-demate cycle. Thus, seal qualification is based on inspection or seal ring replacement rather than the mate-demate cycles and wear cycle aging is considered insignificant.

### 3.1.4 Qualified Life

The qualified life of electrical equipment is a period of time for which satisfactory performance can be demonstrated for a specific set of service conditions, IEEE 323-1974, (Reference 13). The Arrhenius model is an adequate model, when considered as part of the entire design and qualification process, to provide reasonable assurance that important to safety electrical equipment will perform its safety function before and during a Design Basis Accident (DBA). The aim of Equipment qualification is to eliminate "common cause" failures; it does not eliminate random failures. Establishing qualified life with the Arrhenius model requires using engineering judgement. Engineering judgement is not only an essential factor; it is actually the dominant factor to ensure the proper activation energy and reasonableness of the end results. The intent is to make sure the electrical equipment can be installed in the plant such that it will retain sufficient capacity to perform its required safety function during a design basis accident condition.

NOTE:
As defined in section 10.2, qualified life is separate from shelf life. The beginning of life for electrical equipment is when it is physically installed in the plant. For equipment installed prior to initial plant criticality (beginning of power ascension testing), the equipment's life began on the date of initial criticality, which is considered the point at which the equipment began to experience age-related degradation. The date of WCGS initial criticality is 9/3/1985**.**

Qualified life starts upon installation. Shelf life is only accounted for in qualified life (i.e., qualified life reduced) if the warehouse component exceeds the shelf life. This is consistent with the concept of qualified life in the following documents:

- 50.49(e)(5) is specific to simulating the installed life of the equipment, based on "Equipment qualified by test that must be preconditioned by natural or artificial (accelerated) aging to its end-of-installed life condition."
- NUREG-0588 (Section 2.2.(2)) also is specific to test programs demonstrating the ability to perform the required function for all postulated service conditions during the installed life.
- IEEE 323-1974: Qualified Life: The period of time for which satisfactory performance can be demonstrated for a specific set of service conditions.
- EPRI TR-100844, *Nuclear Power Plant Common Aging Terminology*: The period for which an SSC has been demonstrated, through testing, analysis or experience, to be capable of functioning within specified acceptance criteria during specified operating conditions while retaining the ability to perform its safety function in a design basis accident or earthquake.

At WCGS, the desired qualified life for equipment is 60 years at the maximum normal plant service conditions, which the equipment should be exposed. However, a 60 year qualified life may not always be achieved due to aging limitations and the variations in degradation rates of the materials used in equipment construction. In these cases, it is acceptable to determine a qualified life of less than 60 years.

The qualified life of a piece of equipment is a function of the aging mechanisms and limitations identified with respect to thermal, radiation, cycle, and mechanical aging. If certain safety- related (quality classification "Q") life limiting parts are renewable, then the qualified life of the device is the lowest life determined for any part that is not replaceable. That is, the qualified life of the entire device is the equal to the time period when the whole device must be replaced.

The qualified life of equipment should not be limited by cycle and wear aging unless these stresses are found to be significant aging mechanisms for the specific device being evaluated (see Section 3.1.3.1 of this document). In addition, subcomponent parts whose failure should not affect component performance, as shown by a failure mode and effects analysis (FMEA), need not be assigned a qualified life. This type of part level evaluation is captured by the EQWP/PQE process.

The qualified life determined for each item of equipment shall be given as either 60 years or for those devices where the life of the entire device or part of the device is determined to be less than 60 years a renewable part replacement interval is specified.

### 3.1.5 Temperature

Qualification of equipment for use in harsh temperature environments requires that the tested temperature conditions envelope the postulated plant accident temperature conditions for the post-accident duration during which the equipment must function. Specific margins applied are identified in Section 3.1.13 of this document.

In cases where the actual temperature test duration is less than the specific equipment's required post-accident operating time, a comparison of the test results to plant requirements may be made using Arrhenius methodology to demonstrate acceptable post-accident operating qualification. Section 3.1.10 of this document details the use of the Arrhenius methodology in this application.

Some events, such as a MSLB inside containment, may expose equipment to an initial temperature rise, or spike, whose peak temperature is greater than the peak temperature for which the device has been tested. However, the equipment may not experience the peak temperature of a quick temperature spike due to its inherent thermal lag. The temperature of equipment exposed to a short spike (i.e., less than 2 minutes in duration) typically should not exceed saturation temperature. If it can be shown for the specific piece of equipment being qualified, either through analysis or testing, that the thermal lag of the device maintains its peak temperature, due to exposure to the accident spike, below the longer duration test temperature, then the test temperature is said to envelop the plant temperature and the equipment is qualified for the plant temperature environment.

It is this same thermal lag effect, which makes discrepancies between the initial test and plant rise times insignificant. A device's temperature should increase only within the limits of its ability to absorb heat. As long as the rates of rise of the test and plant temperature are similar, equipment response should not vary significantly. Therefore, rise times need not be evaluated when comparing test and plant accident temperature profiles.

#### 3.1.5.1 Post-DBA Temperature Qualification with Essential HVAC

The Safety Injection, Residual Heat Removal (RHR), Component Cooling Water, Charging, Containment Spray pump room coolers; and Electrical Penetration (Class 1E MCCs) room cooler are served by essential HVAC post-DBA (excluding Auxiliary Building HELB) and should remain at or below normal temperature design limits (M-10GL Auxiliary Building Ventilation System Description, Reference 42. Each area containing safety related equipment that is heat sensitive is provided with a local independent cooling unit. These cooling units utilize essential service water as the heat sink and are powered by the same Class IE supply as the associated equipment to be cooled. Each unit has the capacity to provide 100% of the cooling required. The Fuel building is served by an essential HVAC system post-DBA, however it performs no cooling function.

#### 3.1.5.2 Post-DBA Temperature Qualification without Essential HVAC

Equipment located within non-essential HVAC areas of the Auxiliary, Main steam enclosure (area 5 of the auxiliary building), and Fuel Buildings may be exposed to elevated ambient temperatures post-DBA (excluding Auxiliary Building HELB). This temperature increase is due to a postulated loss of offsite power and resulting loss of non-essential HVAC.

The restoration of offsite power following a DBA is governed by WCGS emergency operating procedures (EOPs) OFN NB-0035, Loss of Off-Site Power Restoration (Reference 43) and Emergency Action Level, EAL-6, Loss of Electrical Power/Assessment Capability (Reference 85). These procedures contain provisions for restarting the non-essential HVAC units. Although these actions are proceduralized in the EOPs, there is no time requirement governing when offsite power must be restored. These actions should eventually be accomplished after plant stabilization, but timing is not critical to the EOP strategy. Once offsite power is restored following a DBA, the non-essential HVAC should provide normal cooling. Due to their location, the Central Chillers (non-essential HVAC heat sink) should not be subjected to harsh accident environmental conditions and therefore are not postulated to experience failures resulting from environmental stresses of a design basis accident.

The largest heat loads following a DBA should be the 480V Class 1E motor control centers (MCCs) and equipment powered from the 4.16 kV Class 1E buses. This equipment consists of the Safety Injection, Residual Heat Removal (RHR), Component Cooling Water, Charging, and Containment Spray pump motors. The Class 1E MCCs and the 4.16 kV motors are located within rooms which are served by essential HVAC during emergency operations, and therefore should not contribute to ambient temperature increases. The remainder of equipment required to operate post-DBA consists of instrumentation, solenoid valves, 480V continuous duty motors and motor operated valves. The contribution from instrumentation and motor operated valves to ambient temperatures should be minimal due to the low current circuits used and the intermittent duty characteristic of motor operated valves.

Solenoid operated valves and continuous duty motors that are required post-DBA may contribute to the ambient heat load. However, building structures and inoperable non-Class 1E equipment in the vicinity should serve as heat sinks to adsorb area radiate heat. In addition, operator actions post-accident may replace HVAC with various methods including the use of portable blowers and fans to mitigate ambient temperature effects, if necessary, until normal HVAC is restored. Therefore, the long term heat loading effects of these sources are considered to be minimal.

For qualification of equipment in areas of the Auxiliary, MSSS, and Fuel buildings, which are not served by essential HVAC post-DBA, the normal design limits are considered conservative and should be used, plus applicable margin, for the post-accident duration of a DBA.

### 3.1.6 Pressure

Qualification of equipment for use in harsh pressure environments requires that the tested peak pressure conditions envelop the postulated plant accident peak pressure conditions. Specific margins applied are identified in Section 3.1.13 of this document. It is not necessary to envelop the entire pressure profile, only the peak pressure conditions, since there is no recognized time-pressure degradation mechanism for equipment. Once the peak pressure is enveloped to account for superheat conditions, the environment returns to saturated conditions and enveloping of the temperature profile means that the pressure profile is also enveloped.

### 3.1.7 Humidity

Moisture concentration in air is not considered to significantly affect equipment performance during a design basis accident, or HELB. However, performance may be affected, when the conditions are such that the moisture condenses and forms water films and droplets on equipment, or condenses inside electrical enclosures, then accumulates in conduit low points as discussed in NRC Information Notice 89-63.

Equipment in containment is exposed to harsh humidity conditions during a LOCA and MSLB. For equipment outside containment, harsh humidity conditions should only exist in those plant areas where high energy line breaks (HELB) are postulated to occur, indicating a saturated steam environment. Any 100 percent relative humidity environments occurring in non-HELB areas are considered non-harsh and are not expected to impact equipment performance.

Saturated steam conditions during design basis accident testing are adequate for demonstrating qualification for postulated plant 100% relative humidity conditions. The presence of chemical or demineralized water spray during steam testing also adequately demonstrates qualification for required humidity conditions.

With respect to the issue of potential cable submergence in conduits, the Wolf Creek design basis includes consideration for the drainage of enclosures and the sealing of conduits to prevent the possible submergence of cable under the conditions identified in the IE Information Notice. Qualification of equipment against moisture intrusion/localized submergence is being demonstrated by either sealing the equipment using a qualified seal so that moisture is prevented from entering the device or by providing a drainage pathway such that for unsealed devices, no accumulation of moisture/water is possible (Reference 81)

### 3.1.8 Chemical Spray

The Containment Spray system (CSS) consists of two separate trains of equal capacity, each independently capable of meeting the design bases. Each train includes a containment spray pump, spray header and nozzles spray additive eductor, valves, and the necessary piping, instrumentation, flushing connections, and controls. The containment spray additive tank supplies 30 weight percent (nominal) sodium hydroxide (NaOH) to both trains.

The CSS provides a spray of cold or subcooled borated water, adjusted with NaOH, from the upper regions of the containment to reduce the containment pressure and temperature; and remove fission products during either a LOCA or MSLB inside the containment.

The CSS has two phases of operation, which are initiated sequentially following system actuation; they are the injection phase and the recirculation phase. For EQ purposes the worst case chemical concentrations, resulting from a single failure (pH = 4.0 and pH = 11.0) as spelled out in SLNRC 84-0013, (Reference 17) and is summarized below:

> The value of pH=4.0 results from a single failure of the containment spray additive tank isolation valve. If this valve fails to open, water from the refueling storage tank (pH = 4.0) is sprayed directly to the containment without NaOH being added. The valve is powered from a safety-related power source that has multiple sources (including the emergency diesel generator). If this valve should fail to open due to loss of power, it is probable that the rest of the train would also not have the power to operate. Therefore, no spray would be introduced from that train. In the unlikely event that the valve did fail to operate and the rest of the train did function, this condition would be immediately identified in the control room on the status panel. If the valve does not open (and no resulting operator action is taken), the resulting condition would be one train providing spray at pH = 4.0 while the other train provides spray at pH ≥ 10.0. Since the spray header is redundant the components being sprayed should receive a spray from both headers. The resultant pH at the components should be approximately 7.0. Additionally, the injection phase is the only time that this pH = 4.0 condition could exist. The injection phase is short (<1 hour) relative to the entire spray duration (approximately 24 hours). During the recirculation phase the pH range is 8.0 to 9.0. This spray is directed through the same spray headers and, therefore, should rinse all the previously sprayed components (for a period of approximately 23 hours).
>
> The normal spray PH during the injection phase is 9.5 to 10.5. The higher value occurs early during the injection phase. As the level in the spray injection tank decreases, the head on the spray eductor decreases; accordingly, the pH level decreases in the spray. It is possible during the beginning of the recirculation phase to still be adding NaOH, via the eductor(s). During this short period of time (≤ 1 minute) it is possible to have an elevated pH = 11.0. Assuming a single failure in the spray system, this period could last up to 30 minutes. For the remainder of the recirculation phase (22 to 23 hours) the spray pH = 8.0 to 9.0.

A caustic spray with an upper limit of pH = 11.0 is used in the review; however, it is recognized that this event should only occur for a short period, SLNRC 84-0013, (Reference 17). A maximum boron concentration of 2500 ppm is utilized for EQ review, (Reference 41).

### 3.1.9 Submergence

Submergence occurs as a result of fluid discharge from pipe breaks and operation of containment spray. Submergence may occur inside and outside containment. WCGS flood level calculations are typically performed determining the volume of the discharged fluid and the resulting building, room, compartment elevation corresponding to the fluid volume surface (Attachment A of this document identifies the flood levels for all the EQ rooms). Any equipment below this flood level should be submerged during the accident. The depth of submergence affects the pressure at the equipment's location. This pressure is the sum of the static fluid pressure and the accident pressure in the vapor space above the fluid.

Qualification for submergence requires that, either the equipment be tested in a submerged state for the duration the equipment would be submerged in the plant during design basis accident conditions, or justification be provided that the equipment completes its safety function prior to being submerged and any subsequent failure once submerged should not be detrimental to plant safety. Additionally, per paragraph C.3.a. of Regulatory Guide 1.89 Revision 1, for equipment exposed to submerged conditions, test duration shorter than the required duration is acceptable when justified.

Acceptable testing for submergence requires that the hydrostatic head applied to the test specimen be at least equivalent to, or greater than, the hydrostatic head the equipment would experience in the plant during accident conditions. The maximum submergence levels inside containment have been established in the Equipment Qualification program in calculation FL-18 (Reference 44) and are shown in Attachment A.

Equipment that performs no function, or has no failure mode, for the specific design basis accident that causes the flooding is not required to be qualified for the submergence condition.

According to 10CFR50 Appendix A, Criterion 4, environmental and dynamic effects design bases. Structures, system and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents. These structures, systems, and components shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit However, dynamic effects associated with postulated pipe ruptures in nuclear power units may be excluded from the design basis when analyses reviewed and approved by the Commission demonstrate that the probability of fluid system piping rupture is extremely low under conditions consistent with the design bases for the piping.

In addition, USAR 3.6.1.1.(g) states ‘When the postulated piping failure occurs and results in damage to one of two or more redundant or diverse safety related trains, single failures of components in other trains (and associated supporting trains) are not assumed. Postulated failures are precluded, by design, from affecting the opposite train or from resulting in a DBA. The safety-related systems are designed to the following criteria:

a) Seismic Category I standards
b) Powered from both offsite and onsite sources
c) Constructed, operated, and inspected to quality assurance, testing, and in-service inspection standards appropriate for nuclear safety systems”.

USAR 3.11(B)-14 states that the effects of flooding were considered in the NUREG-0588 review. The applicable flood levels are identified in attachment A of this document with reference to the Wolf Creek Flood Level Calculations the information is found. The identified flood levels for the auxiliary building were not developed solely for the purpose of the NUREG-0588 review. As a result, some flood levels are generated by breaks that are not assumed to occur concurrent with an MSLB or LOCA, which is the EQ environmental qualification condition.

In some room environments the SR equipment in the room is submerged by the “FL” calculation identified worst case flood levels. Additional review is provided in these calculations for the submergence. As stated above, the NUREG 0588 EQ program flooding flood levels used for qualification are those breaks that occur during a MSLB or LOCA (containment flooding only). This flooding is a result of a HELB/MEC (MSLB, FWLB, or other HELBs) and must consider if the submerged equipment is a NUREG 0588 Category “C” (will not cause a safety concern or mislead the operators). In cases where the HELB is not the worst case flood level the reduced flood level of the HELB break can be used in the EQ program. A Design Basis Accident is not postulated concurrent with a seismic event. This is consistent with the assumption in USAR Section 3.1.2.e which states “When evaluating the effects of any earthquake, no other major hazard or event is assumed, and no seismic Category I equipment is assumed to fail as a result of the earthquake.” Calculation YY-49, sheet 15 (Reference 29)

identifies that based on the line size, fluid pressure and temperature condition a determination was made of which lines were the worst case lines to be used for HELB analysis for a particular room.

Reference 29 Appendix 1, USAR section 3.6 (Table 3.6-4 and 3B-1) and the “FL” flood calculations identify the HELB lines that have been considered and would be responsible for any EQ qualification flooding during a LOCA or MSLB. Any room that does not have a HELB line in the room has a flood level of zero for EQ program qualification. In cases where EQ equipment is flooded by the worst case “FL” calculation non-HELB flood level, the flood level in Attachment A will identify both the EQ and FL calculation worst case flood levels. The EQ flood level will be shown first with the EQ flood level followed by (EQ), for a zero EQ flood level it will be shown as “0 (EQ)”.

**Acceptable Flooding Analysis options as identified in the USAR Table 3B-1:**

1) Flooding from sources within the room will affect only equipment within the same train/ subsystem: therefore, post-accident safe shutdown is not compromised.
However, the postulated flood level and equipment unavailability in this room does not negate the system safety function due to the availability of the opposite train. This is consistent with USAR Section 3.6.1.1.(g) guidance that states postulated failures are precluded, by design, from affecting the opposite train and that single failures of components in other trains are not assumed when the postulated piping failure results in damage to one of the redundant trains. Therefore, the flooding level satisfies the requirement of 10 CFR 50 Appendix A, General Design Criteria 4, that safety-related equipment is protected against the effects of flooding from a postulated pipe failure.

   Note:
   Flood levels that occur during a MSLB or LOCA, which are due to a HELB/MEC, need to take into consideration if the submerged equipment for the HELB is NUREG 0588 Category “C” equipment (will not cause a safety concern or mislead the operators) for the HELB or it needs to be qualified for submergence.

2) Flooding from sources external to the room is not credible even with a single active failure.

3) Flooding from any source does not adversely affect SRE because all SRE is located above the maximum design flood depth.

   The expected flood level is less than the level of any safety-related equipment that could be adversely affected, and therefore, satisfies the requirement of 10 CFR 50 Appendix A, General Design Criteria 4, that safety-related equipment is protected against the effects of flooding from a postulated pipe failure.

4) There are not SRE in the room that would be flooded.

## 3.1.10 Post-Accident Operating Time (PAOT)

### 3.1.10.1 Definition of Post-Accident Operating Time

The post-accident operating time is the period of time, beginning with design basis accident initiation, during which the equipment must continue to perform its safety function. The post-accident operating time, or operating time, duration can vary and is based on the required safety function of the equipment. Both operating and "not failing" in a manner detrimental to plant safety can be required safety functions. For example, a transmitter is required for post-accident monitoring; therefore, it must continue to demonstrate its required accuracy for the entire operating time duration.

The required post-accident operating time for WCGS equipment is as follows[7]:

1. The required post-accident operating time for WCGS equipment is 180 days, unless justification is provided, on an equipment specific basis, for a duration of less than 180 days.

   The 180 day operating time is conservatively based on the operability requirements established for post-accident monitoring equipment and equipment required for long term core cooling. When used for any equipment, the 180-day operating time duration requires no further justification.

2. When a post-accident operating time of less than 180 days, but greater than 10 hours (see paragraph 3 below), is specified for any equipment, a justification must be provided. The justification shall, as a minimum, include:

   A. The specific equipment post-accident operating time.

   B. A description of the equipment safety function(s) during all applicable design basis accidents, including an assessment with respect to the potential need for the equipment later in the accident or during long term recovery operations for the 180 day accident duration. This description shall be related to the required equipment operating time.

   C. A determination that failure of the equipment after performance of its safety function (within the less than 180 day time specified) should not be detrimental to plant safety or mislead the operator for the remainder of the 180 day accident duration. All potential equipment failure modes shall be clearly identified and dispositioned.

3. For equipment that should perform its safety function within the first ten (10) hours of a design basis accident, the required operating time for qualification is one (1) hour in excess of the time for the device's operability assumed in the accident analysis, unless a time margin of less than one (1) hour can be justified. Justifications shall consider the requirements of A, B and C in Item 2 above.

   For example, the safety analysis states that the main steam isolation valves (MSIV) should close within 17 seconds after initiation of a large steam line break inside containment (Reference 6, USAR 6.2.1.4.1.9 MSIV and MFIV Closure Times, and Reference 94, NRC Safety Evaluation to License Amendment 176). Therefore, the required post-accident operating time for the MSIVs for this steam line break case would be 17 seconds plus 1 hour (3600 seconds), or 3617 seconds, unless a time margin of less than one (1) hour can be justified.

   This position is consistent with the guidance set forth in Regulatory Guide 1.89, Revision 1, Section C.4, (Reference 3).

### 3.1.10.2 Qualification for Post-Accident Operating Time

Qualification of equipment for the post-accident operating time duration can be demonstrated using the following methods:

1. Testing that simulates the WCGS accident environmental conditions where the test duration exceeds the equipment's required post-accident operating time. Specific margins applied are identified in Section 3.1.13 of this document.

2. For equipment located in plant areas where the only harsh environmental parameter is radiation, the post-accident operating time duration is accounted for within the aging life evaluation, by qualifying for the total dose, which has been integrated for at least the required operating time. Any known synergistic effects with respect to test sequence must be addressed (See Section 3.1.16 of this document).

3. In cases where the accident environmental test duration is less than the equipment's required post-accident operating time, a comparison of portions of the test and WCGS accident temperature profile may be made using Arrhenius methodology to demonstrate that the tested temperature conditions are more severe than the conditions the equipment should be exposed to in the plant, as explained in the later parts of this section. Specific margins applied are identified in Section 3.1.13 of this document.

   When using the Arrhenius methodology, the demonstrated operating time is the sum of the actual test time that envelopes the plant transient conditions and the equivalent operating time determined from the comparison of the latter portions of the test and plant specific profiles.

   Whenever possible, the application of Arrhenius methodology in determining post-accident operating time should be limited to comparing the latter portions of the test and plant profiles after the transients in each have stabilized. Transient portions of the plant/test profiles may be utilized, if necessary, provided 1) they follow the temperature and pressure transient peaks and are decreasing toward the long-term stabilized temperature, and 2) material properties are not significantly different between the temperature plateaus being compared.

   Acceptable qualification requires clear identification of which portions of all profiles are being extrapolated. Post-accident WCGS specific temperature input to the Arrhenius equation shall consider any equipment self-heating and process fluid radiant heat temperature effects as discussed in Section 3.1.1.1 of this manual.

   The form of the Arrhenius equation used in the operating time calculation is as given in Section 3.1.1.1 of this manual, except for minor variations in the input data descriptions as given in the following equation:

   $t_s = t_a \exp[(\Phi/k)\{(1/T_s)-(1/T_a)\}]$

   Where:

   $t_s$ = service time being simulated (same unit as aging time )

   $t_a$ = accelerated aging time

   $\Phi$ = activation energy (eV)

   $T_s$ = service temperature (Kelvin)

   $T_a$ = aging temperature (Kelvin)

   k = Boltzmann's constant = 8.617 E-5 eV/ºK

Exemptions from the 180-day PAOT are shown in Attachment C, Table C.2.

### 3.1.11 Equipment Performance Criteria

Qualification of WCGS electrical equipment requires the identification of the equipment safety function during design basis accident conditions and the definition of the performance characteristics that must be demonstrated through testing to provide evidence that the equipment should function as required when exposed to design basis accident environmental conditions. Simply "surviving" simulated accident exposure is not sufficient to demonstrate operability. Therefore, equipment performance during exposure to accident radiation and steam conditions, rather than performance before and after the test, is necessary unless specifically justified. For radiation, this is critical only for components, which contain electronics, with the exception of Metal Oxide Semiconductors (MOS) devices; most discrete semiconductors can tolerate radiation of $10^5$ rads. MOS devices can be affected by doses as low as $10^3$ rads. (Ref. 33, Section 3.2.2.2). For almost all other components, the effects of radiation are cumulative and non-reversible and, therefore, it is acceptable to measure

performance before and after irradiation.

Equipment functional requirements vary with equipment type and application. Some examples are:

1. A power cable must remain intact and supply rated current and voltage to run a motor; however, variations in cable insulation resistance (IR) should not affect motor performance. Variations in instrument cable IR, however, can affect the output accuracy of a connected transmitter. Therefore, IR values become a functional requirement for the instrument cable, but not the power cable. The equipment test reports IR results as applicable are used during the design development of any new equipment as a part of the calculation process to ensure the losses do not affect the function of the equipment (Ref. AN-94-031, Appendix 1 as an example).

2. Three (3) solenoid valves are located in containment and must function during a LOCA. All three (3) valves must close initially to ensure containment isolation. However, one of the valves must be cycled (opened/closed) periodically during the entire post-accident period, another must be opened and remain open, while the third valve must remain closed. Qualification requires that the valves tested simulate each of these functions.

Equipment performance requirements include the measurable or observable actions of the equipment and the range of environmental conditions during which the actions are required. Performance requirements form the basis for acceptance criteria that is demonstrated during testing. These criteria are a direct result of translation of the safety function into measurable or observable physical or electrical characteristics.

Instrument Uncertainty can also affect equipment performance. Instrument Uncertainty is addressed as a part of the calculations process not in the program documents. Design Guide DG-J-001 (Reference 125) <found in Curator “Design” Library> provides the instructions to perform instrument uncertainty calculations. This guide documents how to perform uncertainty calculations, and any resulting instrument setpoints. As part of this guide environmental effects are taken into consideration and the acceptability of a particular device’s Equipment qualification is to be documented and reviewed. A generic calculation is shown on page 183 of the guide; the following is similar representation of that generic equation:

e±=±[RA2+(SCA+MTE)2+TE2+RE2+SE2+HE2+SP2+PS2+ DR2 ]1/2 ± B±

This equation contains different attributes (parameters) of the instruments used within a calculation. TE (Temperature Effect), RE (Radiation Effect), SE (Seismic Effect), HE (Humidity Effect) and SPE (Static Pressure Effect) are values used to determine instrument uncertainty. The values could be used for one particular instrument or for a loop of instruments. The terms are used for normal conditions or for accident conditions, depending on the particular equipment functional environment. An uncertainty calculation is done on an instrument using known parameters for that instrument, for a particular situation (i.e. including specific environmental conditions).

### 3.1.12 Voltage and Frequency Variations

Qualification of electrical equipment requires that sufficient evidence exist to demonstrate that equipment should perform its safety function under the extremes of supply voltage and frequency variations that may be present during design basis accident conditions.

Acceptable qualification evidence is achieved with design basis accident testing during which the equipment performs its safety function while experiencing actual variations in supply voltage and frequency. For example, a solenoid valve powered from the 125 V dc system must energize to change position during a LOCA. Acceptable qualification requires a demonstration that a similar solenoid valve should change position when a minimum of 105 V dc (See Table 3-1 below) is applied during a design basis accident test simulation. The normal and post-accident voltage and frequency

limits for Class 1E equipment are listed in Table 3-1 below.

As stated in Section 3.11 (B).1.3 of the WCGS USAR, voltage variations for the AC system are either operational variations which are to be expected from the offsite power sources or variations from the diesel generator upon loss of offsite power. The variations have been accounted for in the qualification of safety-related equipment.

Frequency variations are only a concern for AC circuits and associated equipment. Therefore, equipment powered from DC circuits is not required to be qualified for any frequency variation.

Variations in frequency and voltage are not identified failure modes for electrical cable and simple conduction devices, such as terminations, provided the device test voltage meets plant requirements. Therefore, voltage and frequency variations are not required to be considered when qualifying cable and terminations.

**Table 3-1**
**Normal and Post Accident Voltage and Frequency Limits for Class 1E Equipment**

| Nominal System Rated Voltage | Voltage Range | | Frequency Range | |
|---|---|---|---|---|
| | Voltage | Percent | Frequency | Percent |
| 4.16 kV Power | 4400 | +6 | 61.2 | +2.00 |
| (4160 V ac) | 3600 | -14 | 57 | -5.00 |
| Standby Generation | 4368 | +5 | 62 | +3.30 |
| (4160 V ac)* | 3952 | -5 | 58 | -3.30 |
| 480 / 460 V ac Power | 506 | +6 | 61.2 | +2.00 |
| | 414 | -14 | 57 | -5.00 |
| 125 V dc Power (Note 1) | 140 | +12 | Not Applicable | |
| | 90 | -28 | | |
| 120 V ac | 132 | +10 | 61.2 | +2.00 |
| | 108 | -10 | 57.0 | -5.00 |

Note 1:
Calculation NK-E-001 identifies the float voltage is 133.8 VDC on the safety related batteries.

Voltage and frequency values are derived from the Reference 14 WCGS NUREG-0588 report and Section 3.11 (B) .1.3 Voltage and Frequency of the WCGS USAR (Reference 6). *Diesel Generator transient voltage regulation is $\pm 10\%$ ; steady state voltage regulation is $\pm 0.5\%$ of output rated value (4160 Vac). Diesel Generator steady state frequency is $\pm 0.5\%$ of rated value (60 Hz). Refer to Design Specification M-018, Design Specification for Standby Diesel Generators.

### 3.1.13 Margins

Margin is required in electrical equipment qualification programs to account for reasonable uncertainties in demonstrating satisfactory performance and normal variations in commercial production, thereby providing assurance that the equipment can perform under the most adverse service condition specified. Margins, therefore, represent the conservatism that exists when comparing the actual performance and environmental requirements established for plant equipment with those similar requirements demonstrated during test simulations. Margins are applied in addition to any conservatism applied during the derivation of the WCGS design basis accident environmental conditions.

Acceptable methods for ensuring that adequate margin exists include increasing the test parameter values, number of tests, test transients, operability time, or test duration. Acceptable margin values which, when applied, satisfy WCGS Equipment qualification requirements are developed using the guidelines provided in Section 6.3.1.5 of IEEE Standard 323-1974 (Reference 13) & USAR 3.11 (B) .5.3). These values are only applied for design basis accident conditions, and include the following:

1. Temperature: +15°F (8°C). The peak test temperature of that portion of the test used for qualification should be at least 15°F (8°C) greater than the peak design basis accident temperature postulated for the equipment being qualified.
2. Pressure: +10 percent of gauge.

Accident Radiation Dose: +10 percent. WCGS has taken exception to the Accident Radiation Dose + 10% stated in IEEE 323-1974. As identified in item 1.4 of NUREG-0588, additional margin need not be added to the radiation parameters if the methods identified an Appendix D of NUREG-0588 are utilized. (Refer to USAR Section 3.11 (B) .5.3 Margins.

Correspondence 15-00942 (Reference 109) “NUGEQ Position Paper: Radiation Testing - Instrumentation Tolerances” on page 2 and 3 note 1 states “ the group notes that it is possible to roughly quantify the conservatism contained in these LOCA source term assumptions by considering the results of other analyses of fuel rod failures. The NRC notes in NUREG-0588 Appendix D, "SAMPLE CALCULATION AND TYPE METHODOLOGY FOR RADIATION QUALIFICATION DOSE" that calculations using the RELAP-EM program and 10 CFR 50 Appendix K, ECCS EVALUATION MODELS conservative assumptions result in estimates of between 20% and 80% fuel rods with cladding failure for a typical PWR with a smaller fraction for a BWR. It also notes that when calculations use the best estimate RELAP-SE program and assumptions, fuel rod cladding failures are estimated to be less than 10%.”

The results of these analyses suggest that only rod gap releases occur for design basis LOCA accidents. Since meltdown, fuel vaporization, and oxidation releases do not occur, only a fraction of the fuel activity is released to the containment atmosphere. Using these Appendix K estimates along with the fuel rod gap activity referenced in NUREG-0588 para. C.2.c.(2) (I.e. 10% noble gases and 10% Iodine), the resulting fission product releases would be approximately 2% to 8% for noble gases and 2% to 8% for Iodine (the principal halogen) for the design basis LOCA. Furthermore, only a portion of these core releases would be released from the reactor coolant system to the containment. The significant difference between such likely release values for design basis LOCAs and the LOCA source terms used for equipment qualification provides the fundamental technical basis for the NRC's guidance concerning additional radiation margin.

As a result, since Wolf Creek calculated the radiation values per 1.4 of NUREG-0588 the subject 10% margin and more is considered to exist in the worst case environment radiation values identified in this document.

4. Power Supply Voltage: ±10 percent of rated value. The WCGS electrical system design limits given in Table 3-1 of this manual may be used as acceptable margins in lieu of the 10 percent value. See Section 3.1.12 of this manual for guidance on when voltage variations must be considered with respect to the qualification of WCGS electrical equipment.
5. Line Frequency: ±5 percent of rated value. The WCGS electrical system design limits given in Table 3-1 of this manual may be used as acceptable margins in lieu of the 5 percent value. See Section 3.1.12 of this manual for guidance on when frequency variations must be considered with respect to the qualification of WCGS electrical equipment.
6. Equipment Operating Time: +10 percent of the period of time the equipment is required to be operational following the initiation of a design basis accident.

This margin need only be applied when the equipment post-accident operating time is less than 180 days, except as provided in the next paragraph for equipment that should perform its safety function within the first ten (10) hours of a design basis accident or HELB. Margin need not be applied to an operating time of 180 days or greater because of the conservatism inherent in the 180 day time period. See Section 3.1.10.1 of this manual for additional clarification.

If specified, the required operating time for equipment that should perform its safety function within the first ten (10) hours of a design basis accident is one (1) hour in excess of the time assumed in the accident analysis. This one (1) hour addition to the actual equipment operating time is sufficient for demonstrating qualification with margin. Therefore, the +10 percent margin is not required to be applied to this equipment. See Section 3.1.10.1 of this manual for additional clarification.

In some cases the HELB temperature profile for specific rooms (such as room AB-1104) in calculation YY-49 run for only a few second, minutes or hours as the energy from the HELB in the room has all but stopped at that point. The required operating time at Wolf Creek after a DBE is 180 days. In these cases the temperature in the room at that time the profile stops is decreasing. On EQ program document analysis, where the room environment HELB profiles are too short in duration, the LOCA profile data starting where the last point the HELB profile temperature ended is used in the EQMS database to complete the DBE profile required for 180 days at Wolf Creek. On the pressure profile, analysis of the peak pressure is all that is required for EQ purposes. In most cases this is due to either manual/ automatic actuations that occur which stop the release of energy.

7. Establishing qualification without the margins above may be found acceptable, on a case-by-case basis, provided that adequate engineering justification is presented to conservatively demonstrate that the equipment can perform under the design basis accident conditions.

## 3.1.14 Equipment Sealing and Moisture Exclusion

### 3.1.14.1 Moisture Effects on Equipment Performance

Electrical equipment performance is affected by exposure to moisture. The extent of performance degradation is a function of equipment type, design, and materials of construction, as well as the type, form, and duration of the moisture environment applied. For example, transmitters with electronic circuit boards are less likely to remain operable than motor operated valves when exposed to the steam conditions present during a steam line break event. Moisture exposure affects equipment accuracy, response time, and insulation resistance and may result in electrical equipment failure. Therefore, equipment that must function in high humidity, steam, or even submerged environments is uniquely designed and installed to ensure that moisture should not impair performance.

### 3.1.14.2 Environmental Test Configurations

The verification of equipment performance when exposed to moisture conditions during design basis accidents and HELBs is established by testing to the same or more severe environmental conditions in a test chamber. This testing emulates the steam, chemical spray, humidity, pressure, and when appropriate, the submerged conditions for which the equipment must be designed. Testing occurs in a steam chamber, or autoclave, wherein the equipment is mounted and connected electrically in a manner analogous to plant installation.

The mounting of the equipment in its tested configuration often includes the isolation of the electrical conduit connection from the test chamber environment to ensure that the test steam/chemical spray mixture does not enter the equipment. This isolation may be achieved by sealing the equipment conduit entrance with a manufactured conduit seal design (e.g., Conax ECSA), the use of potting compounds (e.g., epoxy, RTV silicone compounds or BISCO seals), or

by the connection of rigid conduit and pipe between the test equipment and the test chamber wall. Regardless of the sealing method used, the fact that steam was not allowed to enter the tested equipment requires that the equipment be installed in the plant in a similar manner (i.e., with a sealed conduit connection) so that it should function when exposed to the steam, spray, and high humidity environments resulting from design basis accidents and HELBs. Therefore, the test specimen configuration (i.e., sealed conduit) and location of the equipment in the plant (i.e., in an area where steam/spray environments occur) determines the sealing requirements necessary for the plant installed equipment.

It should also be noted that if an equipment item or unique configuration is tested where a conduit sealing mechanism was not used and the equipment functions acceptably, then installation in the plant need only reflect the tested configuration. Further, it also follows that an equipment item sealed in a test but installed in a plant area where it should not be exposed to harsh steam, chemical spray, or high humidity environments, need not be sealed in the plant since a moisture environment should not be present as a result of a design basis accident or HELB to impair equipment performance.

### 3.1.14.3 Equipment Sealing Requirements

Equipment located in harsh steam, spray, and condensing humidity environments, which must function in these environments, must be installed in configurations that emulate tested conditions. If tested configurations utilized unique sealing and/or drainage mechanisms, then the plant installed configurations must be similar. Conversely, equipment tests without sealing mechanisms support the installation of equipment without sealing provisions in the plant.

The primary transport mechanism for moisture intrusion into equipment is the differential pressure developed as a result of the design basis accident or HELB pressure transient. The high pressures evident during accidents that occur in the containment should result in moisture entry into unsealed equipment through conduit connections and covers. Numerous tests completed throughout the industry support the need for conduit and cover sealing mechanisms for specific types of equipment (e.g., transmitters, limit switches, temperature elements, solenoid valves, etc.) installed in high pressure steam environments. Reference 81 states the sealing requirements to prevent moisture intrusion for each specification number.

There are, however, certain HELB events outside containment that may result in relatively low pressure, short duration transients. These HELB events are dominated by energy (heat) rather than mass (moisture) releases in the initial seconds of transient inception. For an unsealed enclosure, the pressure differential between the equipment internals and the ambient environment should equalize before the moisture content of the air has increased significantly. Without this driving differential pressure, condensation drainage and random air mixing are the only remaining mechanisms postulated that would allow moisture to enter equipment. Both condensate drainage and random air mixing are considered relatively ineffective ways for moisture intrusion because the barriers and drainage paths (e.g., weep holes) used in the terminal boxes and conduit systems inhibit the moisture flow to connected plant equipment. Therefore, equipment sealing is not required. Refer to Specification E-028 and Drawing E-11011 (Ref. 15) as well as M-0Y005 and TSA 20419-000 also addressed the IE 89-63 sealing review performed plant sealing equipment review to confirm plant sealing is acceptable.

Based on the environments postulated to occur in various plant areas subsequent to the initiation of design basis accidents and HELBs (see Section 2.3 of this manual), WCGS equipment sealing requirements are established as follows:

#### 3.1.14.3.1 Containment Building Equipment

The high accident pressure, the presence of large volumes of steam and the initiation of containment spray require that equipment be sealed in accordance with any unique tested configurations. Tested configurations are as defined in the equipment specific test reports. For terminal boxes, refer to Specification E-028 and Reference 15. For some boxes, a drainage path is required. (Refer to Note 1, sheet iii of Ref. 15). In cases where splices have been used instead of terminations in boxes, a drainage path is not required. (Refer to Note 2, sheet iii of Ref. 15).

### 3.1.15 Dust

The potential effects of dust are considered based on the equipment type, the dust environment to which the equipment could be exposed and the potential degradations that could result from this exposure. In the NUREG-0588 review, dust was considered and was determined to be an insignificant factor in Equipment Qualification because outside air sources and ventilation units are typically equipped with filters which remove airborn dust. Also concrete coating, plant housekeeping, dust seals, and equipment maintenance requirements provide assurance that dust should not degrade equipment performance. For sealing requirements see drawings M-663-00017 Penetration Seals, Typical Details, M-1Y006A and M-1Y006B Electrical Equipment Requiring Vapor and Dust Seals.

### 3.1.16 Synergisms

Environmental qualification in accordance 10 CFR 50.49 (Reference 1) requires that synergistic effects be considered when the effects are believed to have a significant effect on equipment performance [Reference 1, Section (e)(7)]. Regulatory Guide 1.89, Section C.5.a (Reference 2), provides further guidance for addressing synergisms, wherein it is stated that only known synergistic effects need be accounted for in the WCGS qualification program.
Currently, the only known synergistic effects required to be addressed within the qualification process are dose rate effects and effects resulting from the different sequence of applying radiation and elevated temperature (thermal aging) [Reg. Guide 1.89, Section C.5.a (Reference 2)].

A synergistic relationship is observed when two or more stresses applied simultaneously produce degradation of a different type or magnitude than the same stresses applied sequentially. A review of industry published data has revealed that research has generally been limited to electric cables used inside containment for a limited range of specific environmental conditions.
Given the limited scope and applicability of available synergistic documentation, the effects of the various service conditions are typically addressed individually.

The synergistic relationship between multiple stresses usually cannot be deduced from physical principles; rather, an experimental approach must be employed. Synergistic stresses usually require extensive testing to reveal their magnitudes, since most interaction effects are minute by comparison to the primary effects, and thus require significantly more experimental evidence to identify. Current research, as referenced below, indicates that synergistic effects can typically be categorized under two main headings:

- Test Sequence Effects - The sequence in which radiation and thermal aging exposures occur is an important consideration. Radiation combined with elevated temperatures or radiation followed by elevated temperatures may produce more material degradation than when thermal aging precedes radiation exposure [NUREG/CR-3629 (Reference 26)].
- Radiation Dose Rate Effects - For many materials, it has been observed that lower dose rates produce more degradation than a higher dose rate for the same total applied dose [NUREG/CR-2157 (Reference 27)].

Guidance for the application of these potential synergistic effects in the qualification of WCGS electrical equipment is provided in the following sections:

### 3.1.16.1 Test Sequence Effects

Although most IEEE Standards pertaining to Equipment Qualification (e.g., IEEE Stds. 323, 334, 382, 383, etc.) specify a qualification test sequence where accelerated thermal aging precedes radiation exposure, research (References 26 and 16) conducted after the issue of these standards indicates that radiation exposure prior to thermal aging may be a more conservative test sequence for some organic materials.

It should be noted that synergistic degradation mechanisms are only addressed for certain inorganic materials based on available research, and these effects have not been established for inorganic and metallic materials operating within the specified range of WCGS environmental conditions.

Research into the effects of thermal and irradiation aging test sequences on polymer material properties was conducted from 1982 to 1984, as reported in NUREG/CR-3629 (Reference 26). The effort focused on the aging of several polymer insulation and compression materials to the same parameters in different test sequences and simultaneously, and evaluating the resulting total change in specific properties. Material properties evaluated were elongation, tensile strength and compression set. Not all materials were evaluated for each material property. The polymer materials consisted of compounds common to the United States and French nuclear industries. Both are discussed here because of the chemical family similarities. The polymer materials included in the study, the properties evaluated and a brief description of the results are provided in Table 3-2.

A review of the results presented in Table 3-2 show that there is some basis for a preferential test sequence where radiation is completed prior to thermal aging. However, the desired sequence is also a function of the material compounding and the property of concern. It should also be noted, that the tests measured changes in degradation of material samples and did not evaluate the overall performance of equipment and subject them to complete test sequences (e.g., LOCA) so that the full impact of different aging sequences could be evaluated.

From a regulatory perspective, only those synergistic effects identified, or "known", prior to the initiation of qualification activities, including testing, should be addressed in a qualification program [Reg. Guide 1.89, C.5.a (Reference 2)]. Therefore, the test and qualification activities initiated prior to the early 1980's had no reason to be concerned that the aging test sequence specified in the various IEEE Standards may not be the most conservative. Further, the studies previously discussed herein do not require judging the adequacy of previous testing in "hindsight", but rather show the need to establish a policy for future qualification efforts that reflects the evolutionary trend in the known state-of-the-art with respect to sequential testing effects.

Test sequence synergistic effects shall be accounted for in the WCGS EQ Program by identifying equipment constructed with CSPE (chlorosulfonated polyethylene, or Hypalon), XLPE (chemically crosslinked polyethylene), or EPR and EPDM (ethylene propylene rubber compounds) insulation and jacket materials, and addressing these effects as follows:

1. If the test sequence provides for radiation aging before thermal aging, then any postulated effects are adequately addressed.

2. For cases where thermal aging was applied prior to radiation aging, the test results may be evaluated with respect to the overall severity of the test parameters and duration, such that the extremes of testing adequately account for any unknown or unaccounted for synergistic degradation mechanisms with respect to test sequence. The severity of the testing as compared to the environmental conditions the equipment should experience in the plant may also be used as further justification that a reversal of the aging sequence would not result in a finding that the equipment would not perform as required when exposed to postulated WCGS design basis accident conditions.

3. Tests initiated prior to the early 1980's in accordance with recognized IEEE Standards (e.g., 323-1974 and 383-1974) are acceptable as evidence of qualification regardless of the aging sequence applied. Synergistic effects that were not "known" did not have to be accounted for in the test process.

4. Further environmental testing, or retesting, must account for any “known” synergistic effects with respect to the application of radiation prior to thermal aging.

**Table 3-2**
**Effects of Thermal and Irradiation Test Sequence**
**A Summary of NUREG/CR-3629 Results**

| Polymer Material | Property Measured | Summary of Results |
|---|---|---|
| EPR (Radiation crosslinked, fire-retardant EPDM insulation) | Elongation, Tensile strength | Degradation of properties not dependent on sequential ordering of tests. |
| EPR (Chemically crosslinked, fire-retardant EPDM insulation) | Elongation, Tensile strength | Degradation of properties not dependent on sequential ordering of tests. |
| XLPO (Crosslinked Polyolefin insulation) | Elongation, Tensile strength | Degradation of properties not dependent on sequential ordering of tests. |
| Tefzel (Flouropolymer insulation) | Elongation, Tensile strength | Property loss greater with thermal followed by radiation aging sequence. |
| CSPE (Chlorosulfonated Polyethylene jacket - Hypalon) | Elongation, Tensile strength | Property loss greater with radiation followed by thermal aging sequence in U.S. test. However, French test showed no effects of test sequence. |
| CPE (Chlorinated Polyethylene jacket) | Elongation, Tensile strength | More total loss of elongation with radiation testing first; however, differences where within 10%. Tensile results show little dependence on sequence. |
| PRC (Chemically crosslinked Polyethylene insulation) | Elongation, Tensile strength | Property loss greater with radiation followed by thermal aging sequence. |
| EPR (Ethylene Propylene rubber) | Elongation, Tensile strength | Property loss greater with radiation followed by thermal aging sequence. |
| VAMAC (Acrylic Polyethylene) | Elongation, Tensile strength, Compression set | Degradation of properties not dependent on sequential ordering of tests. |
| Polydiallyl-phtalate (Thermosetting Polyester) | Elongation, Tensile strength | Degradation of properties not dependent on sequential ordering of tests. |
| PPS (Phenylene Polysulfide) | Elongation, Tensile strength | Degradation of properties not dependent on sequential ordering of tests. |
| EPDM (Insulation, no fire-retardant) | Elongation, Tensile strength | Property loss greater with radiation followed by thermal aging sequence. |
| EPDM (Insulation, Alumina-loaded as fire-retardant | Elongation, Tensile strength | Property loss greater with radiation followed by thermal aging sequence. |
| EPR, BUNA-N, Silicone rubber, Viton | Compression set | Permanent set relatively unaffected by test sequence. |

### 3.1.16.2 Dose Rate Effects

Dose rate effects have been noted to some degree for cross-linked polyolefin, EPR (ethylene propylene), CSPE (chlorosulfonated polyethylene - Hypalon), chloroprene rubber, polyethylene, and PVC (polyvinylchloride) cable insulating and jacket materials in research conducted by Sandia National laboratories (NUREG/CR-2157 (Reference 27) and NUREG/CR-2877 (Reference 38)).

Dose rate effects occur over long periods and, therefore, need only be addressed during the radiation conditions that occur during normal plant operation. A review of the data and conclusions presented in NUREG/CR-2157 (Reference 27) and NUREG/CR-2877 (Reference 38) show that there are threshold doses below which dose rate effects for these cable insulation and jacket materials are not significant. Table 3-3 lists the materials of concern and the corresponding threshold dose below which dose rate effects are not evident.

The WCGS EQ Program need only address dose rate synergistic effects for equipment constructed with crosslinked polyolefin, ethylene propylene (EPR), CSPE (Hypalon), chloroprene rubber, polyethylene, and PVC (polyvinylchloride) insulation and jacket materials that are located in plant areas where the normal 60 year total integrated radiation dose exceeds the values given in Table 3-3.

**Table 3-3**
**Threshold Doses for the Application of Dose Rate Effects**

| Polymer Material | Material Properties | Threshold Dose for Consideration of Dose Rate Effects (Rads) | Reference |
|---|---|---|---|
| Crosslinked Polyolefin Insulation | Tensile Strength Elongation | 2.0E+7 | Reference 27 Figure 1 |
| Ethylene Propylene Rubber (EPR) Insulation | Tensile Strength Elongation | 2.0E+7 | Reference 27 Figure 2 |
| Chlorosulfonated Polyethylene (CSPE) (Hypalon) Insulation | Tensile Strength Elongation | 1.25E+7 | Reference 27 Figure 4 |
| Chloroprene Rubber Insulation | Tensile Strength Elongation | 1.0E+7 | Reference 27 Figure 3 |
| Polyethylene Insulation | Tensile Strength Elongation | 1.0E+7 | Reference 38 Figure 16 |
| Polyvinylchloride (PVC) Jacketing | Tensile Strength Elongation | 1.5E+7 | Reference 38 Figure 15 |

# 4.0 EQ PROGRAM IMPLEMENTATION

The implementation of the WCGS EQ Program is the process of maintaining the requirements based on testing on which qualification is based through the proper installation, maintenance and rework of equipment, and the use of acceptable spare and replacement parts.

## 4.1 EQ Maintenance Requirements

Equipment Qualification maintenance requirements are the preventive maintenance and/or surveillance activities specified in the qualification test reports, analyses, and vendor instructions necessary to maintain the environmental capacity of the equipment. Performance of preventive maintenance and/or surveillance activities ensures that the equipment is in a known configuration and state of operational readiness so that it should perform its safety function when exposed to design basis accident environmental conditions for the duration of the accident required.

Failure to perform the required EQ maintenance, including the replacement of parts with limited qualified life, within the time period specified invalidates the qualification of the equipment. There is no "grace period" for specified EQ maintenance and part replacement intervals.

Equipment Qualification related maintenance is derived from the qualification evaluations completed as part of the design verification process. These qualification maintenance requirements are different from "other" maintenance activities since EQ maintenance actions are necessary to maintain the equipment in the similar configuration and operational state as the tested specimen. By maintaining the installed equipment to be similar to the tested equipment, the performance of the tested equipment can be used to simulate the behavior of the equipment in the plant when it is exposed to design basis environmental conditions. "Other", or "suggested", maintenance activities may originate from vendor recommendations and may be "good" maintenance practices, but are not specifically required from a qualification perspective.

Normal terminating of cables/wires at terminal blocks shall be skill-of-the-craft with the exceptions noted in the EQ Component Maintenance/Replacement Information Sheet(s). Skill-of-the-craft skills are considered to be standard industry practices and are basic craft experience or those skills resulting from training required to obtain independent qualification, or enhanced basic journeyman skills. The EQ, or "required", maintenance activities are identified in the EQ Component Maintenance/Replacement Information Sheet(s) located in the Equipment Qualification Summary Document (EQSD).

## 4.2 EQ Equipment Configuration Requirements

Equipment Qualification equipment configuration and installation requirements are necessary to ensure that the equipment is installed in the plant in a manner that simulates the tested configuration. The installed equipment configuration must be based on the tested equipment configuration to ensure that installed equipment should perform like the tested equipment under design basis accident conditions.

The tested configuration defines the plant installed configuration because the test is the proof of performance, even though another configuration may appear to be acceptable. For example, a terminal block is tested in a box with a weep hole drilled in the bottom of the box.

The block may function satisfactorily without the weep hole; however, it was not tested in a configuration where the weep hole did not exist. Therefore, no tested proof exists that the block's performance is acceptable without the weep hole. The weep hole must be an EQ configuration requirement for the terminal block.

The equipment's EQ configuration requirements are derived from the qualification evaluations completed as part of the design verification process. Any equipment specific requirements identified are provided in the EQ Component Maintenance/Replacement Information Sheet(s).

## 4.3 Replacement of EQ Equipment and Parts

The design, specification and procurement of new, replacement, or reworked equipment and parts shall consider the specific requirements necessary to maintain the continued qualification of installed equipment and environmental performance requirements of any "new" equipment (e.g., additions to plant design). The use of correct parts and equipment ensures that installed equipment remains in the configuration that was tested and that equipment that is replaced remains qualified by the documentation contained in the Equipment Qualification Work Package (EQWP) or Plant Qualification Evaluation (PQE). For example, a Rosemount transmitter is replaced by a Barton transmitter, which performs its function with the same accuracy. The qualification test in the EQWP or PQE is for the Rosemount transmitter installed under a specific Component Number. Qualification would be invalid because the test only supports the qualification of the Rosemount transmitter.

The use of reworked components or parts requires the adherence to the guidelines stipulated for a model substitution evaluation. The rework evaluation ensures that the reworked component remains in the exact configuration tested and that components/parts requiring rework remain qualified by the documentation contained in the EQWP(s)/PQE(s).

Equipment specific model, materials of construction and parts information can be found in the appropriate sections of the EQWP/PQE.

### 4.3.1 Equipment Specification

Specifications for EQ equipment shall include the environments the equipment may be exposed to during normal and design basis accident conditions. Specific equipment performance requirements (e.g., accuracy, insulation resistance, continuous operation, cycle open/close, etc.) that must be demonstrated during exposure to these environments shall also be included in the specification. The requirement that qualification documentation be provided that demonstrates this performance in accordance with IEEE Standard 323-1974, or any appropriate daughter standards, shall also be included in the specification.

### 4.3.2 Equipment Procurement

Procurement documents shall specify complete equipment model numbers, drawing and Bill of Material revision levels, lubricants, and unique material requirements as necessary to ensure that the equipment is purchased as specified. Required qualification documentation shall be clearly identified, including the document titles, revision levels and dates, when appropriate. Vendor certifications shall state the specific qualification document and its revision level to which certification is made.

Specific EQ related procurement requirements are provided in the EQWP/PQE. Procurement procedures shall ensure that any substitutions, or specification deviations, are approved by the EQ Group prior to purchase.

### 4.3.3 "Like-for-like" Replacement

The similarity of the test specimen to the qualified plant equipment has been established as part of the design verification process in the EQWP/PQE. The replacement of equipment, or parts within the equipment, changes the basis of the similarity if the new component is not identical. This should invalidate qualification because the documentation is no longer representative of the installed equipment.

The replacement of parts within equipment because of qualified life expiration or other maintenance activities shall be like-for-like. Where like-for-like is defined as the identical part, or a part that is "equivalent" in form, fit and function such that the "equivalent" part should enable the parent equipment to complete its safety function when exposed to WCGS design basis accident conditions. All equivalency evaluations shall be approved by the EQ Group for EQ equipment. Equivalency evaluations shall not be used for parent equipment (i.e., equipment qualified as an assembly). For example, a Rosemount 1153 Series B transmitter could be considered "equivalent" to a Rosemount

1153 Series D model. However, replacement of the Series B with a Series D model would invalidate the qualification evaluation in the EQWP/PQE which is based on the Series B model such that the test documentation for the Series D model must be incorporated into an EQWP/PQE in conjunction with plant installation. Parent equipment substitutions shall be considered a design change.

### 4.3.4 Design Changes

The design change and modification process may significantly impact the bases of the EQ Program and the qualification of installed equipment. The qualification of new equipment and designs shall be verified prior to their installation in the plant. Changes to plant layout, piping addition or rerouting, system and equipment operating mode changes, and setpoint changes can change the basis on which the qualification evaluations were conducted. Examples include the creation of new, or the modification of, normal and accident environments with the addition or deletion of high energy lines, creation of pathways between rooms, the isolation of rooms previously connected, movement of fire barriers, and changes in HVAC design and operation. These actions may create new harsh areas or vary the calculated parameters in existing harsh areas. Changes in equipment operating modes from normally de-energized to energized should affect the qualified life analysis. Therefore, Equipment Qualification shall be part of the design change and modification process, AP 02-005, “Disposition and Change Packages” (Reference 87).

The design change process shall be used when the make/model of EQ equipment changes. Refer to Engineering Screening Form Desktop Instruction, Item 1.2 Environmental Qualification.

# 5.0 TEMPERATURE MONITORING PROGRAM

The purpose of the WCGS thermal monitoring program is to provide actual plant ambient temperature data to validate existing equipment aging analysis assumption and provide the basis for refining qualified life (Reference 88). This monitoring program should also serve to identify any plant areas experiencing elevated temperatures (i.e., hot spots) in response to NRC Information Notice 89-30 (Reference 34). Permanent temperature instrumentation is located within the containment building to support this program.

The temperature data derived from the temperature monitoring program should enable equipment thermal life to be determined based on actual plant ambient temperature conditions as opposed to the normal area design temperatures currently used in the EQWP(s)/PQE(s). The results of this program may increase conservatively calculated qualified lives and thereby decrease equipment maintenance and replacement actions or decrease existing equipment qualified life because of installation in plant areas where the ambient temperature is higher than originally assumed. Although, a decrease in life should likely result in increased maintenance activities, the ability of the equipment to perform its safety function during design basis accident conditions should be enhanced.

## 5.1 Qualified Life Calculation Methodologies

The Arrhenius has evolved into the standardized methodology for addressing time temperature aging effects. Both the NRC and IEEE-323 [4-5] consider the arrhenius methodology an acceptable method for addressing temperature aging effects. Other models have also been used. For example, a simpler model, the 10°C rule states that chemical reaction rates double and the material life decreases by one-half for every 10°C increase in temperature. However, the Arrhenius model is preferred over the 10°C rule (Reference 33, Section 4.4.1). At WCGS the qualified life of equipment should be calculated utilizing the Arrhenius methodology. The qualified life of equipment typically depends on the temperature the equipment experiences during normal plant operation.

Licensee design temperature is the maximum calculated temperature based on the HVAC design calculations (See, Attachment. A). This temperature may be used as the normal ambient temperature during the entire life of the plant to calculate the qualified life of equipment utilizing the Arrhenius equation.

All service temperature ranges are calculated at a given baseline temperature (usually 120°F for Containment, 104°F for Aux. Bldg., etc.) and totaled. The aging temperature is also calculated at the same baseline temperature. The qualified life is then calculated by dividing the thermal aging equivalent at the baseline temperature to the total equivalent service temperature aging at the baseline temperature. EPRI 1021067 R/1 page 6-28 provides summary that documents that hot spot (process fluid temperatures and heat rise need to be considered) and it is acceptance to use average temperature from temperature monitoring but it is recommended that margin be added (Ref IN 87-65 & 89-30, see QH-2019-1827 page 10).

Conservative average or maximum design temperature should be used, unless detailed information about the specific temperature profile in a plant area is available. When actual temperature information is used to define the normal thermal profile, the data should be representative of the specific equipment location and verified to be representative of existing conditions. Any temperature values must account for hot spots due to localized heating effects.

Arrhenius-based equivalent temperature is a calculated continuous operating temperature which should produce the same level of thermal degradation during some total time that occurs when the equipment is exposed to a range of operating temperatures. This methodology is discussed in detail in Reference 33, Section 4.4.1. The Arrhenius model can be expressed in several forms, but the most useful for the purpose of accelerated aging is:

$$t_s = (t_a)[\exp^{(Ea/K)(1/Ts - 1/T_a)}]$$

Where,

$t_s$ = Service time being simulated or the qualified life (hours)
$t_a$ = is the accelerated aging test time (hours)
$T_a$ = is the aging temperature (°K)
$T_s$ = is service temperature (°K)
Ea is the activation energy (eV)
K is Boltzmann's constant (8.617E-5 eV/°K)

## 5.2 Use of Actual Containment Temperatures Data Analysis

Recording ambient temperatures and operating temperatures of devices for use in qualified life evaluations allows more accurate prediction of qualified life and can justify longer qualified lives. Engineering Disposition 13-376192-002 (Reference 101) provides analysis and justification of raw temperature data collected within containment by Calculation GP-Q-001, Inside Containment Data for Temperature Monitoring (Reference 88) to determine a more realistic normal operating temperature than the design basis temperature.

Engineering Disposition 13-376192-002 approved guidance provided in the tables below. This guidance can be used to establish an acceptable containment ambient temperature to be used to determine the EQ equipment program Qualified Life (QL).

| **Ambient Temperature** | **Source** | **Circumstance** |
|---|---|---|
| 120 °F | Containment Design Basis Normal Worst Case Operating Temperature | • EQ Equipment used throughout containment.<br>• Vendor has provided adequate testing that Qualified Life is ≥60 years at 120 °F. |
| T-12 Location Worst Case Actual Containment Average Temperature with margin =103.9°F + 5°F = 108.9°F<br><br>See attachment 1 and Evaluation Section for justification | Hottest Average Location #12 | • EQ Equipment used throughout containment.<br>• Based on confidence in qualified life applied activation energy (Ea), test report testing (temperatures/ radiation/ aging), industry operating experience and Wolf Creek performance; the EQ Qualified Engineer can determine to use the worst case average containment actual average temperature plus 5°F margin value can be used.<br>Note:<br>Using the full 5°F is recommended but not required. Depending on the other margins of the application it may be acceptable to reduce the 5°F margin. |
| Specific Applicable Containment Location Average Temperature, plus 5°F to 10°F margin. | Best/ Closest Location Average Temperature<br>Analysis from - Attachments | • All EQ Equipment of a specific model is located near a specific RTD or not near the worst case T-12 location.<br>• Based on confidence in qualified life applied activation energy (Ea), test report testing (temperatures/ radiation/ aging), industry operating experience and Wolf Creek performance the EQ Qualified Engineer can determine by the equipment's proximity, to the monitoring RTD, to use the closer RTD.<br>• A 5°F to 10°F margin is to be added to assure conservative approach is maintained. (See examples below)<br>• Can be used for one time PM extensions or operability assessments for individual equipment. |

Below are the Average Ambient Temperatures derived from the analysis from Attachment 1.
Attachment 2 shows physical location of the RTDs.

| RTD Location (#) | **1 (44) (2068'EL)** | **2 (45) (2068' EL)** | **3 (46) (2047' EL)** | **4 (47) (2047' EL)** | **5 (48) (2047' EL)** | **6 (49) (2047' EL)** |
|---|---|---|---|---|---|---|
| Average Ambient Temperature | **85.945** | **93.753** | **99.111** | **87.920** | **82.063** | **82.551** |
| RTD Location (#) | **7 (50) (2026' EL)** | **8 (51) (2026' EL)** | **10 (53) (2000' EL)** | **11 (54) (2000' EL)** | **12 (55) (2000' EL)** | **13 (56) (2000' EL)** |

| **Ambient Temperature** | **Source** | | | **Circumstance** | | |
|---|---|---|---|---|---|---|
| Average Ambient Temperature | **82.209** | **91.067** | **77.074** | **78.641** | **103.9*** | **80.424** |

* As identified in Engineering Disposition 13-376192-002 Attachment 1 this is the only RTD average ambient temperature that credits 30 days' worth of outage down time (refuel/forced outage - 55 day average per year at end of RF20) to reduce the average temperature for the RTD 12 location by 1.867°F.

# 6.0 LUBRICATION CONTROL PROGRAM

Lubricants are used in electro-mechanical equipment with rotating and sliding shafts and bearings. Lubricants used at WCGS include oils and greases. The use of the proper lubricant is necessary to ensure that equipment should function as required when exposed to the environmental conditions postulated to occur at WCGS subsequent to design basis accidents.

The selection and application process of proper lubricants (including lubricants approve for EQ related equipment) and the use of the Master Lubrication List are controlled by WCGS procedure AP 16-003, “Master Lubrication List and Control of Lubricants”. The Supervisor Predictive Maintenance is responsible for the administration of the Master Lubrication List, the application of it into the Preventive Maintenance Program and for approving significant changes to the Master Lubrication List. The Lubrication Engineer, Predictive Maintenance is responsible for selecting and recommending approval of lubricants based on evaluations. Qualified lubricants are stated in the Equipment Qualification Work Package/Plant Qualification Evaluation. The Equipment qualification of lubricants requires that all lubricants used in equipment within the scope of the EQ Program be evaluated and found acceptable for use with respect to both the equipment they lubricate and the operational and environmental conditions under which the grease or oil must provide its lubricating function. Therefore, the adequate Equipment qualification of lubricants must consider the following:

1. The compatibility of the lubricant with the parts being lubricated (e.g., roller or sleeve bearings),
2. The operational characteristics of the equipment (e.g., normal continuous operation versus operation for surveillance testing),
3. The normal and accident environmental conditions under which the lubricant must continue to exhibit its lubricating characteristics,
4. The compatibility of a new lubricant (e.g., different brand) with the lubricant it replaces.

## 6.1 Equipment Design and Lubrication

Equipment is designed by its manufacturer to perform certain functions under given conditions, which are detailed in the equipment specifications. Lubricant requirements are part of these specifications. Much of this equipment is delivered to WCGS with the specified lubricant already installed (e.g., greased bearings in motors). Therefore, the compatibility of the lubricant with the equipment is predetermined by the manufacturer.

## 6.2 Equipment Qualification of Lubricants Used in EQ Equipment

Acceptable equipment qualification requires that sufficient documentation exist that demonstrates that equipment should perform its required function when exposed to design basis accident conditions. For WCGS, proof of qualification is by test. During testing, the equipment is operated in a manner similar to the WCGS performance requirements. Therefore, the qualified lubricant is the one tested with the equipment.

The qualification documentation evaluation process requires the document reviewer (e.g., the EQ Engineer) to identify any lubricants tested with the equipment. These qualified lubricants are stated in the Equipment Qualification Work Package/Plant Qualification Evaluation, and are the lubricants that should be used to ensure that the equipment would perform in the plant in a manner similar to the tested equipment. The qualified life of lubricants is discussed in Section 6.3 of this manual.

There are situations where it is desirable to use a lubricant other than the one originally tested. Examples include, original lubricant is unavailable, or a desire to purchase one brand of lubricant for all equipment. The replacement of one lubricant with another is acceptable provided the characteristics of the different lubricants are evaluated to ensure that the replacement lubricant maintains the same attributes when exposed to design basis accident environmental conditions. This evaluation must address any potential differences in the lubricant base, as the mixing of bases may degrade lubrication qualities (Reference 30).

## 6.3 Qualified Life of Lubricants

Equipment Qualification requires that an assessment of equipment aging degradation be performed to determine the period of time a piece of equipment can remain in the plant such that it should retain sufficient capacity to perform its safety function during design basis accident conditions (See Section 3.1.1, 3.2.1 and 3.1.4 of this manual). For most EQ equipment, radiation aging life is usually established based on sequential aging tests, and thermal life is based on accelerated testing with extrapolation using Arrhenius methodology based on the non-metallic parts used in equipment construction. However, the size of the equipment often prohibits the testing of the entire assembly, and accelerated aging techniques are not applicable to lubricants [IEEE Std. 334 (Reference 21)].

The qualified life of lubricants is a function of the normal equipment and environmental operating conditions, and the bearings, seals and other features of the equipment lubrication system. Therefore, the lubricant qualified life, or replacement interval, is based on the periodic evaluation of the condition of the lubricant, such that the lubricant installed should always exhibit sufficient characteristics so that the lubricated equipment should perform its safety function when required.

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# 7.0 COMPLIANCE

## 7.1 Non-Conforming Conditions

A non-conforming condition for qualified equipment exists whenever the installed equipment configuration is not in accordance with the qualification evaluations and documentation contained in the EQWP/PQE. Examples of non-conforming conditions include equipment installation beyond its qualified life, EQ-related maintenance activities not completed within the specified interval, the installation of incorrect parts, the use of improper torque values for equipment covers (i.e., a value different from the one specified in the EQWP/PQE) and the installation of equipment with model numbers different from those evaluated in the EQWP/PQE. Qualified equipment non-conforming conditions are identified, evaluated and dispositioned through the Corrective Action Program processed in accordance with WCGS procedure AP 28A-100, “Condition Reports” (Reference 79).

## 7.2 Operability Determination

Operability Determination (OD) is the decision made by the Shift Manager (SM) or designated senior reactor operator (SRO) on the operating shift crew as to whether or not an identified or postulated condition has an impact on the operability of an System, Structure or Components (SSC) (i.e., operable or inoperable). For a determination that an SSC is operable, there must be reasonable assurance that an SSC can perform its specified safety function(s).

Procedure AP 26C-004, “Operability Determination / Functional Assessment,” (Reference 77) is applicable to the Operations evaluation of CRs to determine impact to the function of SSCs as described in the Current Licensing Basis (CLB). The evaluation by Operations determines the applicability of Operability Determination (ODs) and Functional Assessments (FAs) consistent with guidance provided by the Nuclear Regulatory Commission (NRC) in Regulatory Issue Summary (RIS) 2005-020, RIS2005-020 Rev. 1 and its associated NRC Inspection Manual Part 9900 Technical Guidance. This guidance supersedes the guidance previously provided in GL 91-18 and Revision 1 to GL 91-18. Appendix C, “Specific Operable Issues,” of this guidance, contains C.7, Environmental Qualification,” which states:

“When a licensee identifies a degraded or nonconforming condition that affects compliance with 10 CFR 50.49, (i.e., a licensee does not have an adequate basis to establish qualification), the licensee is expected to apply the guidance of procedure AP 26C-003.

Procedure AP 26C-004 provides guidelines and instructions for evaluating the operability or functionality of Systems, Structures or Components (SSCs), when a condition is identified that potentially impacts a specified safety function of the SSC. This procedure establishes the methods for performing and documenting the operability/functionality decision. WCGS Condition Report (CR) describe a potential problem related to SSCs subject to Technical Specifications (TS) or SSCs required by licensing documents other than Technical Specifications.

OD Guidelines for Equipment Qualification

If a potential deficiency has been identified relative to compliance with 10 CFR 50.49 in the EQ of SSCs, an OD should be performed. The SSC may be demonstrated Operable using analysis and test data providing reasonable expectation the SSC should perform its specified TS functions. In this connection, it must also be shown that subsequent failure of the SSC, if likely under accident conditions, should not result in significant degradation of any specified TS function or provide misleading information to the operator.

SSCs shall be declared inoperable if EQ installation and maintenance requirements, as defined in the EQWP/PQE, have not been met to the extent it is obvious after evaluation the device would not perform its specified TS functions under all postulated service conditions or there is no ‘reasonable expectation’ that the SSC is operable and that the operability determination should support that expectation. Even though the device may function properly in its normal environment and appear Operable, the decision must be made considering all postulated service conditions (harsh environments) as defined in the EQWP/PQE for the device.

For example, the EQ installation and maintenance requirements for an instrument transmitter may require it to be sealed against moisture/steam intrusion. If the transmitter does not have a seal installed, it is inoperable because it is obvious it would not meet the EQ installation and maintenance requirements.

If upon determining that EQ requirements have not or may not have been met, the effect of the missed requirement is not obvious, the component or device may remain Operable pending a POD.

For example, the EQ installation and maintenance requirements for an instrument transmitter may require it to be sealed against moisture/steam intrusion. If the transmitter has an unused conduit connection sealed only with a plastic shipping plug, then the transmitter may be operable. This may be either because other testing has been performed for this configuration or the EQ documentation may not have differentiated between LOCA and HELB mitigation, which have different qualification requirements.

For another example, a procedural EQ installation and maintenance requirements may require replacement of an instrument transmitter's O rings at five year intervals. If it is determined that a transmitter has exceeded this five year O-ring replacement interval, it is not obvious that performance of its specified function is prevented. An evaluation (OD) using transmitter/O ring test data is required to confirm its operability.

EQ requirements for a component or device may be implicit or explicit. The OD must be made considering all postulated service conditions (harsh environments) as defined for the device.

# 8.0 REVIEW OF REGULATORY, INDUSTRY AND VENDOR DOCUMENTATION

## 8.1 Regulatory Issues

Licensing personnel review Generic Letters and Bulletins. The Industry Operating Experience Program (IOE) group and Licensing review 10 CFR Part 21 conditions and other NRC correspondence. They also identify and categorize issues that need to be tracked, designate the organization responsible for addressing the identified issues, and ensure issues are tracked in accordance with Corrective Action Program (CAP). The review is done in accordance with procedure AP 20E-001, “Industry Operating Experience Program” (Reference 78).

The evaluation of 10 CFR Part 21 conditions reported by external agencies (e.g., the NRC, vendors and manufacturers) for applicability to WCGS is completed in accordance with the same Industry Operating Experience Program procedure.

The evaluation and disposition of NRC Bulletins, Generic Letters, and 10 CFR Part 21 conditions found to impact equipment in the EQ Program is contained in the CAP.

## 8.2 Industry Operating Experience

Procedure AP 20E-001, and AI 20E-004, Processing and Maintaining Incoming Operating Experience, Industry Operating Experience Program, describes the process and responsibilities for screening and evaluating Industry Operating Experience (IOE) information. The IOE program uses the CAP for initiation of actions to incorporate lessons learned from the industry into plant design, programs, or operating practices to improve plant safety and reliability. Some of the examples of source documents evaluated that contain industry operating experience are NRC Information Notices, NRC Regulatory Summaries, and INPO Event Reports (IER) Level 1-4. The industry operating experience review process is implemented via the details provided in this procedure and Condition Reports procedure AP 28A-100 (Reference 79).

INPO revised their Operating Experience program (INPO 10-006) that historically kept the SEE-IN program, but moving forward implemented INPO Event Reports (IERs) Level 1, Level 2, Level 3, and Level 4. Wolf Creek's Industry Operating Experience (IOE) Program was revised to add the graded risk approach with IER L1 documents being the most significant to IER L4 documents being the least of their significant risk order. These changes also increased the management level of ownership and oversight for initial/effectiveness review IER L1&L2 evaluation to require senior management to own the evaluation and also require CARB reviews as guided by INPO 10-006 and SOER 10-2. IER L3 & L4 evaluations also require management ownership, but a CARB review is not required.

Other changes to the program included more guidance for completing IER/SOER Effectiveness reviews by implementing form AIF 20E-004-01 that standardizes the effectiveness review process. More guidance was also included in the OE program procedures for sharing OE with 3rd party members such as our owner companies. Improvements for more effectively reporting Wolf Creek events to INPO were included as well.

To better address low-level IOE, the program implemented a "Collegial Review" that uses a cross-disciplinary group to review low-level INPO Consolidated Event System (ICES) Reports and LERs. At first the low-level ICES report disposition was documented on a spreadsheet, but later implemented Experience Way OE software to track the disposition for incoming industry operating experience.

The evaluation and disposition of industry operating experience documents found to affect equipment in the EQ Program is usually contained in the evaluation/response of the CR.

## 8.3 Vendor Documentation

The request, receipt, transmittal, review, approval, revision, distribution and use of vendor documentation are controlled by the requirements detailed in procedure AP 15A-002, Control of Documents (Reference 84). Vendor documentation is defined in the Reference 84 procedure as:

1. Design Documents: A document that specifies technical and quality requirements governing the fabrication, installation, test or operation of a component, system or structure.

2. Miscellaneous Document: A document that is not considered a design document, drawing, calculation, procedure, instruction or program description. Documents classified as miscellaneous should have a review or approval signature of the responsible organization. Miscellaneous documents do not require Quality Assurance review, PSRC review and approval, and are not listed in the Quality Program Compliance Verification Matrix (QPCVM) as Quality Assurance ANSI N18.7/ANS 3.2-1976 procedural compliance documents. Miscellaneous documents do not affect the regulatory requirements of the operating license, 10CFR 50.59, or 10CFR 50.54. [3.2.1 and 3.2.2]

3. Vendor Technical Documents: Drawings, instruction maintenance booklets, procedures, test reports, data sheets, calculations, specifications, bills of material and other textual or graphic documents produced by vendors and submitted for WCNOC acceptance. The information generally pertains to a specific component.

## 8.4 License Renewal

The License Renewal Application (LRA) was developed and submitted to the NRC September 27, 2006. This date was committed to under letter to the NRC, dated July 22, 2003. Following submittal of the Application, the project continued through NRC review and approval for a 26-month period. Completion of the NRC review resulted in the November 20, 2008 issuance of a renewed Operating License for WCGS.

Scope:

The project scope includes four phases:

- Phase 1 - Project Definition
- Phase 2 - License Renewal Application (LRA) Production
- Phase 3 - NRC Review
- Phase 4 - Aging Management Program (AMP) Implementation.

Phase 1 – Project Definition (July 2004 – September 2004)

Phase 1 activities included: readiness review, project plan and resource leveled schedule, project metrics and milestones, project procedures.

Phase 2 –LRA Production (October 2004 – September 2006)

Phase 2 activities included: scoping and screening, aging management reviews, time-limited aging analysis (TLAA), preparation of an environmental supplement, preparation and submittal of a License Renewal Application.

An impact to phase 2 scope was the issuance of NUREG-1801 Generic Aging Lessons Learned (GALL) document Revision 1 in September 2005. The GALL is the main guidance document used to develop a License Renewal Application. The deliverables issued prior to GALL Rev 1 were reconciled to Rev 1 and the project recovered from impact by year-end 2005.

Phase 3 – NRC Review (October 2006 – November 2008)

Phase 3 activities included: NRC sufficiency review, public meetings, audits, inspections, Requests for Additional Information (RAIs), Safety Evaluation Report, Advisory Committee on Reactor Safeguards (ACRS).

An impact to phase 3 scope was the NRC budget continuing resolution, which caused a 4 month delay in the NRC review schedule. Other impacts were the revised process for Environmental audits, which now includes issuance of Environmental RAIs, and also an addition of a time-limited aging analysis (TLAA) audit. A TLAA is an analysis or calculation for a structure, system, or component in the scope of license renewal that meets certain criteria such as involving a time-limited assumption (for example, 40 years) and is referenced in the plant's licensing basis. The additional TLAA audit specifically reviewed metal fatigue analyses of ASME Section III Class 1 components (reactor pressure vessel and reactor coolant system piping and piping nozzles).

At the completion of Phase 3, there are 29 open NRC Commitments. There were as many as 41 NRC Commitments in Phase 3, but 1 was deleted and 11 were completed during the NRC review process.

Phase 4 – AMP Implementation (December 2008 - Present)

Phase 4 activities include: documentation of NRC Commitments and credited activities, long term program development and ownership.

There are 39 Aging Management Programs credited in the License Renewal Application and Safety Evaluation Report. 13 programs are existing WCGS programs that should need to be enhanced. There are 7 new programs:

1. One Time Inspection (Year 30)
2. Selective Leaching of Materials
3. Buried Piping and Tanks Inspection
4. Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
5. Electrical Cables and Connections Not Subject to 10 CFR 50.49 EQ Requirements
6. Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 EQ Requirements
7. Reactor Coolant System Supplement

# 9.0 EQ PROGRAM DOCUMENTATION

Qualification is the verification that equipment should perform its required safety function when exposed to design basis accident environmental conditions. This verification is established through several EQ Program documents, which form the basis for the continued qualification of WCGS electrical equipment. The EQ Program documents are the Equipment Qualification Master List (EQML), Equipment Qualification Work Packages (EQWP)/Plant Qualification Evaluation (PQE), and the EQ Summary Document. Together, these documents constitute the scope of the equipment for which qualification is required, the basis for methodology used in qualification, the configuration and maintenance requirements necessary to implement qualification in the plants and the auditable files wherein the qualification evaluations and test documentation resides. These EQ Program documents are prepared, revised and evaluated under procedures AP 05G-002 (Reference 25), AP 05G-004 (Reference 85) and AP 05G-006 (Reference 86).

Each of the EQ Program documents is described in more detail in the following sections.

## 9.1 Equipment Qualification Change Notice (EQCN)

WCGS Procedures AP 05G-002 (Reference 25) and AP 05G-006 (Reference 86) establish the responsibilities and methods for performing preparation and independent review of qualification change documentation in accordance with the requirements of 10CFR50.49 and NUREG-0588. EQCN is a design document used by WCGS Equipment Qualification Group for evaluations and impact assessments of documents or data having potential EQ impact. Examples of documents, which might require evaluation under EQCNs, include NRC issuances, vendor documents, plant equipment modifications, equipment non-conformances, and industry operating experience information. Preparation and revision of EQ Program documents (EQWPs, GQEs, PQEs, EQML, EQSD etc.) may also be performed under EQCNs. The EQCN is also a design document used to review and approve EQ documents or activities.

Evaluations and impact assessments performed under EQCNs may utilize existing plant documentation in order to determine the installed condition and qualification status of equipment. Work Order and Class/Item histories are two tools that may be used for these evaluations. These histories provide the chronology of maintenance and material control activities for plant equipment. Utilized with actual work order documents, these histories may be used to determine the installed plant equipment configuration at any given time during the component life, down to a part level. This information may then be used in qualification evaluations under an EQCN.

Evaluations and impact assessments of environmental parameter changes (for example, change from mild to harsh environment due to increase in post-accident radiation doses) must include the review of equipment not currently in the EQML and the utilization of the selection criteria in Section 2.1.1 in determining the equipment that must then be qualified due to the environmental parameter changes.

## 9.2 Equipment Qualification Master List

Electrical equipment important to safety is categorized for LOCA/HELB/MSLB in accordance with NUREG-0588 Appendix E (Reference 5). It is noted that Appendix E to Regulatory Guide 1.89 (Ref. 3) defines Category C & D different than NUREG-0588, but WCGS follows NUREG-0588 per USAR. As required by 10CFR50.49 the electrical equipment located in a harsh environment and has to function in that environment has to have an EQ qualification program document. As identified in NUREG-0588 Appendix E the equipment is categorized into one of the following categories for each accident:

**CAT A:**
Equipment that should experience the environmental conditions of design basis accidents for which it must function to mitigate said accidents, and that should be qualified to demonstrate operability in the accident environment for the time required for accident mitigation with safety margin to failure.

**CAT B:**
Equipment that should experience environmental conditions of design basis accidents through which it need not function for mitigation of said accidents, but through which it must not fail in a manner detrimental to plant safety or accident mitigation, and that should be qualified to demonstrate the capability to withstand any accident environment for the time during which it must not fail with safety margin to failure.

**CAT C:**
Equipment that should experience environmental conditions of design basis accidents through which it need not function for mitigation of said accidents, and whose failure (in any mode) is deemed not detrimental to plant safety or accident mitigation, and need not be qualified for any accident environment, but should be qualified for its non-accident service environment.

**CAT D:**
Equipment that should not experience environmental conditions of design basis accidents and that should be qualified to demonstrate operability under the expected extremes of its non-accident service environment. This equipment would normally be located outside the reactor containment.

The list of all the electrical equipment required to be qualified in accordance with 10 CFR 50.49 is contained within the EQML. The selection criteria for determining which electrical equipment must be qualified are given in Section 2.2.1.

EQSD-II (Reference 122) Table 1 is the Equipment Qualification Master List (EQML). EQSD-II, table 1 identifies all categories A and B equipment is in a harsh environment and is required to function in accident conditions. This set of equipment does require an EQ program qualification document as required by 10CFR50.49. EQSD-II, table 2 identifies all the electrical equipment that has been evaluated for the equipment qualification program and determined to be either a category C and/or D for all accident conditions. This equipment is not part of the EQML, but provides supporting information to show why the identified electrical equipment is not required to have an EQ program qualification document per 10CFR50.49. The table 2 equipment is not part of the EQ program. Control and maintenance of the EQSD-II is by WCGS Procedure AP 05G-004.

EQSD-III (Reference 129) is the Component Replacement Information Sheet. Table 1 is a list of the components with a qualified life (QL) frequency that requires a replacement preventive maintenance file to ensure the qualified life is maintained. Table 2 is a list of components that have a requirement to replace the O-ring and/or gasket that per the manufacture is required to be replaced anytime the cover is opened or connection is broke.

## 9.3 Equipment Qualification Work Packages or Plant Qualification Evaluation

The Equipment Qualification Work Package (EQWP) or Plant Qualification Evaluation (PQE) provides the documented evidence that the electrical equipment is qualified. The record of qualification must be maintained for the entire period during which the equipment is installed in the plant [Reference 1, (j)]. Control and maintenance of the EQWP/PQE is by WCGS Procedures AP 05G-002/AP 05G-006.

The EQWP includes the following sections:

- Electrical Equipment Qualification Data Sheet
- Equipment Qualification Check Sheet
- References (Attachment 1)
- Components Number List (Attachment 2)
- Calculation of Post Accident Operability (Attachment 3)
- Calculation of Qualified Life (Attachment 4)
- Check Sheet Supplement (Note/Remarks)
- Equipment Evaluation Work Sheet

The PQE includes the following sections:

- Item Identification
- Similarity of the equipment tested vs installed
- Thermal Aging & Cycle Aging qualified life
- Radiation
- DBA Evaluation
- Post Accident Operating Time Evaluation
- Chemical Spray Evaluation
- Submergence Evaluation
- Replacement Parts Evaluation
- Maintenance Requirements & Evaluation
- Industry Issues (IN Bulletins, Notices, Circulars, 10 CFR Part 21, etc.)
- Qualification Summary
- Notes & References

# 10.0 ABBREVIATIONS AND DEFINITIONS

## 10.1 Acronyms

| | |
| --- | --- |
| CFR | Code of Federal Regulations |
| CRDR | Condition Report/Disposition Request |
| DBA | Design Basis Accident |
| DBE | Design Basis Event |
| DOR | Division of Operating Reactors |
| ECCS | Emergency Core Cooling System |
| EPRI | Electric Power Research Institute |
| EQ | Equipment Qualification |
| EQWP | Equipment Qualification Work Package |
| EQML | Equipment Qualification Master List |
| EQMS | Environmental Qualification Management System |
| ESF | Engineered Safety Features |
| eV | Activation Energy |
| GQE | Generic Qualification Evaluation |
| HELB | High Energy Line Break |
| HVAC | Heating, Ventilation and Air Conditioning |
| IEEE | Institute of Electrical and Electronic Engineers |
| INPO | Institute of Nuclear Power Operations |
| IPDC | Intact Primary Degraded Core Loss |
| LOCA | Loss of Coolant Accident |
| MEC | Moderate Energy Cracks |
| MCC | Motor Control Center |
| MSLB | Main Steam Line Break |
| OE | Operating Experience |
| PQE | Plant Qualification Evaluation |
| SGTR | Steam Generator Tube Rupture |
| USAR | Updated Final Safety Analysis Report |
| USNRC | United States Nuclear Regulatory Commission |
| WCGS | Wolf Creek Generating Station |

## 10.2 Definitions

**Activation Energy** - An empirical constant unique to a material. A measure of the minimum energy required to initiate a chemical reaction in a material that causes a measured property to change (i.e., it represents the energy barrier that has to be overcome for the reaction to proceed). The activation energy determines the way in which the rate of reaction varies with temperature. The activation energy is given in electron volts (eV).

**Aging** - The effect of operational, environmental and system conditions on equipment during a period of time up to, but not including design basis events, or the process of simulating these events (IEEE Std. 323-1974).

**Anticipated/Abnormal Operational Occurrences** - Conditions of normal operation which are expected to occur one or more times during the life of the nuclear power unit and include, but are not limited to loss of power to all recirculation pumps, tripping of the turbine generator set, isolation of the main condenser, and loss of all offsite power (10 CFR 50 Appendix A). A loss of HVAC is an anticipated operational occurrence.

**Beginning of Qualified Life** - The date of initial criticality, which constitutes the start of age-related degradation. For WCGS Unit 1 – September 3, 1985

**Class 1E (or 1E)** - The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or otherwise are essential in preventing significant release of radioactive material to the environment (IEEE Stds. 323-1974 and 344-1975).

**Components** - Items from which a device is assembled (e.g., resistors, wires, connectors, switches, springs, tubes, transistors, etc.).

**Design Basis Accidents (DBA)** - Postulated accidents specified by the WCGC safety analysis used in the design to establish the acceptable performance requirements of the equipment, systems and structures. Design basis accidents are those events analyzed in Chapter 15 of the WCGS UFSAR and include, loss of coolant accidents, main steam line breaks, rod ejection accidents, etc. Design basis accidents may cause harsh environments.

**Design Basis Events (DBE)** - Conditions of normal operation, including anticipated operational occurrences, design basis accidents, external events and natural phenomena for which the plant must be designed to ensure, the integrity of the reactor coolant pressure boundary, the capability to shut down the reactor and maintain it in a safe condition and the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the 10 CFR Part 100 guidelines (10 CFR 50.49).

**Environmental Qualification** - The process of generating, documenting and maintaining auditable evidence that NUREG-0588 required safety-related and post-accident monitoring electrical equipment performs its safety-related function as required when exposed to harsh environment(s) resulting from design basis accidents (also reference section 2.3).

**Equipment Qualification** - The process of generating, documenting and maintaining auditable evidence, by following IEEE 323-1974 (Environmental Qualification) and IEEE 344-1975 (Seismic Qualification), that certain safety-related and post-accident monitoring equipment performs its safety-related function as required when exposed to harsh environment(s) resulting from design basis accidents, including seismic occurrences (also reference sections 1.2 and 2.1).

**Environmental Qualification Management System (EQMS) -** integrated software management tool designed to assist utilities in managing their Equipment qualification (EQ) programs. WCNOC uses the EQMS database to document Equipment qualification. The EQMS database includes four basic modules for storing EQ-related data:

- Generic Qualification Evaluation (GQE) module
- Plant Qualification Evaluation (PQE) module
- Environments module
- Equipment module

**Equipment Qualification Work Package Files (EQWP)** - The collated, auditable evidence of Equipment Qualification for electric equipment located in a harsh environment.

**Equipment Qualification Master List (EQML)** - The set of equipment required to be qualified as identified by the following:

**Harsh Environment** - The environment in any plant area where there is an increase above the normal conditions in one or more environmental parameters, except radiation, due to a Design Basis Accident (DBA) or High Energy Line Break (HELB). For radiation, a plant area is considered harsh for all nuclear power plant components with the exception of radiation sensitive semi-conductor devices (e.g. metal oxide semi-conductor or MOS) and Teflon. A plant area is considered harsh for radiation sensitive semi-conductor devices and Teflon when the total integrated normal plus accident radiation dose exceeds 1.0E+3 rads.

**High Energy Line Break (HELB)** - A breach in a high energy fluid system.

**Generic Qualification Evaluation (GQE) –** Part of the EPRI EQMS Database. In the GQE module, EQ test reports are evaluated to establish the parameters to which a piece of equipment has been qualified. Test report temperature and pressure profiles from the GQE are imported into the PQE and compared with profiles from the room environments.

**Important to Safety** - The term applied to the electrical equipment that must be addressed within the scope of Environmental qualification in accordance with 10 CFR 50.49 (Reference 1). Its use is generally "electrical equipment important to safety." The term embodies safety-related electric equipment (Class 1E), certain non-safety-related electric equipment and certain post-accident monitoring equipment [per R.G. 1.97 (Reference 9)] as defined in 10 CFR 50.49 (b).

**Mild Environment** - An environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences (10 CFR 50.49).

**Moderate Energy Fluid Systems** - Fluid systems that, during normal plant conditions, are either in operation or maintained pressurized (above atmospheric pressure) under conditions where the maximum operating temperature is 200°F or less, and the maximum operating pressure is 275 psig or less.

**Moderate Energy Crack (MEC)** - A breach in a moderate energy fluid system.

**Normal Environmental Conditions** - The temperature, pressure, humidity and radiation environmental conditions that occur during normal plant operation, including anticipated operational occurrences. Normal plant operation includes system startup, operation in the design power range and hot standby and system shutdown.

**Plant Qualification Evaluation (PQE) -** Part of the EPRI EQMS Database. In the PQE module, plant requirements are evaluated against the qualification levels established in the GQE to document the qualification of equipment for applications at a WCNOC.

**Qualified Life** - The period of time the equipment can be installed in the plant such that it should retain sufficient capacity to perform its safety function during design basis accident conditions. For originally installed equipment, its qualified life began at the date of initial critically for the WCGS unit (see Beginning of Qualified Life definition). The life of new equipment begins when the equipment is installed in the plant.

**Safety-Related Equipment** - Equipment that is relied upon to remain functional during and following design basis events to ensure the integrity of the reactor coolant pressure boundary, the capability to shut-down the reactor and maintain it in a safe shut down condition, or the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the 10 CFR Part 100 guidelines (10 CFR 50.49).

**Seismic Qualification** - The process of generating, documenting and maintaining auditable evidence to assure that equipment should operate as required before, during or after seismic occurrences.

**Shelf Life** - The maximum period of time, from the cure date, that a molded, fabricated, or manufactured product can be stored such that it is expected to retain its characteristics as originally specified. The shelf life period ends at the item's expiration date or when the item is installed in the plant. The qualified life of an item begins when it is installed in the plant (see definitions for Qualified Life and Beginning of Qualified Life).

**Synergism** - Cooperative action of discrete agencies such that the total effect is greater than the sum of the effects taken independently. For example, a "synergistic effect" would exist if the changes in a material subjected simultaneously to radiation and other environmental stresses are different from the changes that occur in the material when subjected to the stresses separately and sequentially.

**Thermal Aging** - The deterioration of components and equipment due to exposure to normal plant temperatures over extended periods of time. Thermal aging only effects organic materials. Thermal aging effects are one of several elements considered when establishing the qualified life of equipment.

# 11.0 REFERENCES

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55 Calculation No. FL-03, “Flooding of Individual Auxiliary Building Rooms”.

56 Calculation No. FL-04, “Summary of Flood Levels in All Auxiliary Building Rooms Due to a Pipe Break/Crack.

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# WOLF CREEK GENERATING STATION

# EQUIPMENT QUALIFICATION DESIGN BASIS DOCUMENT

# EQSD-I Attachment A

## INTRODUCTION

The Room Environmental Conditions Design Bases Document was assembled to provide a room-by-room synopsis of the environmental conditions expected for normal, and accident conditions. The intended purpose for this document is to assist EQ Engineers in evaluating environmental conditions for rooms in which electrical safety related equipment is installed.

The document includes the environmental conditions for essentially all rooms in the Auxiliary, Control, Diesel, Fuel, and Reactor buildings. The environmental conditions are presented for Normal operation, Loss of Coolant Accident (LOCA), Main Steam Line Break (MSLB) and High-Energy Line Break/Moderate-Energy Crack (HELB/MEC).

Where appropriate, the basis for the environmental conditions has been provided by the use of notes. The purpose of the notes is to give the user an understanding of the event or limiting condition for each of which the environmental conditions were developed. The source documents are referenced for each of the environmental conditions.

The temperature, pressure, chemical spray and humidity conditions were extracted from the Mechanical/Nuclear Design Criteria, system process flow diagrams, and design calculations. The normal radiation dose rates were extracted from the radiation zone drawings and, except for Zone E areas, represent the maximum rate for the given radiation zone. For Zone E, maximum doses were not calculated. The LOCA dose rates were taken from the existing dose calculations. The LOCA integrated doses were taken from the Mechanical/Nuclear Design Criteria. The Normal Integrated Dose values are based on the 60 years qualified life of the plant times the Zone area's maximum dose rate. For Zone E rooms the dose rate is assumed to be 1 Rad/hr, this is a conservative dose rate value based on random HP surveys taken in various room (Zone E) locations.

The following guidelines may be used per drawing A-1701 (Reference 11)

- Rooms with a dose rate < 0.5 mR/hr are considered accessible (Zone A)
- Rooms with a dose rate of ≤ 2.5 mR/hr controlled access is limited occupancy 40hr/wk (Zone B).
- Rooms with a dose of ≤ 15 mR/hr controlled access limited occupancy between 6-40 hr/wk (Zone C).
- Rooms with dose ≤100 mR/hr controlled access limited occupancy for short periods, 1-6 hr/wk (Zone D).
- Rooms with a dose rate of > 100 mR/hr normally inaccessible controlled access limited occupancy for short periods for essential activities (Zone E).

The flood level and rate conditions were taken from the flooding calculations. For certain rooms the maximum flood level is based on Operator action taken. This is stated in the individual rooms' Notes Section and is part of the qualification.

The following information is provided for each room/area:

1. A table that provides the environmental parameters values for the room, including normal and accident temperature, pressure, humidity, radiation, chemical spray and flood level conditions. The accident data is presented by initiating event (e.g., HELB, LOCA), as appropriate

2. One or more graphic representations (profiles) for accident temperature and pressure versus time conditions. These are provided immediately after the page that contains the room environmental parameters.

3. References to appropriate calculations or other documents for each environmental parameter presented. Revision number for these calculations, documents should be provided at the end of the document. This eliminates the need to update each page where the calculation/document is referenced in this Design Bases Document.

4. Only the 180 day total integrated radiation dose are shown. See Reference 17, SLNRC 84-0013, “Environmental Qualification of Safety Related Electrical Equipment”; dated February 1, 1984; for basis to use 180 day total integrated radiation dose. Accident dose rates identified in the reference radiation calculations are highly dependent on the time following an event, they are integrated over the entire event and only the cumulative dose is plotted. To establish the 180 day accident dose for each environment as identified in calculation XX-43 Table A and Table B (Reference 46) an integration factor has to be used. The radiation dose rate changes from the first day of the accident to the end of the post-accident required 180 day period. Thus the total accident dose cannot be established by simply multiplying the dose rate by the number of hours in 180 days.

5. Although WCGS is designed and has satisfactorily completed a review to a 1 percent cesium post-accident source term, the radiation levels obtained using a 50 percent cesium source term were utilized during the NUREG-0588 review. Due to the extreme conservatism in the equipment specifications, most components were qualified to this radiation level. The NRC has resolved GSI 187; the staff concluded that there was no clear basis for backfitting the requirement to modify the design basis for equipment qualification to adopt the AST. The additional Cesium contribution only becomes limiting after 30 days post-accident. If the PAOT of the equipment being qualified is less than 30 days, the source term with 1% cesium remains bounding. For equipment where the PAOT requirement is > 30days, the continued use of 1% cesium is consistent with the resolution of GSI-187. Plus as identified in section 3.1.13.3 radiation margins section and reference 109, the way WCGS calculations use the RELAP-EM program and 10 CFR 50 Appendix K, ECCS EVALUATION MODELS conservative assumptions result in estimates of between 20% and 80% fuel rods with cladding failure for a typical PWR. Thus, where the 50 percent cesium source term radiation is too severe, the equipment can be evaluated against a 1 percent cesium source term (Ref. 6, Section 3.11(B).1.2.2).

6. The EQWP or PQE should identify if the 1 percent cesium term vs. 50 percent cesium source term was utilized (Reference 17).

7. The page number(s) shown with reference in room tables or notes are information only, and not subject to revision if that that is referenced changes to a different page.

The environmental parameters given herein are used as the basis for the qualification of the equipment within the scope of the Wolf Creek EQ program. Plant rooms not showing in this document are not considered to be harsh environments areas.

ROOM ENVIRONMENTAL CONDITIONS & DBA TEMPERATURE & PRESSURE PROFILES

- Reactor Building
- Auxiliary Building
- Control Building
- Diesel
- Fuel Building

**NOTES:**

1. Plant Environmental Normal Conditions environmental pH is 7.0 for all the building areas identified in Attachment A & B (Reactor, Auxiliary, Control, Turbine, Diesel Generator, Fuel, ESW Pump House, Radwaste and etc. Buildings) at WCNOC. (Reference 17, Table 1)

2. Plant Environmental Normal Conditions environmental effects of localized hazards such as pipe breaks are reviewed on a case by case basis for equipment qualification.

3. The original USAR table 3.11(B).1 included the minimum normal operating room temperatures and stated in note 8 that “they do not represent operability or equipment qualification limits. They do not represent the minimum temperature that may occur during abnormal conditions.” The minimum operating temperature values have not been included in the EQSD-I attachments. This is because for EQ qualification purposes the qualified life for the safety related equipment is determine by using either the average temperature or the maximum temperature where the equipment is installed. The minimum temperature values can be found in the applicable equipment specifications.

4. Maximum pressure, temperature, and humidity are based upon postulated pipe breaks for all rooms in the auxiliary building assuming initial conditions of atmospheric pressure, 104 °F and 70 percent relative humidity (reference 29, page 21). Note that the maximum temperature and relative humidity in these rooms may be higher for the loss of normal ventilation case as detailed in the notes of specific room environments.

**Cross Reference Table between Figures 3.11(B)-1 through 3.11(B)-49 of Section 3.11(B) of the USAR and EQSD-I, Attachments A & B**

| Figure # from the USAR | EQSD-I USAR FIGURE TITLE | EQSD-1, Figure Location (See Room #) |
|---|---|---|
| 3.11(B)-1 | Containment Temperature (LOCA) | 2000 |
| 3.11(B)-2 | Containment Temperature (MSLB) | 2000 |
| 3.11(B)-3 | Containment Temperature (LOCA & MSLB) | 2000 |
| 3.11(B)-4 | Containment Pressure (LOCA) | 2000 |
| 3.11(B)-5 | Containment Pressure (MSLB) | 2000 |
| 3.11(B)-6 | Containment Pressure (LOCA & MSLB) | Note 1 |
| 3.11(B)-7 | Surface Temperature (MSLB) | 2000 |
| 3.11(B)-7A | Cable Surface Temperature (MSLB) | 2000 |
| 3.11(B)-8 | Auxiliary Building HELB Temperature (Rooms 1101-left, 1102, 1120 & 1121) | 1101, 1102, 1120 &1121 |
| 3.11(B)-9 | Auxiliary Building HELB Temperature (Rooms 1128, 1129, 1206 & 1207) | 1128, 1129, 1206 & 1207 |
| 3.11(B)-9A | Auxiliary Building HELB Temperature (Rooms 1122 & 1130) | 1122 & 1130 |
| 3.11(B)-10 | Auxiliary Building HELB Temperature (Rooms 1107 through 1114) | 1107 - 1114 |
| 3.11(B)-11 | Auxiliary Building HELB Temperature (Rooms 1115, 1116 & 1117) | 1115, 1116 & 1117 |
| 3.11(B)-12 | Auxiliary Building HELB Temperature (Room 1126) | 1126 |
| 3.11(B)-13 | Auxiliary Building HELB Temperature (Rooms 1301(south), 1314, 1314 (south – room 4), 1319, 1321, 1323, 1502, 1503, 1504, 1505, 1506, 1507 & 1513) | 1301(south), 1314, 1314 (south – room 4), 1319, 1321, 1323, 1502, 1503, 1504, 1505, 1506, 1507 & 1513 |
| 3.11(B)-14 | Auxiliary Building HELB Temperature (Rooms 1201 & 1202) | 1201 & 1202 |
| 3.11(B)-15 | Auxiliary Building HELB Temperature (Rooms 1203 & 1203A- Left) | 1203 |
| 3.11(B)-16 | Auxiliary Building HELB Temperature (Rooms 1203A-Right & 1204) | 1204 |
| 3.11(B)-17 | Auxiliary Building HELB Temperature (Rooms 1301-West, 1314 & 1315) | 1315 |
| 3.11(B)-18 | Auxiliary Building HELB Temperature (Rooms 1301-North, & 1320) | 1301 & 1320 |
| 3.11(B)-19 | Auxiliary Building HELB Temperature (Rooms 1302, 1306) | 1302, 1306 |
| 3.11(B)-19A | Auxiliary Building HELB Temperature (Rooms 1307, 1309, 1310, 1311 & 1312) | 1307, 1309, 1310, 1311, 1312 |
| 3.11(B)-19B | Auxiliary Building HELB Temperature (Room 1308) | 1308 |
| 3.11(B)-20 | Auxiliary Building HELB Temperature (Rooms 1313) | 1313 |
| 3.11(B)-20A | Auxiliary Building HELB Temperature (Rooms 1318) | 1318 |
| 3.11(B)-21 | Auxiliary Building HELB Temperature (Rooms 1322 & 1323) | 1316, 1317, 1322 & 1323 |
| 3.11(B)-22 | Auxiliary Building HELB Temperature (Rooms 1401, 1402, 1406 & 1408) | 1408 (Room 12)<br>Notes 2 |
| 3.11(B)-23 | Auxiliary Building HELB Temperature (Rooms 1405, 1409 & 1410) | 1409 & 1410 |
| 3.11(B)-24 | Auxiliary Building HELB Temperature (Rooms 1506 & 1507)) | 1506 & 1507 |
| 3.11(B)-25 | Auxiliary Building HELB Temperature (Rooms 1411, 1412, 1508 & 1509) | 1411, 1412, 1508 & 1509 |
| 3.11(B)-26 | Auxiliary Building HELB Pressure (Rooms 1101, 1102, 1120 & 1121) | 1101, 1102, 1120 & 1121 |
| 3.11(B)-27 | Auxiliary Building HELB Pressure (Rooms 1107 through 1114) | 1107 - 1114 |
| 3.11(B)-27A | Auxiliary Building HELB Pressure (Rooms 1115, 1116 & 1117) | 1115, 1116 & 1117 |
| 3.11(B)-28 | Auxiliary Building HELB Pressure (Room 1126) | 1126 |
| 3.11(B)-29 | Auxiliary Building HELB Pressure (Room 1127) | 1127 |
| 3.11(B)-30 | Auxiliary Building HELB Pressure (Rooms 1122, 1128, 1129, 1130, 1206 & 1207) | 1122, 1129, 1130, 1206, 1207 |
| 3.11(B)-31 | Auxiliary Building HELB Pressure (Rooms 1201 & 1202) | 1201 & 1202 |
| 3.11(B)-32 | Auxiliary Building HELB Pressure (Room 1203 & 1203A) | 1203 |
| 3.11(B)-33 | Auxiliary Building HELB Pressure (Rooms 1204) | 1204 |
| 3.11(B)-34 | Auxiliary Building HELB Pressure (Room 1301) | 1301 |
| 3.11(B)-35 | Auxiliary Building HELB Pressure (Rooms 1302, 1306, 1307 through 1312, 1316 & 1317) | 1307 - 1312, 1316 & 1317 |
| 3.11(B)-36 | Auxiliary Building HELB Pressure (Rooms 1314, 1315 & 1320) | 1314, 1315 & 1320 |
| 3.11(B)-37 | Auxiliary Building HELB Pressure (Rooms 1322 & 1323) | 1322 & 1323 |
| 3.11(B)-38 | Auxiliary Building HELB Pressure (Rooms 1401, 1402, 1405 through 1410, 1502 through 1507 and 1513) | 1408, 1409, 1410, 1506 & 1507<br>Note 2 |
| 3.11(B)-39 | Auxiliary Building HELB Pressure (Rooms 1411, 1412, 1508 & 1509) | 1411, 1412, 1508 & 1509 |

| Figure # from the USAR | EQSD-I USAR FIGURE TITLE | EQSD-1, Figure Location (See Room #) |
|---|---|---|
| 3.11(B)-40 | No Figure exists. | 1321 |
| 3.11(B)-41 | Auxiliary Building HELB Temperature (Rooms 1103, 1105 & 1106) | 1103, 1105 & 1106 |
| 3.11(B)-41A | Auxiliary Building HELB Temperature (Rooms 1104) | 1104 |
| 3.11(B)-42 | Auxiliary Building HELB Temperature (Rooms 1123 through 1125) | 1123, 1124 & 1125 |
| 3.11(B)-43 | Auxiliary Building HELB Pressure (Rooms 1103 through 1106) | 1103, 1104 1105 & 1106 |
| 3.11(B)-44 | Auxiliary Building HELB Pressure (Rooms 1123 through 1125) | 1123, 1124 & 1125 |
| 3.11(B)-45 | Auxiliary Building HELB Temperature (Room 1205) | 1205 |
| 3.11(B)-46 | Auxiliary Building HELB Pressure (Room 1205) | 1205 |
| 3.11(B)-47 | Auxiliary Building HELB Temperature (Room 1329) | Note 3 |
| 3.11(B)-48 | Auxiliary Building HELB Pressure (Room 1329) | Note 3 |
| 3.11(B)-49 | Typical Thermal Model for Environmental Qualifications | Introduction Section |

Figure Notes:

1. The original USAR Figure 3.11(B)-6 was a composite profile of the LOCA & MSLB pressure during a DBE. However, for the purposes of the EQ program the equipment only needs to be qualified for the maximum peak pressure during the LOCA or MSLB accident. The pressure profile for a LOCA is shown in Figure 3.11(B)-3 and for MSLB inside containment in Figure 3.11(B)-4. The peak pressure value during a LOCA is 47.88 psig (Reference 103, Table 3-1) and for MSLB is 52.85 psig (Reference 102, Table 3-1) as already shown on Figure 3.11(B)-3 & 4 of EQSD-I, Attachment A as well as in the peak pressure rows of the environment summary tables associated with the containment. Based on this no composite figure is necessary for the EQ qualification and thus Figure 3.11(B)-6 of USAR is superseded by Figure 3.11(B)-3 & 4.

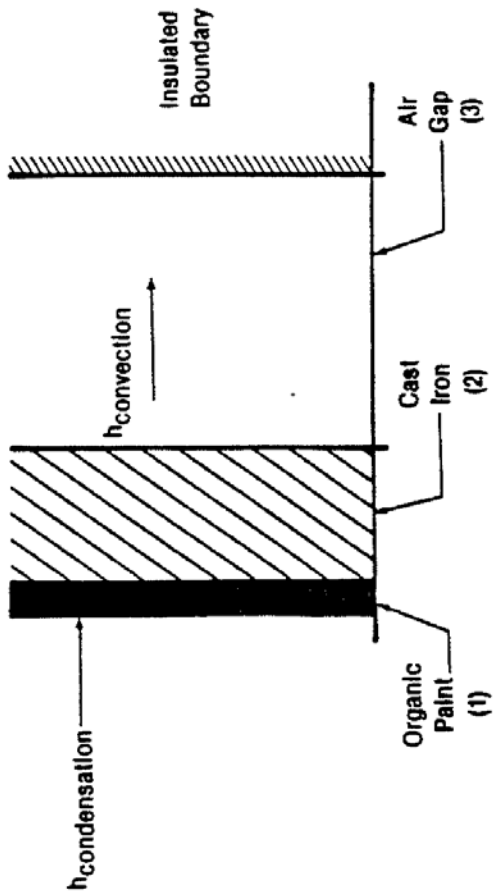
2. Rooms 1401, 1402, 1405, 1406, 1407, 1502, 1503, 1504, 1505 & 1513 are mild environment rooms. Therefore, the environments for these rooms can be found in Attachment B of EQSD-I.

3. Room 1329 is a mild environment room and as such Figures 3.11(B)-47 and 3.11(B)-48 have been voided, reference calculation YY-43. The environments for this room can be found in Attachment B of this document.

Figure 3.11(B)-49 Typical Thermal Model for Environmental Qualifications

WOLF CREEK

SLAB GEOMETRY (1-D)




| Region | Material | Thickness (ft) | No. of Nodes | Thermal Properties K (Btu/hr-ft-°F) | ρCp (Btu/ft³-°F) |
|---|---|---|---|---|---|
| (1) | Organic Paint | .0005 (.006 in) | 6 | 1.0 | 20.0 |
| (2) | Cast Iron | .01092 (.131 in) | 5 | 25.0 | 53.0 |
| (3) | Air Gap | .0234 (.2808 in) | 2 | .017 | .0145 |

Equiv. Dia = 2.83 ft
Surface Area = 8 ft²

Rev. 0

WOLF CREEK
UPDATED SAFETY ANALYSIS REPORT

FIGURE 3.11(B)-49

TYPICAL THERMAL MODEL FOR ENVIRONMENTAL QUALIFICATIONS

**BUILDING: REACTOR BUILDING** **ROOM NUMBER 2000**
**ROOM DESCRIPTION: REACTOR BUILDING**

| ENVIRONMENTAL CONDITIONS | Normal | REF | LOCA | REF | MSLB | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 120 (G) | 28, Page 2-8 | 307.9 | 103, Table 3-1 | 364.9 | 102, Table 3-1 |
| **PEAK PRESSURE (PSIG)** | ±2 (G) & (H) | 17, Table 1 | 47.83 | 103, Table 3-1 | 52.85 | 102, Table 3-1 |
| **HUMIDITY (%)** | 100 | 28, Page 2-8 | 100 | 103 | 100 | 102 |
| **INTEGRATED DOSE (RADS)** | $9 \times 10^6$ (D) & (F) | 17, Table 1 Sheet 1 48, Page 6 | $2.67 \times 10^8$ (B) | 17, Table 6 | (C) | NA |
| **DOSE RATE (R/hr)** | 17.12 (F) | | (C) | See Note C | (C) | N/A |
| **CHEMICAL SPRAY** | NE | N/A | 2500 ppm (A) | 41 | 2500 ppm (A) | 41 |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | 4.625 | 44, Page 6 | 4.492 | 44, Page 6 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

## REFERENCES


17. SLNRC 84-0013
24. Calculation XX-86
28. M-000 (Q)
41. USARCR-90-114
44. Calculation FL-18
48. XX-F-014
89. Calculation XX-Q-005
102. Calculation AN-05-016
103. Calculation AN-97-004
104. C-150


## NOTES

A The concentration of the chemical spray can range from pH 4.0 to 11.0. A pH of 4.0 could be experienced following a single failure in the containment spry system. The 11.0 pH could occur for approximately 30 minutes. It is possible during the beginning of the recirculation phase to still be adding NaOH, via the educator(s). During this time a high pH concentration of 11.0 is only for a short period of time ~ 1 minute for the remainder of the recirculation phase (22 to 23 hours), the spray pH = 8.0 – 9.0. The spray duration is for 24 hours.

B The total integrated dose values during a LOCA are the following:

| For the 50 % Cesium Source term | For the 1% Cesium Source term |
|---|---|
| $1.78 \times 10^8$ β dose | $1.69 \times 10^8$ β dose |
| $8.85 \times 10^7$ γ dose | $2 \times 10^7$ γ dose |

Values obtained to cover power rerate to 3565 MWth and to change from 12 month to 18 month cycle by increasing Reference 17, Table 6 levels using 50% Cesium source assumption as explained in reference 48 (i.e., by multiplying previous liquid and plate-out source values by 1.42; and by multiplying previous airborne gamma and beta values by 1.01 and 1.08, respectively). Worst case radiation values are obtained by adding the normal and accident dose values

C Radiological consequences of specific MSLB have not been included, since the LOCA conditions are more severe. The accident dose rates are provided in the appendices of XX-42. However, since the dose rates are highly dependent on the time following an event, they are integrated over the entire event and only the cumulative dose is plotted.

D The normal dose is for 60 years life of the plant

E Following a postulated main steam line break, the containment vapor could become superheated, and the temperature of the vapor could exceed the containment design value of 320°F for a short period of time. Equipment evaluation considers the following containment vapor condition:

Superheated vapor temperature 364.9°F
Saturated (condensing) vapor temperature 279.4°F
Duration of superheated conditions 150 seconds

As shown in Calculation AN-05-016 (Containment Temperature-MSLB), these analyses show that the containment temperature reaches 364.9°F for a brief period of time. The current equipment qualification envelope is conservative since the superheated vapor temperature is assumed to exist for 150 seconds; and as shown on Tables 8.9 & 9.2 for the equipment surface temperatures (see Figure 7 (Figure 3.11(B)-7) in this document) and Tables 8.10, 8.11, 8.12 & 9.2 for cable surface temperature (see Figure 7A (Figure 3.11(B)-7A in this document) of Calculation SA-91-011, the equipment and cables should not reached the MSLB peak temperature of 364.9°F

F There are other areas inside containment where the normal radiation and dose rates are lower than the Steam Generator Loop Compartment. These areas were previously listed in the USAR table 3.11(B)-1 as the Operating Floor and Outside S/G Loop Compartment Areas. The normal Operating Integrated Dose for these areas is $5.25.5 \times 10^3$ rads for 60 years and a maximum dose rate of 0.4 R/hr

G The steam generator (S/G) loop compartment has the same environment as the reactor building environments identified in the above table. It is noted that short-term pressure differential across the steam generator loop compartment walls of <20 psi, and the short-term temperature differential across the steam generator loop compartment walls of <475°F can occur.

H. The reactor building integrity will be tested at a maximum pressure of 69 psig. at up to 100 percent relative humidity, and up to 120°F simultaneously. In addition, the containment has a negative design pressure of -3.0 psig (reference 104, pg. 6).

**BUILDING: REACTOR BUILDING**
**ROOM DESCRIPTION: REACTOR CAVITY**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | MSLB | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 150/100 (G) (F) | 17, Table 1 | 307.9 | 103, Table 3-1 | 364.9 | 102, Table 3-1 |
| **PEAK PRESSURE (PSIG)** | ±2 (F) | 17, Table 1 | 47.83 | 103, Table 3-1 | 52.85 | 102, Table 3-1 |
| **HUMIDITY (%)** | 100 | 28, Page 2-8 | 100 | 103 | 100 | 102 |
| **INTEGRATED DOSE (RADS)** | $4.2 \times 10^{10}$ (D) | 17, Table 1 48, Page 6 | $2.67 \times 10^{8}$ (B) | 17, Table 6 | (C) | NA |
| **DOSE RATE (R/hr)** | 79908 | 17, Table 1 | (C) | See Note C | (C) | N/A |
| **CHEMICAL SPRAY** | NE | N/A | 2500 ppm (A) | 41 | 2500 ppm (A) | 41 |
| **MAX. FLOOD LEVEL (FT) (above the 2000' el. Floor)** | NE | N/A | 4.625 | 44, Page 6 | 4.492 | 44, Page 6 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**REFERENCE**

17. SLNRC 84-0013
24. Calculation XX-86
41. USARCR-90-114
44. Calculation FL-18
48. XX-F-014
89. Calculation XX-Q-005
102. Calculation AN-05-016
103 Calculation AN-97-004

**NOTES**

A The concentration of the chemical spray can range from pH 4.0 to 11.0. However, the high pH concentration of 11.0 is only for a short period of time ~ 1 minute for the remainder of the recirculation phase (22 to 23 hours), the spray pH = 8.0 – 9.0. The spray duration is for 24 hours

B The total integrated dose values during a LOCA are the following:

| For the 50 % Cesium Source term | For the 1% Cesium Source term |
|---|---|
| $1.78 \times 10^{8}$ β dose | $1.69 \times 10^{8}$ β dose |
| $8.85 \times 10^{7}$ γ dose | $2 \times 10^{7}$ γ dose |

Values obtained to cover power rerate to 3565 MWth and to change from 12 month to 18 month cycle by increasing Reference 17, Table 6 levels using 50% Cesium source assumption as explained in Reference 48 (i.e., by multiplying previous liquid and plate-out source values by 1.42; and by multiplying previous airborne gamma and beta values by 1.01 and 1.08, respectively). Worst case radiation values are obtained by adding the normal and accident dose values

C Radiological consequences of specific MSLB have not been included, since the LOCA conditions are more severe. The accident dose rates are provided in the appendices of XX-42. However, since the dose rates are highly dependent on the time following an event, they are integrated over the entire event and only the cumulative dose is plotted. Reference 24, page 1 identifies that the dose rate on the containment dome is 212.1 (also see general note 4 of Attachment A cover sheet).

D The normal dose is for 60 years life of the plant.

E Following a postulated main steam line break, the containment vapor could become superheated, and the temperature of the vapor could exceed the containment design value of 320°F for a short period of time. Equipment evaluation considers the following containment vapor condition:

Superheated vapor temperature 364.9°F
Saturated (condensing) vapor temperature 279.4°F
Duration of superheated conditions 150 seconds

As shown in Calculation AN-05-016 (Containment Temperature-MSLB), these analyses show that the containment temperature reaches 364.9°F for a brief period of time. The current equipment qualification envelope is conservative since the superheated vapor temperature is assumed to exist for 150 seconds; and as shown on Tables 8.9 & 9.2 for the equipment surface temperatures (see Figure 7 (Figure 3.11(B)-7 in this document) and Tables 8.10, 8.11, 8.12 & 9.2 for cable surface temperature (see Figure 7A (Figure 3.11(B)-7A in this document)) of Calculation SA-91-011, the equipment and cables should not reached the MSLB peak temperature of 364.9°F

F It is noted that the short-term pressure differential across the reactor cavity wall is <150 psi, and the short-term temperature differential across the reactor cavity wall is <500°F.

G The Reactor cavity Seal Ring Support can reach normal operating temperature of 220ºF. This area was defined previously in the USAR as that portion of the reactor cavity concrete directly below the seal ring down a distance of 3 feet. There is no EQ safety related equipment in this area

CONTAINMENT WORST CASE*
RADIATION LEVELS (MRADs)

| SOURCE | UPPER CTMT. | ABOVE SUMP | SUBMERGED IN SUMP |
|---|---|---|---|
| Gamma | | | |
| Airborne Source | 8.21 | 2.90 | Negl. |
| Liquid Source | 20.6 | 85.4 | 170 |
| Plateout Source | 0.125 | 0.187 | Negl. |
| Total | 28.9 | 88.5 | 170 |
| Beta | | | |
| Airborne Source | 150 | 150 | 0 |
| Liquid Source | 0 | 0 | 21 |
| Plateout Source | 18.9 | 28.1 | 0 |
| Total | 169 | 178 | 21 |
| Total | 197.9 | 266.66 | 191 |

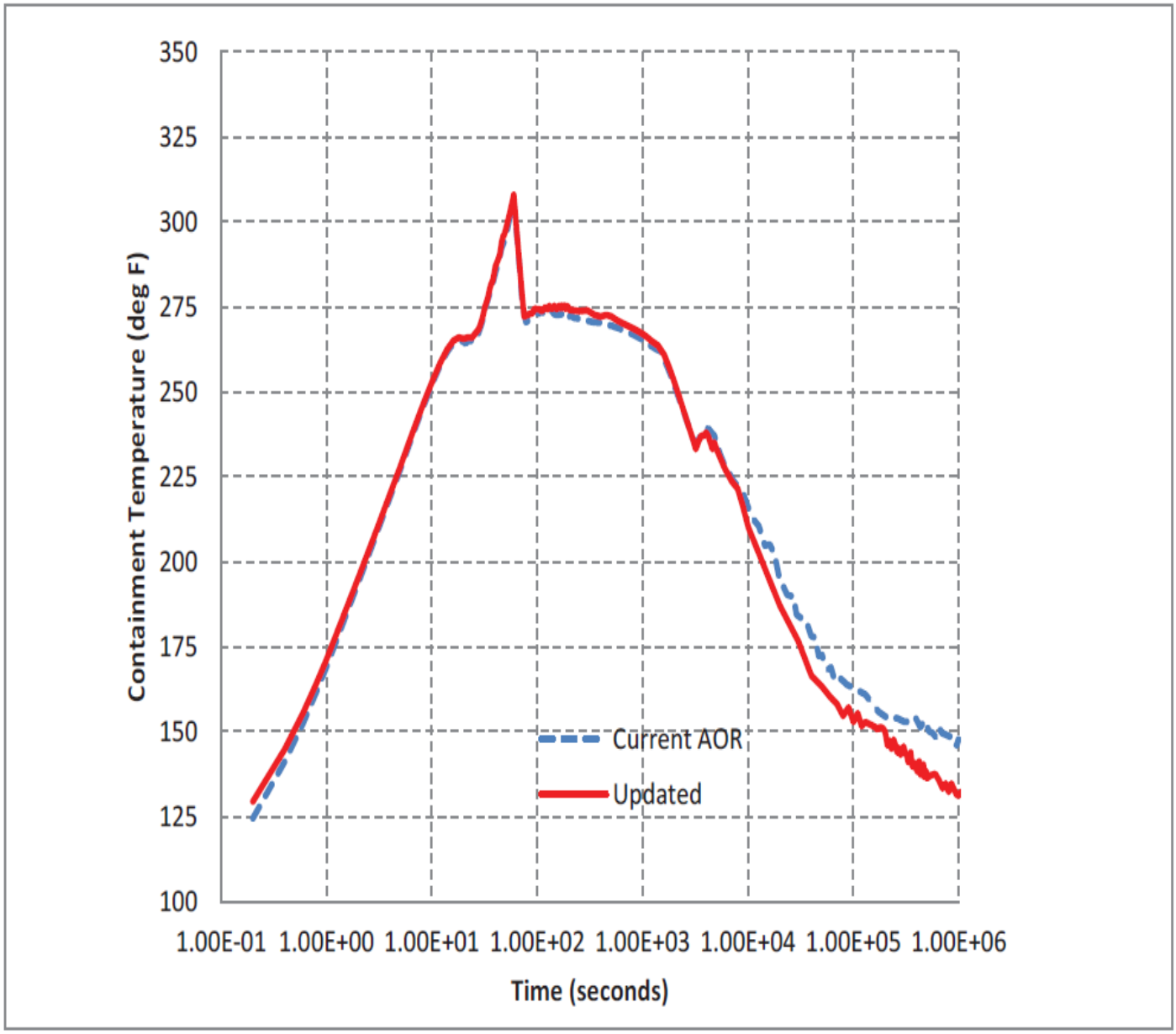
The Gamma & Beta integrated doses for upper containment were obtained from Reference 123, page C-154, with the exception of gamma airborne source.

The Gamma & Beta integrated doses for above the sump were obtained from Reference 123, pages C-617 & C-922

The Gamma & Beta integrated doses submerged in the sump were obtained from Reference 123, Page C-427 & Reference 124, sheet 3.

*Values obtained to cover power rerate to 3565 MWth and to change from 12 month to 18 month fuel cycle by increasing USAR rev. 0 levels using 50% Cesium source assumption as explained in calculation XX-F-014 (i.e., by multiplying previous liquid and plate-out source values by 1.42; and by multiplying previous airborne gamma and beta values by 1.01 and 1.08, respectively).

USAR Figure 3.11(B)-1 LOCA Temperature Profile




Calculated Containment Temperature Response for the Limiting LOCA Scenario (Calculation AN-97-004)

Figure 3.11(B)-2 Containment Temperature (MSLB) IC Profile

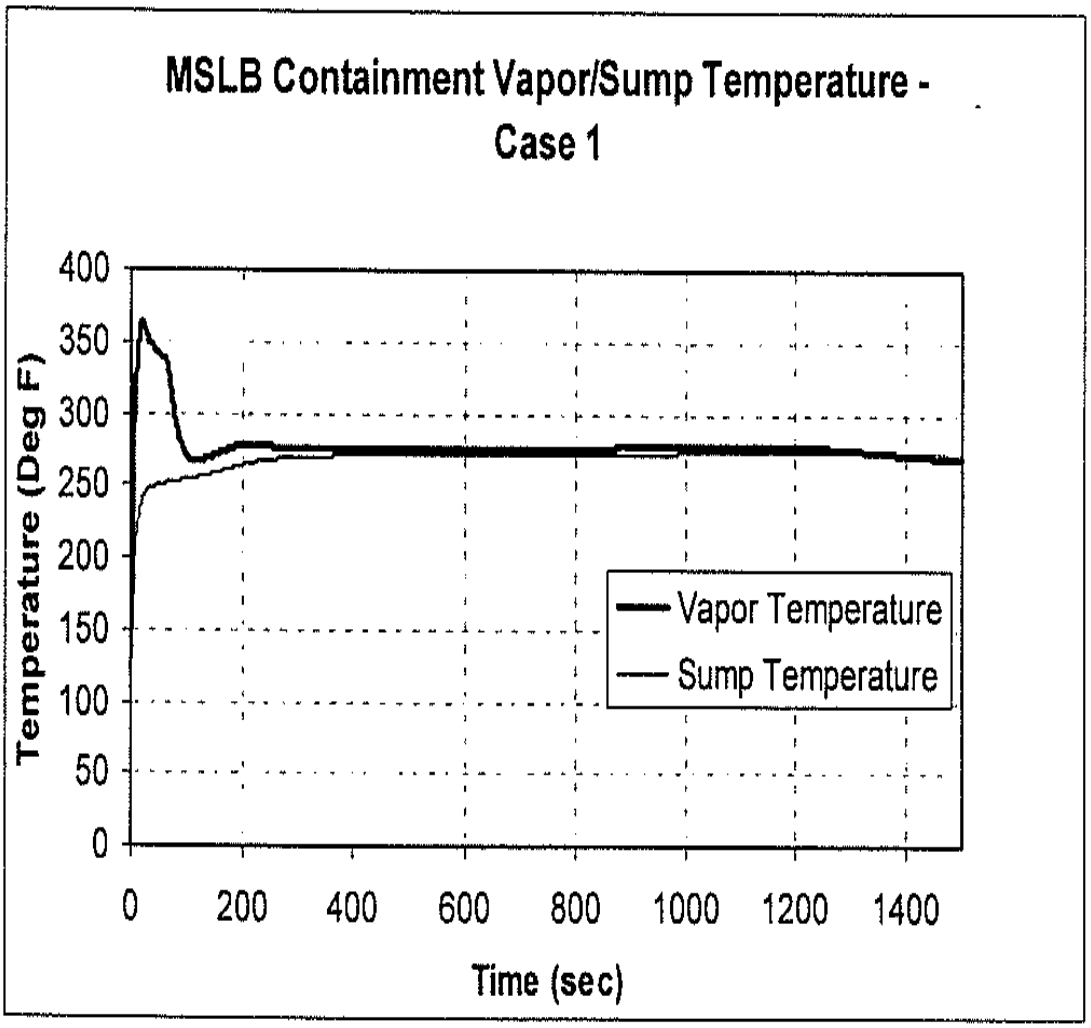
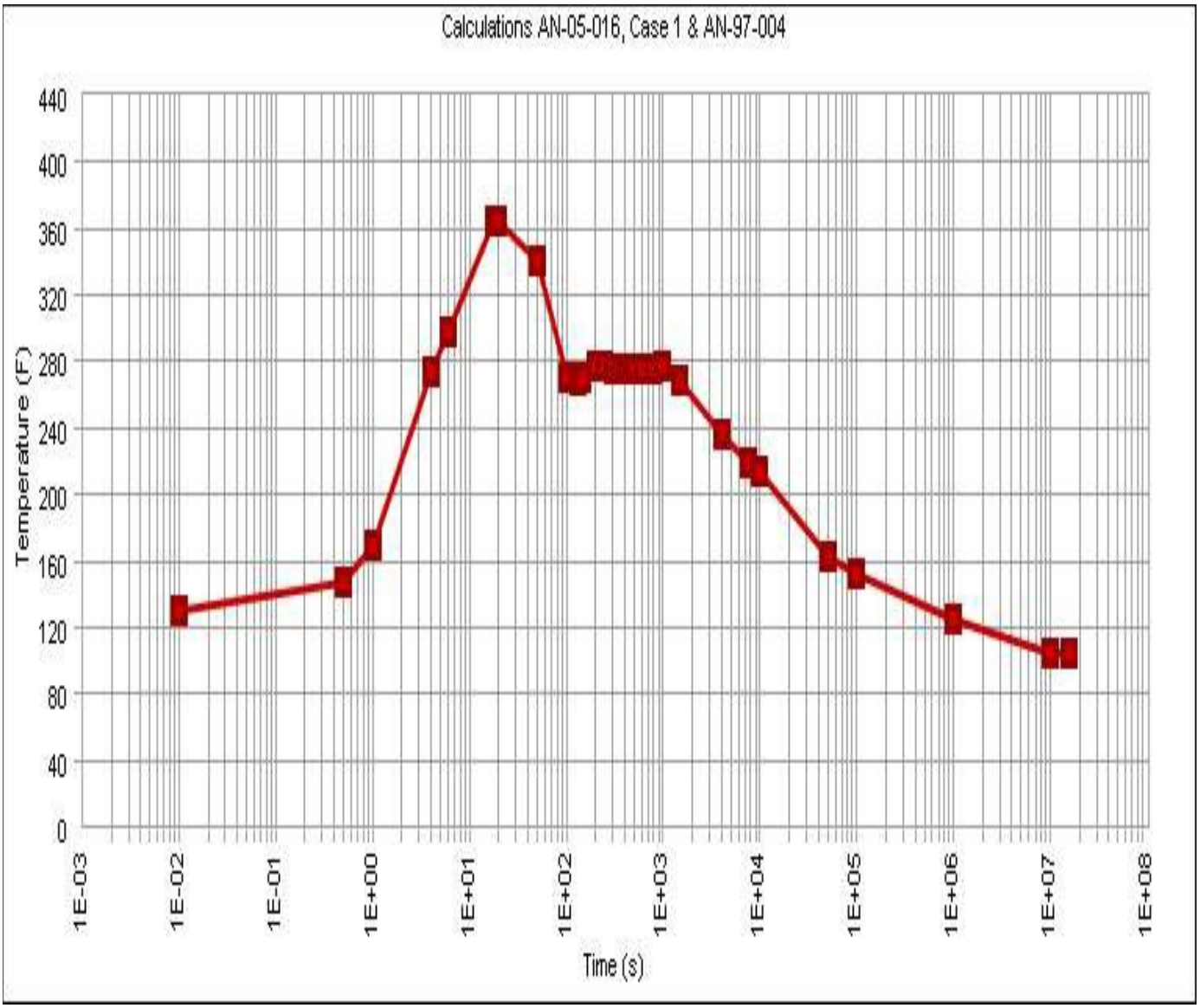



Figure 3-1 Containment Pressure, Vapor and Sump Temperature Response for MSLB Case 1.

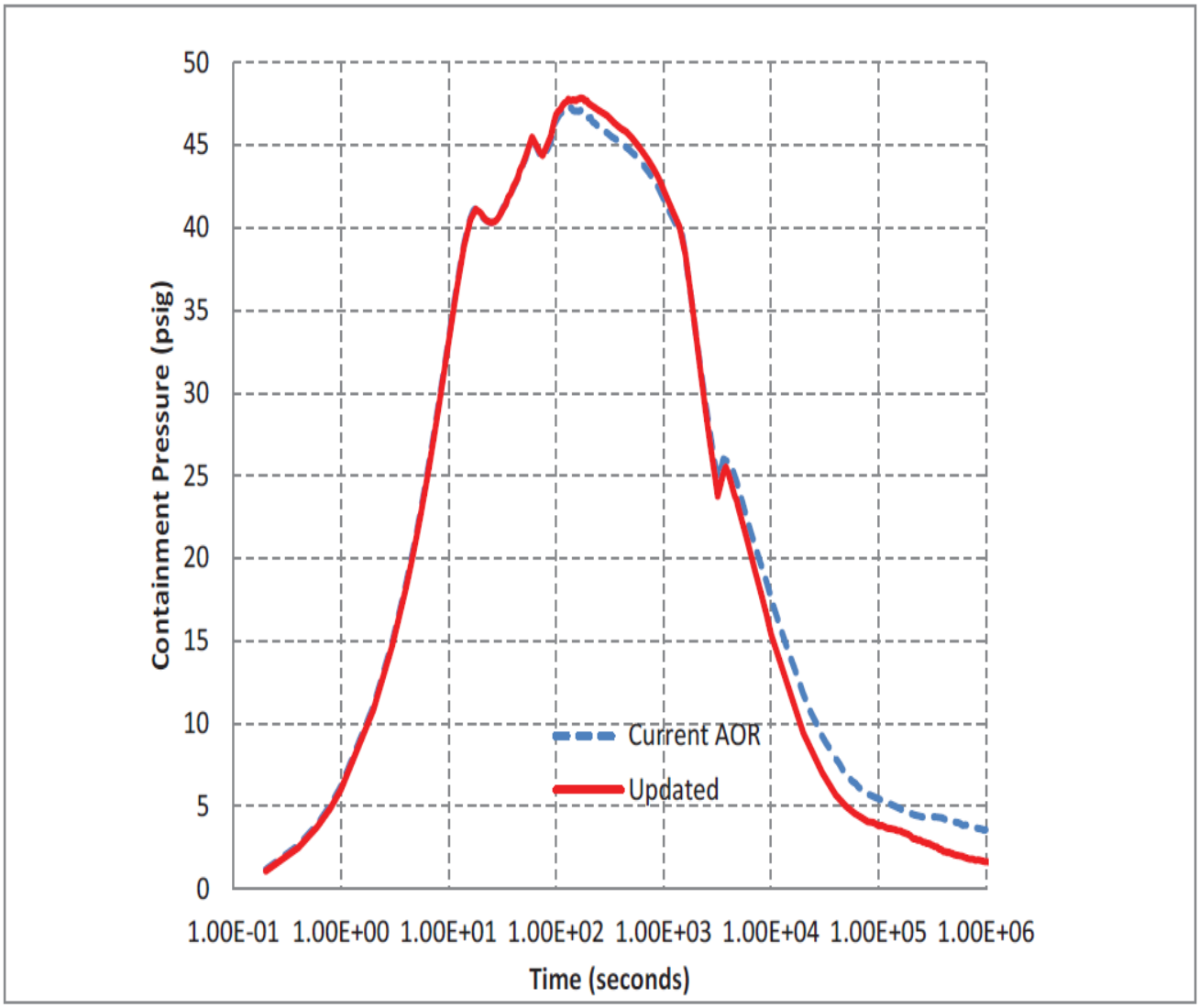
Figure 3.11(B)-3 Containment Temperature Composite (LOCA & MSLB) IC




EQMS Composite Containment Temperature Response for the Limiting LOCA-MSLB Scenario from Calculations AN-97-004, AN-05-016 & SA-92-087

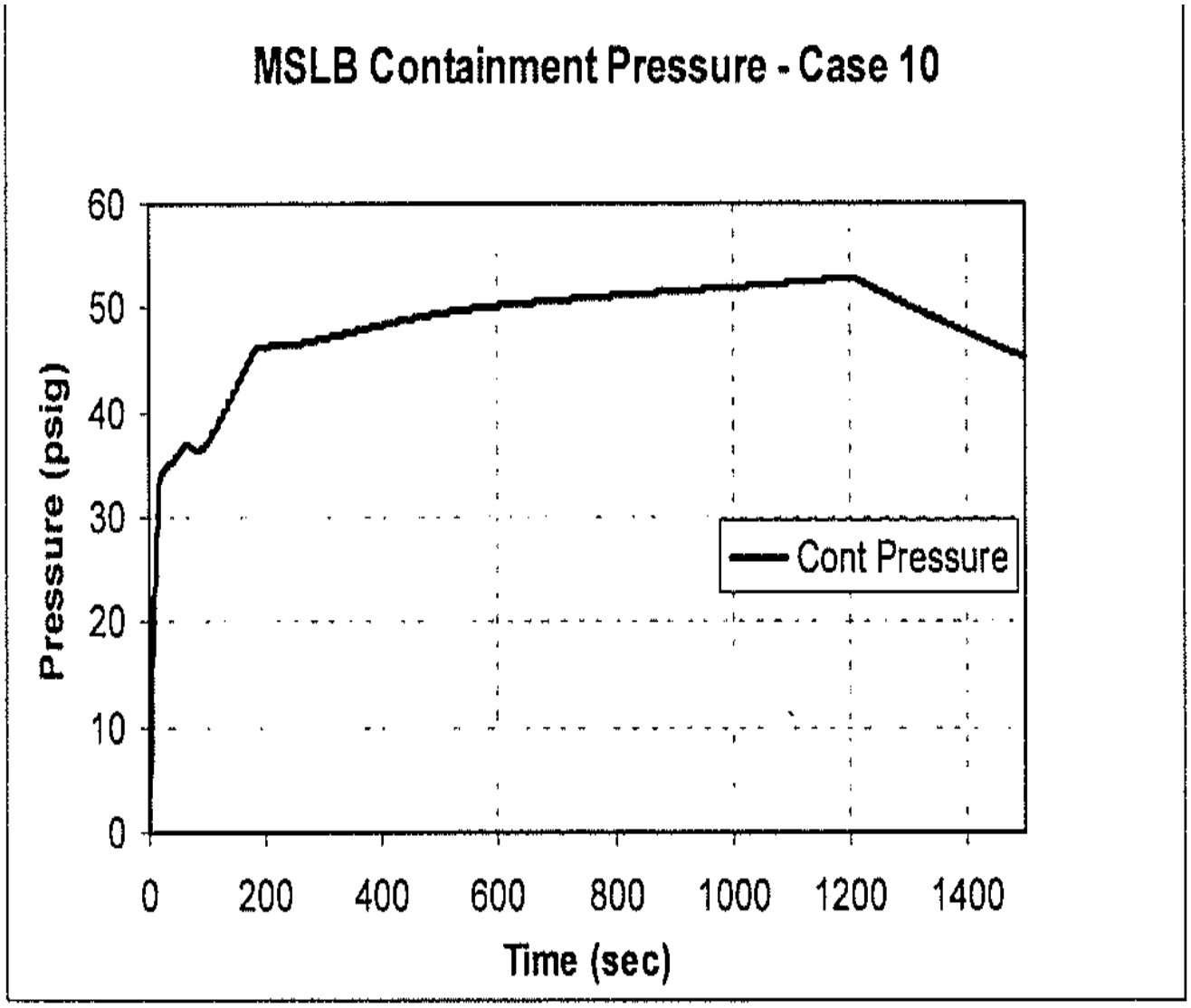
Note: Calculation AN-97-004 was run only for 30 days and the Post-accident time at WC is 180 days. Therefore, the data points for the first 30 days are coming from Calculations AN-97-004 & AN-05-016, and from 31 days to 180 days the data points used are from Calculation SA-92-087 (Reference 108).

Figure 3.11(B)-4 Containment Pressure (LOCA) Profile




Calculated Containment Pressure Response for the limiting LOCA Scenario
(Calculation AN-97-004)

Figure 3.11(B)-5 Containment Pressure (MSLB) IC Profile




Containment Pressure Response for MSLB Case 10 (Calculation AN-05-016)

Figure 3.11(B)-7 Surface Temperature (MSLB)
(See Calculation SA-91-011)

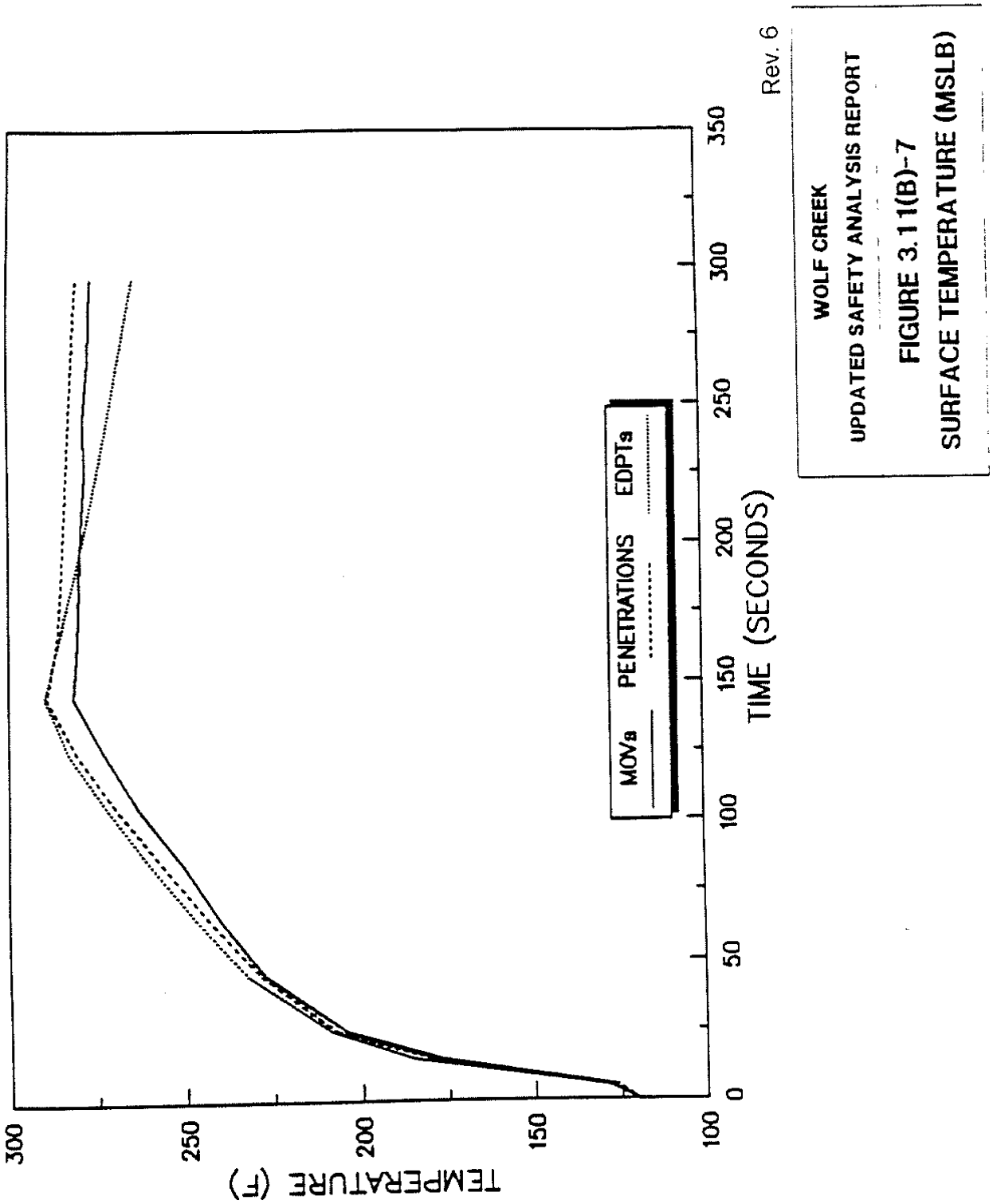
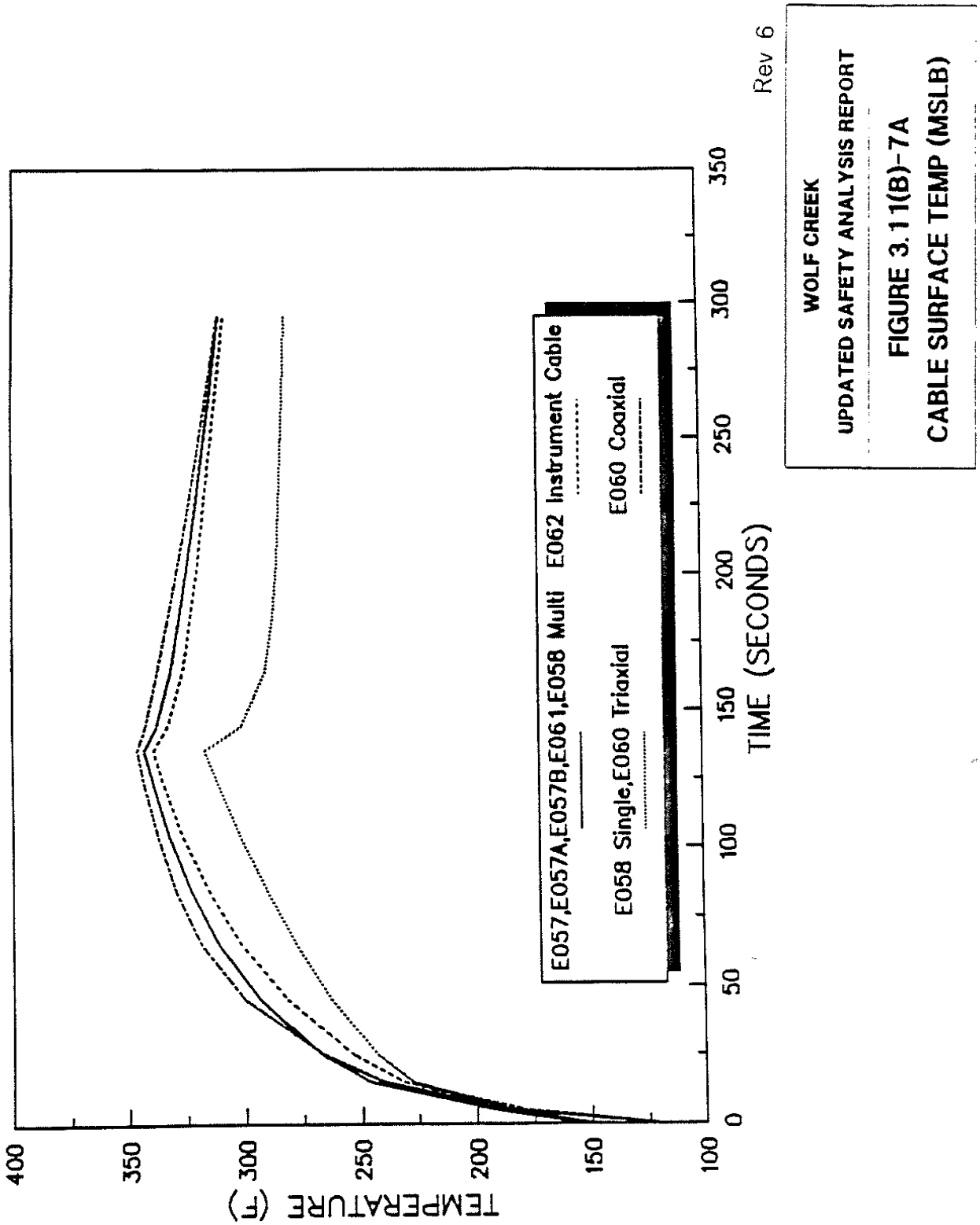


Figure 3.11(B)-7A Cable Surface Temperature (MSLB)
(See Calculation SA-91-011)



**BUILDING: AUXILIARY** **ROOM NUMBER 1101**
**ROOM DESCRIPTION: ELEVATION 1974 GENERAL FLOOR AREA NO. 1**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 140.5/ 300 (A) (E) | 29, Pages, 71, 248 & 283 |
| **PRESSURE (PSIG)** | ATM | | NE | N/A | 1.06 | 29, Pages 247, 270, 271 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 49, (C) | $1.52x10^6$ $7.75x10^6$ (D) | 46, Page 5 46, Page 9 (D) | NE | N/A |
| **DOSE RATE (R/hr)** | $\leq$2.5 mR/hr | 49 | $7.1x10^4$ $8.68x10^4$ (D) | 46, Page 5 46, Page 9 (D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to 8" Auxiliary Steam Line Break in Room 1101L (south) Reference 29, 71 & 283. Room 1101R (north) does not exceed 110°F Reference 29, 70.

B. The design flood level for Room 1101 is 41.64 inches based on the isolation of the break in 40 minutes and is acceptable since it is below the level of the lowest safety related electrical equipment whose functionality would be adversely affected. The Junction Box 4UJ082 is the lowest identified safety related equipment in this room, per Reference 53, Appendix 2 it is ~47 inches (3.91 feet0 above the floor grade.

C The normal integrated dose was obtained by multiplying the dose rate of times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source

E On sheets 248-249 of YY-49 (Ref. 29) there is a statement saying that the maximum temperature in rooms 1101 and 1102 should reach a maximum of 300 °F at any pipe fitting for any equipment near the fittings.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-8 Auxiliary Building HELB Temperature-Room 1 (Rooms 1101-left, 1102, 1120 & 1121)

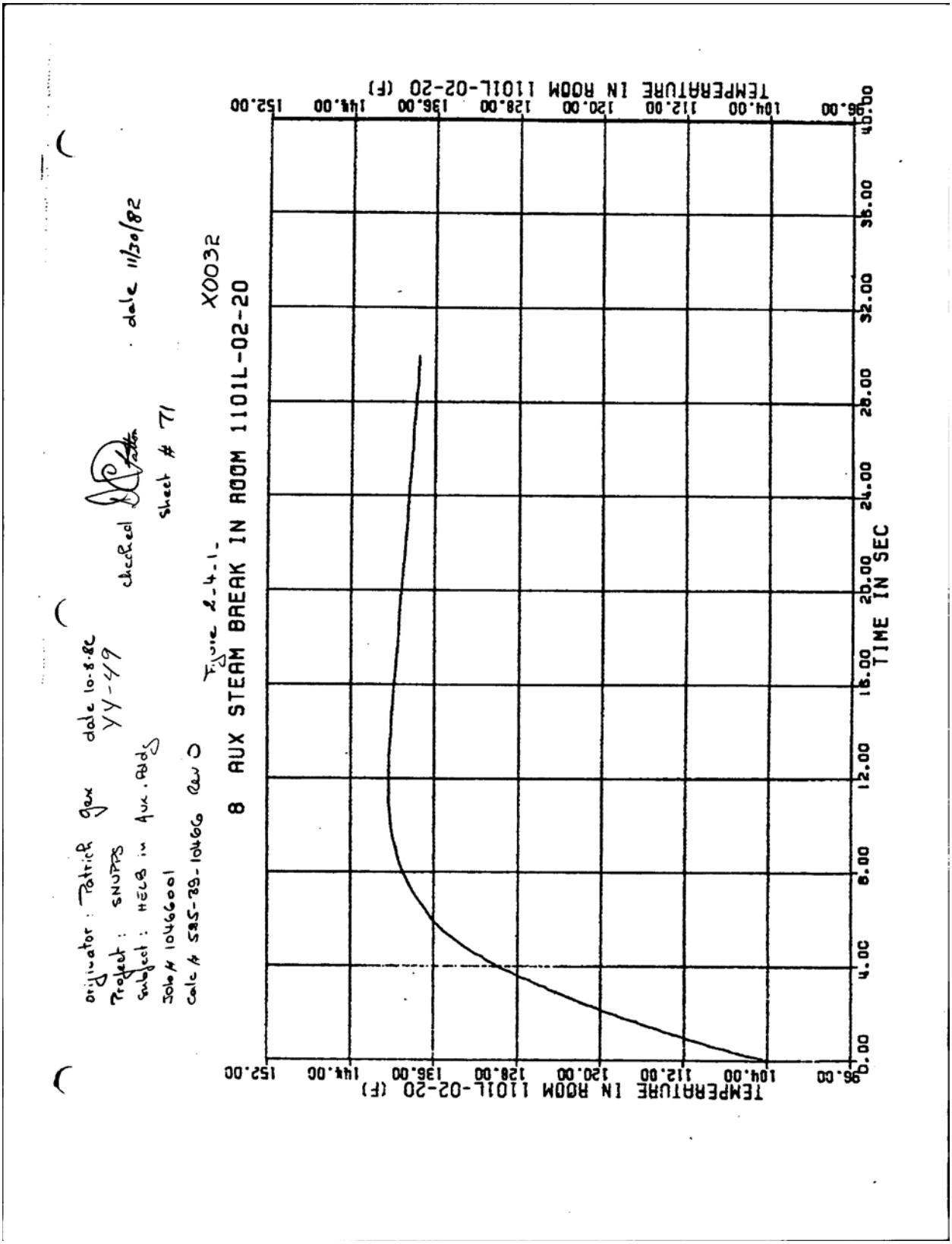
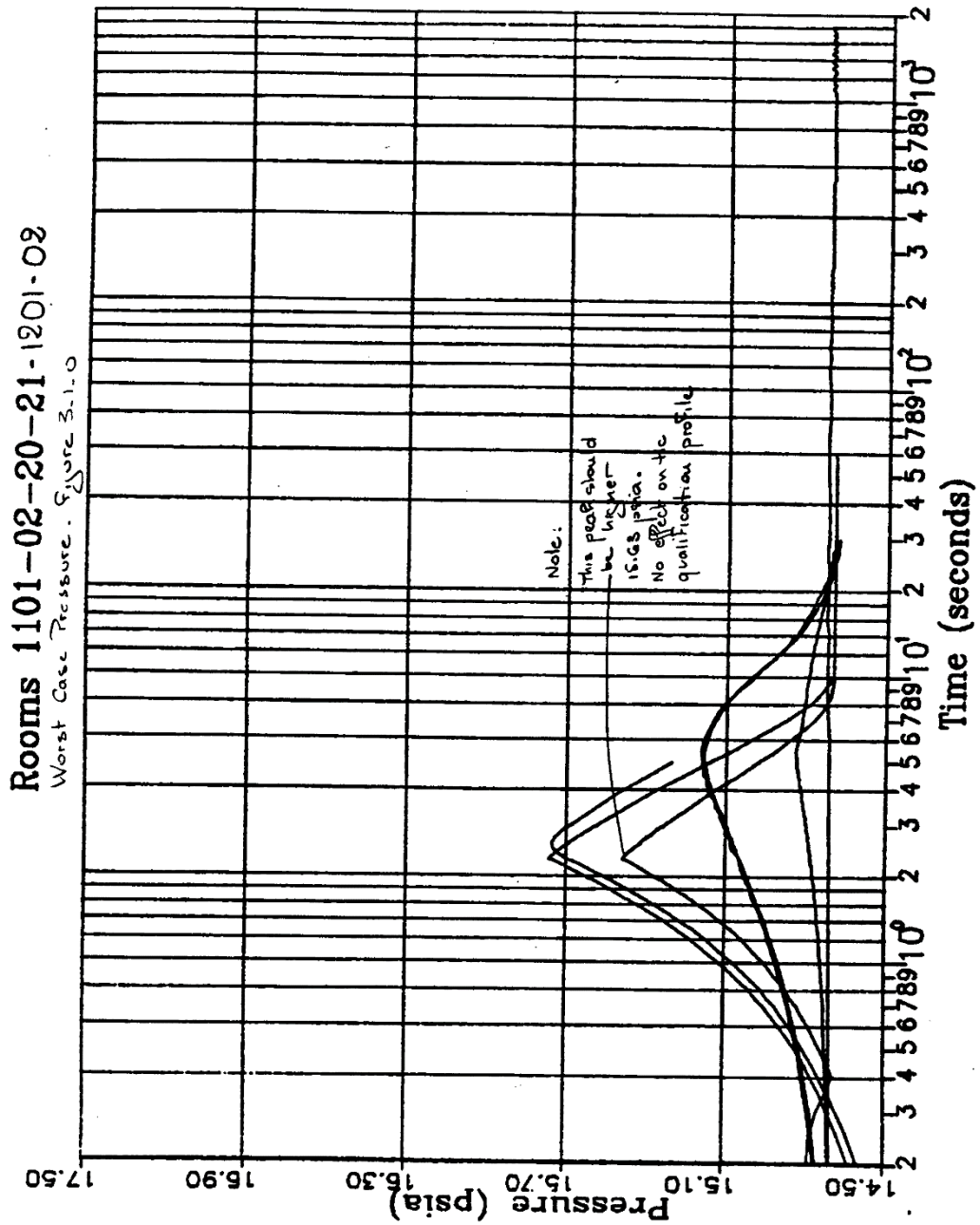


Figure 3.11(B)-26 Auxiliary Building HELB Pressure (Rooms 1101, 1102, 1120 & 1121)

originator Patrick Gex date 10-20-82
Calc: 585-39-10466 Rev 0 YY-49
Job: 10466001
Project: SNUPPS
Subject: HELB in Aux. Bldg sheet # 271
checker: date 12/1/82



**BUILDING: AUXILIARY** **ROOM NUMBER 1102**
**ROOM DESCRIPTION: ELEVATION 1974 CHILLER & SURGE TANK PUMPS AREA**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 140.5 / 300 (A) (E) | 29, Pages, 71, 248 & 283 |
| **PRESSURE (PSIG)** | ATM | | NE | N/A | 1.06 | 29, Pages 247, 270, 271 |
| **HUMIDITY (%)** | 70 | 28, page 2-8 | NE | N/A | 100 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 49, (C) | 1.97 9.68 (D) | 46, page 5 46, page 9 (D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤2.5 mR/hr | 49 | 0.0092 0.113 (D) | 46, page 5 46, page 9 (D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to 8" Auxiliary Steam Line Break in Room 1101L (south) Reference 29, 71 & 283. Room 1101R (north) does not exceed 111°F Reference 29, 70.

B. The design flood level for Room 1102 is 41.64 inches based on the isolation of the break in 40 minutes and is acceptable since it is below the level of the lowest safety related equipment whose functionality would be adversely affected. Per reference 53, Appendix 2, Page 2 conduit 4U1130 and the associated access tunnel XFR fan GLHZ0074 are the lowest identified safety related equipment in this room. They are ~97 inches (8.08 ft) above the floor grade.

C The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source

E On sheets 248-249 of YY-49 (Ref. 29) there is a statement saying that the maximum temperature in rooms 1101 and 1102 should reach a maximum of 300 °F at any pipe fitting for any equipment near the fittings.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg A-1701
53. Calculation FL-01

Figure 3.11(B)-8 Auxiliary Building HELB Temperature-Room 1 (Rooms 1101-left, 1102, 1120 & 1121)

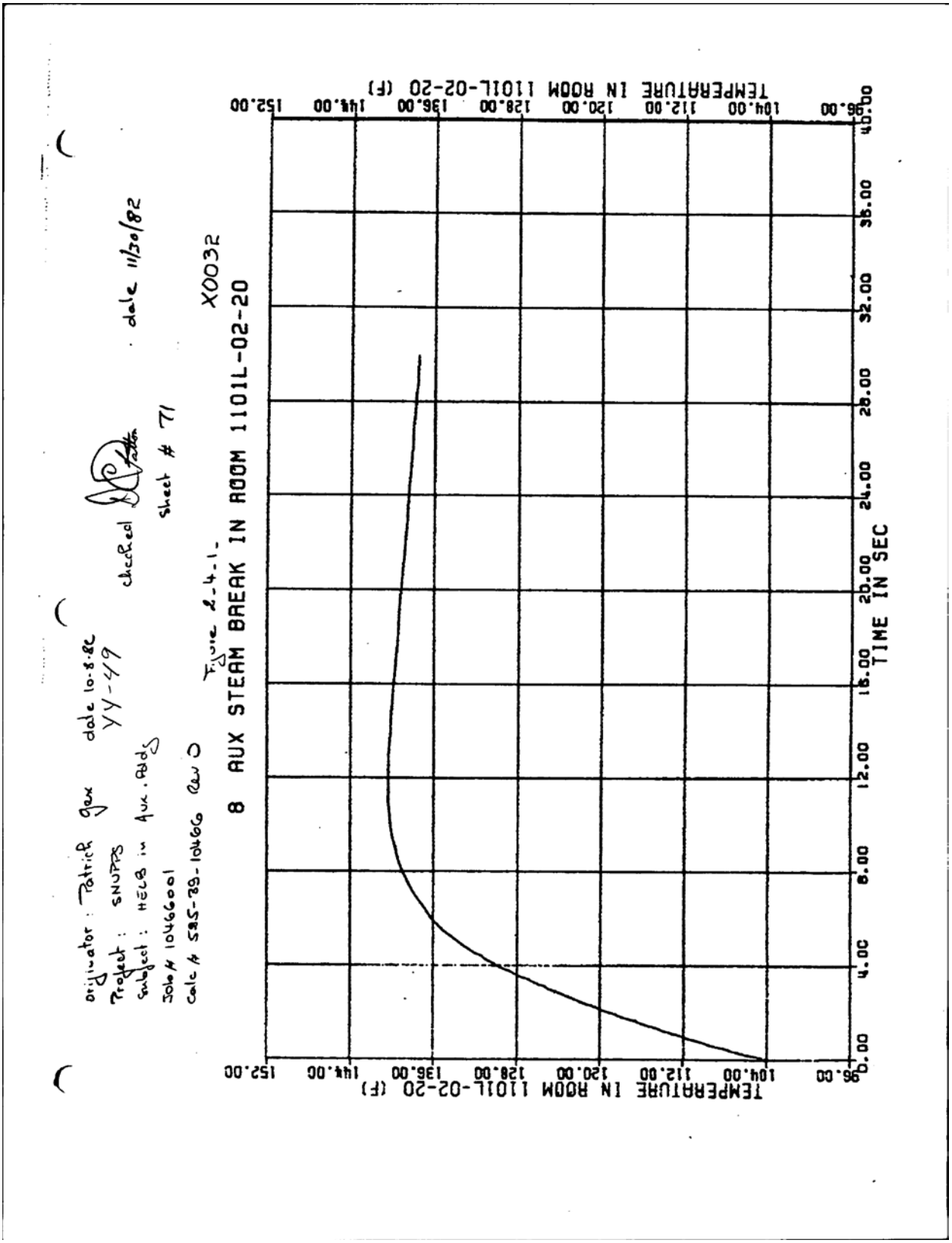
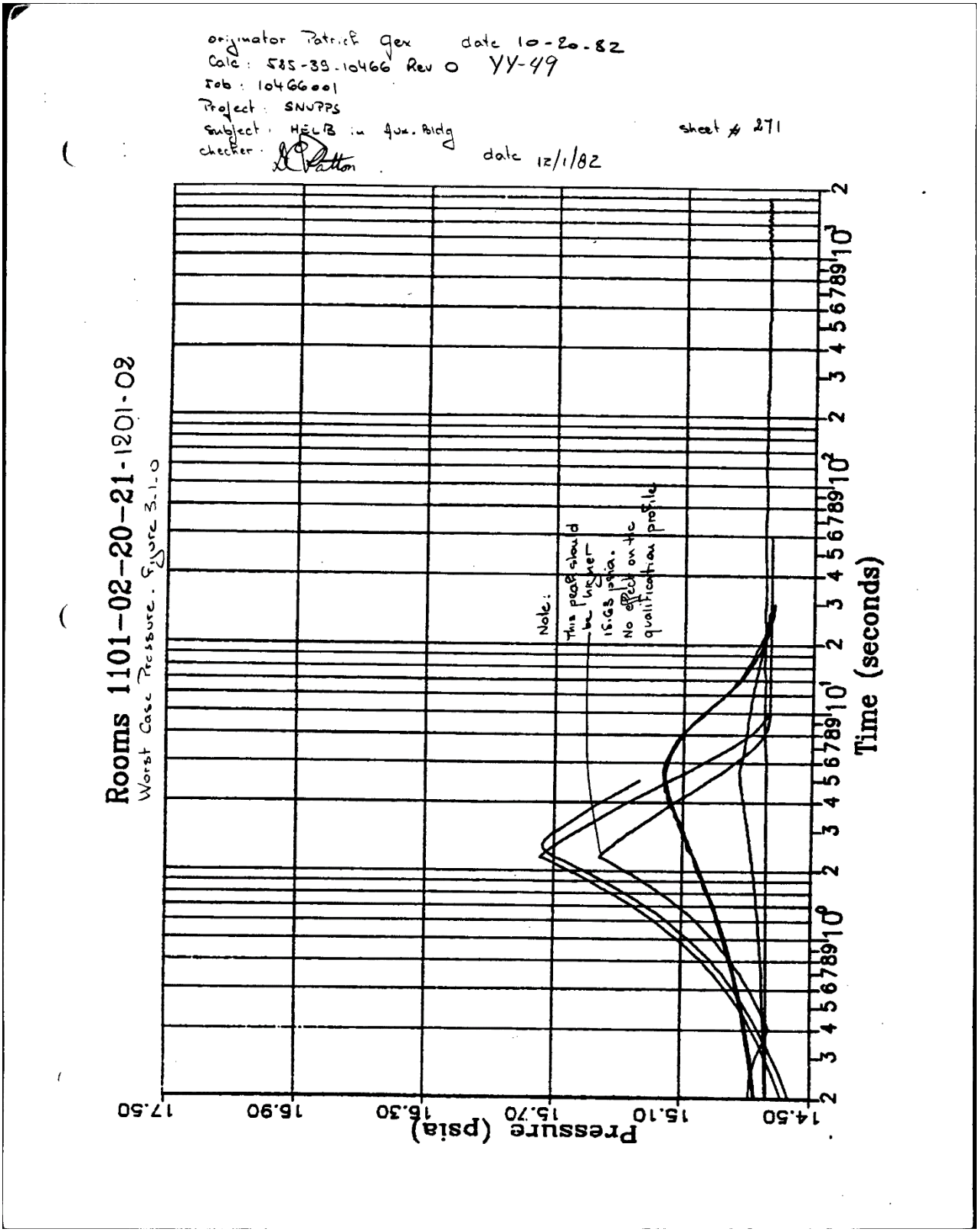


Figure 3.11(B)-26 Auxiliary Building HELB Pressure (Rooms 1101, 1102, 1120 & 1121)



**BUILDING: AUXILIARY** **ROOM NUMBER 1103**
**ROOM DESCRIPTION: ELEVATION 1974 CHILLER HEAT EXCHANGER ROOM**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 118 (A) (F) | 29, Pages, 229, 250 |
| **PRESSURE (PSIG)** | ATM | | NE | N/A | 1.8 | 29, Page 230 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49, (D) | 3850 $1.96 \times 10^4$ (E) | 46, page 5 46, page 9 (E) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | 180 220 (E) | 46, page 5 46, page 9 (E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to 3" CVCS Line Break in Room 1105 Reference 29, 229. There is no EQ equipment installed in this room (Reference 29, page 250).

B. Per Reference 53, Appendix 2, Page3, This room does not contain safety related equipment

C. Radiological consequences of specific HELB/MEC's have not been developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F On sheet 250 of YY-49 (Ref. 29) there is a statement saying that the maximum temperature in rooms 1103, 1104, 1105, 1106, should reach a maximum of 300 °F. CR 88065 identifies the 300°F temperature is only applicable to equipment within a close proximity to the 3" CVCS pipe break in RM 1104 or 1105 so the 300°F does not apply to any other rooms.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-41 Auxiliary Building HELB Temperature (Rooms 1103, 1105 & 1106)

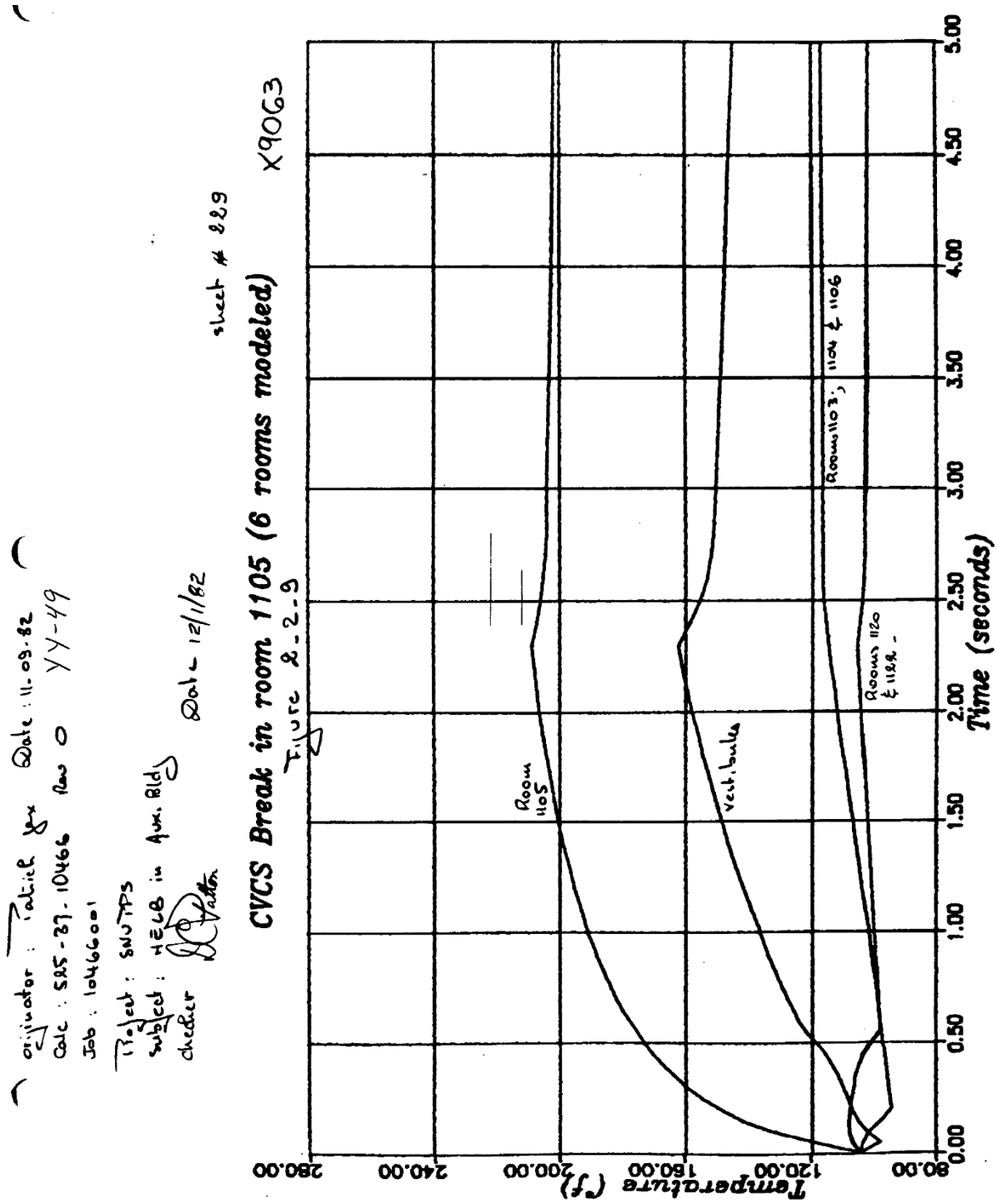
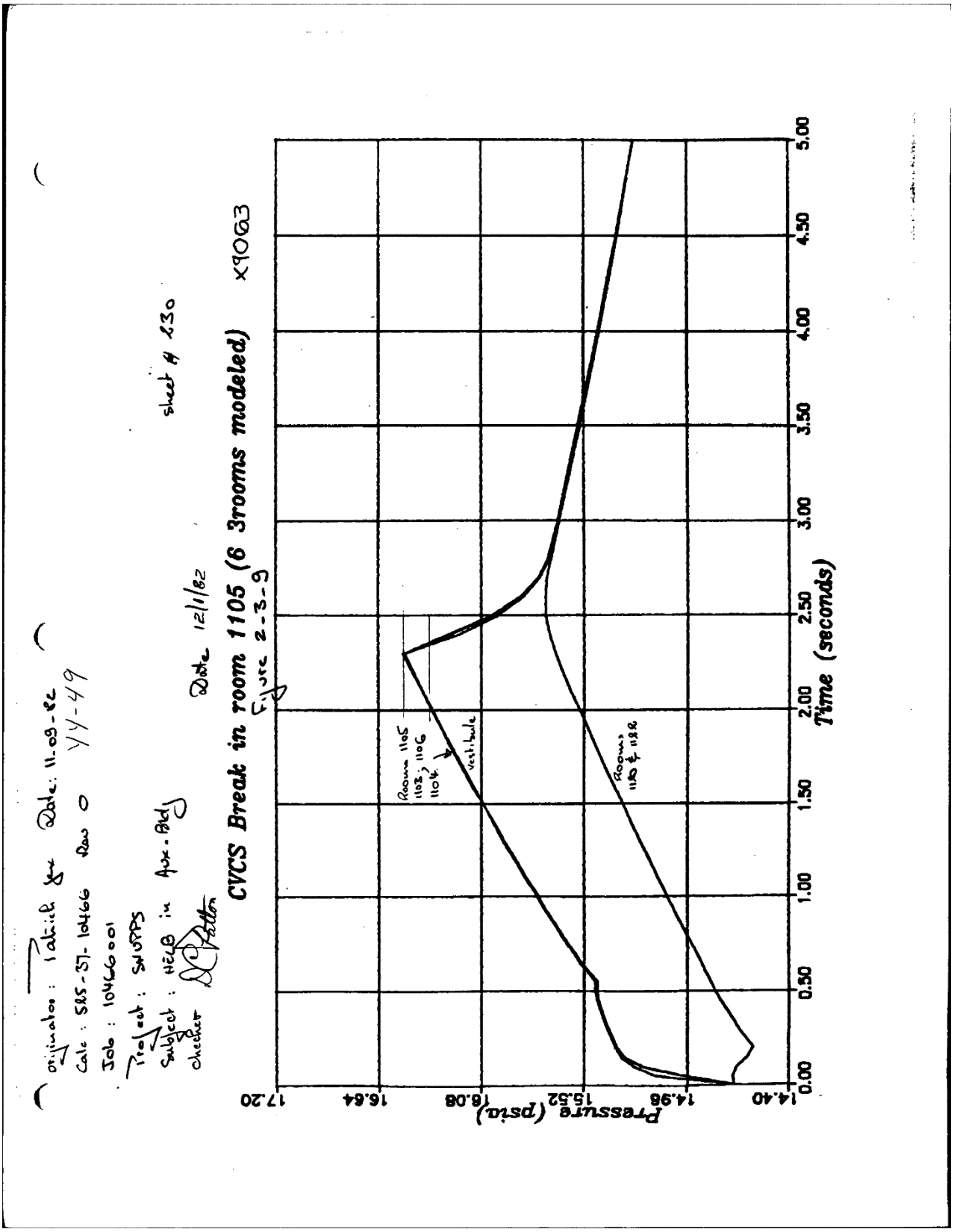


Figure 3.11(B)-43 Auxiliary Building HELB Pressure (Rooms 1103 through 1106)



**BUILDING: AUXILIARY** **ROOM NUMBER 1104**
**ROOM DESCRIPTION: ELEVATION 1974 LETDOWN REHEAT HEAT EXCHANGER ROOM**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 217/ 300 (A)(F) | 29, Page 223, 250 |
| **PRESSURE (PSIG)** | ATM | | NE | N/A | 1.8 | 29, Page 230 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | <100 | 29 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49 & (D) | 3850<br>$1.96 \times 10^4$<br>(E) | 46, page 5<br>46, page 9<br>(E) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | 180<br>220<br>(E) | 46, page 5<br>46, Page 9<br>(E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47<br>(B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to 3" CVCS Line Break in Room 1104 Reference 29, 223 & 224. There is no EQ equipment installed in this room (Reference 29, page 250).

B. Per Reference 53, Appendix 2, Page 4, this room does not contain safety related equipment.

C. Radiological consequences of specific HELB/MEC's have not been developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source

F On sheet 250 of YY-49 (Ref. 29) there is a statement saying that the maximum temperature tin rooms 1103, 1104, 1105, 1106, should reach a maximum of 300 °F. CR 88065 identifies the 300°F temperature is only applicable to equipment within a close proximity to the 3" CVCS pipe break in RM 1104 or 1105 so the 300°F does not apply to any other rooms.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-41A Auxiliary Building HELB Temperature (Rooms 1104)

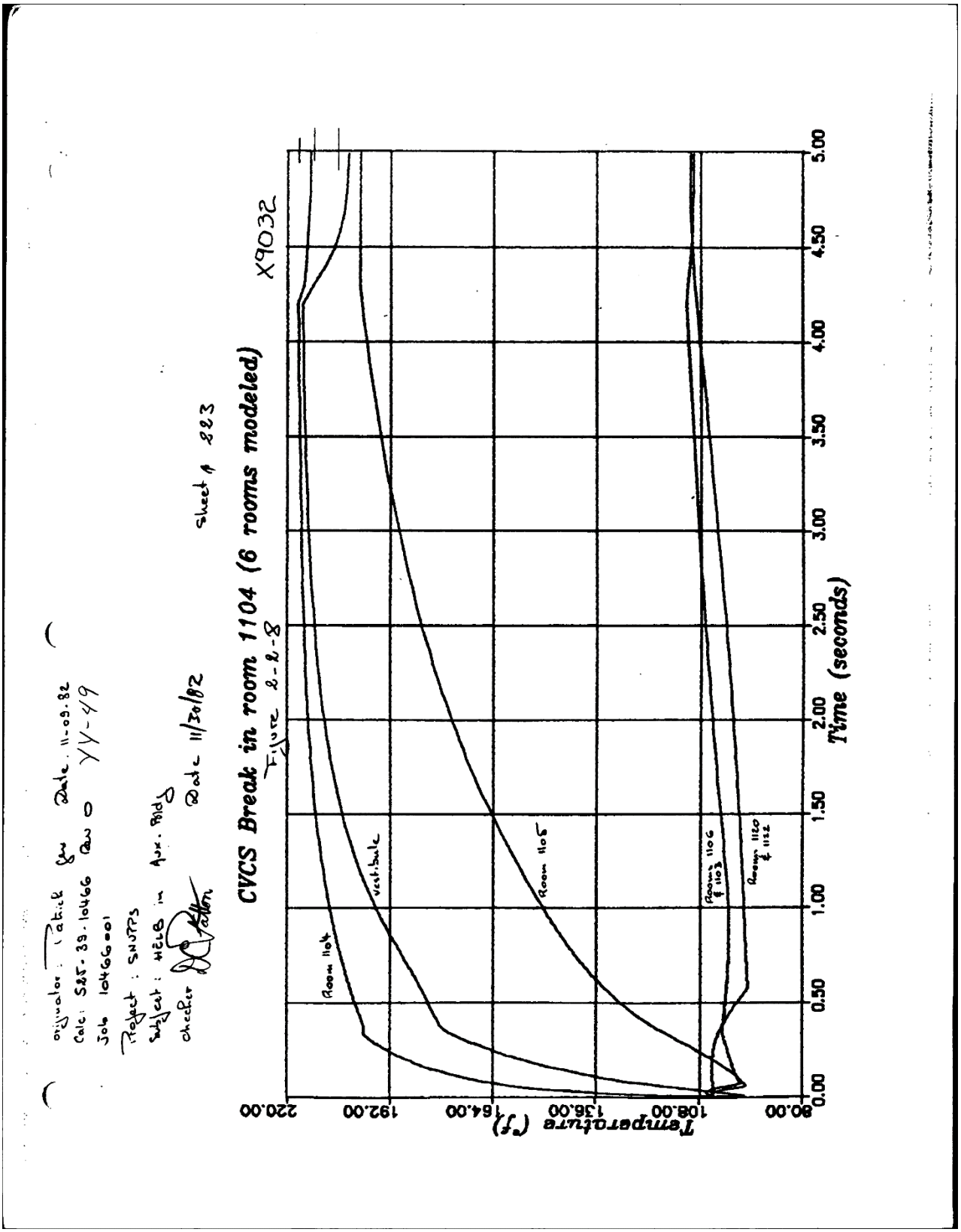
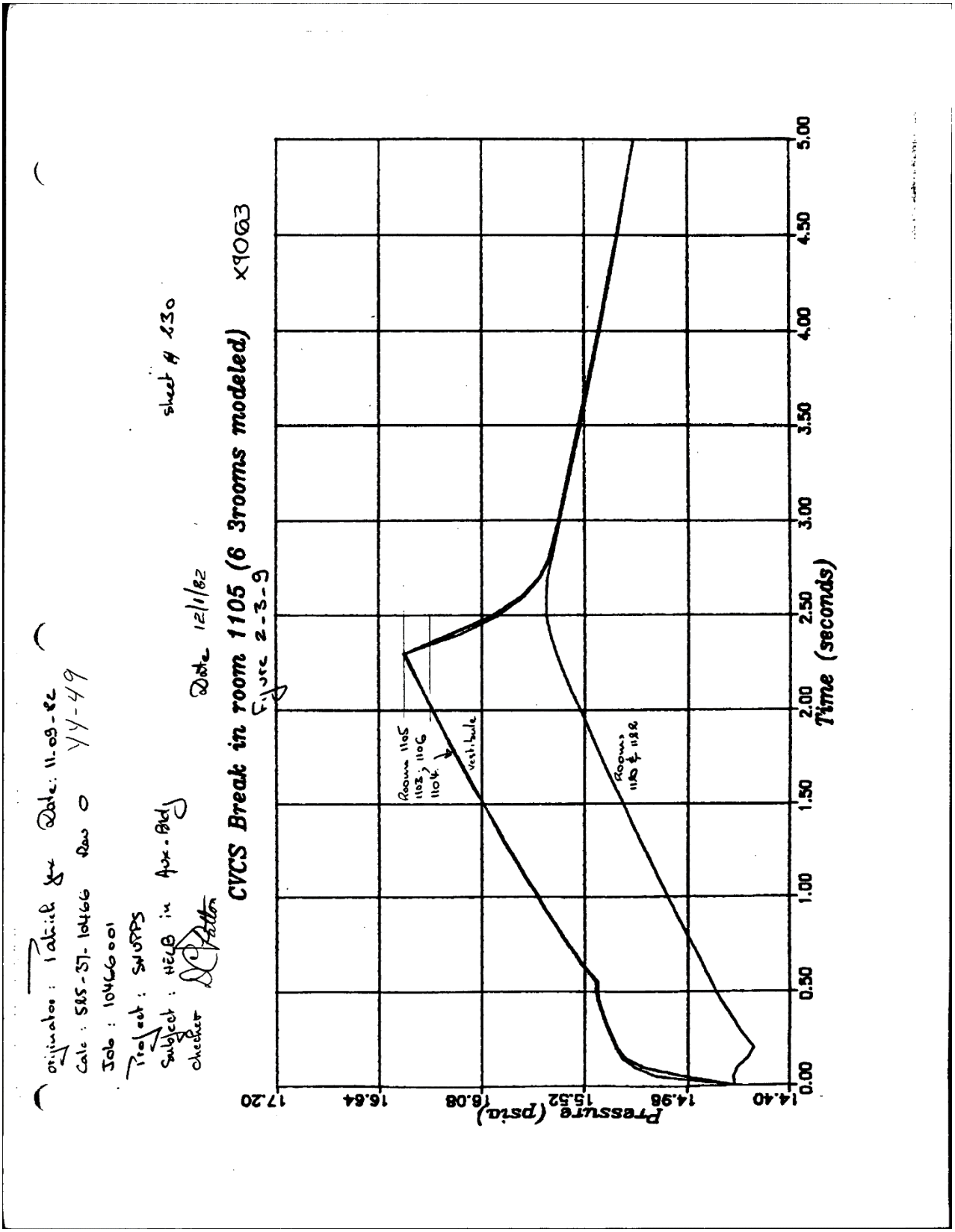


Figure 3.11(B)-43 Auxiliary Building HELB Pressure (Rooms 1103 through 1106)



**BUILDING: AUXILIARY** **ROOM NUMBER 1105**
**ROOM DESCRIPTION: ELEVATION 1974 HEAT EXCHANGER VALVE COMPARTMENT**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 212/ 300 (A)(D)G) | 29, Pages 229, 250 |
| **PRESSURE (PSIG)** | ATM | | NE | N/A | 1.8 | 29, Page 230 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | <100 | 29 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49, (E) | 3850 $1.96 \times 10^4$ (F) | 46, page 5 46, page 9 (F) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | 180 220 (F) | 46, page 5 46, page 9 (F) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to 3" CVCS line break in Room 1105, Reference 29, pages 229 & 230.

B. Per Reference 53, Appendix 2, Page 5, this room does not contain safety related equipment.

C. Radiological consequences of specific HELB/MEC's have not been developed, since the LOCA conditions are more severe.

D There is no EQ equipment installed in this room (Reference 29, page 250).

E The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant

F The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source

G On sheet 250 of YY-49 (Ref. 29) there is a statement saying that the maximum temperature in rooms 1103, 1104, 1105, 1106, should reach a maximum of 300 °F. CR 88065 identifies the 300°F temperature is only applicable to equipment within a close proximity to the 3" CVCS pipe break in RM 1104 or 1105 so the 300°F does not apply to any other rooms.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-41 Auxiliary Building HELB Temperature (Rooms 1103, 1105 & 1106)

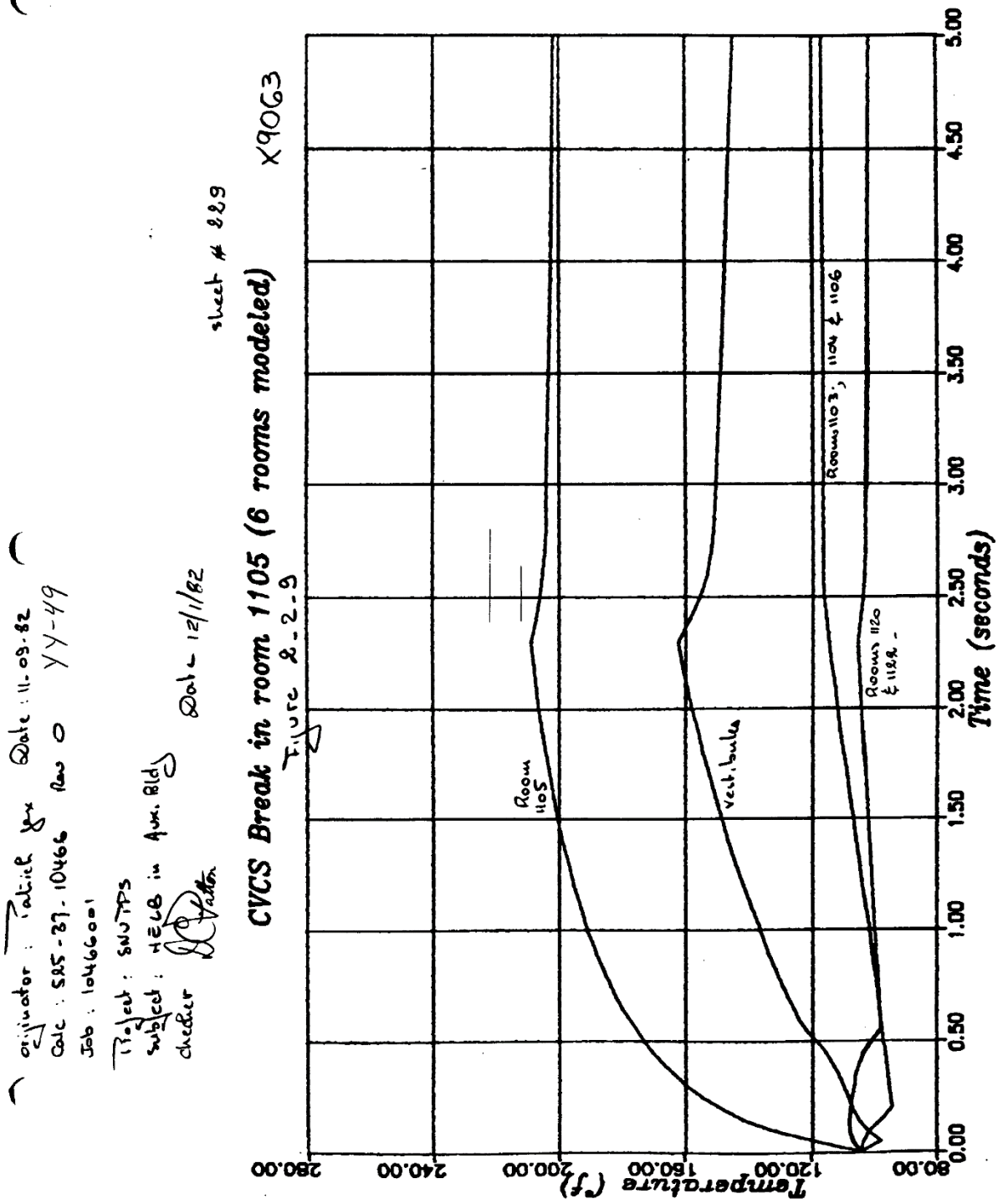
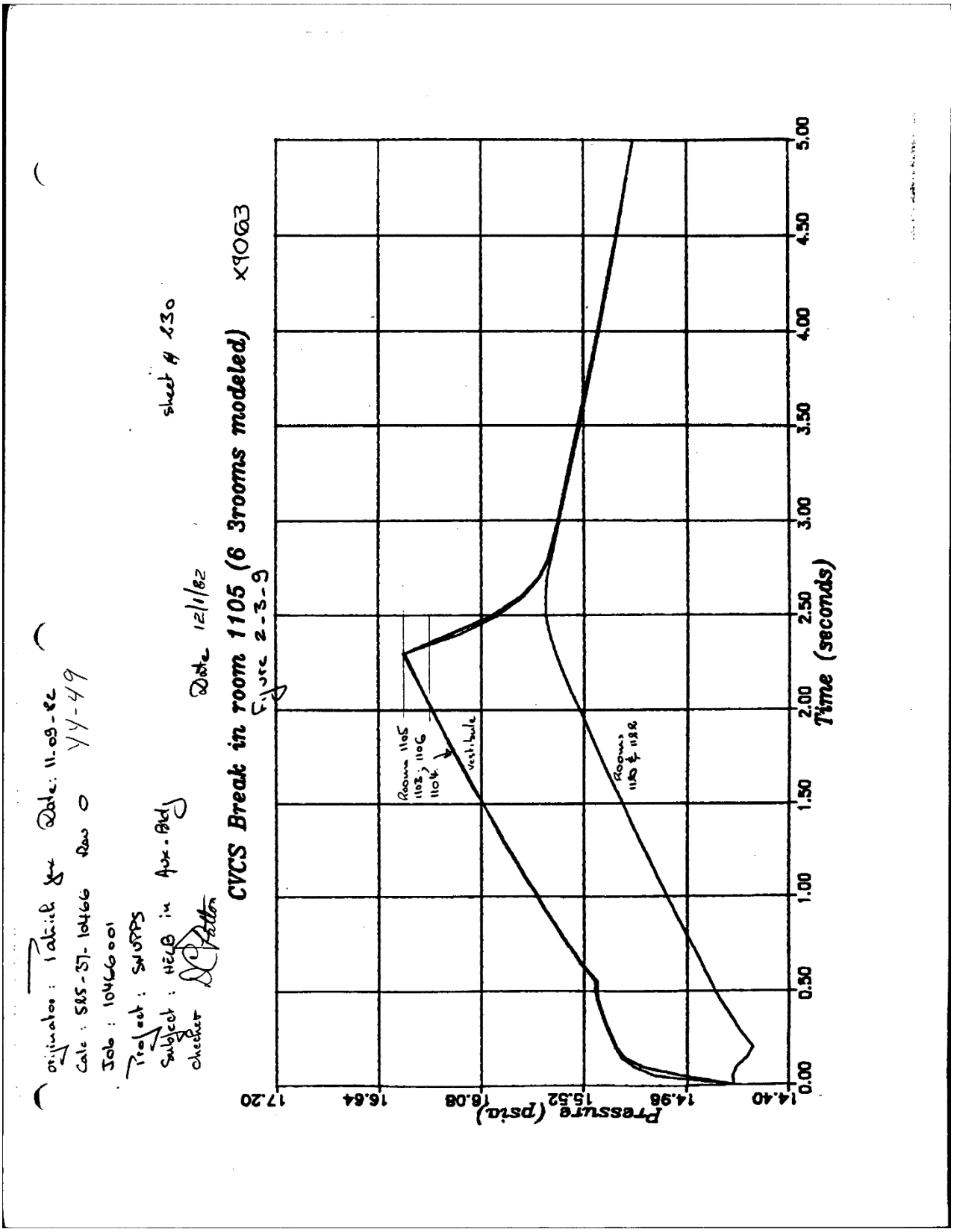


Figure 3.11(B)-43 Auxiliary Building HELB Pressure (Rooms 1103 through 1106)



**BUILDING: AUXILIARY** **ROOM NUMBER 1106**
**ROOM DESCRIPTION: ELEVATION 1974 MODERATING HEAT EXCHANGER ROOM**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 118 (A)(D)(G) | 29, Pages 229 |
| **PRESSURE (PSIG)** | ATM | | NE | N/A | 1.8 | 29, Page 230 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49, (E) | 3850 $1.98 \times 10^4$ (F) | 46, page 5 46, page 9 (F) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | 180 220 (F) | 46, page 5 46, page 9 (F) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to 3" CVCS line break in Room 1105, Reference 29, pages 229 & 230.

B. Per Reference 53, Appendix 2, Page 6, this room does not contain safety related equipment

C. Radiological consequences of specific HELB/MEC's have not been developed, since the LOCA conditions are more severe.

D. There is no EQ equipment installed in this room (Reference 29, page 250).

E The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant

F The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source

G On sheet 250 of YY-49 (Ref. 29) there is a statement saying that the maximum temperature tin rooms 1103, 1104, 1105, 1106, should reach a maximum of 300°F. CR 88065 identifies the 300°F temperature is only applicable to equipment within a close proximity to the 3" CVCS pipe break in RM 1104 or 1105 so the 300°F does not apply to any other rooms.

REFERENCE

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-41 Auxiliary Building HELB Temperature (Rooms 1103, 1105 & 1106)

originator : Patrick Date : 11-09-82
Calc : SAS-87-10466 Rev 0 YY-49
Job : 10466001
Project : SNUPPS
Subject : HELB in Aux. Bldg
checker Date 12/1/82

sheet # 289

X9063

CVCS Break in room 1105 (6 rooms modeled)

Figure 2-2-9

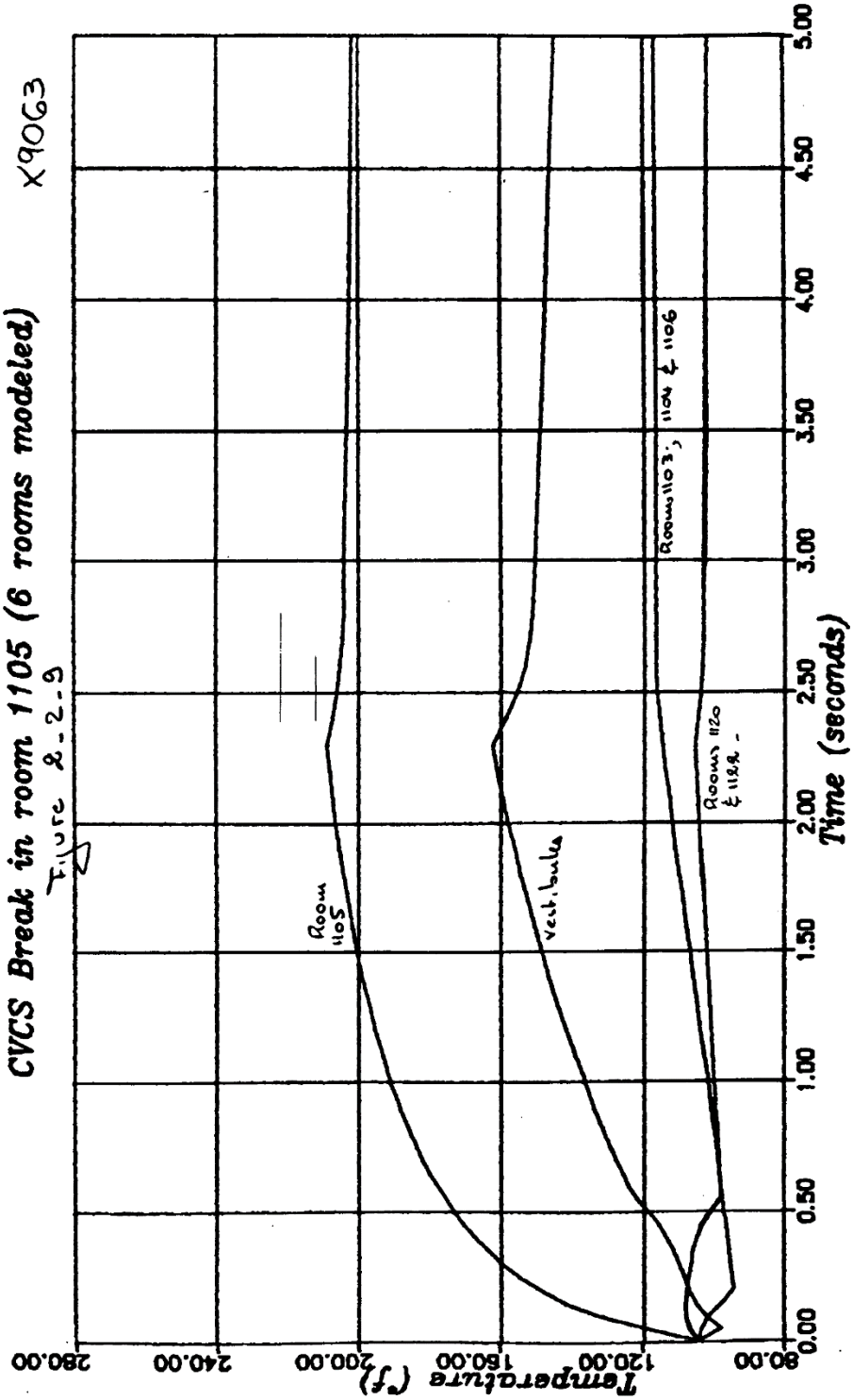
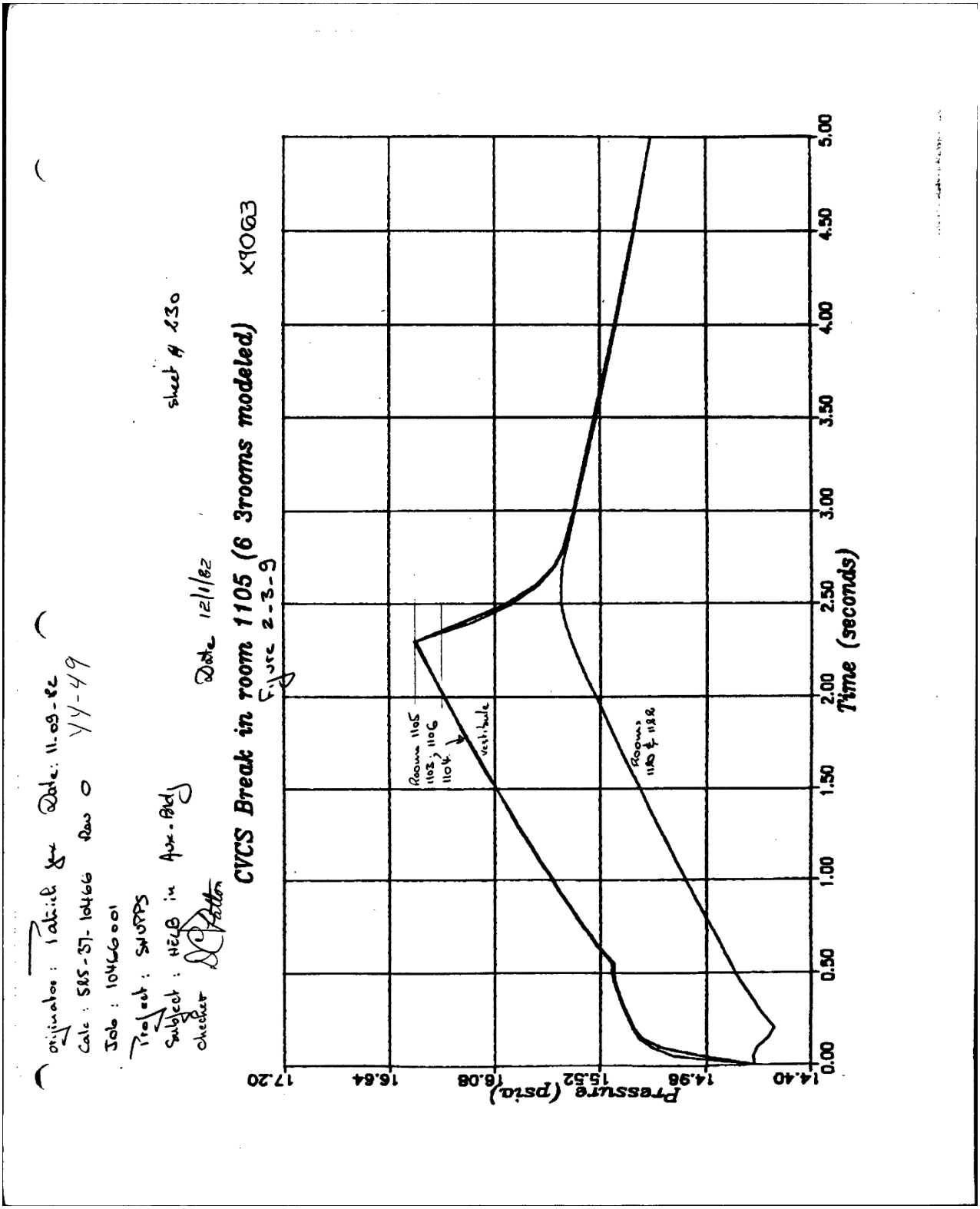


Figure 3.11(B)-43 Auxiliary Building HELB Pressure (Rooms 1103 through 1106)



**BUILDING: AUXILIARY** **ROOM NUMBER 1107**
**ROOM DESCRIPTION: ELEVATION 1974 CENTRIFUGAL CHARGING PUMP ROOM B**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 (A) | 28, Page 2-8 | NE | N/A | 109.4 (B) | 29, Pages 73, 250 & 283 |
| **PRESSURE (PSIG)** | ATM | | NE | N/A | 1.06 | 29, Pages 247, 270 & 272 |
| **HUMIDITY (%)** | 95 | 28, Page 2-8 | NE | N/A | 76 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49, (E) | $1.22 \times 10^6$ $6.22 \times 10^6$ (F) | 46, Pages 5, 9 | (D) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | $5.9 \times 10^4$ $6.97 \times 10^4$ (F) | 46, Pages 5, 9 | (D) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 1.893 (C) | 54, Pages 7 & 8 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. With the Centrifugal Charging pump operating, the room temperature and humidity are limited to 122ºF and 95% during loss of normal ventilation.

B. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1102, Reference 29, page 283.

C. The calculated flood level exceeds the level of safety related equipment in the ECCS rooms, based on an isolation time of 40 minutes. However, the postulated flood level and equipment unavailability in this room does not negate the system safety related function due to the redundancy of the opposite train. The flood level in room 1107 is caused by HELB but the lowest EQ electrical equipment (SGL12B motor) in the room is above the flood level. The flood level identified does not affect any of the electrical parts of this cooler based on walkdowns of the room. Therefore, the flood level satisfies the requirement of 10CFR50, Appendix A, General Design Criteria 4, that safety related equipment is protected against the effects of flooding from postulated pipe failure.

D. Radiological consequences of specific HELB/MEC's have not been developed, since the LOCA conditions are more severe.

E The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant

F The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source

G This room contains components with greater than or equal to (≥) 4.0 wt. % (7000 ppm), but less than or equal to (≤) 4.4 wt. % (7000 ppm) boric acid solution should be maintained at min. 65°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
54. Calculation FL-02

Figure 3.11(B)-10 Auxiliary Building HELB Temperature (Rooms 1107 through 1114)

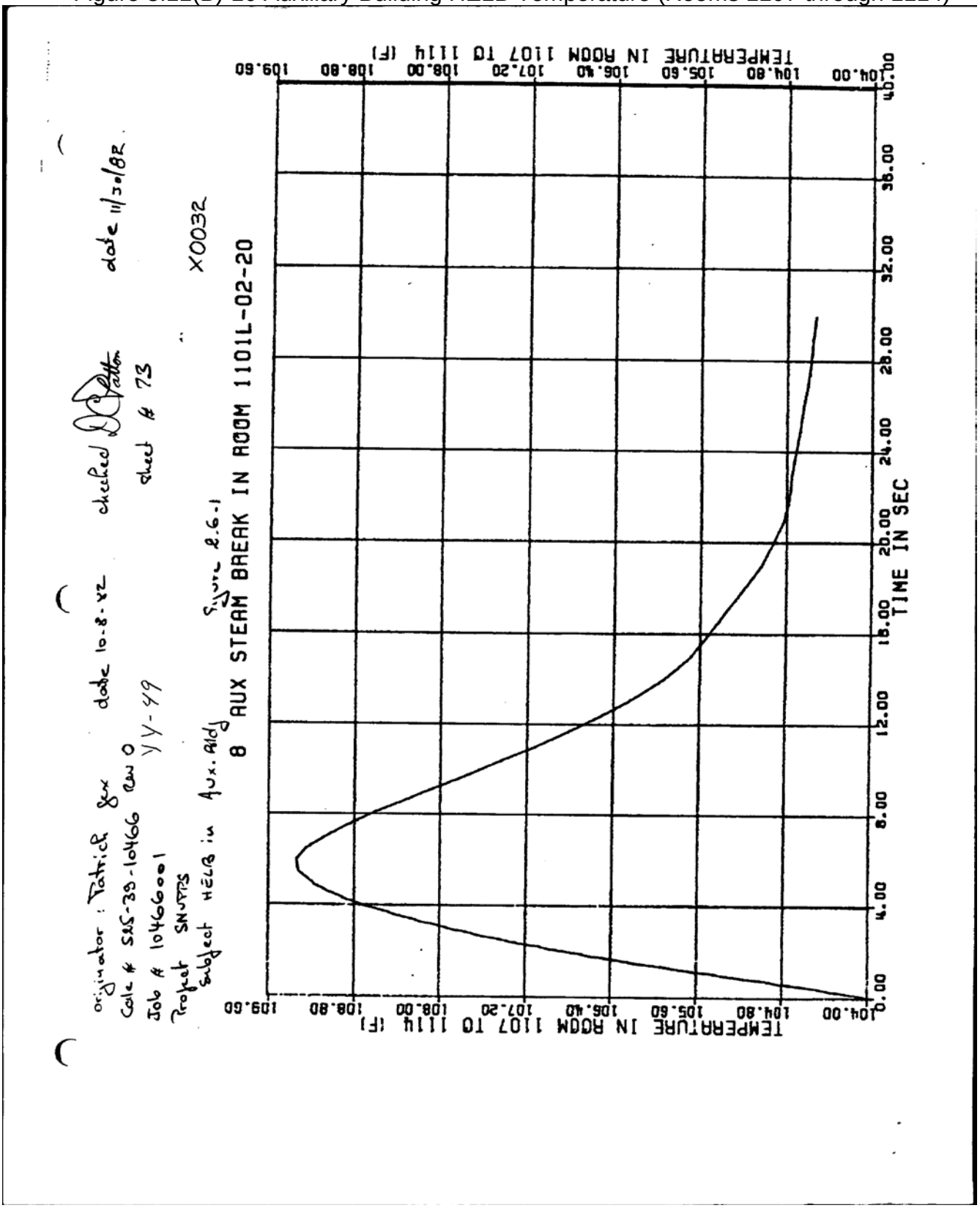
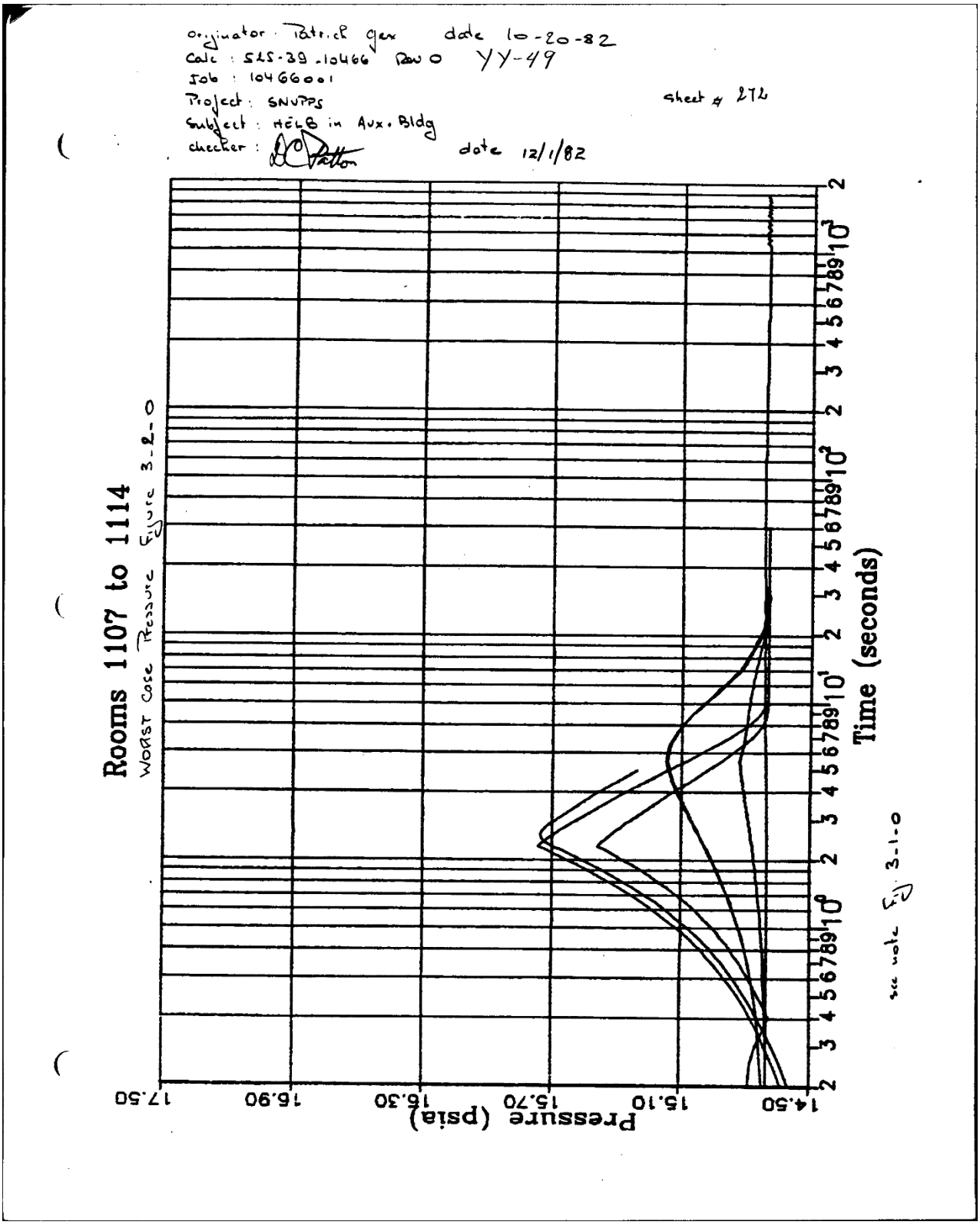


Figure 3.11(B)-27 Auxiliary Building HELB Pressure (Rooms 1107 through 1114)



**BUILDING: AUXILIARY** **ROOM NUMBER 1108**
**ROOM DESCRIPTION: ELEVATION 1974 SAFETY INJECTION PUMP ROOM B**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 (A) | 28, Page 2-8 | NE | N/A | 109.4 (B) | 29, Pages 73, 250 & 283 |
| **PRESSURE (PSIG)** | ATM | | NE | N/A | 1.06 | 29, Page 247, 272 |
| **HUMIDITY (%)** | 95 | 28, Page 2-8 | NE | N/A | 76 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 7884 | 49 & (E) | $2.63 \times 10^6$ $1.34 \times 10^7$ (F) | 46, page 5 46, page 9 (F) | (D) | NA |
| **DOSE RATE (R/hr)** | ≤15 mR/hr | 49 | $1.23 \times 10^5$ $1.50 \times 10^5$ (F) | 46, page 5 46, page 9 (F) | (D) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ) 1.893 (C) | 54, Pages 7 & 8 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. With the SI pumps operating, the room temperature and humidity are limited to 122ºF and 95% during loss of normal ventilation.

B. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1102, Reference 29, Page 283.

C. The calculated flood level exceeds the level of safety related equipment in the ECCS rooms, based on an isolation time of 40 minutes. However, the postulated flood level and equipment unavailability in this room does not negate the system safety related function due to the redundancy of the opposite train. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero. Therefore, the flood level satisfies the requirement of 10CFR50, Appendix A, General Design Criteria 4, that safety related equipment is protected against the effects of flooding from postulated pipe failure

D Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

E The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

F The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
54. Calculation FL-02

Figure 3.11(B)-10 Auxiliary Building HELB Temperature (Rooms 1107 through 1114)

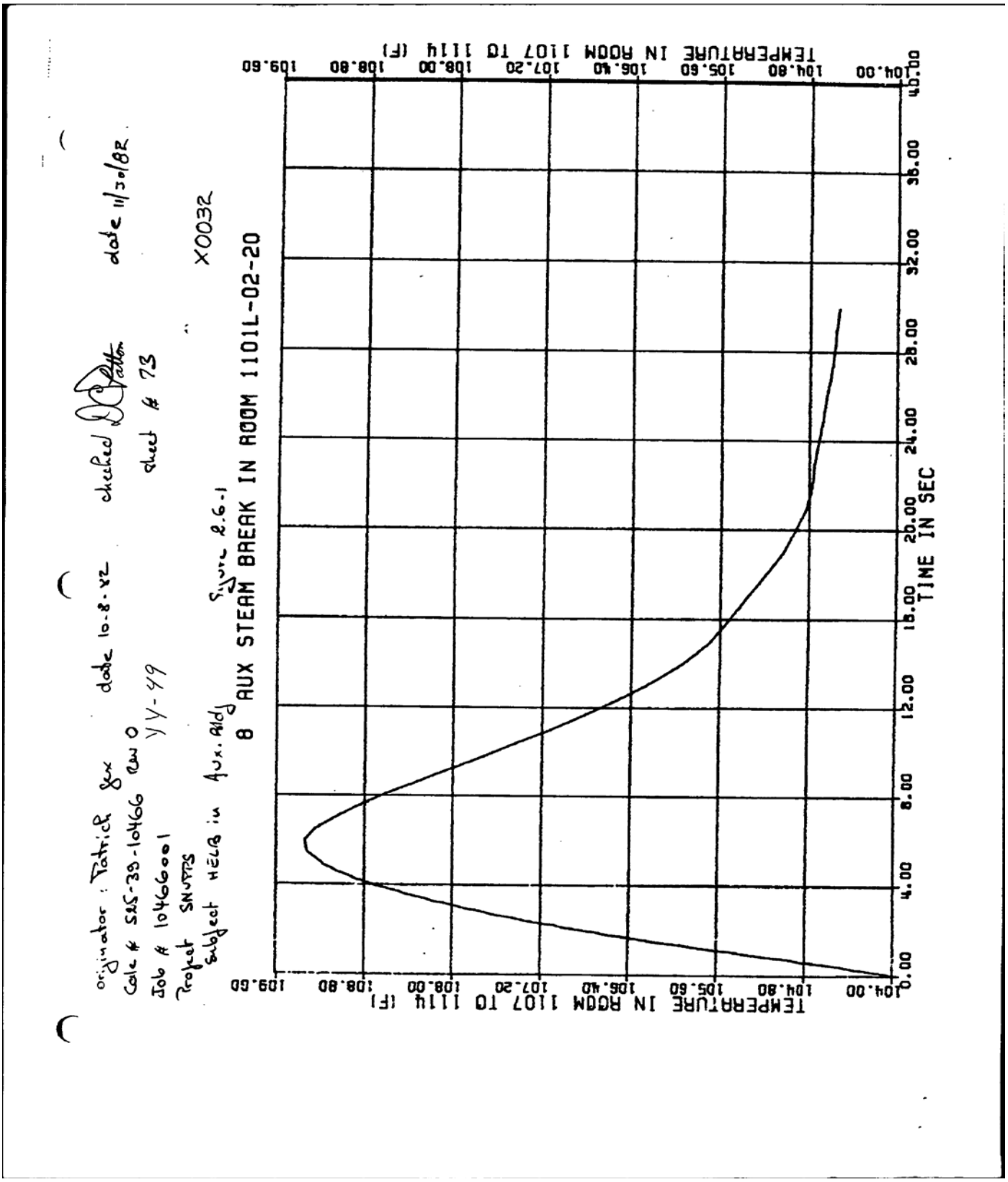
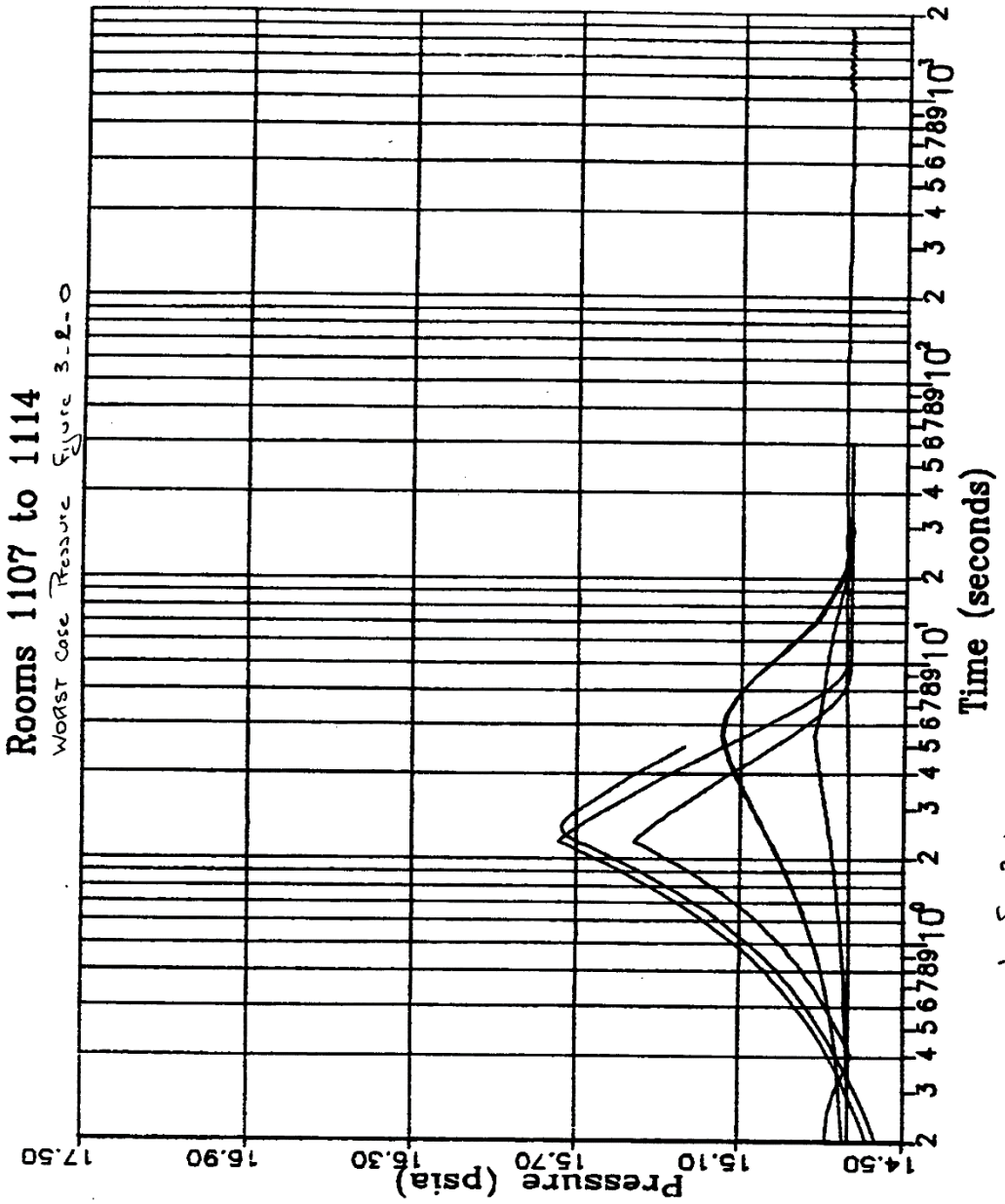


Figure 3.11(B)-27 Auxiliary Building HELB Pressure (Rooms 1107 through 1114)

originator: Patrick Gex date 10-20-82
Calc: 515-39-10466 Rev 0 YY-49
Job: 10466001
Project: SNUPPS
Subject: HELB in Aux. Bldg
checker: D.C. Patton date 12/1/82
sheet # 272



**BUILDING: AUXILIARY** **ROOM NUMBER 1109**
**ROOM DESCRIPTION: ELEVATION 1974 RHR PUMP ROOM B**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 (A) | 28, Page 2-8 | NE | N/A | 109.4 (B) | 29, Pages 73 250 & 283 |
| **PRESSURE (PSIG)** | ATM | | NE | N/A | 1.06 | 29, Page 247, 272 |
| **HUMIDITY (%)** | 95 | 28, Page 2-8 | NE | N/A | 76 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49 & (E) | $3.46 \times 10^6$ $1.78 \times 10^7$ (F) | 46, page 5 46, page 9 (F) | (D) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | $1.62 \times 10^5$ $1.98 \times 10^5$ (F) | 46, page 5 46, page 9 (F) | (D) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ) 8.893 (C) | 54, Pages 7 & 8 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. With the RHR pump operating, the room temperature and humidity are limited to 122ºF and 95% during loss of normal ventilation.

B. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1102, Reference 29, Page 283.

C. The calculated flood level exceeds the level of safety related equipment in the ECCS rooms, based on an isolation time of 40 minutes. However, the postulated flood level and equipment unavailability in this room does not negate the system safety related function due to the redundancy of the opposite train. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero. Therefore, the flood level satisfies the requirement of 10CFR50, Appendix A, General Design Criteria 4, that safety related equipment is protected against the effects of flooding from postulated pipe failure.

D. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

E The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

F The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
54. Calculation FL-02

Figure 3.11(B)-10 Auxiliary Building HELB Temperature (Rooms 1107 through 1114)

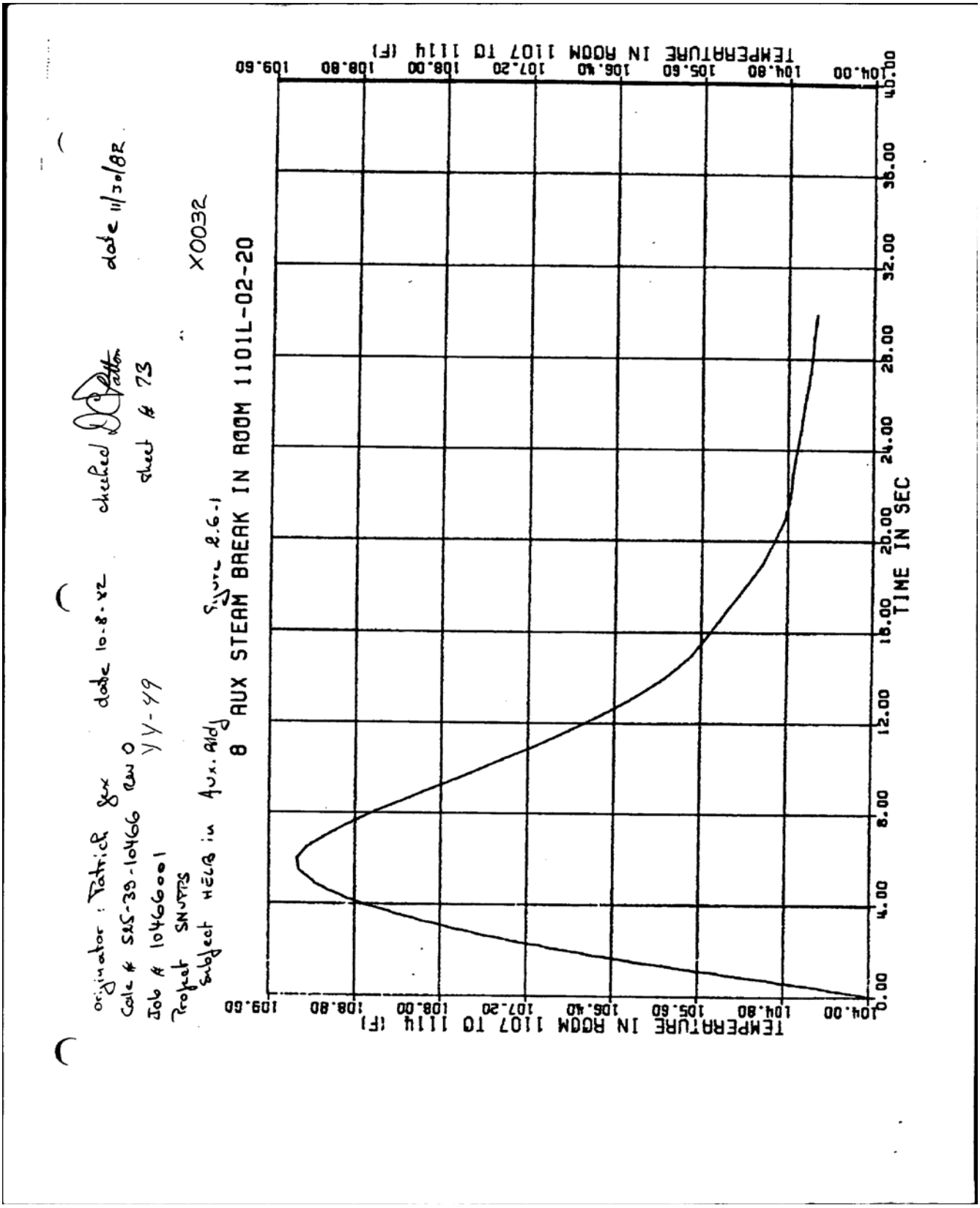
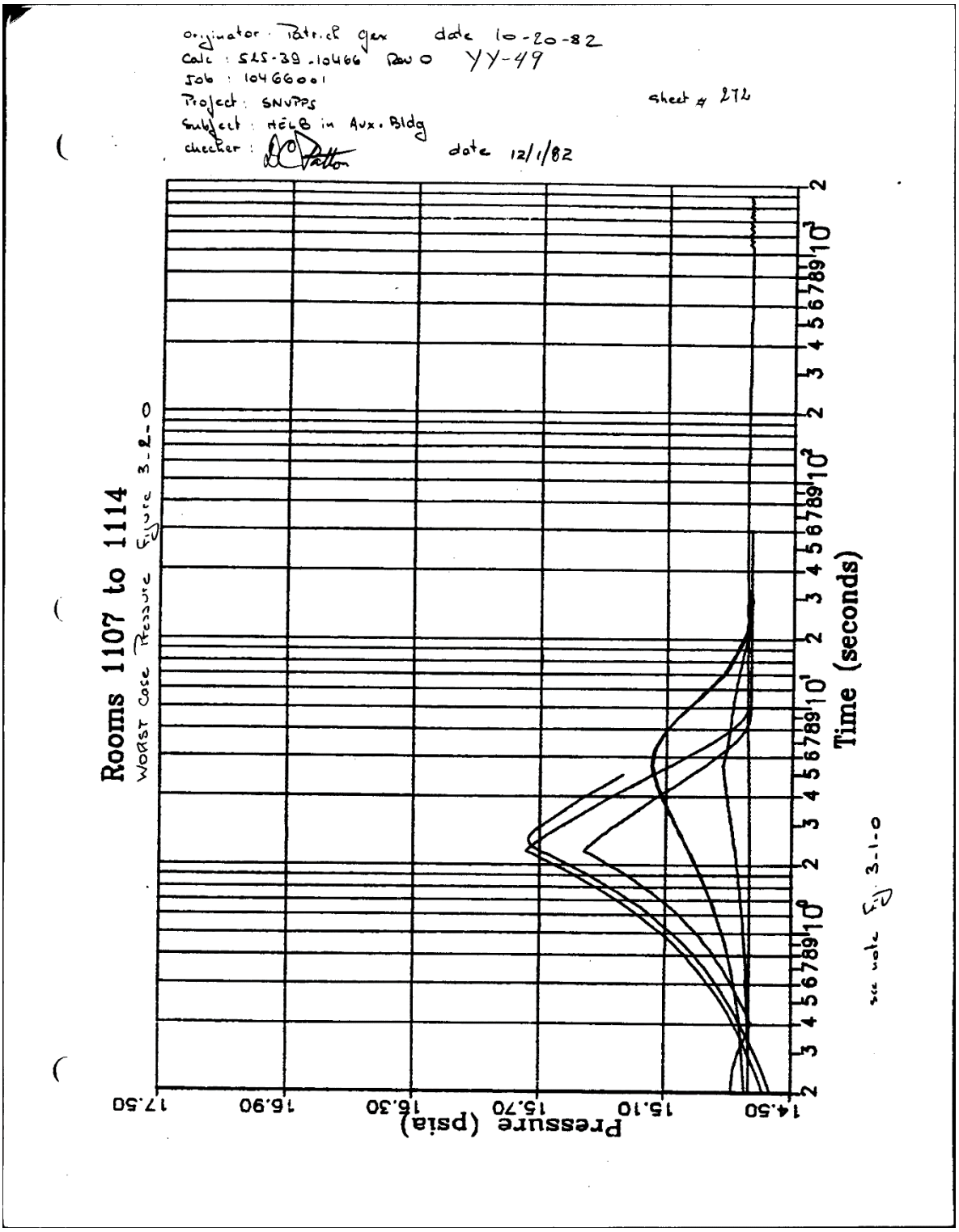


Figure 3.11(B)-27 Auxiliary Building HELB Pressure (Rooms 1107 through 1114)



**BUILDING: AUXILIARY** **ROOM NUMBER 1110**
**ROOM DESCRIPTION: ELEVATION 1974 CONTAINMENT SPRAY PUMP ROOM B**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 (A) | 28, Page 2-8 | NE | N/A | 109.4 (B) | 29, Pages 73 250 & 283 |
| **PRESSURE (PSIG)** | ATM | | NE | N/A | 1.06 | 29, Page 247, 272 |
| **HUMIDITY (%)** | 95 | 28, Page 2-8 | NE | N/A | 76 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 7884 | 49 & (E) | $4.44 \times 10^6$ $1.60 \times 10^7$ (F) | 46, page 5 46, page 9 (F) | (D) | NA |
| **DOSE RATE (R/hr)** | ≤15 mR/hr | 49 | $2.08 \times 10^5$ $2.54 \times 10^5$ (F) | 46, page 5 46, page 9 (F) | (D) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ) 8.893 (C) | 54, Pages 7 & 8 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. With the Containment Spray pump operating, the room temperature and humidity are limited to 122ºF and 95% during loss of normal ventilation.

B. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1102 (Reference 29, page 283).

C. The calculated flood level exceeds the level of safety related equipment in the ECCS rooms, based on an isolation time of 40 minutes. However, the postulated flood level and equipment unavailability in this room does not negate the system safety related function due to the redundancy of the opposite train. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero. Therefore, the flood level satisfies the requirement of 10CFR50, Appendix A, General Design Criteria 4, that safety related equipment is protected against the effects of flooding from postulated pipe failure.

D. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

E The normal integrated dose was obtained by multiplying the dose rate of times 60 years life of the plant.

F The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
54. Calculation FL-02

Figure 3.11(B)-10 Auxiliary Building HELB Temperature (Rooms 1107 through 1114)

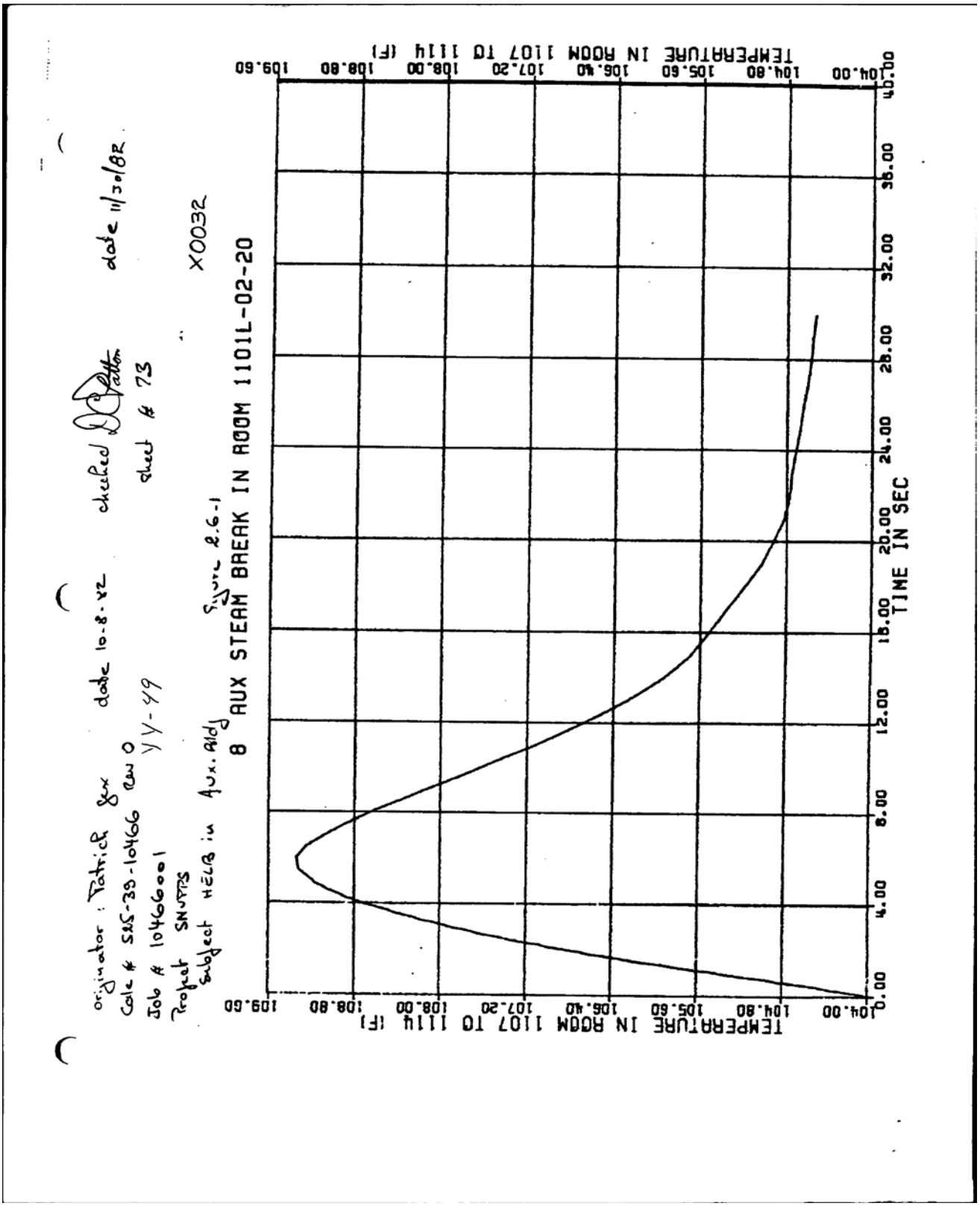
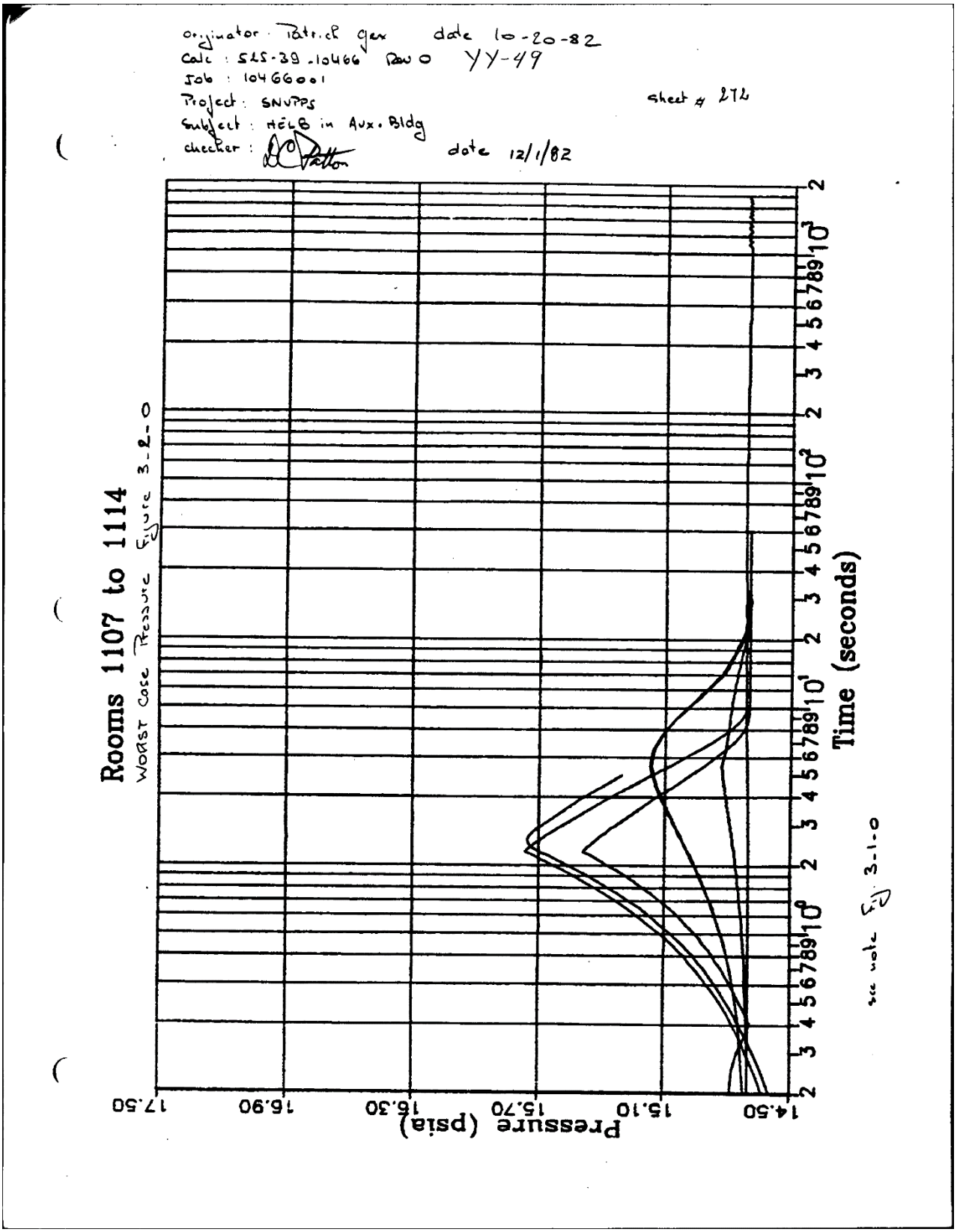


Figure 3.11(B)-27 Auxiliary Building HELB Pressure (Rooms 1107 through 1114)



**BUILDING: AUXILIARY** **ROOM NUMBER 1111**
**ROOM DESCRIPTION: ELEVATION 1974 RHR PUMP ROOM A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 (A) | 28, Page 2-8 | NE | | 109.4 (B) | 29, Pages 73, 250 & 283 |
| **PRESSURE (PSIG)** | ATM | | NE | | 1.06 | 29, Page 247, 272 |
| **HUMIDITY (%)** | 95 | 28, Page 2-8 | NE | | 76 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49 & (E) | $3.57 \times 10^6$ $1.75 \times 10^7$ (F) | 46, page 5 46, page 9 (F) | (D) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | $1.67 \times 10^5$ $2.04 \times 10^5$ (F) | 46, page 5 46, page 9 (F) | (D) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ) 8.845 (C) | 54, Pages 7 & 8 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. With the RHR pump operating, the room temperature and humidity are limited to 122ºF and 95% during loss of normal ventilation.

B. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1102 (Reference 29, Page 283).

C. The calculated flood level exceeds the level of safety related equipment in the ECCS rooms, based on an isolation time of 40 minutes. However, the postulated flood level and equipment unavailability in this room does not negate the system safety related function due to the redundancy of the opposite train. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero. Therefore, the flood level satisfies the requirement of 10CFR50, Appendix A, General Design Criteria 4, that safety related equipment is protected against the effects of flooding from postulated pipe failure.

D. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

E The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

F The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
54. Calculation FL-02

Figure 3.11(B)-10 Auxiliary Building HELB Temperature (Rooms 1107 through 1114)

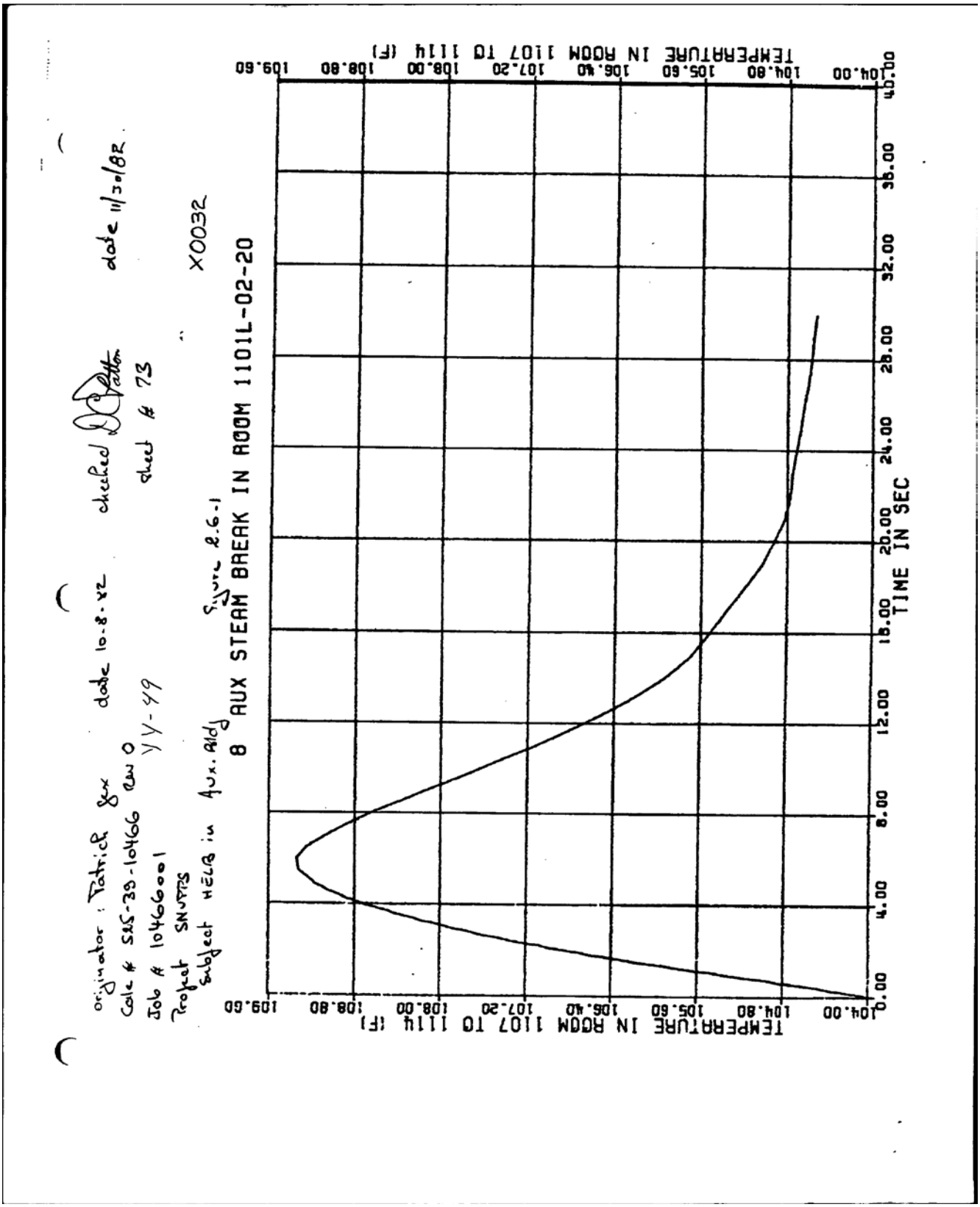
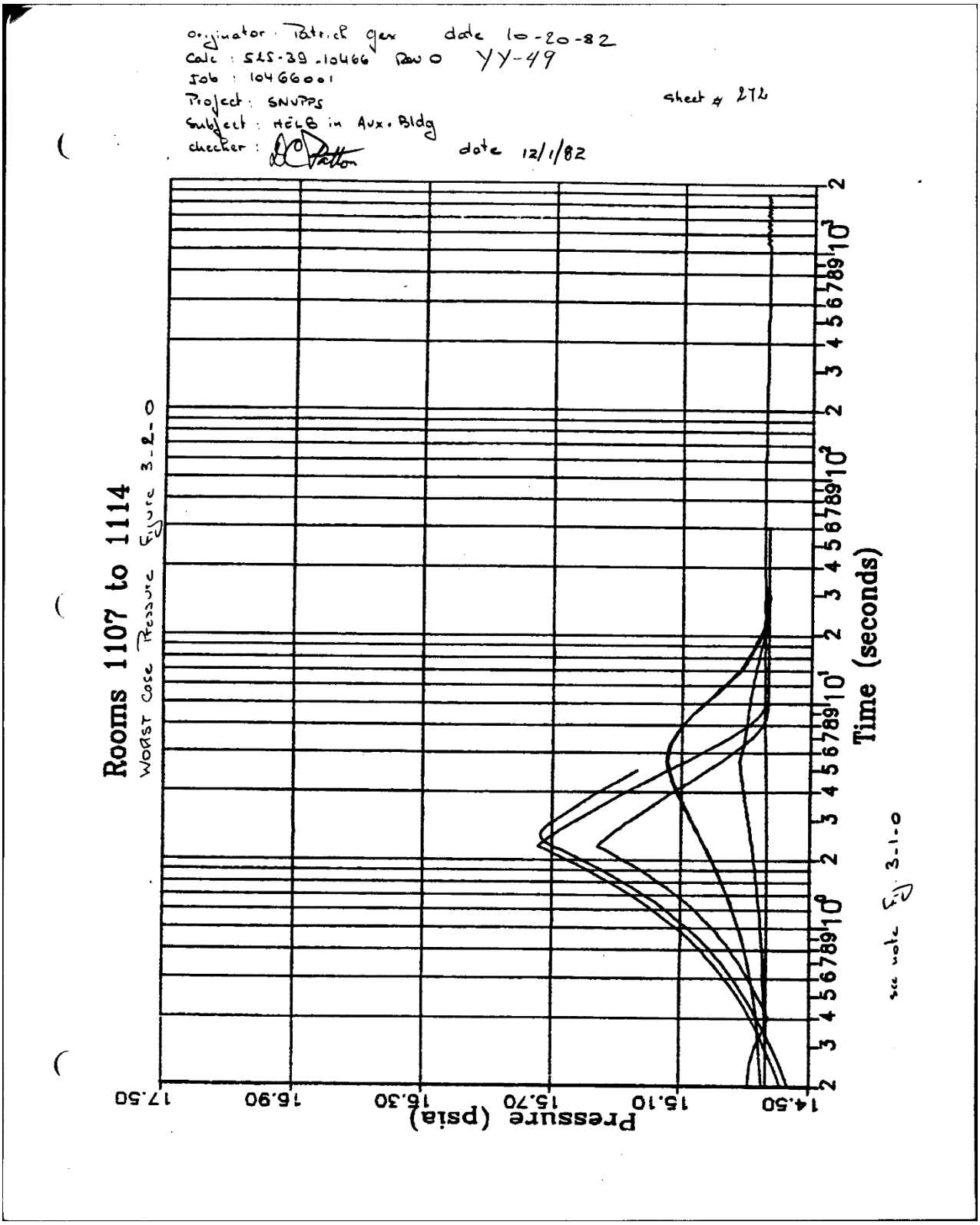


Figure 3.11(B)-27 Auxiliary Building HELB Pressure (Rooms 1107 through 1114)



**BUILDING: AUXILIARY** **ROOM NUMBER 1112**
**ROOM DESCRIPTION: ELEVATION 1974 CONTAINMENT SPRAY PUMP ROOM A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 (A) | 28, Page 2-8 | NE | N/A | 109.4 (B) | 29, Pages 73, 250 & 283 |
| **PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 247, 272 |
| **HUMIDITY (%)** | 95 | 28, Page 2-8 | NE | N/A | 76 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 7884 | 49 & (E) | $3.91X10^6$ $2.00x10^7$ (F) | 46, Page 5 46, page 9 (F) | (D) | NA |
| **DOSE RATE (R/hr)** | ≤15 mR/hr | 49 | $1.83x10^5$ $2.24X10^5$ (F) | 46, Page 5 46, page 9 (F) | (D) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ) 8.845 (C) | 54, Pages 7 & 8 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. With the Containment Spray pump operating, the room temperature and humidity are limited to 122ºF and 95% during loss of normal ventilation.

B. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1102 (Reference 29, Page 283).

C. The calculated flood level exceeds the level of safety related equipment in the ECCS rooms, based on an isolation time of 40 minutes. However, the postulated flood level and equipment unavailability in this room does not negate the system safety related function due to the redundancy of the opposite train. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero. Therefore, the flood level satisfies the requirement of 10CFR50, Appendix A, General Design Criteria 4, that safety related equipment is protected against the effects of flooding from postulated pipe failure.

D. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

E The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

F The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
54. Calculation FL-02

Figure 3.11(B)-10 Auxiliary Building HELB Temperature (Rooms 1107 through 1114)

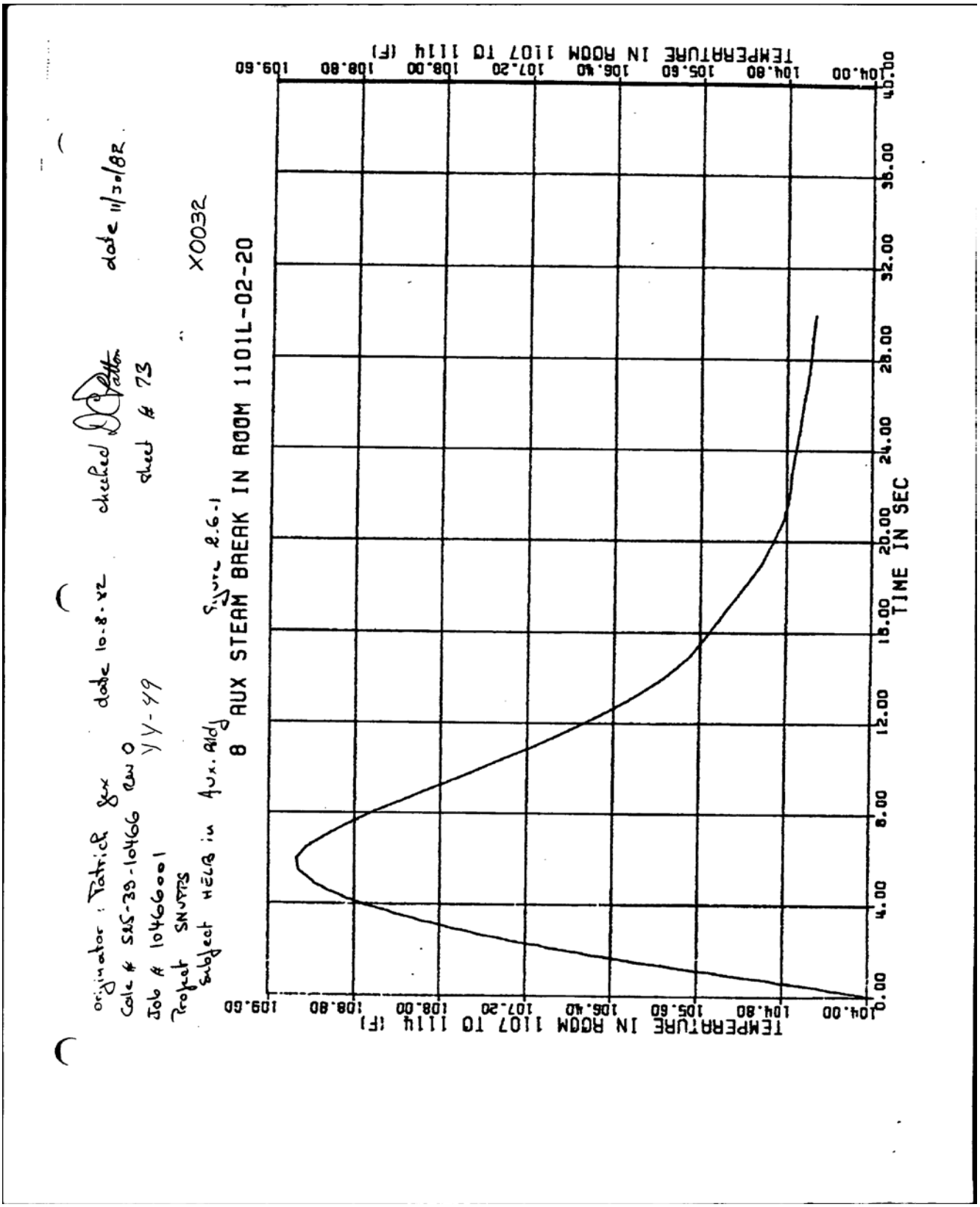
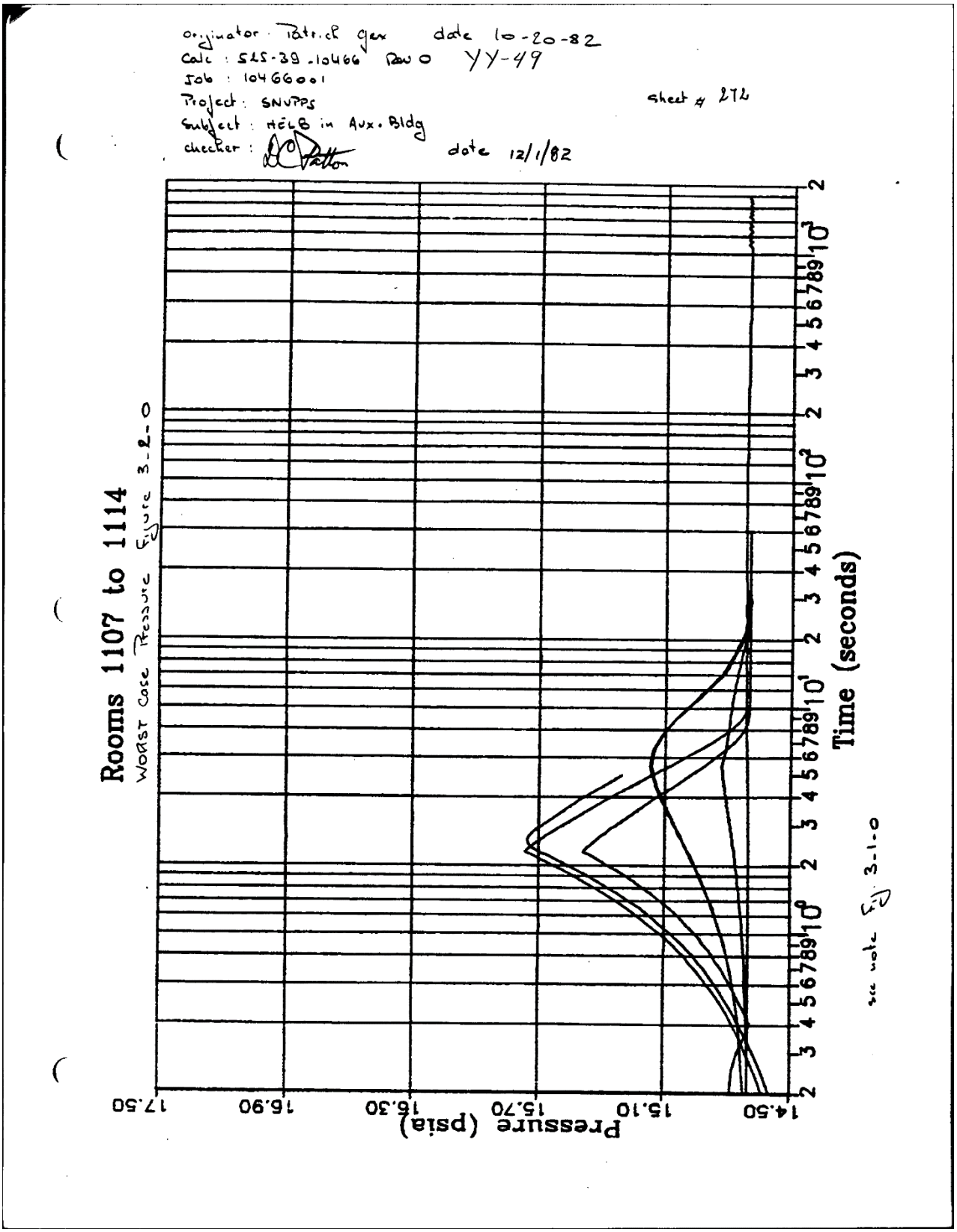


Figure 3.11(B)-27 Auxiliary Building HELB Pressure (Rooms 1107 through 1114)



**BUILDING: AUXILIARY** **ROOM NUMBER 1113**
**ROOM DESCRIPTION: ELEVATION 1974 SAFETY INJECTION PUMP ROOM A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 (A) | 28, Page 2-8 | NE | N/A | 109.4 (B) | 29, Page 73, 250 & 283 |
| **PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 247, 272 |
| **HUMIDITY (%)** | 95 | 28, Page 2-8 | NE | N/A | 76 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 7884 | 49 & (E) | $2.61 \times 10^6$ $1.332 \times 10^7$ (F) | 46, page 5 46, page 9 (F) | (D) | NA |
| **DOSE RATE (R/hr)** | ≤15 mR/hr | 49 | $1.22 \times 10^5$ $1.49 \times 10^5$ (F) | 46, page 5 46, page 9 (F) | (D) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ) 1.845 (C) | 54, pages 7 & 8 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. With the SI pump operating, the room temperature and humidity are limited to 122ºF and 95% during loss of normal ventilation.

B. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1102 (Reference 29, Page 283).

C. The calculated flood level exceeds the level of safety related equipment in the ECCS rooms, based on an isolation time of 40 minutes. However, the postulated flood level and equipment unavailability in this room does not negate the system safety related function due to the redundancy of the opposite train. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero. Therefore, the flood level satisfies the requirement of 10CFR50, Appendix A, General Design Criteria 4, that safety related equipment is protected against the effects of flooding from postulated pipe failure.

D. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

E The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

F The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

G This room contains components with greater than or equal to (≥) 4.0 wt. % (7000 ppm), but less than or equal to (≤) 4.4 wt. % (7000 ppm) boric acid solution should be maintained at min. 65°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
54. Calculation FL-02

Figure 3.11(B)-10 Auxiliary Building HELB Temperature (Rooms 1107 through 1114)

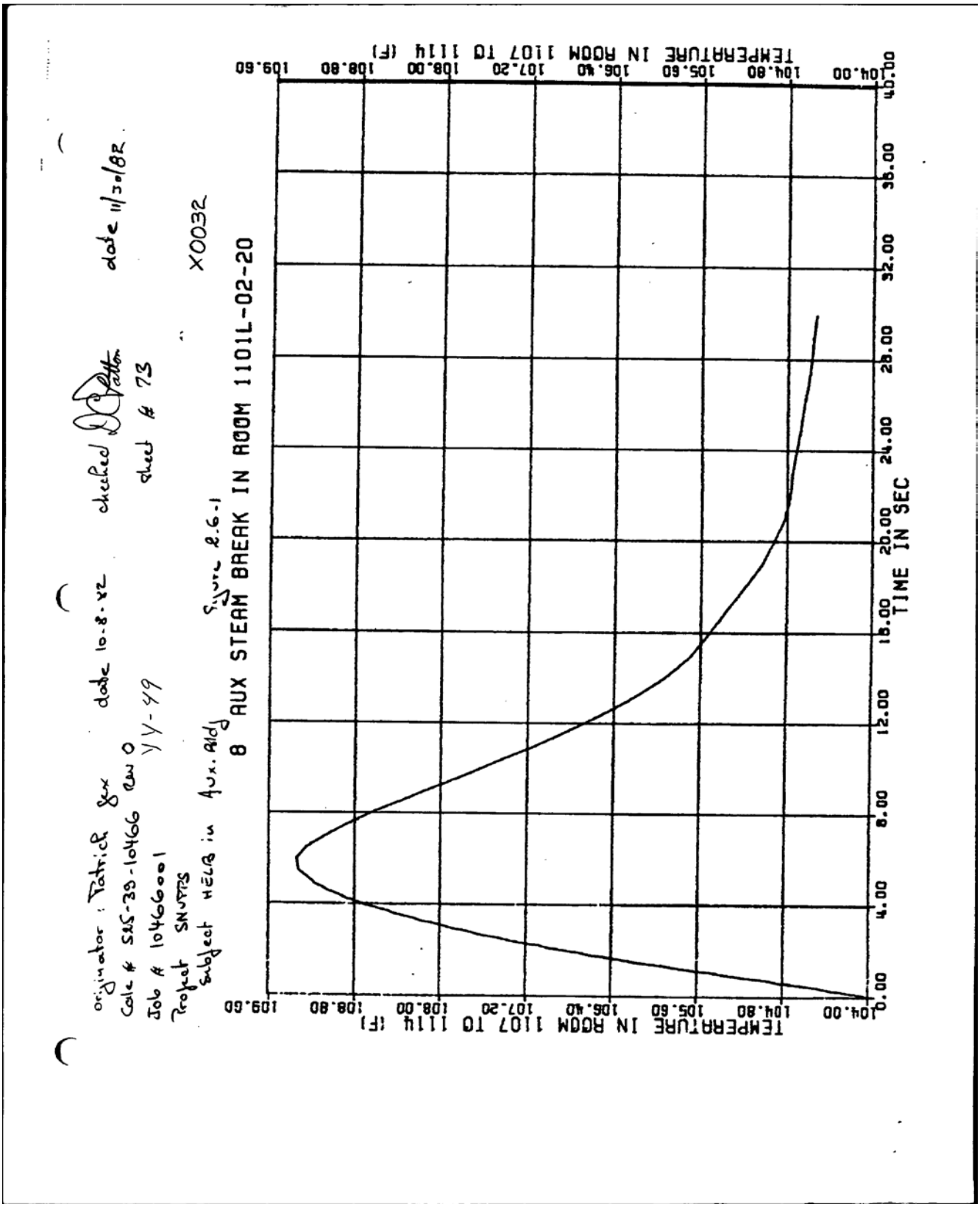
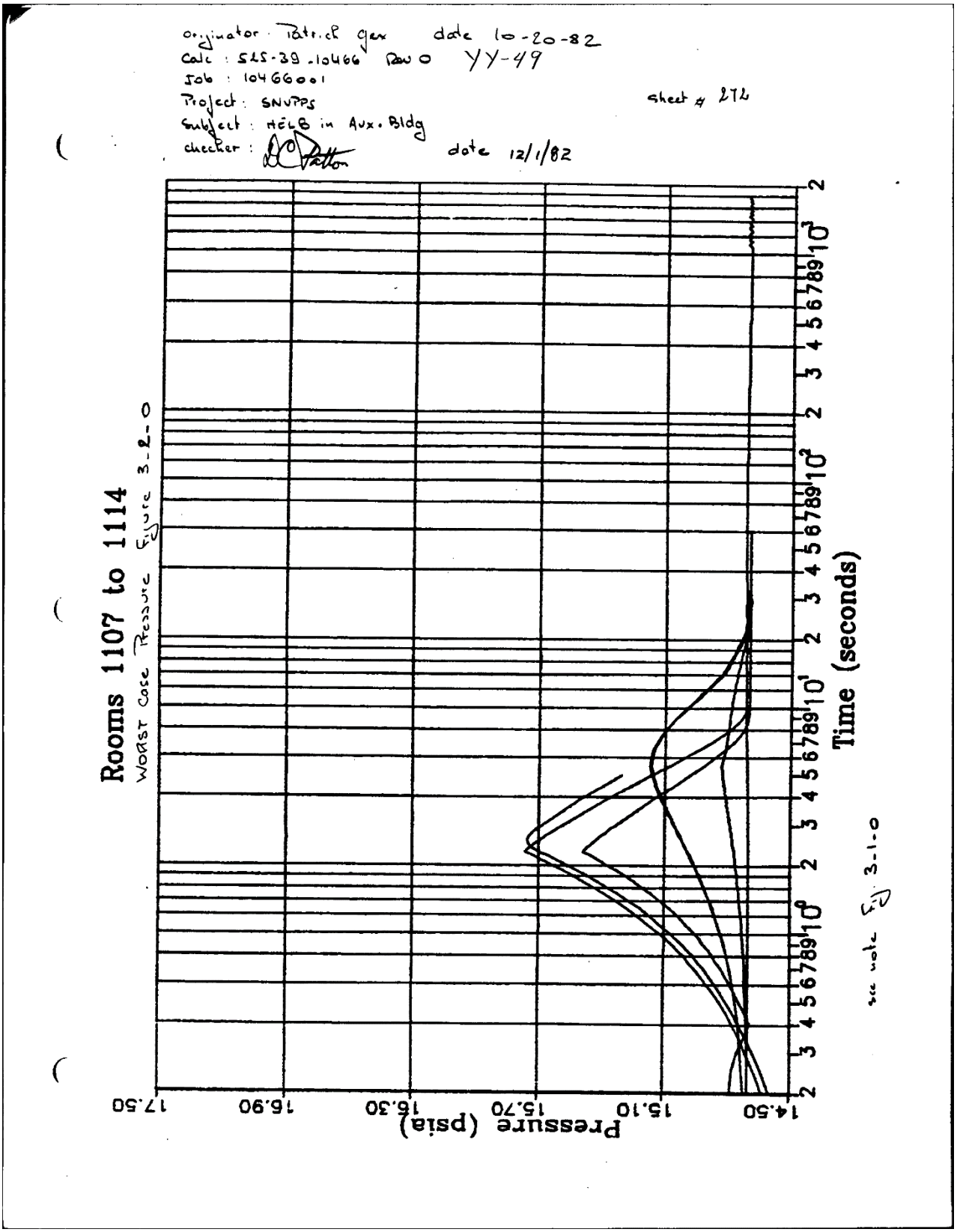


Figure 3.11(B)-27 Auxiliary Building HELB Pressure (Rooms 1107 through 1114)



**BUILDING: AUXILIARY** **ROOM NUMBER 1114**
**ROOM DESCRIPTION: ELEVATION 1974 CENTRIFUGAL CHARGING PUMP ROOM A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 (A) | 28, Page 2-8 | NE | N/A | 109.4 (B) | 29, Pages 73 250 & 283 |
| **PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 247, 272 |
| **HUMIDITY (%)** | 95 | 28, Page 2-8 | NE | N/A | 76 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49 & (E) | $1.22 \times 10^6$ $6.22 \times 10^6$ (F) | 46, Page 5 46, Page 9 (F) | (D) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | $5.7 \times 10^4$ $6.97 \times 10^4$ (F) | 46, Page 5 46, Page 9 (F) | (D) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 1.845 (C) | 54, Pages 7 & 8 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. With the Centrifugal Charging pump operating, the room temperature and humidity are limited to 122ºF and 95% during loss of normal ventilation.

B. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1102 (Reference 29, Page 283).

C. The calculated flood level exceeds the level of safety related equipment in the ECCS rooms, based on an isolation time of 40 minutes. However, the postulated flood level and equipment unavailability in this room does not negate the system safety related function due to the redundancy of the opposite train. The flood level in room 1114 is caused by HELB but the lowest EQ electrical equipment (SGL09A motor) in the room is above the flood level. The flood level identified does not affect any of the electrical parts of this cooler based on walkdowns of the room. Therefore, the flood level satisfies the requirement of 10CFR50, Appendix A, General Design Criteria 4, that safety related equipment is protected against the effects of flooding from postulated pipe failure.

D. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

E The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

F The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

G This room contains components with greater than or equal to (≥) 4.0 wt. % (7000 PPM), but less than or equal to (≤) 4.4 wt. % (7000 PPM) boric acid solution should be maintained at min. 65°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
54. Calculation FL-02

Figure 3.11(B)-10 Auxiliary Building HELB Temperature (Rooms 1107 through 1114)

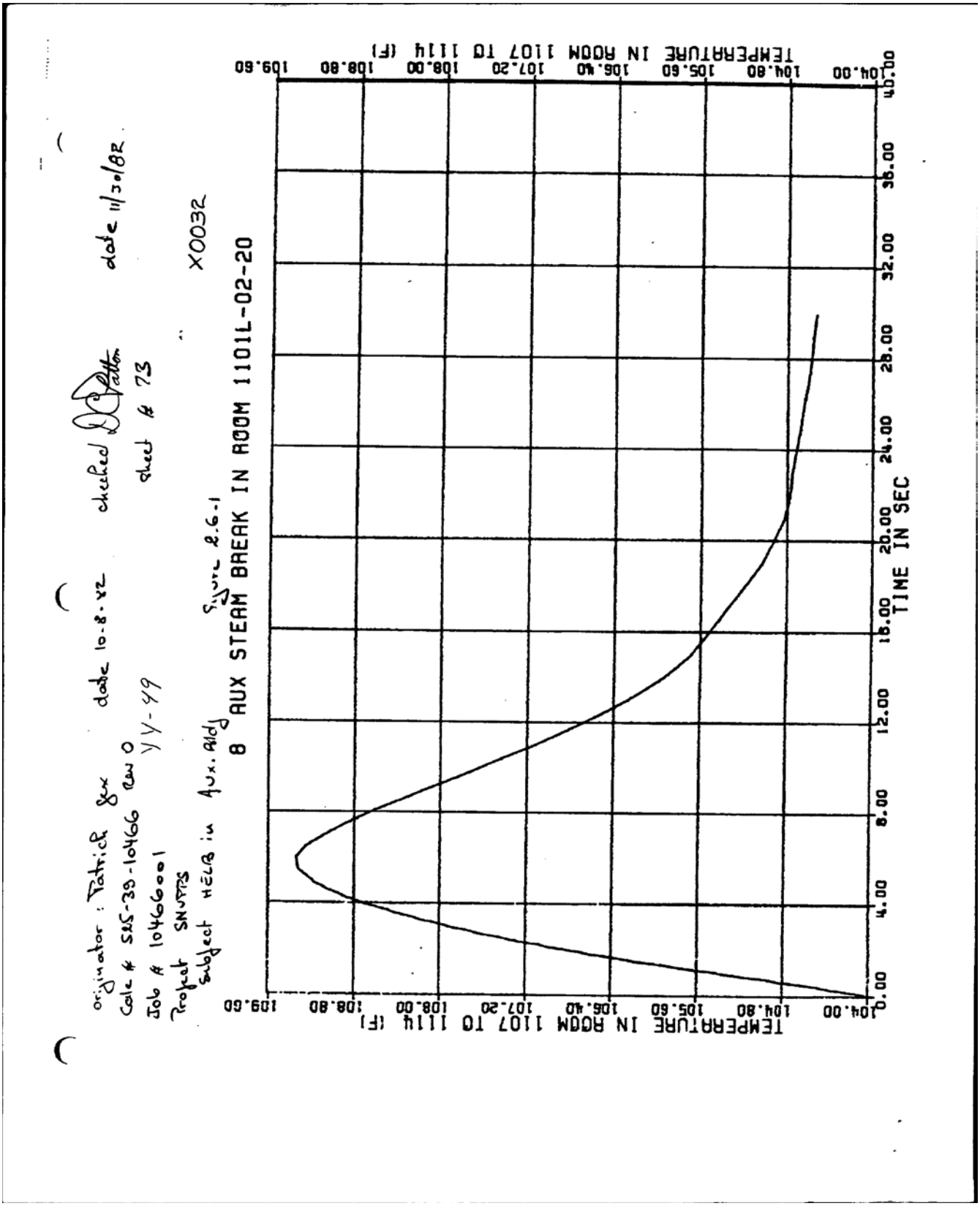
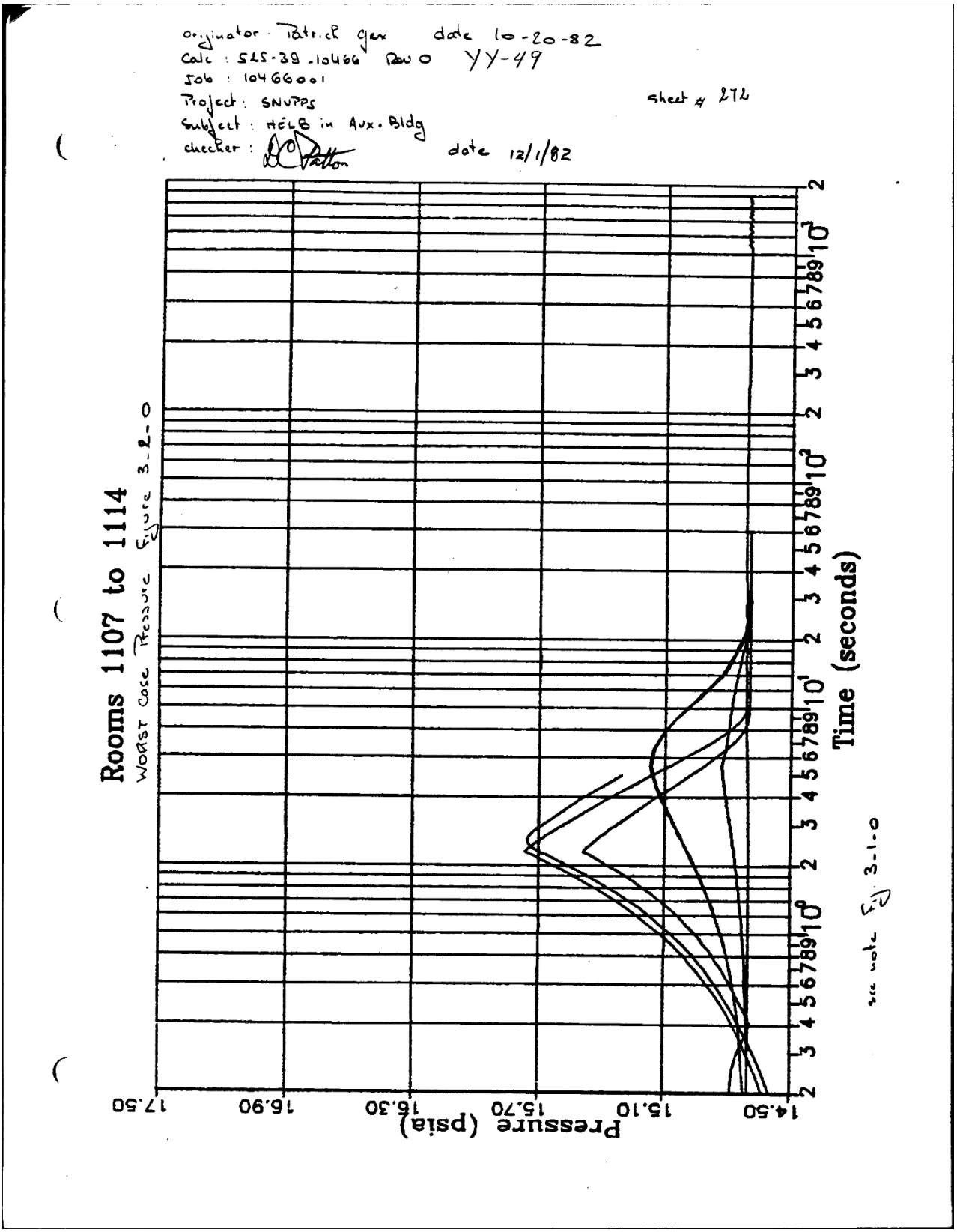


Figure 3.11(B)-27 Auxiliary Building HELB Pressure (Rooms 1107 through 1114)



**BUILDING: AUXILIARY** **ROOM NUMBER 1115**
**ROOM DESCRIPTION: ELEVATION 1974 NORMAL CHARGING PUMP ROOM**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 (F) | 28, Page 2-8 | NE | N/A | 109.2 (A) | 29, Page 106, 251 & 283 |
| **PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 88, 247 & 270 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 74 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49 & (D) | $3.85 \times 10^6$ $1.96 \times 10^7$ (E) | 46, Page 5 46, page 9 (E) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | $1.8 \times 10^5$ $2.20 \times 10^5$ (E) | 46, Page 5 46, page 9 (E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1130 (Reference 29, Page 283).

B. Per Reference 53, Appendix 2, Page 7, this room does not contain safety related equipment.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F With the Charging pump operating, the room temperature and humidity are limited to 122ºF and 95% during loss of normal ventilation

G This room contains components with greater than or equal to (≥) 4.0 wt. % (7000 ppm), but less than or equal to (≤) 4.4 wt. % (7000 ppm) boric acid solution should be maintained at min. 65°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-11 Auxiliary Building HELB Temperature (Rooms 1115, 1116 & 1117)

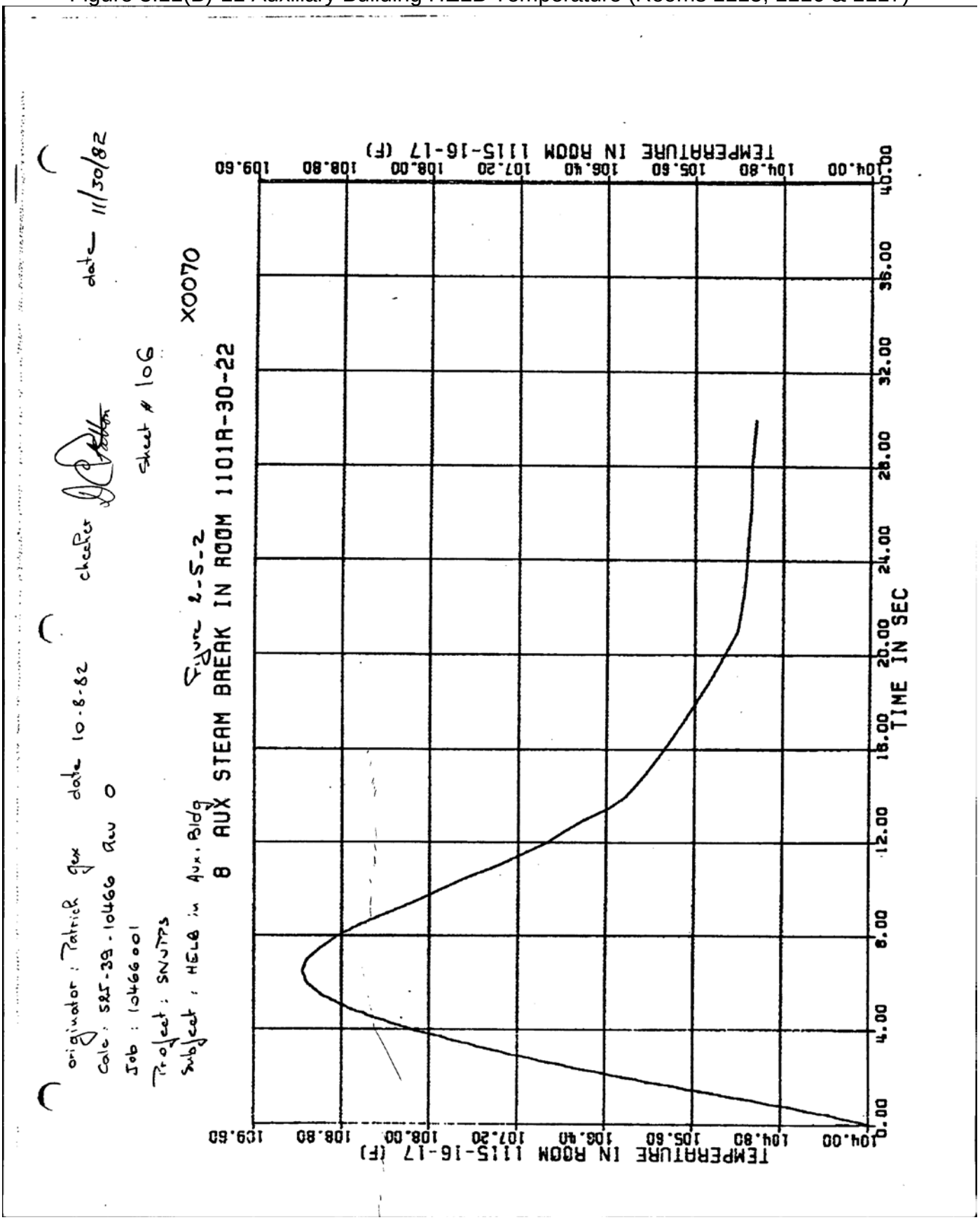
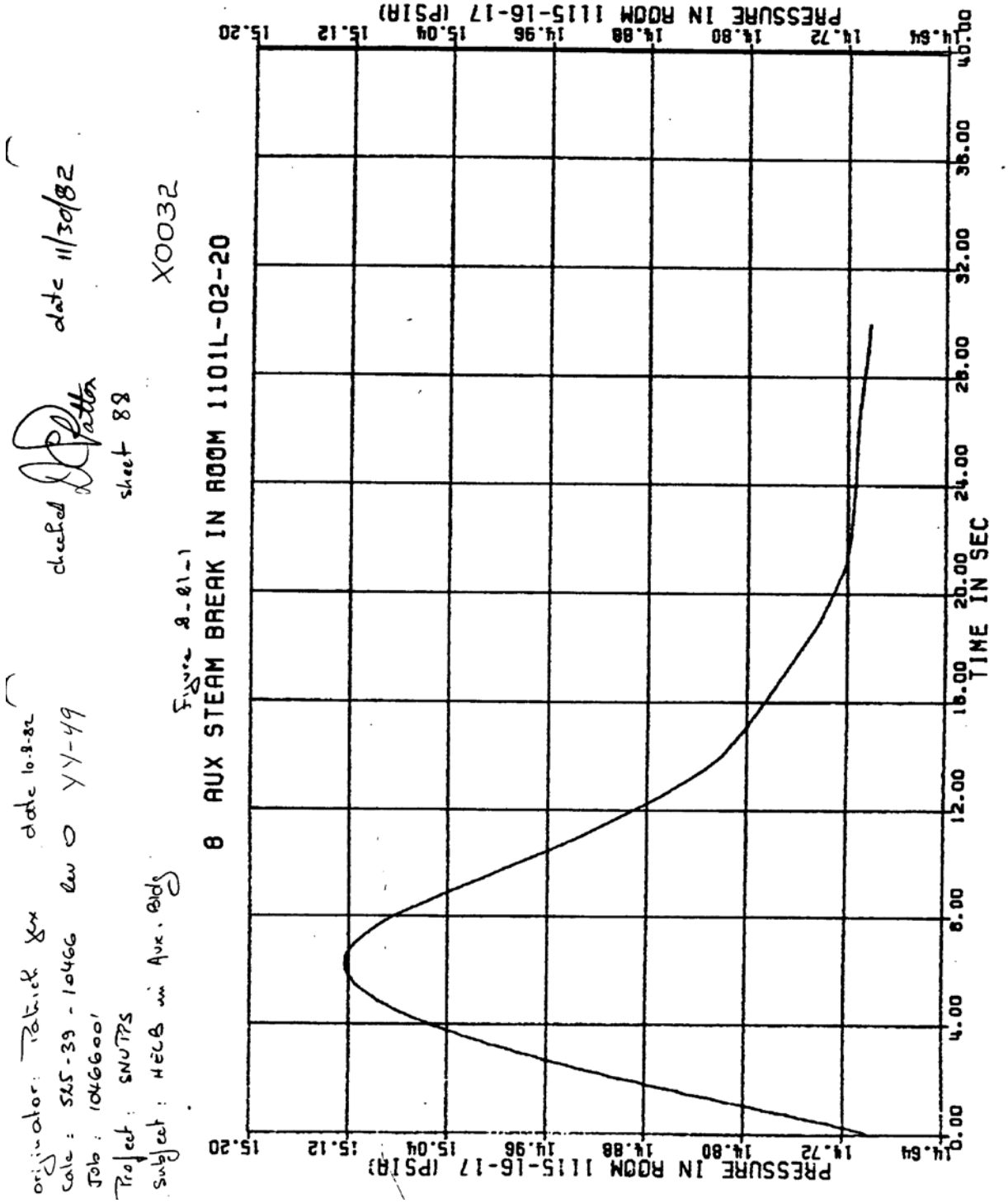


Figure 3.11(B)-27A Auxiliary Building HELB Pressure (Rooms 1115, 1116 & 1117)

**Note:** Reference 29, page 247 & 270 identify that the maximum pressure is 15.76 psia, but no figure is provided. The following figure is the pressure from the HELB worst temperature case.



**BUILDING: AUXILIARY** **ROOM NUMBER 1116**
**ROOM DESCRIPTION: ELEVATION 1974 BORIC ACID TANK ROOM B**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 109.2 (A) | 29, Page 106, 251 & 283 |
| **PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages, 247 & 270 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 74 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 7884 | 49 & (D) | $7.99 \times 10^3$<br>$4.09 \times 10^4$<br>(E) | 46, Page 5<br>46, page 9<br>(E) | (C) | NA |
| **DOSE RATE (R/hr)** | ≤15 mR/hr | 49 | 374<br>457<br>(E) | 46, Page 5<br>46, page 9<br>(E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 and Room 1130 (reference 29, Page 283).

B. The design flood level for Room 1103 is 41.64 inches based on the isolation of the break in 40 minutes and is acceptable since it is below the level of the lowest safety related equipment whose functionality would be adversely affected. Per reference 53, Appendix 2, Page 8, BGLT0105 is the lowest identified safety related equipment in this room. It is ~ 44 inches (3.66 ft) above the floor grade.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F This room contains components with greater than (>) 4.4 wt. % (7000 ppm) boric acid solution and should be maintained at min. 75°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-11 Auxiliary Building HELB Temperature (Rooms 1115, 1116 & 1117)

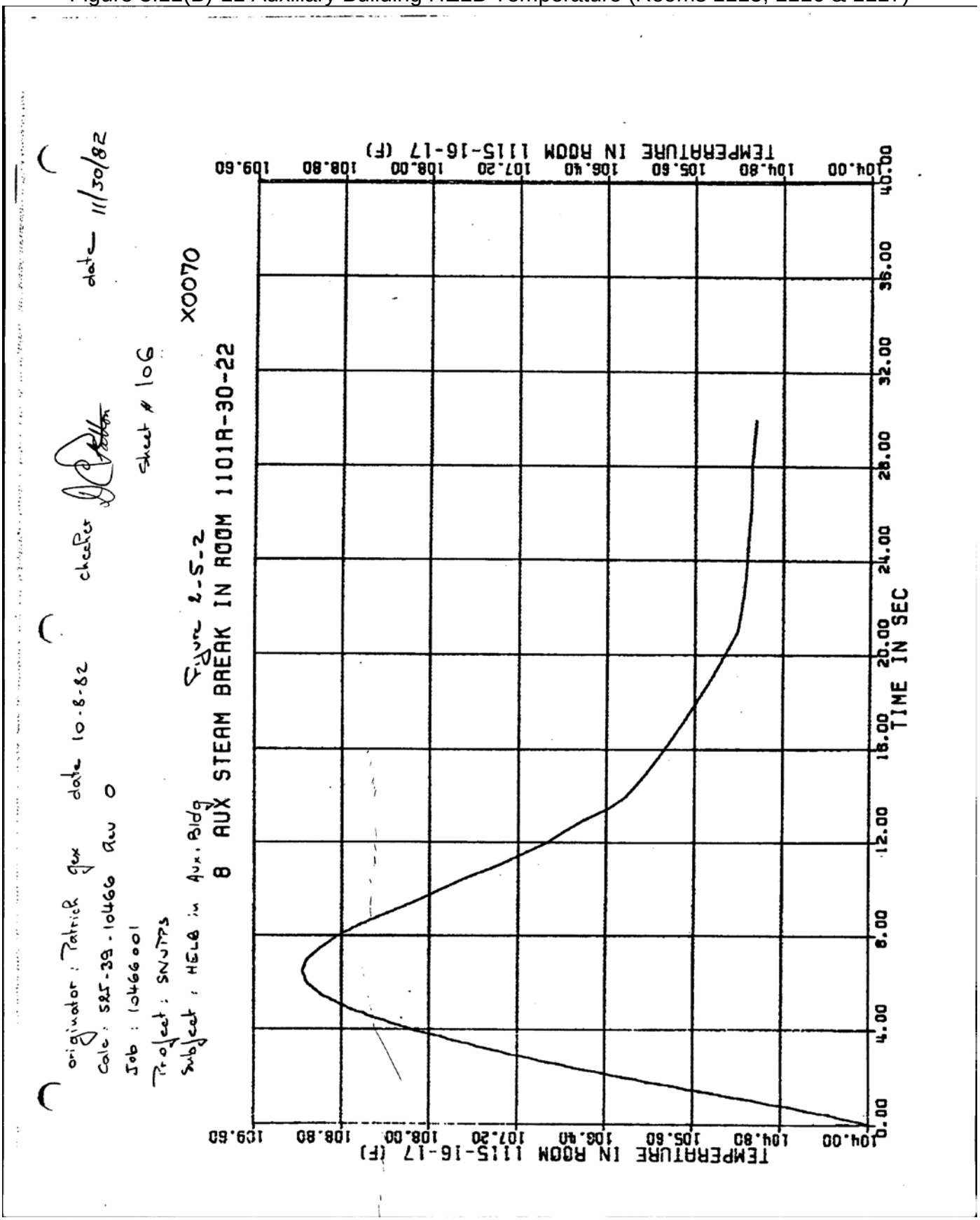
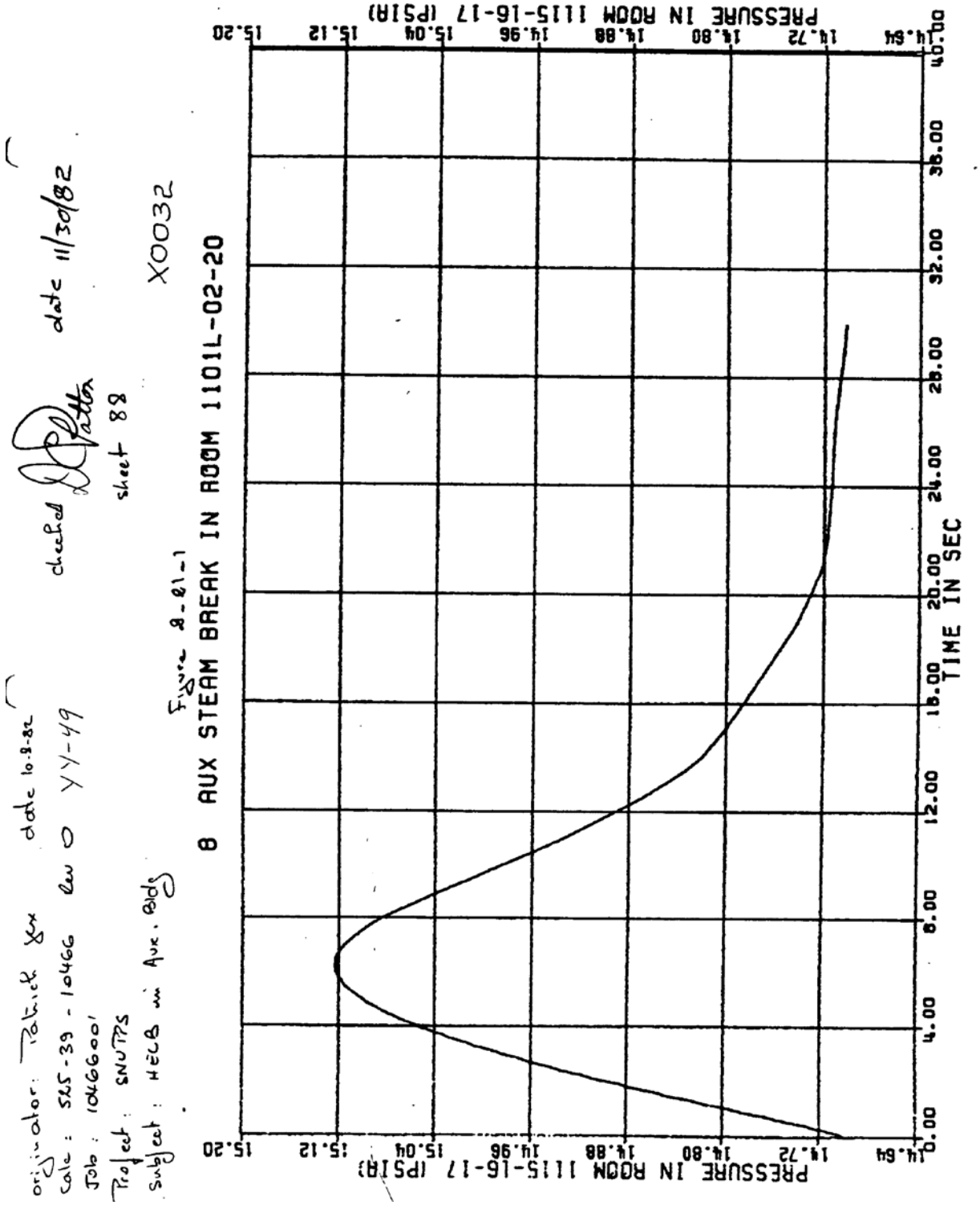


Figure 3.11(B)-27A Auxiliary Building HELB Pressure (Rooms 1115, 1116 & 1117)

**Note:** Reference 29, page 247 & 270 identify that the maximum pressure is 15.76 psia, but no figure is provided. The following figure is the pressure from the HELB worst temperature case.



**BUILDING: AUXILIARY** **ROOM NUMBER 1117**
**ROOM DESCRIPTION: ELEVATION 1974 BORIC ACID TANK ROOM A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 109.2 (A) | 29, Page 106, 251 & 283 |
| **PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 247 & 270 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 74 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 7884 | 49 & (D) | $7.99 \times 10^3$<br>$4.09 \times 10^4$<br>(E) | 46, Page 5<br>46, page 9<br>(E) | (C) | NA |
| **DOSE RATE (R/hr)** | ≤15 mR/hr | 49 | 374<br>457<br>(E) | 46, Page 5<br>46, page 9<br>(E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 and Room 1130 (Reference 29, Page 283).

B. The design flood level for Room 1103 is 41.64 inches based on the isolation of the break in 40 minutes and is acceptable since it is below the level of the lowest safety related equipment whose functionality would be adversely affected. Per Reference 53, Appendix 2, Page 9, BGLT0104 is the lowest identified safety related equipment in this room. It is ~ 44 inches (3.66 ft) above the floor grade.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F This room contains components with greater than (>) 4.4 wt. % (7000 PPM) boric acid solution and should be maintained at min. 75°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-11 Auxiliary Building HELB Temperature (Rooms 1115, 1116 & 1117)

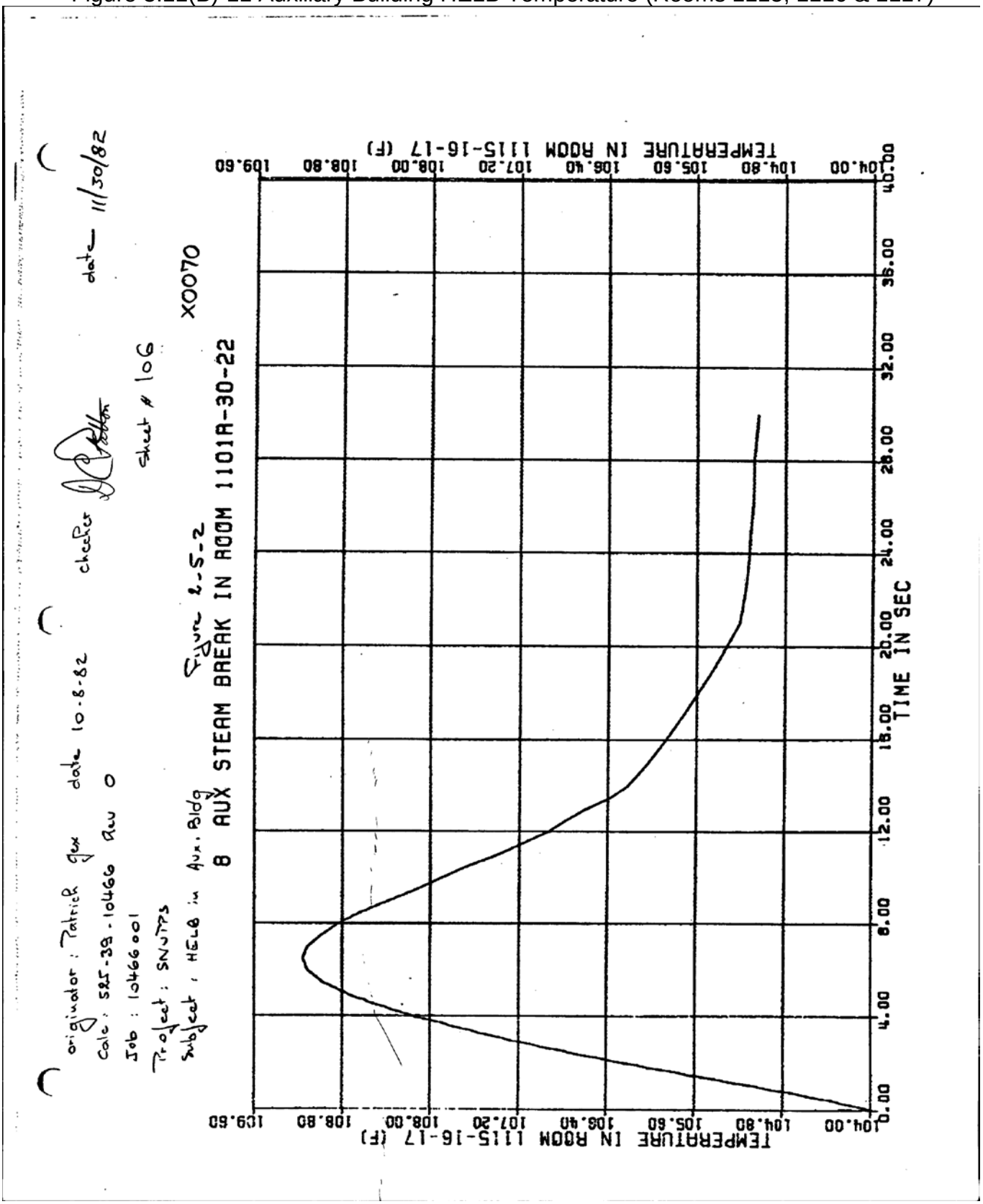
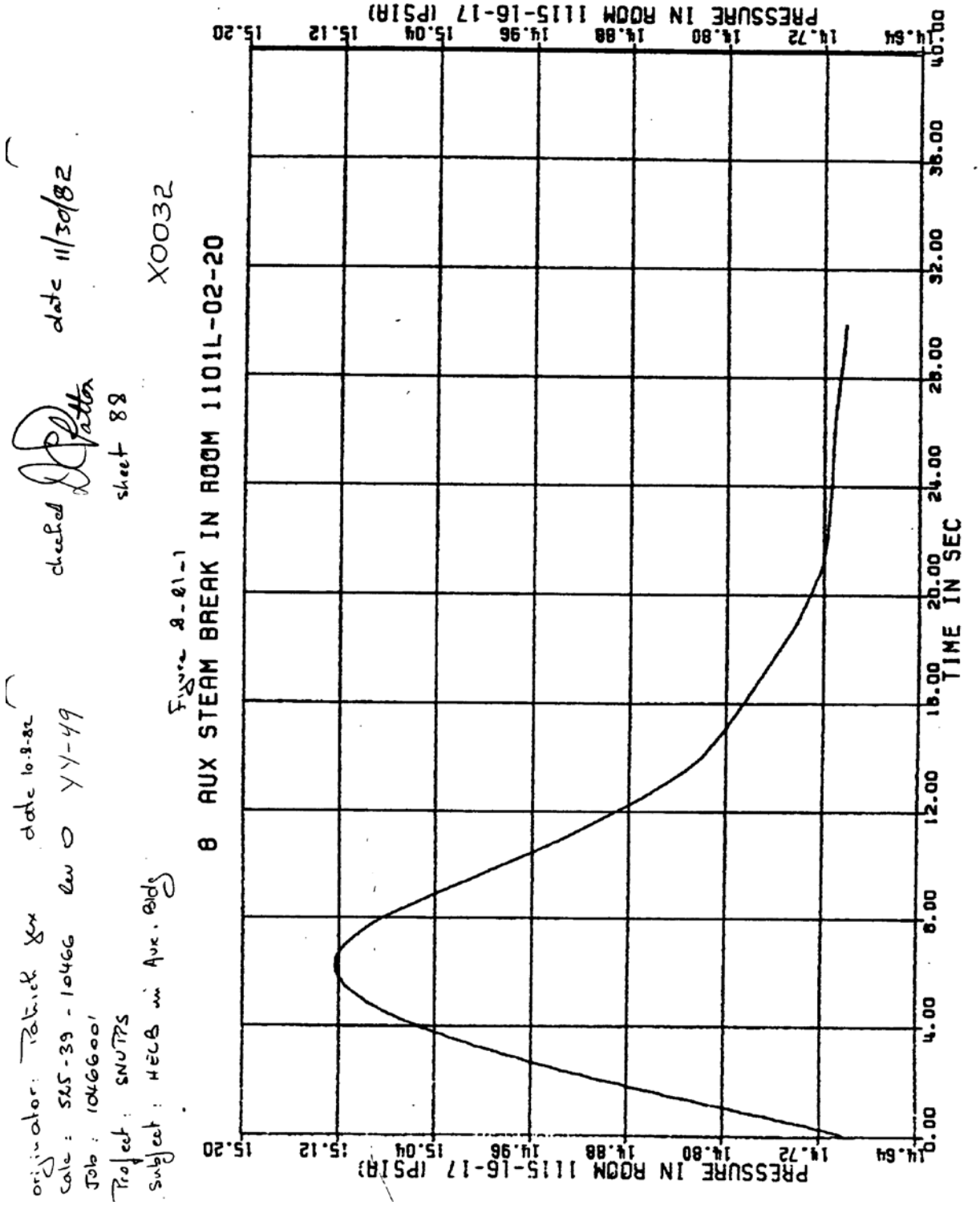


Figure 3.11(B)-27A Auxiliary Building HELB Pressure (Rooms 1115, 1116 & 1117)

**Note:** Reference 29, page 247 & 270 identify that the maximum pressure is 15.76 psia, but no figure is provided. The following figure is the pressure from the HELB worst temperature case.



**BUILDING: AUXILIARY** **ROOM NUMBER 1119**
**ROOM DESCRIPTION: SOUTH STAIRWELL A-1**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 106.5 (A) | 29, Page 163 |
| **PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 166, 247 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29 |
| **INTEGRATED DOSE (RADS)** | 1314 | 49 & (D) | 1220<br>6230<br>(E) | 46, Page 5<br>46, page 9<br>(E) | (C) | NA |
| **DOSE RATE (R/hr)** | ≤2.5 mR/hr | 49 | 57.2<br>70<br>(E) | 46, Page 5<br>46, page 9<br>(E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | N/A (B) | 56, Page 8 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to 8" Auxiliary Steam Line Break in Room 1301/ 1320 Reference 29, 163 (Room 1119 is Room 11 on the figure).

B. There is no safety related electrical equipment in this room.

C. The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

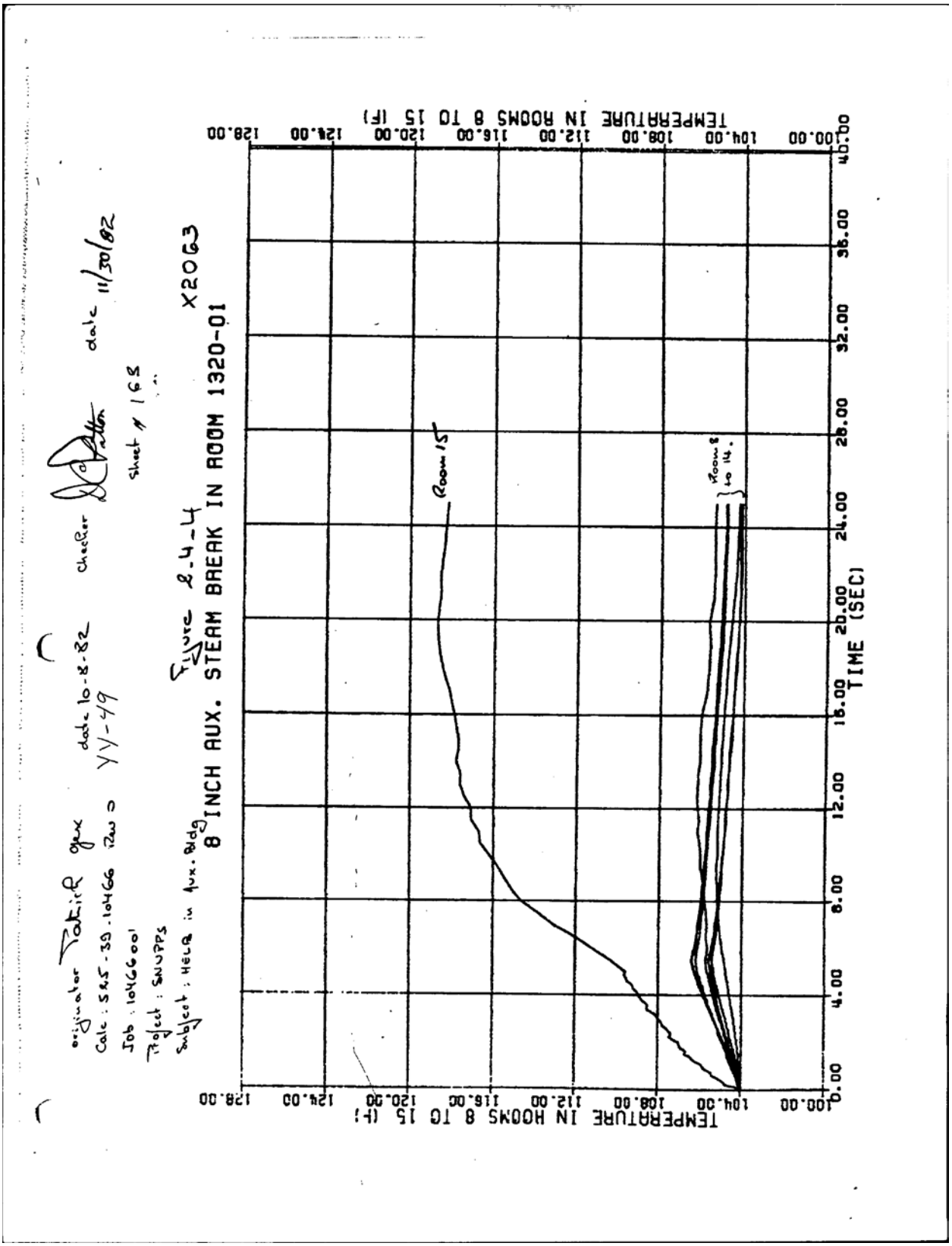
D. The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

E This room contains components with greater than or equal to (≥) 4.0 wt. % (7000 ppm), but less than or equal to (≤) 4.4 wt. % (7000 ppm) boric acid solution should be maintained at min. 65°F.

**REFERENCE**

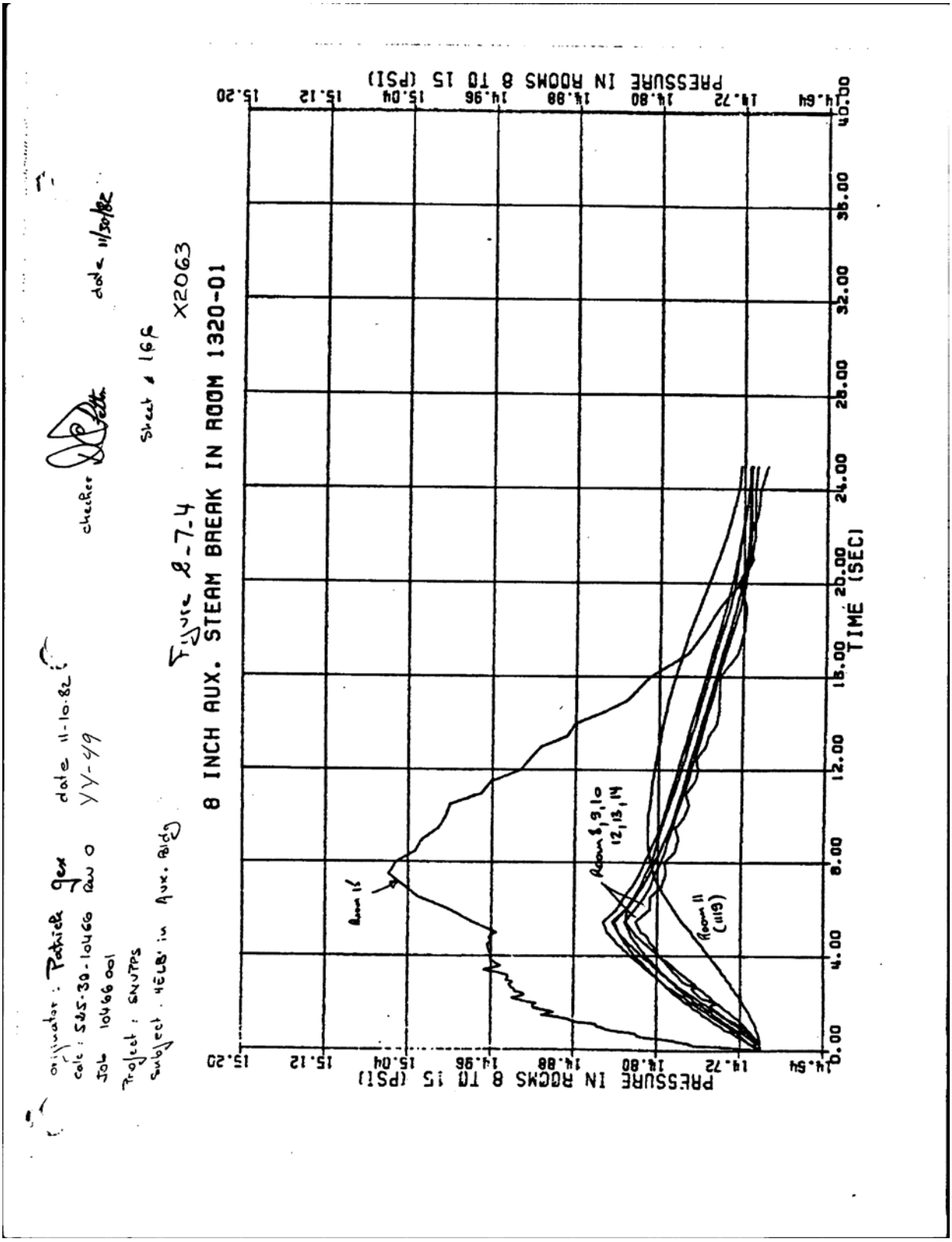
28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
56. Calculation FL-04

Auxiliary Building HELB Temperature Room 1119 (Room 11)



## Auxiliary Building HELB Pressure Room 1119 (Room 11)

**Note:** Reference 29, page 247 & 270 identify that the maximum pressure is 15.76 psia for most rooms, but no figure is provided. The following figure is the pressure from the worst case HELB temperature case.



**BUILDING: AUXILIARY** **ROOM NUMBER 1120**
**ROOM DESCRIPTION: ELEVATION 1974 GENERAL FLOOR AREA NO. 2** (E)

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 140.5 (A) | 29, Pages 71, 283 |
| **PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 271 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 49 & (C) | $1.40X10^5$<br>$7.17x10^5$<br>(D) | 46, Page 6<br>46, page 10<br>(D) | NE | NA |
| **DOSE RATE (R/hr)** | ≤2.5 mR/hr | 49 | $6.57x10^3$<br>$8.04x10^3$<br>(D) | 46, Page 6<br>46, page 10<br>(D) | NE | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1102 (Reference 29, Page 71).

B. The design flood level for Room 1120 is 41.64 inches based on the isolation of the break in 40 minutes and is acceptable since it is below the level of the lowest safety related equipment whose functionality would be adversely affected. Per Reference 53, Appendix 2, Page 11 conduits 4J1042 & 4J1046 are the lowest identified safety related equipment in this room. They are ~89.5 inches (7.45 ft) above the floor grade.

C. The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

E No EQ equipment is installed in this room per Reference 29, page 249.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-8 Auxiliary Building HELB Temperature (Rooms 1101-left, 1102, 1120 & 1121)

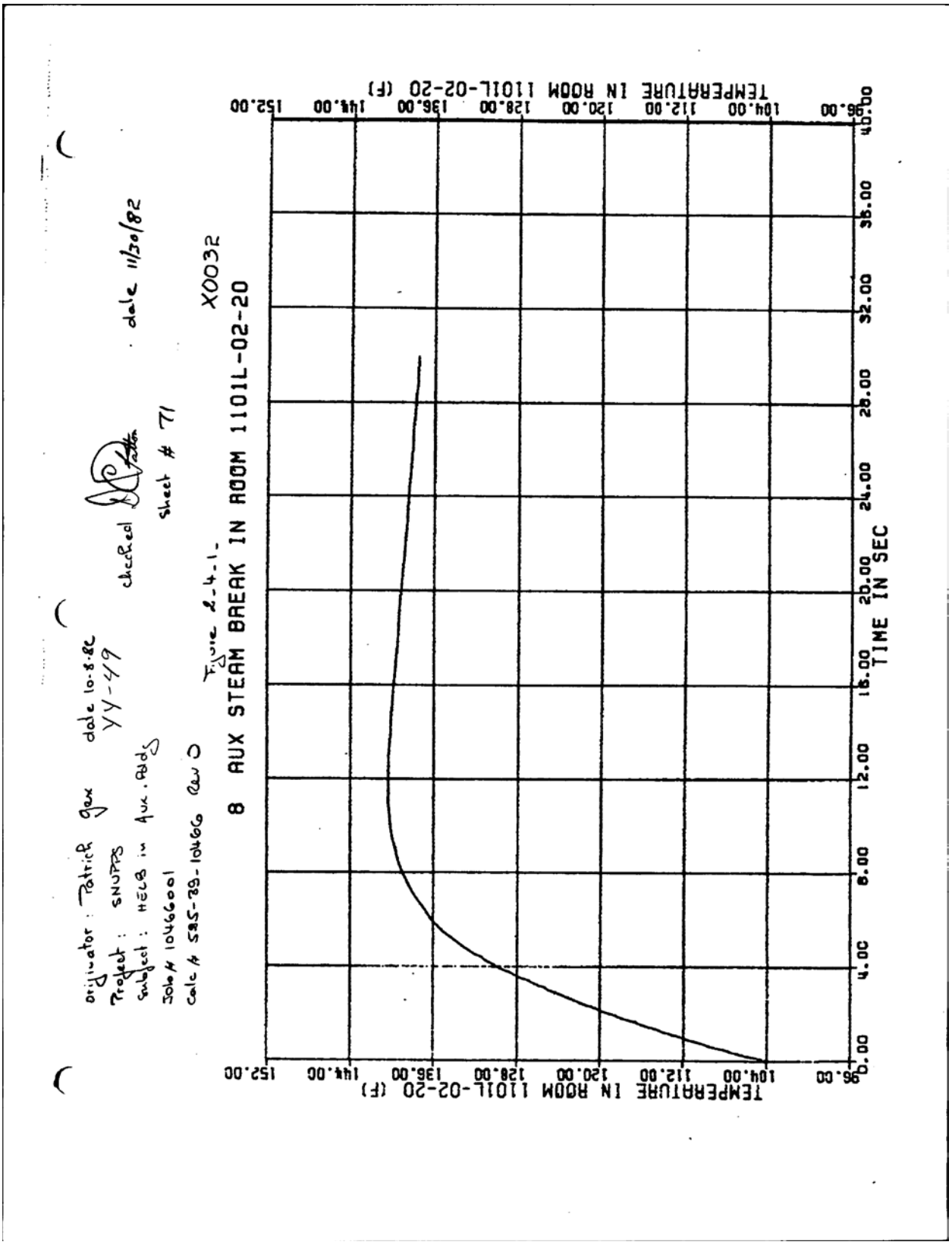
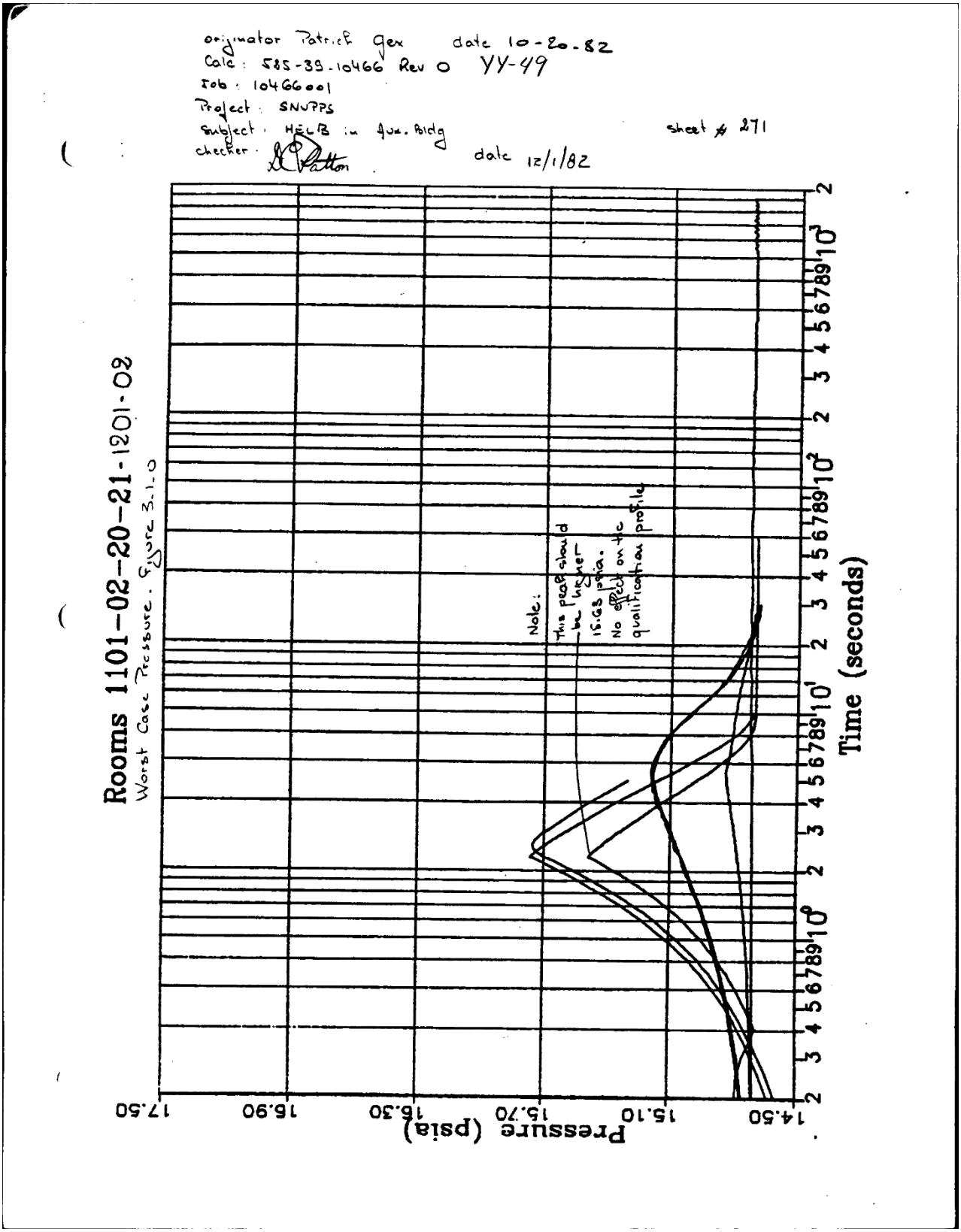


Figure 3.11(B)-26 Auxiliary Building HELB Pressure (Rooms 1101, 1102, 1120 & 1121)



**BUILDING: AUXILIARY** **ROOM NUMBER 1121**
**ROOM DESCRIPTION: ELEVATION 1974 ECCS PUMP ROOM ACCESS PIT**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 140.5 (A) | 29, Pages 71, 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 271 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29, Page 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 49 & (C) | $4.83 \times 10^6$ $2.47 \times 10^7$ (D) | 46, page 6 46, page 10 (D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤2.5 mR/hr | 49 | $2.26 \times 10^5$ $2.76 \times 10^5$ (D) | 46, page 6 46, page 10 (D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 10.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1102 (reference 29, page 71).

B. The design flood level for Room 1121 is 125.64 inches based on the isolation of the break in 40 minutes and is acceptable as there is no safety related equipment that could be adversely affected. Therefore, the flood level satisfies the requirement of 10CFR50 Appendix A, General Design Criteria 4, the safety related equipment is protected against the effects of flooding from a postulated pipe failure.

C. The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-8 Auxiliary Building HELB Temperature (Rooms 1101-left, 1102, 1120 & 1121)

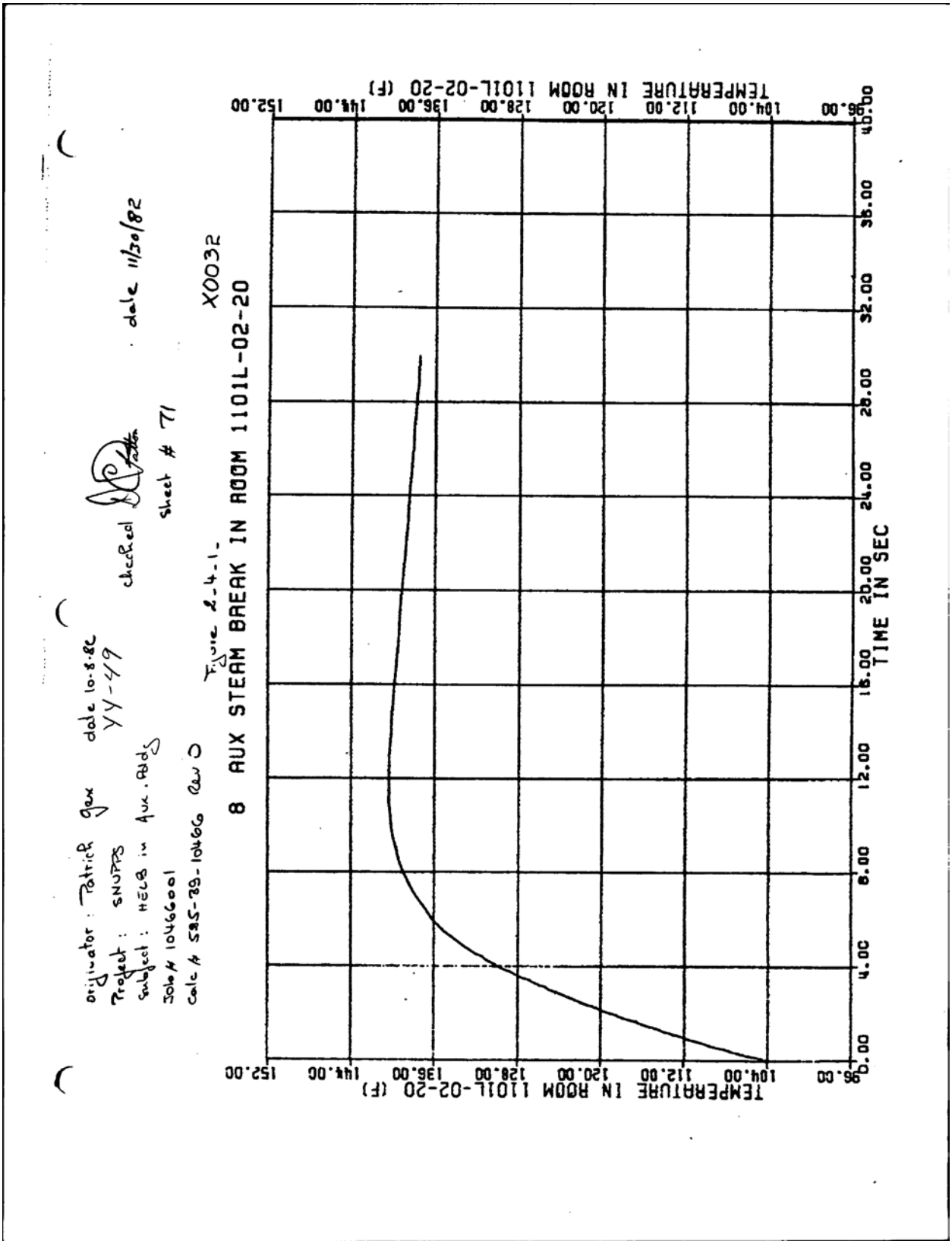
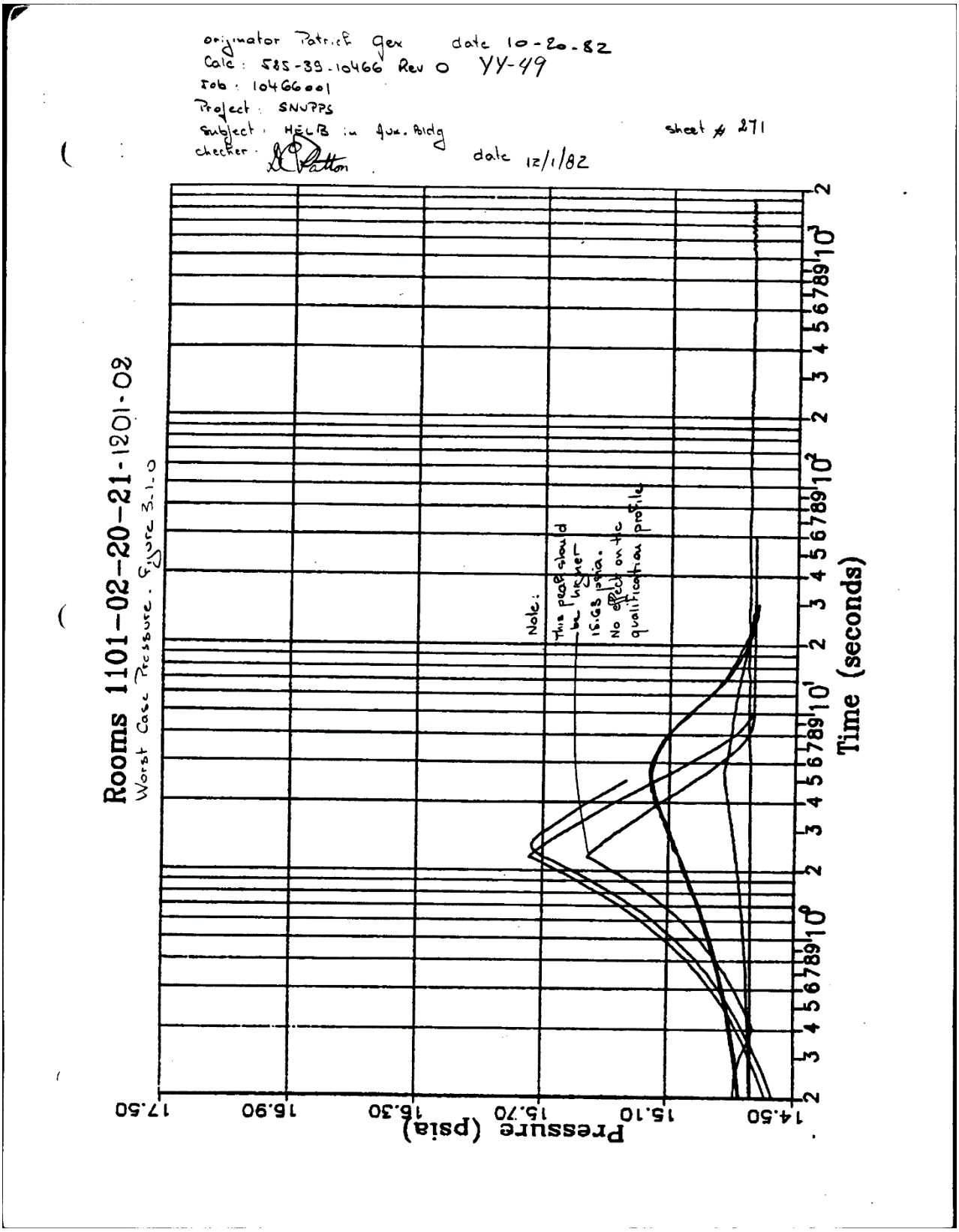


Figure 3.11(B)-26 Auxiliary Building HELB Pressure (Rooms 1101, 1102, 1120 & 1121)



**BUILDING: AUXILIARY** **ROOM NUMBER 1122**
**ROOM DESCRIPTION: ELEVATION 1974 GENERAL FLOOR AREA NO. 3**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 133.3 (A) | 29, Page 102, 252 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 245, 270 & 275 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 49 & (C) | $1.43x10^5$<br>$7.28x10^5$<br>(D) | 46, page 6<br>46, page 10<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤2.5 mR/hr | 49 | $6.67x10^3$<br>$8.16x10^3$<br>(D) | 46, page 6<br>46, page 10<br>(D) | (NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1130 (Reference 29, Page 283).

B. The design flood level for Room 1122 is 41.64 inches based on the isolation of the break in 40 minutes and is acceptable since it is below the level of the lowest safety related equipment whose functionality would be adversely affected.
Per Reference 53, Appendix 2, Page 13 an unidentified electrical conduits and the associated junction box are the lowest identified safety related equipment in this room. They are ~ 80.5 inches (6.70 ft) above the floor grade.

C The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**


28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-9A Auxiliary Building HELB Temperature Rooms 1122 & 1130

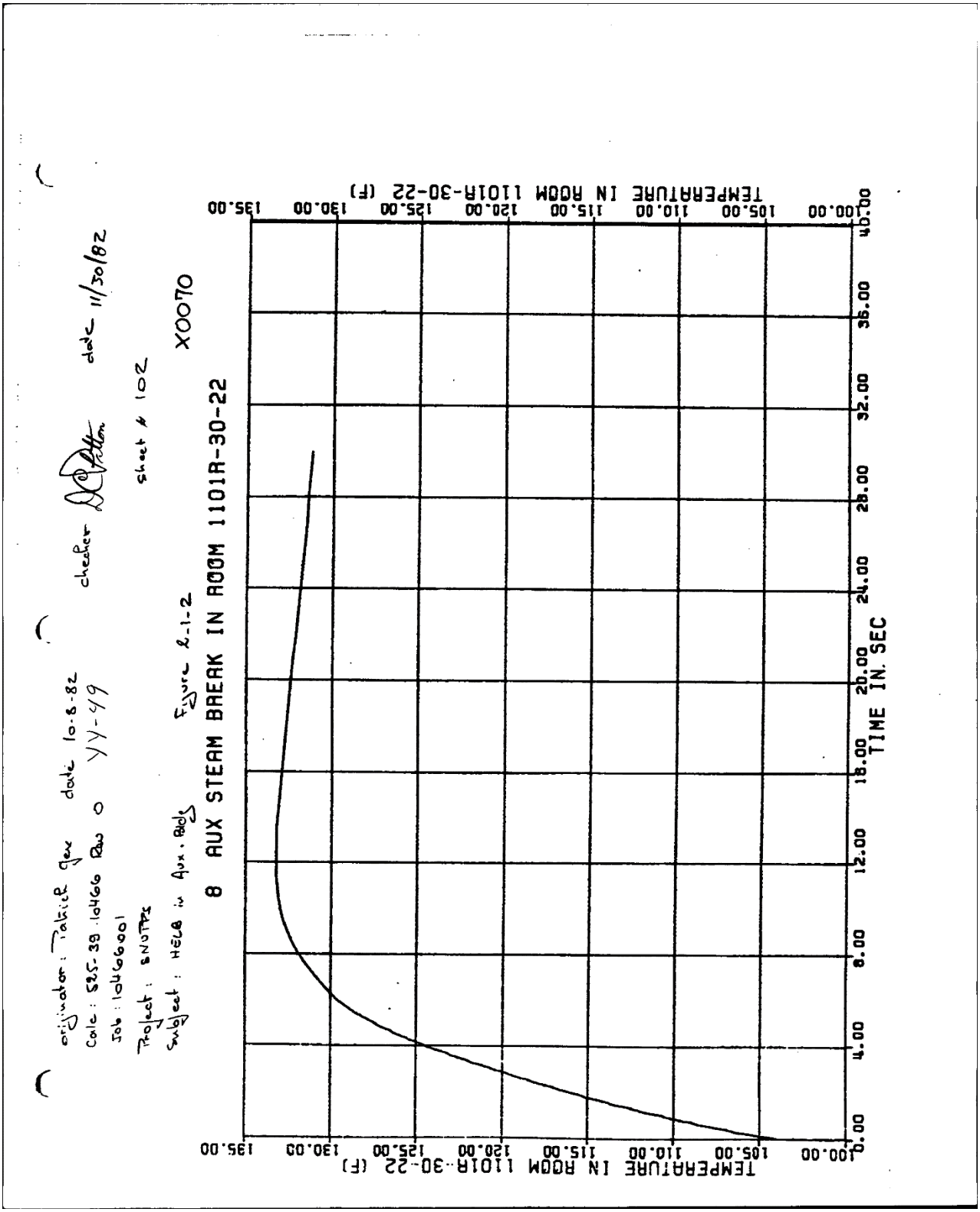
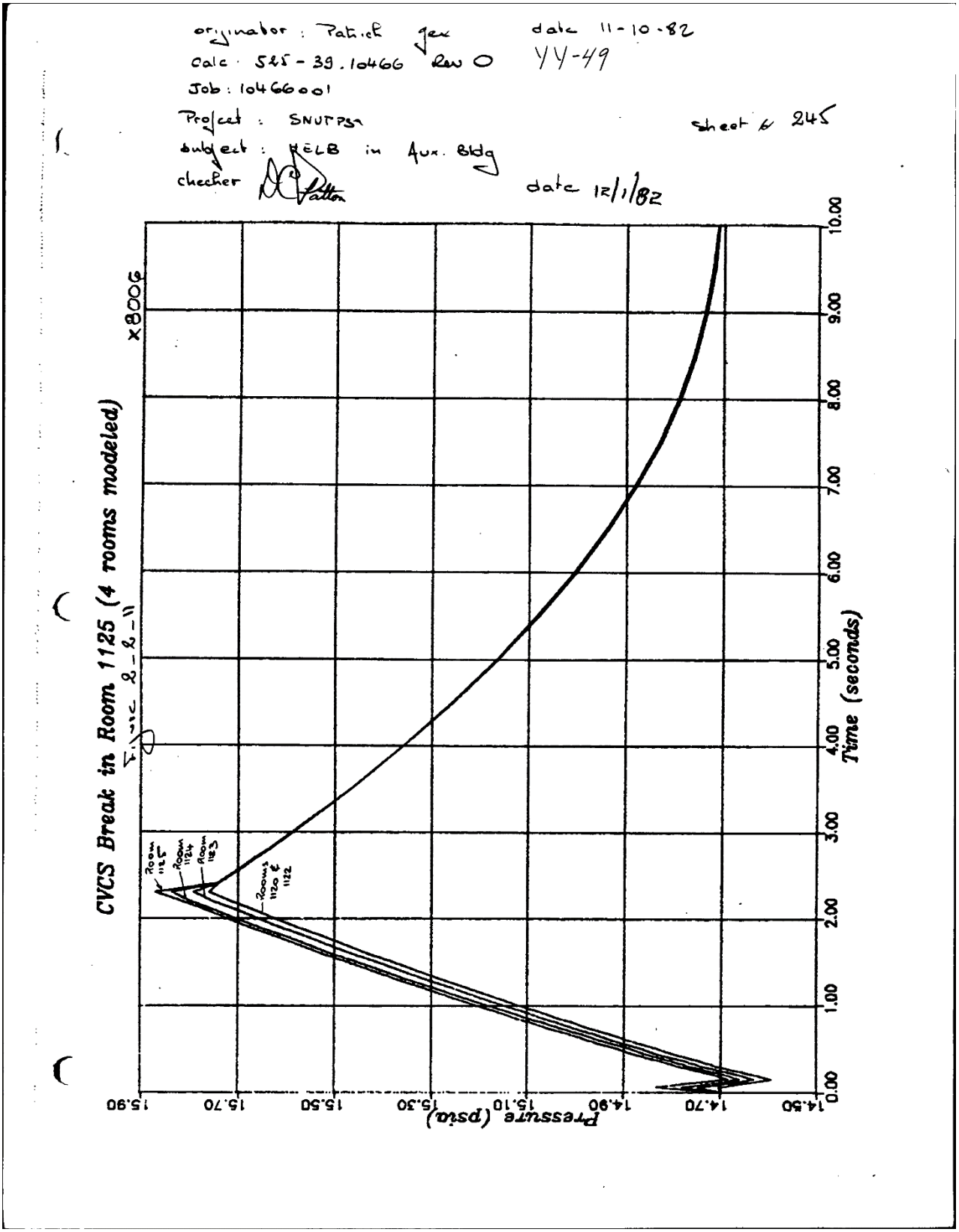


Figure 3.11(B)-30 Auxiliary Building HELB Pressure (Rooms 1122, 1128, 1129, 1130, 1206 and 1207)



**BUILDING: AUXILIARY** **ROOM NUMBER 1123**
**ROOM DESCRIPTION: ELEVATION 1974 LETDOWN HEAT EXCHANGER AREA PASSAGE**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| PEAK TEMPERATURE (°F) | 104 | 28, Page 2-8 | NE | N/A | 215 (A) | 29, Page 237<br>57, Page 5 |
| PEAK PRESSURE (PSIG) | ATM | NA | NE | N/A | 1.17 | 29, Page 245<br>57, Page 5 |
| HUMIDITY (%) | 70 | 28, Page 2-8 | NE | N/A | 100 | 29 |
| INTEGRATED DOSE (RADS) | 7884 | 49 & (D) | $2.77 \times 10^3$ | 47, Page 2 | NE | N/A |
| DOSE RATE (R/hr) | ≤15 mR/hr | 49 | 25.4 | (C) | NE | N/A |
| MAX. FLOOD LEVEL (FT) (above the floor) | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to a 3" CVCS letdown line break in Room 1124 (Case 10, Reference 29, Page 231). Reference 57 page 5 identifies that Room 1124 (Case 10, reference 29) provides the bounding temperature profile and RM 1125 (Case 11, reference 29) provides the bounding pressure profile for Room 1123.

B. Per Reference 53, Appendix 2, Page 14, room 1123 does not contain safety related equipment.

C The dose rate was calculated by dividing the integrated dose by the following multiplication factors 21.36, 3.6 & 1.42. These factors were obtained from Calculations XX-43 (Reference 46), XX-45 (Reference 45) & XX-F-014 (Reference 48) respectively.

E The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
47. Calculation XX-47
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01
57. Calculation YY-57

Figure 3.11(B)-42 Auxiliary Building HELB Temperature (Rooms 1123 through 1125)

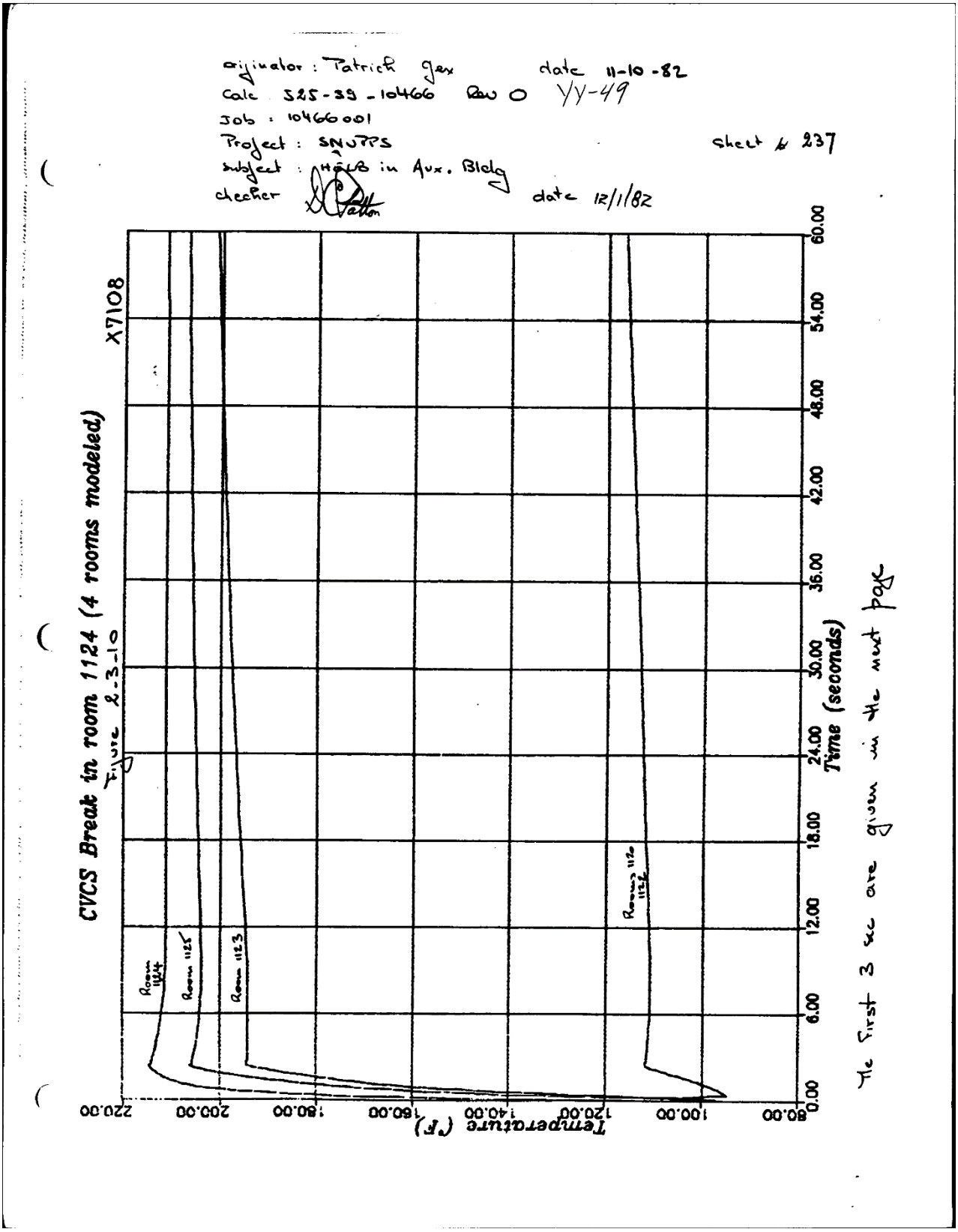
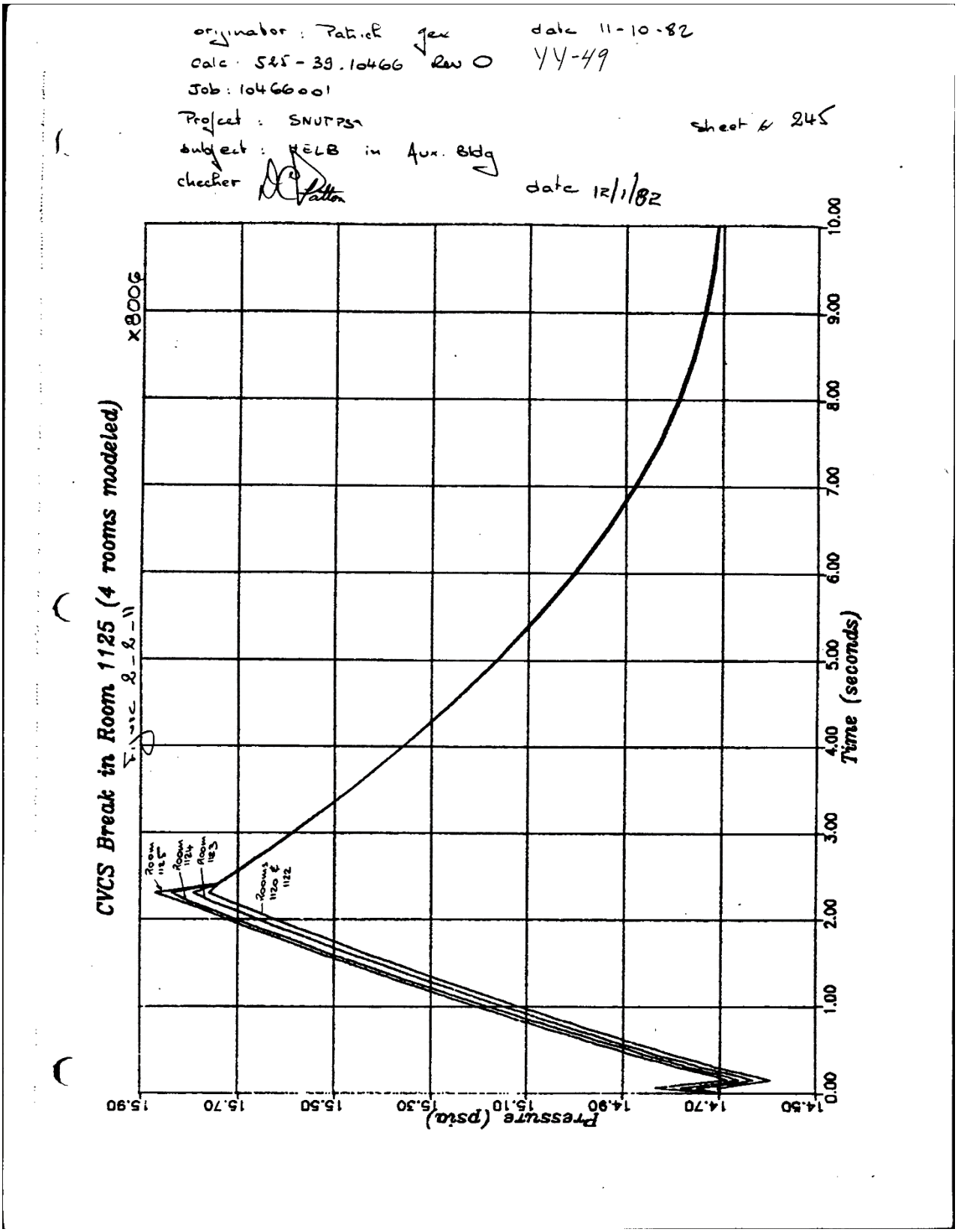


Figure 3.11(B)-44 Auxiliary Building HELB Pressure (Rooms 1123 through 1125)



**BUILDING: AUXILIARY** **ROOM NUMBER 1124**
**ROOM DESCRIPTION: ELEVATION 1974 LETDOWN HEAT EXCHANGER VALVE COMPARTMENT**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 215 (A) | 29, Page 237 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.14 | 29, Page 245 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49 & (D) | 459<br>$2.34 \times 10^3$<br>(E) | 46, page 6<br>46, page 10<br>(E) | (C) | (C) |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | 21.5<br>26.3<br>(E) | 46, page 6<br>46, page 10<br>(E) | (C) | (C) |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to a 3" CVCS letdown line break in Room 1124 (Reference 29, Page 231).

B. Per Reference 53, Appendix 2, Page 15, room 1124 does not contain safety related equipment.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

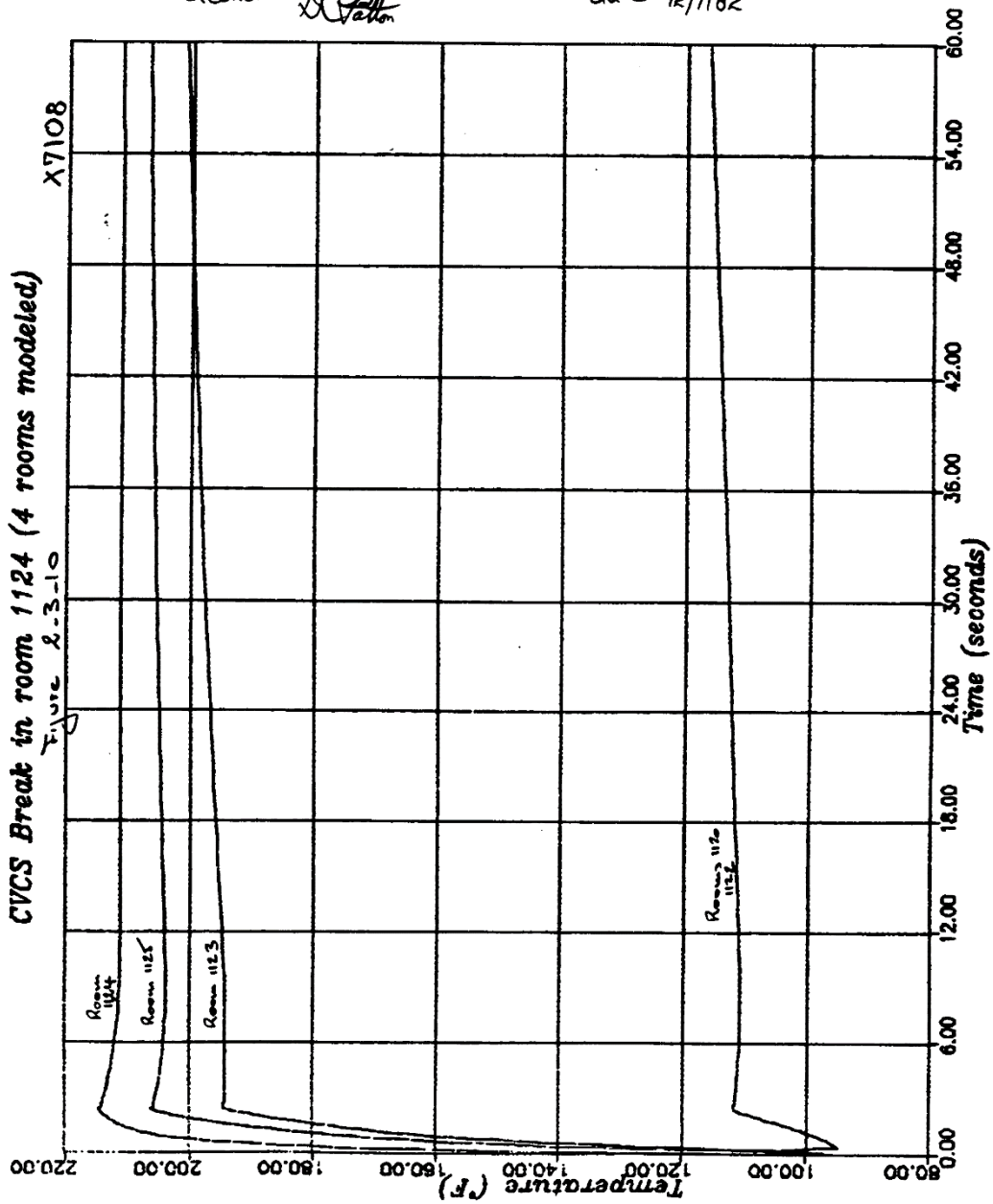
E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

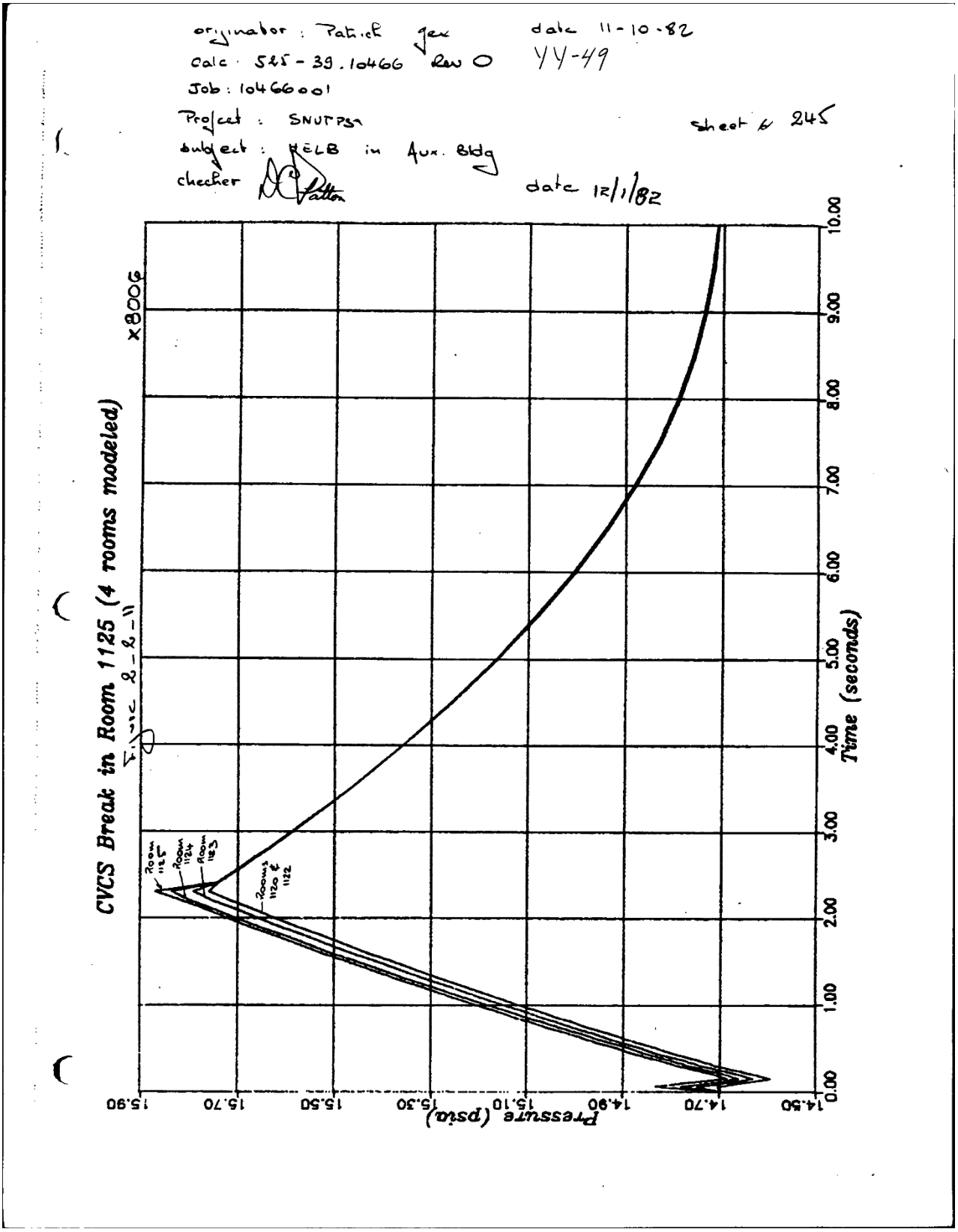
Figure 3.11(B)-42 Auxiliary Building HELB Temperature (Rooms 1123 through 1125)

originator : Patrick gex date 11-10-82
Calc 525-39-10466 Rev 0 YY-49
Job : 10466001
Project : SNUPPS sheet # 237
subject : HELB in Aux. Bldg
checker date 12/1/82




The first 3 sec are given in the next page

Figure 3.11(B)-44 Auxiliary Building HELB Pressure (Rooms 1123 through 1125)



**BUILDING: AUXILIARY** **ROOM NUMBER 1125**
**ROOM DESCRIPTION: ELEVATION 1974 LETDOWN HEAT EXCHANGER ROOM**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 215 (A) | 29, Page 244 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.17 | 29, Page 245 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49 & (D) | 459<br>$2.34 \times 10^3$<br>(E) | 46, page 6<br>46, page 10<br>(E) | (C) | (C) |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | 21.5<br>26.3<br>(E) | 46, page 6<br>46, page 10<br>(E) | (C) | (C) |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to a 3" CVCS letdown line break in Room 1125 (Reference 29, Page 241).

B. Per Reference 53, Appendix 2, Page 16, room 1125 does not contain safety related equipment.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-417
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-42 Auxiliary Building HELB Temperature (Rooms 1123 through 1125)

originator : Patrick gex date 11-10-82
calc : 525-39-10466 Rev 0 YY-49
Job : 10466001
Project : SNUPPS sheet # 244
subject : HELB in Aux. Bldg
checker date 12/1/82

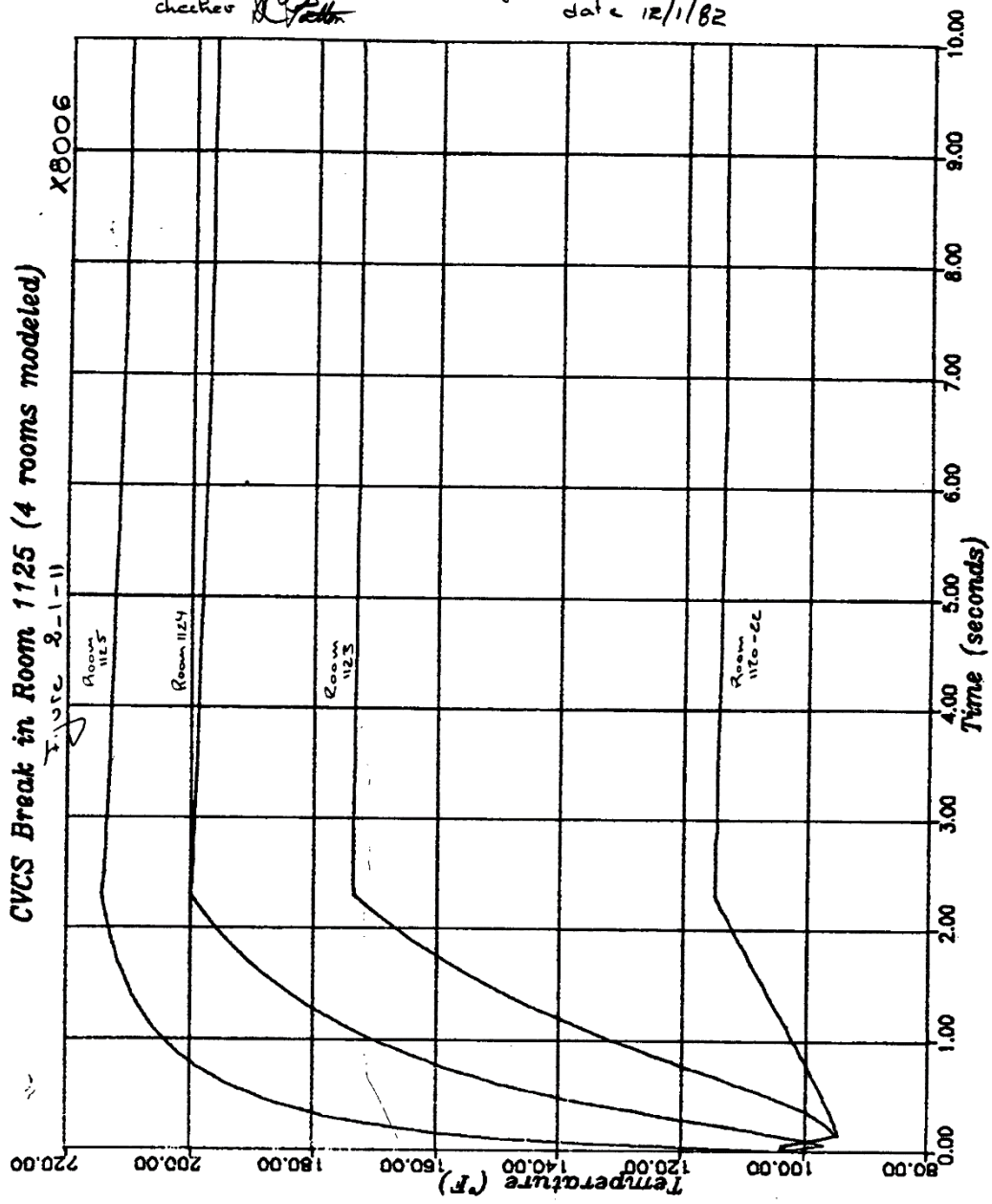
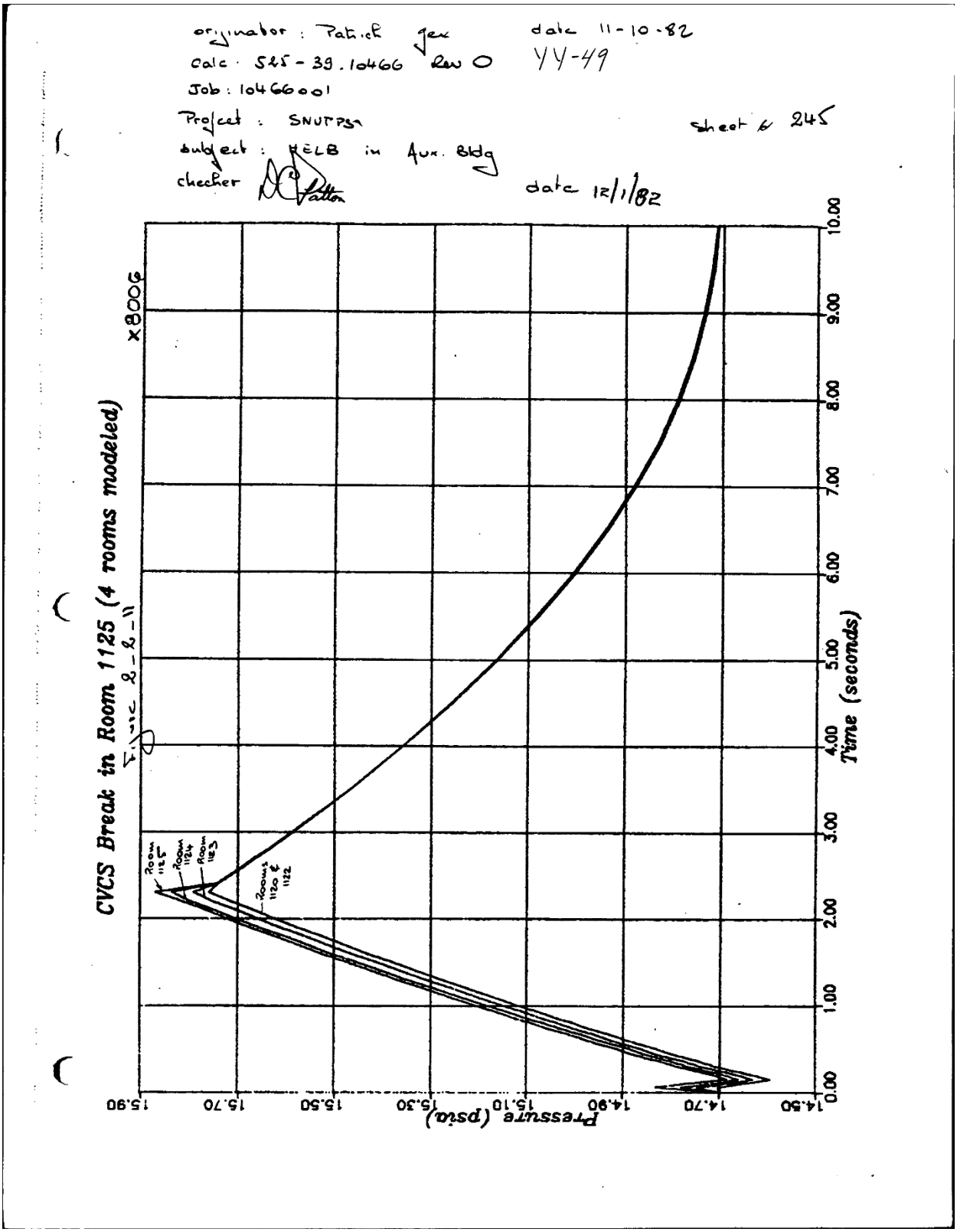


Figure 3.11(B)-44 Auxiliary Building HELB Pressure (Rooms 1123 through 1125)



**BUILDING: AUXILIARY** **ROOM NUMBER 1126**
**ROOM DESCRIPTION: ELEVATION 1974 BORON INJECTION TANK & PUMP ROOM**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 109.9 (A) | 29, Pages 107, 252 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 270, 273,-247 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 81 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 49 & (D) | $6.84 \times 10^5$<br>$3.49 \times 10^6$<br>(E) | 46, page 6<br>46, page 10<br>(E) | (C) | (C) |
| **DOSE RATE (R/hr)** | ≤2.5 mR/hr | 49 | $3.20 \times 10^4$<br>$3.91 \times 10^4$<br>(E) | 46, page 6<br>46, page 10<br>(E) | (C) | (C) |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 39.26 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1130 (Reference 29, Pages 283).

B. The design flood level for Room 1126 is 471.1 inches, based on isolation of the break in 40 minutes. This exceeds the lowest safety related electrical equipment in the room which is located approximately 20 inches above the floor grade. The HELB flooding source is contained with this room, and all safety related equipment in this room is related to the Boron Injection Tank (BIT) HELB. Therefore the potential flooding hazard from a break in this line is inconsequential as it will have no net effect on any safety related equipment not related to the BIT.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F This room contains components with greater than or equal to (≥) 4.0 wt. % (7000 ppm), but less than or equal to (≤) 4.4 wt. % (7000 ppm) boric acid solution should be maintained at min. 65°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
55. Calculation FL-03

Figure 3.11(B)-12 Auxiliary Building HELB Temperature Room 1126

originator : Patrick Gen date 10-6-82
calc : 525-39-10466 Rev 0
Job : 10466001
Project : SNUPPS
subject : HELB in Aux. Bldg
checker date 11/30/82
sheet # 107
X0070

Figure 2-6-2
8 AUX STEAM BREAK IN ROOM 1101A-30-22

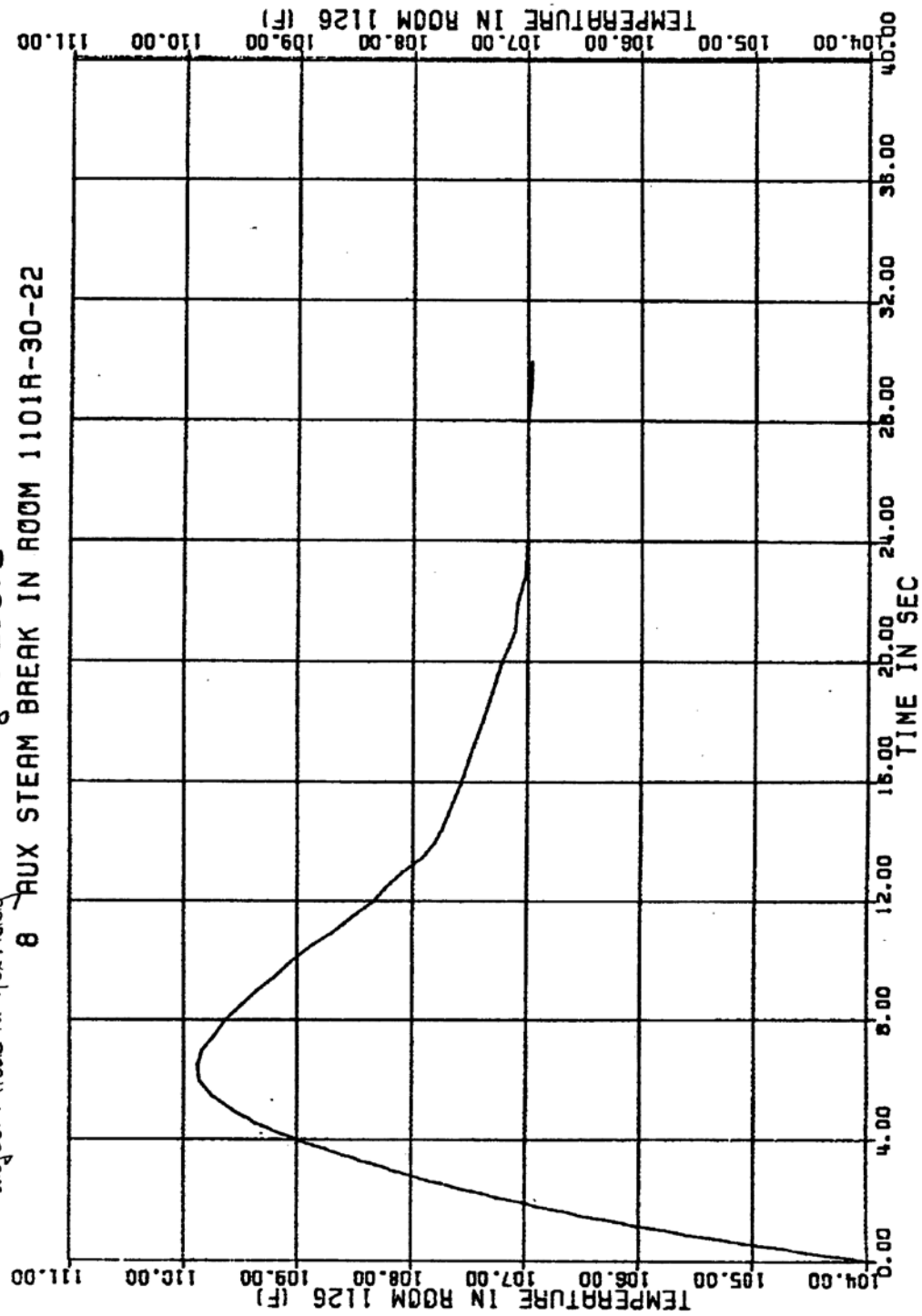
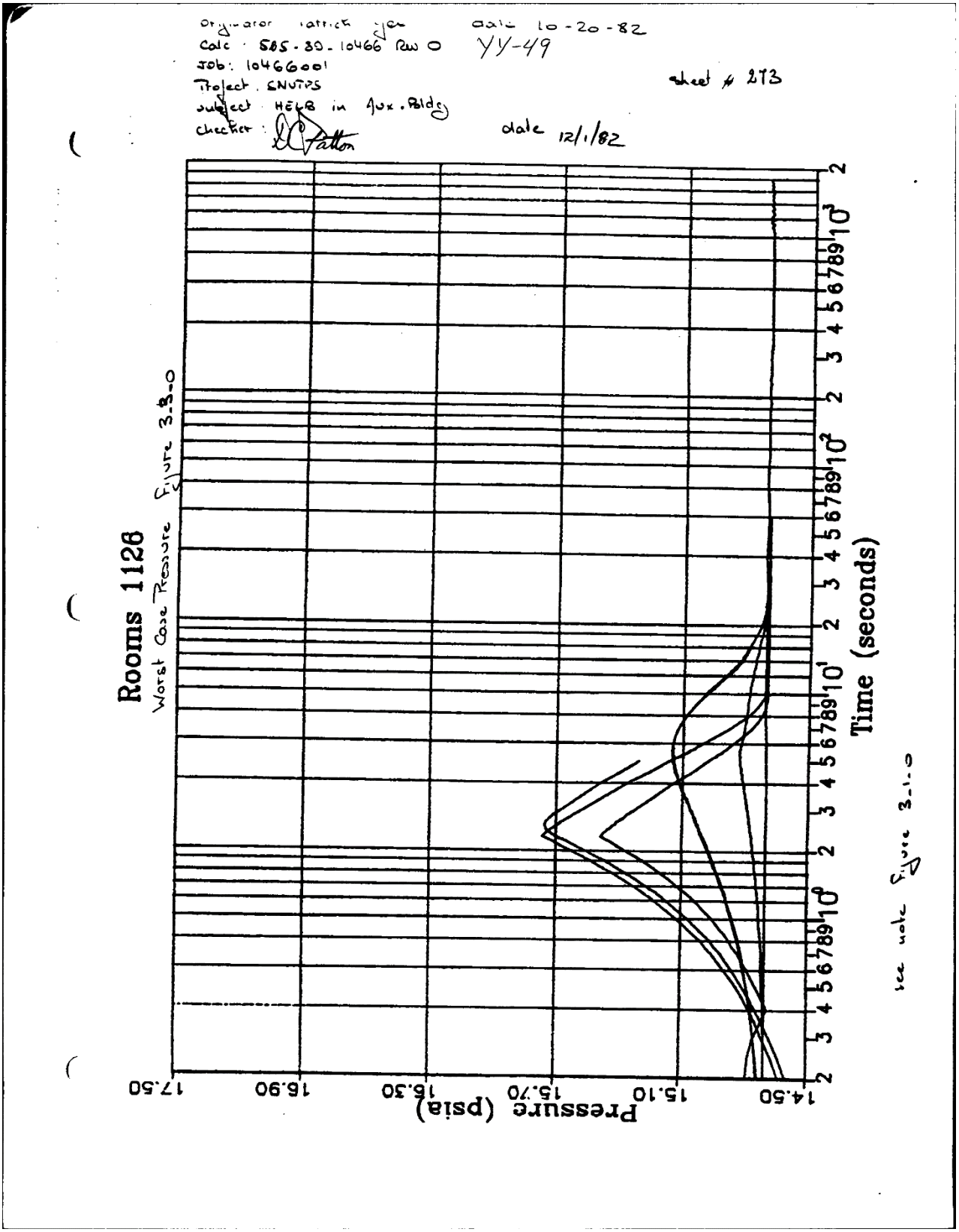


Figure 3.11(B)-28 Auxiliary Building HELB Pressure Room 1126



**BUILDING: AUXILIARY** **ROOM NUMBER 1127**
**ROOM DESCRIPTION: NORTH STAIRWELL A-2**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 107.1 (A) | 29, Pages 254 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 274 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 49 & (C) | $3.93 \times 10^4$ $2.03 \times 10^5$ (D) | 46, page 6 46,page 10 (D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤2.5 mR/hr | 49 | $1.84 \times 10^3$ $2.25 \times 10^3$ (D) | 46, page 6 46,page 10 (D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 15.55 (B) | 53 page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 (Reference 29, Pages 283). There is no temperature profile for this room as noted on page 283 this room was not modeled for the break individually, however a conservative high value was used.

B. The design flood level for Room 1127 is 186.60 inches based on the worst case flood flow rate and is acceptable since it is below the level of the lowest safety related electrical equipment whose functionality would be adversely affected.
Per reference 53, Appendix 2, Page 17 the lowest safety related electrical equipment in this room is conduit 4J3C1E and associated RCP out flow indicator EGFT0062. The indicator was measured at 25 inches below the 2004 foot elevation line, which places the indicator at 27.9 feet above floor grade.

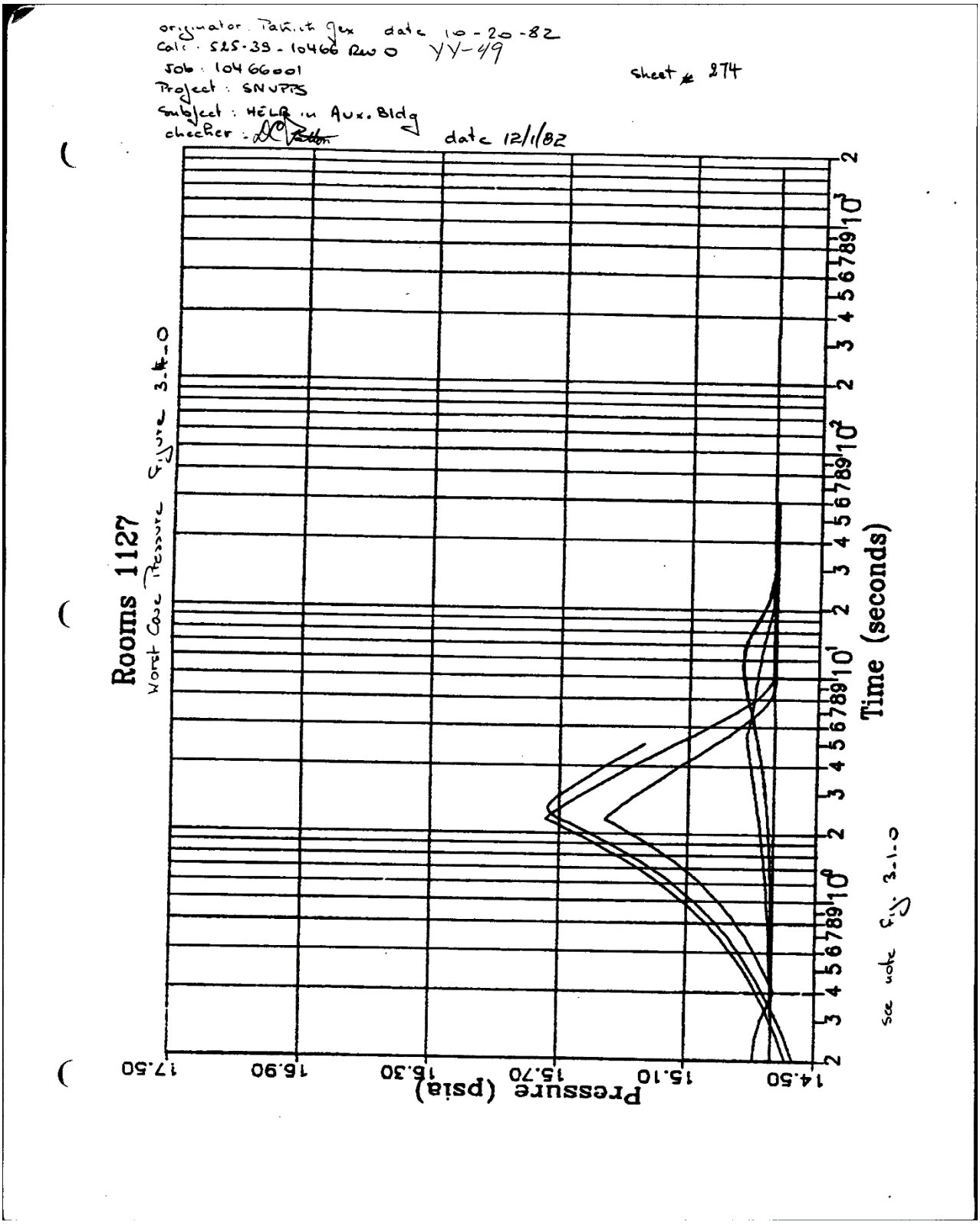
C The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-29 Auxiliary Building HELB Pressure (Room 1127)



**BUILDING: AUXILIARY** **ROOM NUMBER: 1128**
**ROOM DESCRIPTION: ELEVATION 1974 AUXILIARY FEEDWATER SUMP ROOM**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 144 (A) | 82, Page 28 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 275 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 82, Page 30 |
| **INTEGRATED DOSE (RADS)** | 263 | 49 & (C) | 7480<br>$3.82 \times 10^4$<br>(D) | 46, page 6<br>46, page 10<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤0.5 mR/hr | 49 | 350<br>428<br>(D) | 46, page 6<br>46, page 10<br>(D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to a break in Line 054-HBD-4 at the Aux Steam Deaerator Feed Pump Discharge in room 1129. Reference 82 Case 2 identifies the peak accident temperature; Case 1 (Appendix 1, page 25) shows an accident temperature that does not peak as high but exists over a longer extend time by reaches 134F in 8 hours.

B. Per Reference 53, Appendix 2, Page 19 this room does not contain any safety related electrical equipment.

C The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01
82. Calculation FB-M-002

Figure 3.11(B)-9 Auxiliary Building HELB Temperature Rooms 1128, 1129, 1206 and 1207



### 6.2 Case #2 – Line 054-HBD-4 Line Break at Aux Steam Deaerator Feed Pump Discharge

Figure 6, Figure 7, and Figure 8 illustrate the temperature, pressure, and humidity responses for selected rooms for Case 2. The temperature for room 1129 peaks at 152.9°F at 241.2 seconds. The temperature for Room 1207 peaks at 110.8°F at 206.7 seconds. The peak room differential pressure is 0.5 psid.

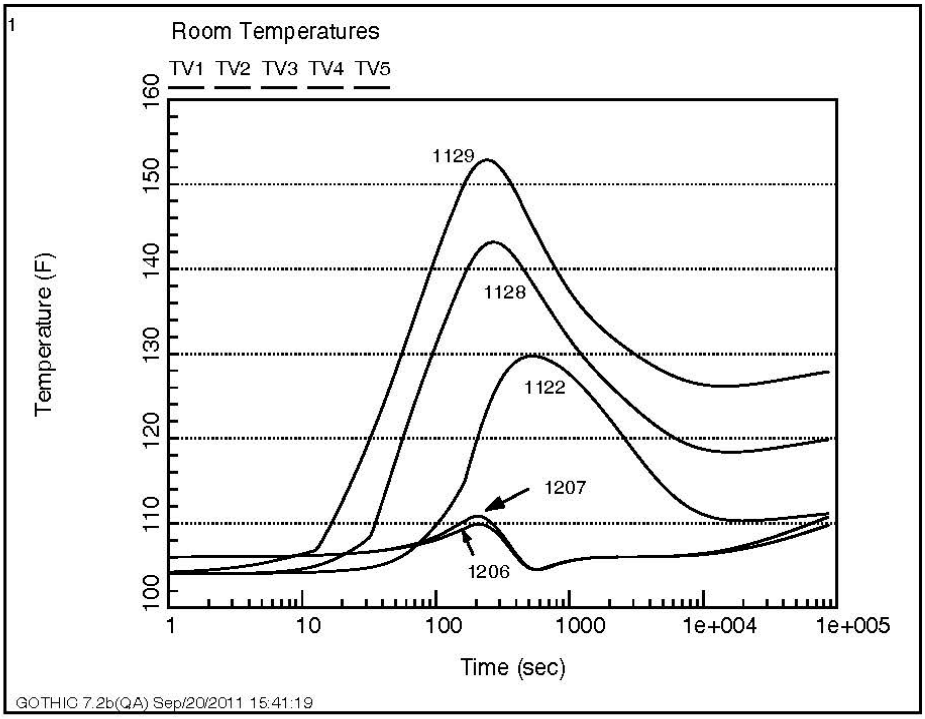
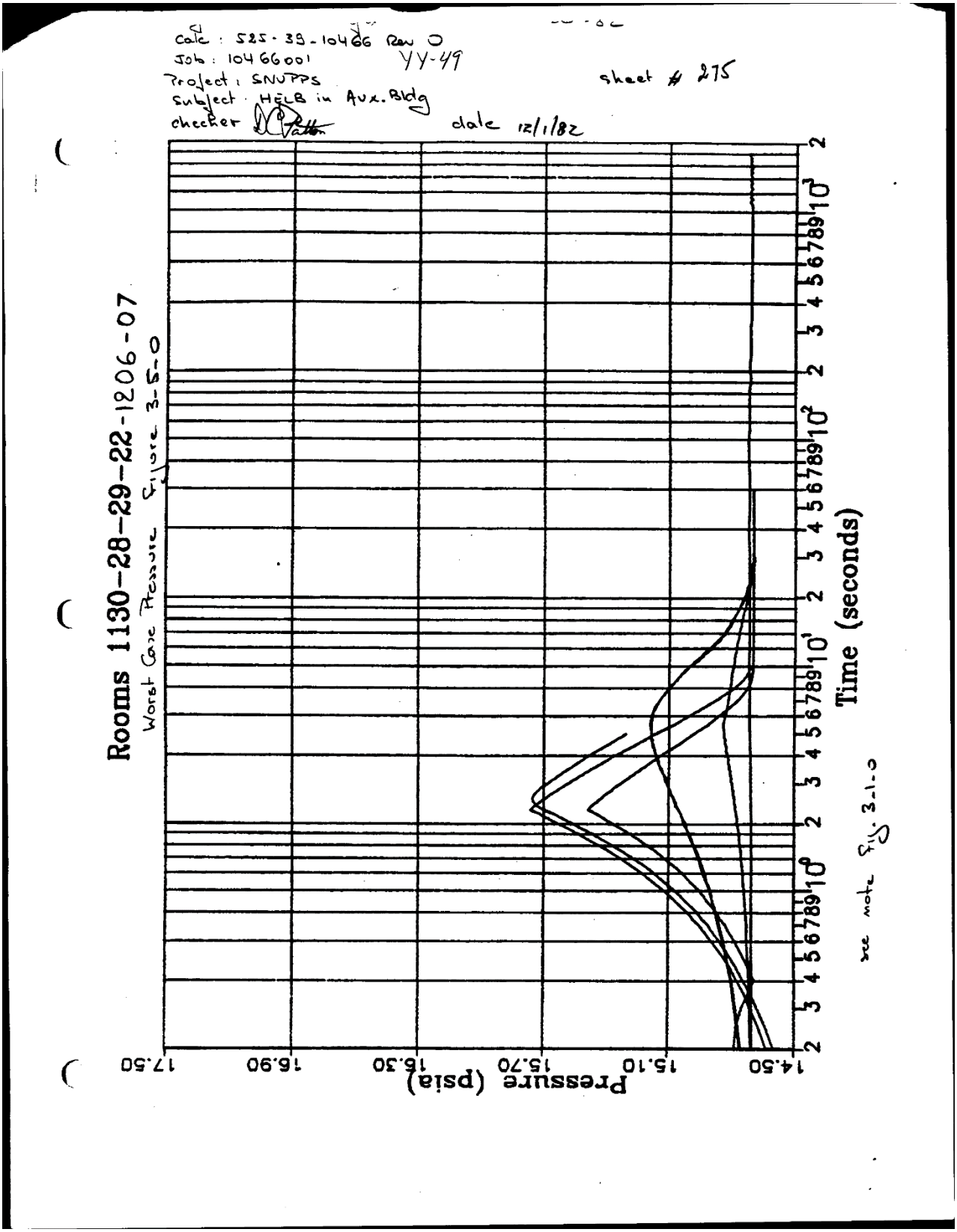



**Figure 6 Case 2 Room Temperatures**

Figure 3.11(B)-30 Auxiliary Building HELB Pressure (Rooms 1122, 1128, 1129, 1130, 1206 and 1207)



**BUILDING: AUXILIARY** **ROOM NUMBER: 1129**
**ROOM DESCRIPTION: ELEV. 1974 AUX. STEAM COND. RECOVERY & STORAGE TANK ROOM**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 153 (A) | 82, Page 28 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 275 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 82, Page 30 |
| **INTEGRATED DOSE (RADS)** | 263 | 49 & (C) | 7480<br>$3.82 \times 10^4$<br>(D) | 46, page 6<br>46, page 10<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤0.5 mR/hr | 49 | 350<br>428<br>(D) | 46, page 6<br>46, page 10<br>(D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to Line 054-HBD-4 Line Break at Aux Steam Deaerator Feed Pump Discharge. Reference 82 Case 2 identifies the peak accident temperature; Case 1 (Appendix 1, page 25) shows an accident temperature that does not peak as high but exists over a longer extend time by reaches 145F in 8 hours.

B. Per Reference 53, Appendix 2, Page 20 this room does not contain any safety related electrical equipment.

C The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01
82. Calculation FB-M-002

Figure 3.11(B)-9 Auxiliary Building HELB Temperature Rooms 1128, 1129, 1206 and 1207



### 6.2 Case #2 – Line 054-HBD-4 Line Break at Aux Steam Deaerator Feed Pump Discharge

Figure 6, Figure 7, and Figure 8 illustrate the temperature, pressure, and humidity responses for selected rooms for Case 2. The temperature for room 1129 peaks at 152.9°F at 241.2 seconds. The temperature for Room 1207 peaks at 110.8°F at 206.7 seconds. The peak room differential pressure is 0.5 psid.

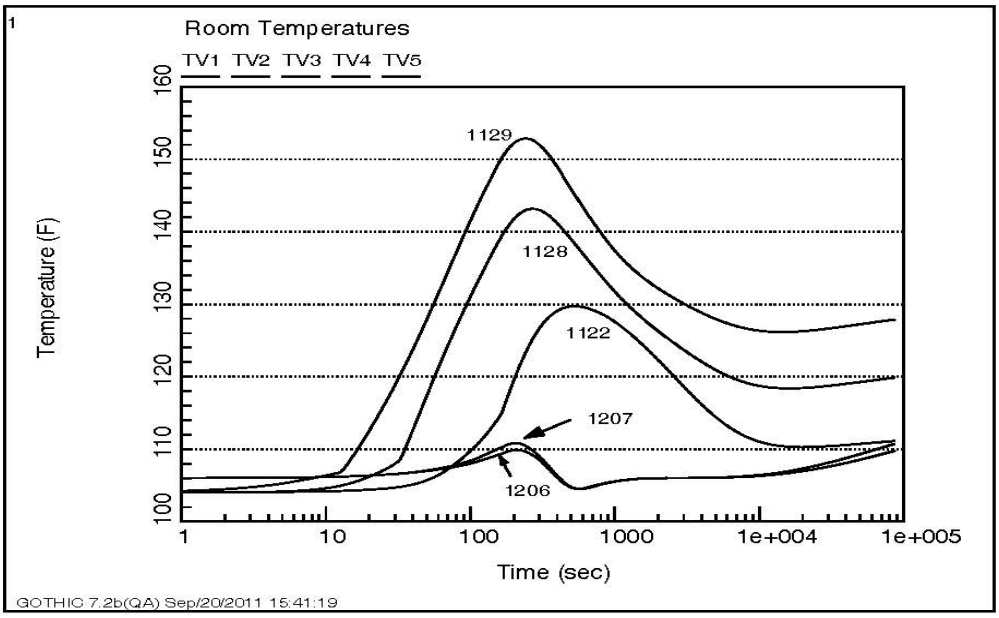
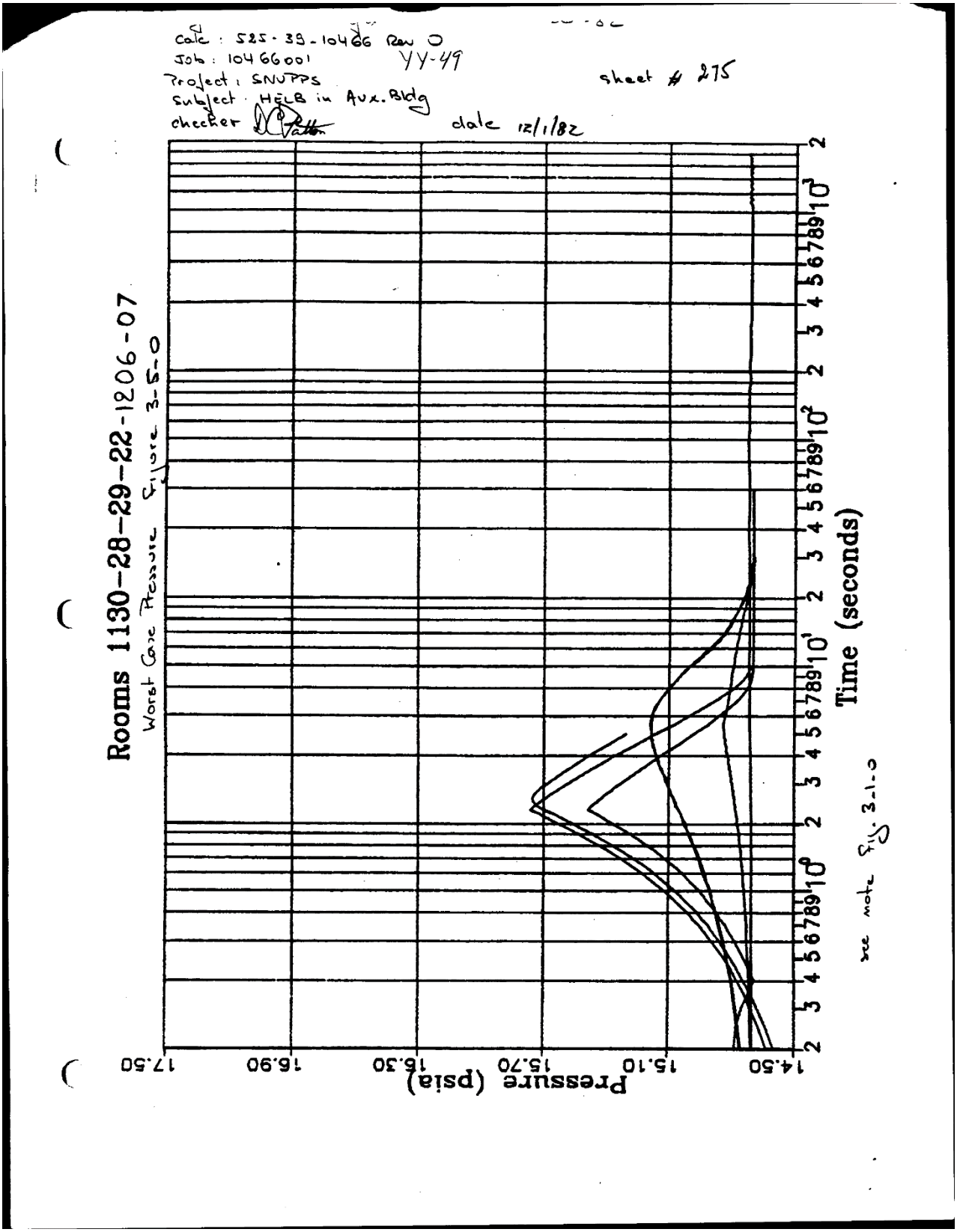



**Figure 6 Case 2 Room Temperatures**

Figure 3.11(B)-30 Auxiliary Building HELB Pressure (Rooms 1122, 1128, 1129, 1130, 1206 and 1207)



**BUILDING: AUXILIARY** **ROOM NUMBER 1130**
**ROOM DESCRIPTION: ELEVATION 1974 NORTH CORRIDOR** (C)

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 133.3 (A) (F) | 29, Pages 102, 252 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 275 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29 |
| **INTEGRATED DOSE (RADS)** | 1314 | 49 & (D) | 44.9<br>230<br>(E) | 46, page 6<br>46, page 10<br>(E) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤2.5 mR/hr | 49 | 2.1<br>2.57<br>(E) | 46, page 6<br>46, page 10<br>(E) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.47 (B) | 53, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1101 or Room 1130 (Reference 29, Pages 283).

B. Per Reference 53, Appendix 2, Page 21 this room does not contain any safety related electrical equipment.

C There is no EQ Equipment installed in this room, Reference 29, Page 252.

D The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F. On sheets 252 of YY-49 (Ref. 29) there is a statement saying that the temperature in room 1130 should be expected to reach a maximum local temperature of 300 °F and equipment in this room is qualified to this temperature. See room 1101 for explanation on sheets 248-249.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-9A Auxiliary Building HELB Temperature Room 1122 & 1130

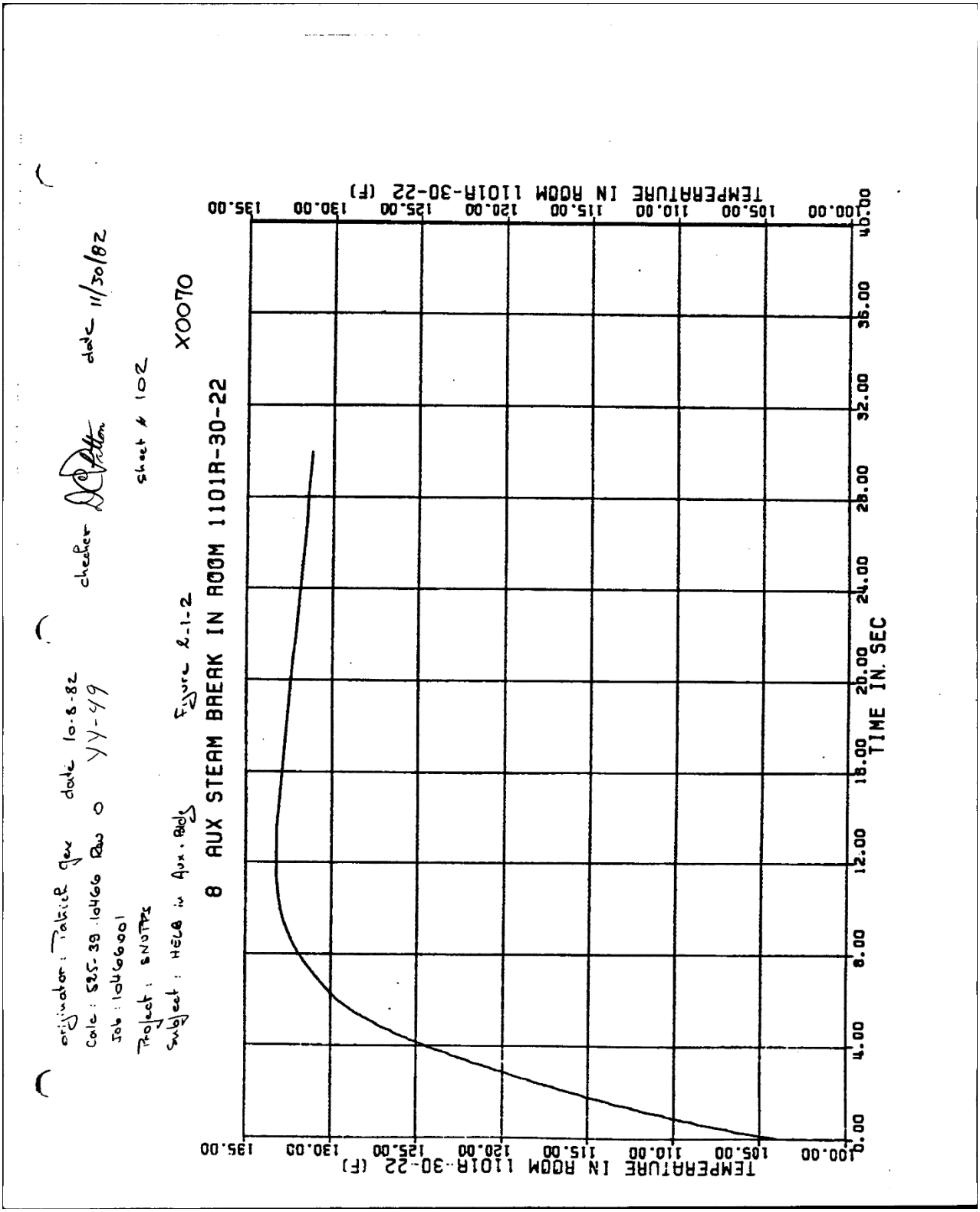
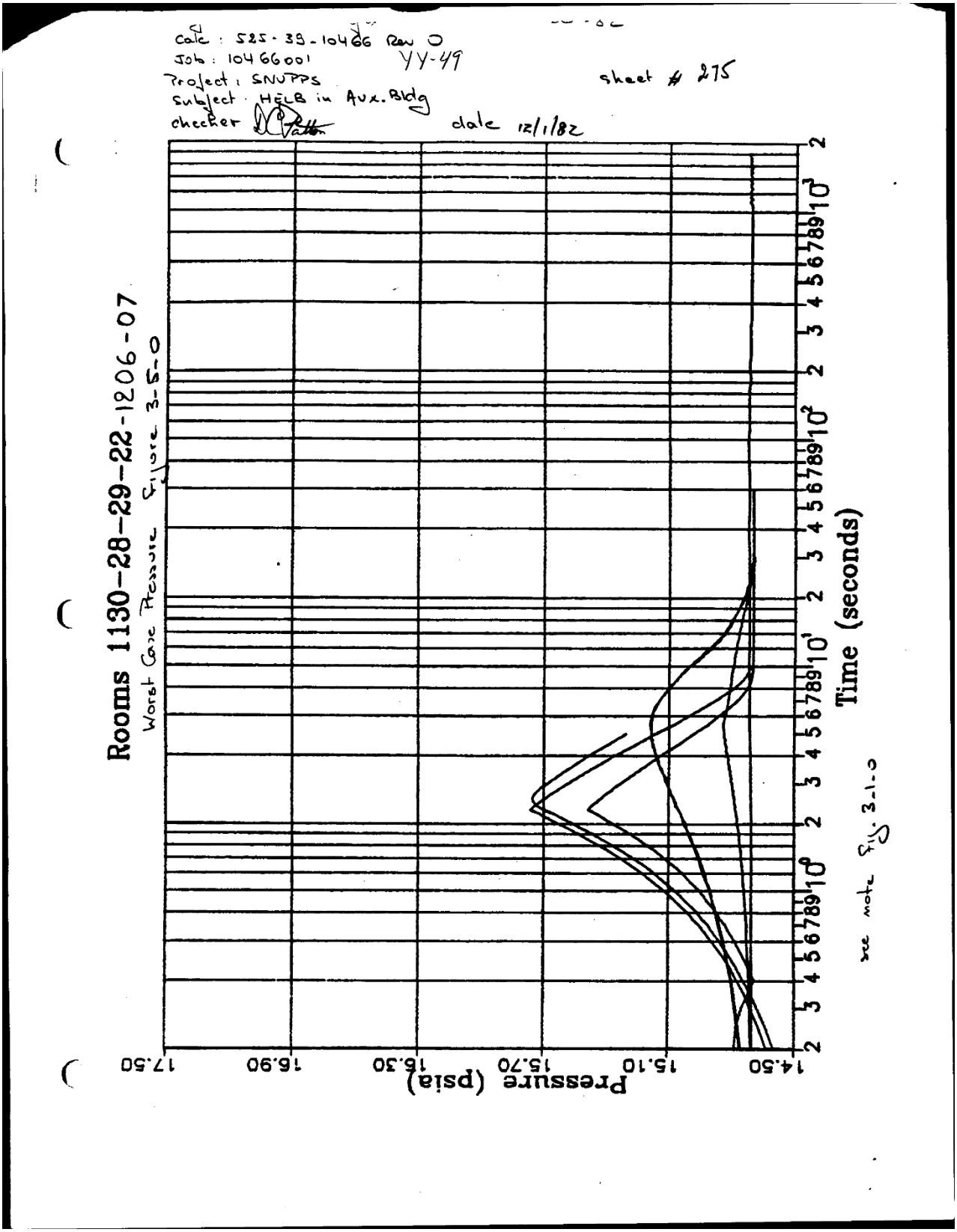


Figure 3.11(B)-30 Auxiliary Building HELB Pressure (Rooms 1122, 1128, 1129, 1130, 1206 and 1207)



**BUILDING: AUXILIARY** **ROOM NUMBER 1201**
**ROOM DESCRIPTION: ELEVATION 1988 VESTIBULE**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 142.6 (A) | 29, Pages 378 & 383 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 271 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 7884 | 49 & (C) | 769<br>3930<br>(D) | 46, page 6<br>46, page 10<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤15 mR/hr | 49 | 36<br>44<br>(D) | 46, page 6<br>46, page 10<br>(D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0<br>(B) | 53, Pages 11 & 12 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. A 3" break in CVCS in room 1202 results in the most severe temperature of 142.6ºF (Reference 29, Page 378 & 383).

B. The design flood level is 0 feet. Given that there is no water accumulation in this room, all safety related electrical equipment will not be affected from flooding effects

C. The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-14 Auxiliary Building HELB Temperature-Room 1 (Rooms 1201 & 1202 Compartment 3)

| JOB NUMBER | CALCULATION NUMBER | REV. NO. | SHEET NO. |
|---|---|---|---|
| 16577-232 | 525-39-10466 YY-49 | 1 | 383 |

| ORIGINATOR | DATE | CHECKED | DATE |
|---|---|---|---|
| F.M. Staszesky | 08/04/92 | [illegible] | 8-17-92 |

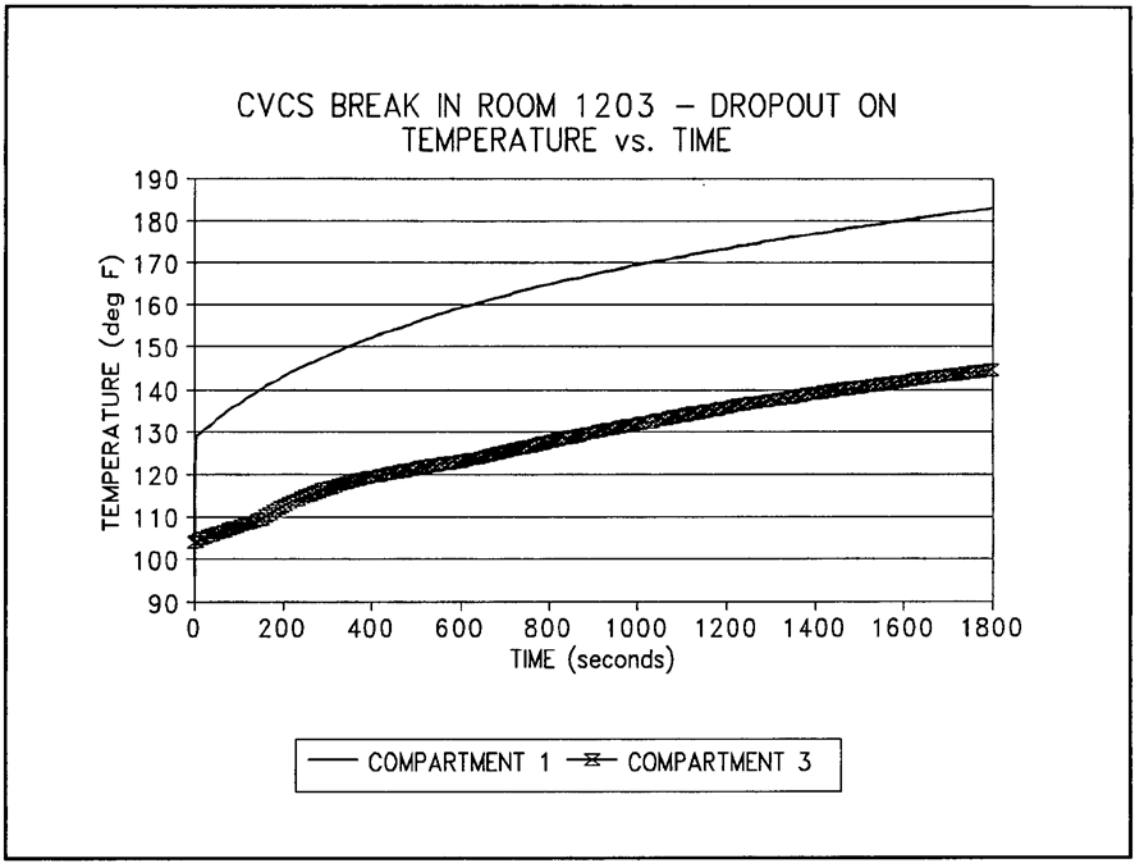
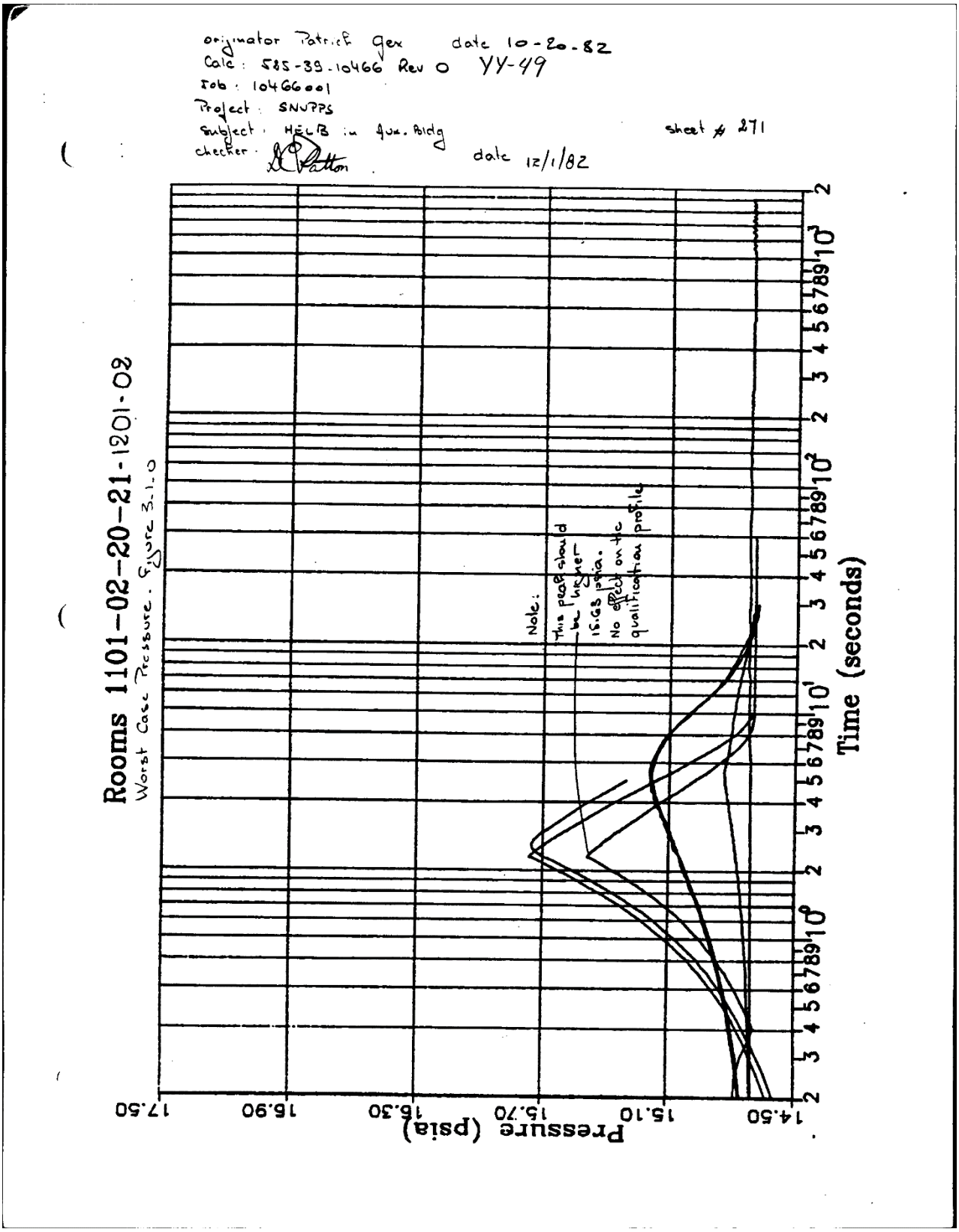



Figure A-36

Figure 3.11(B)-31 Auxiliary Building HELB Pressure (Rooms 1201 & 1202)



**BUILDING: AUXILIARY** **ROOM NUMBER 1202**
**ROOM DESCRIPTION: ELEV 1988 PIPE SPACE ACCESS AREA B & CHILLER SURGE TANK AREA**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 96 | 17, Table 1 | NE | N/A | 142.6 (A) | 29, Pages 378 & 383 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 271 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 7884 | 49 & (C) | 769<br>3930<br>(D) | 46, page 6<br>46, page 10<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤15 mR/hr | 49 | 36<br>44<br>(D) | 46, page 6<br>46, page 10<br>(D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (B) | 53, Pages 11 & 12 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. A 3" break in CVCS in room 1202 results in the most severe temperature of 142.6ºF (Reference 29, Page 378 & 383).

B. The design flood level is 0 feet. Given that there is no water accumulation in this room, all safety related electrical equipment will not be affected from flooding effects.

C The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

17. SLNRC 84-0013
28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01

Figure 3.11(B)-14 Auxiliary Building HELB Temperature-Room 1 (Rooms 1201 & 1202 Compartment 3)

| JOB NUMBER | CALCULATION NUMBER | REV. NO. | SHEET NO. |
|---|---|---|---|
| 16577-232 | 525-39-10466 YY-49 | 1 | 383 |

| ORIGINATOR | DATE | CHECKED | DATE |
|---|---|---|---|
| F.M. Staszesky | 08/04/92 | [illegible] | 8-17-92 |

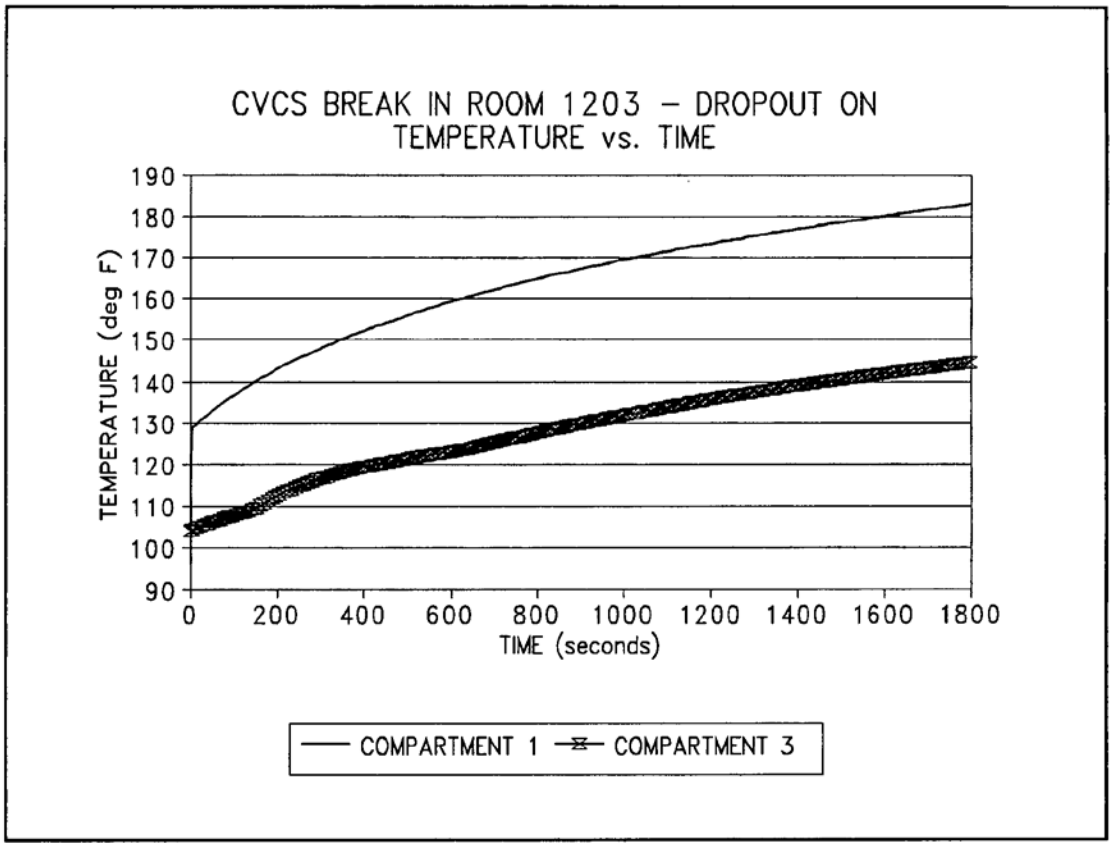
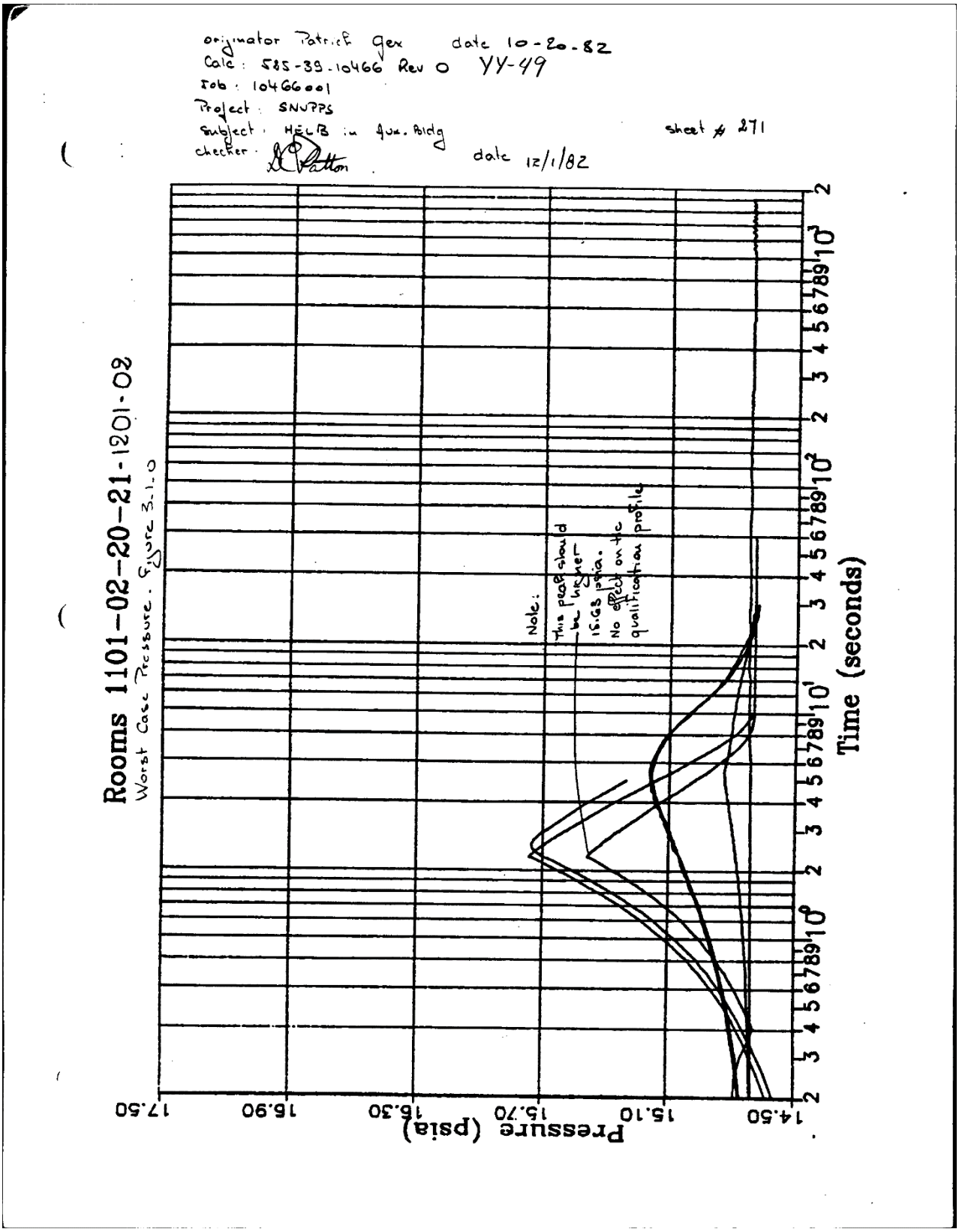



Figure A-36

Figure 3.11(B)-31 Auxiliary Building HELB Pressure (Rooms 1201 & 1202)



**BUILDING: AUXILIARY** **ROOM NUMBER 1203**
**ROOM DESCRIPTION: ELEVATION 1988 PIPE SPACE SOUTH B**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 183 (A) | 29, Page 378 & 383 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.9 | 29, Page 378 & 379 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49 & (D) | $4.27 \times 10^6$<br>$2.19 \times 10^7$<br>(E) | 46, page 6<br>46, page 10<br>(E) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | $2.0 \times 10^5$<br>$2.45 \times 10^5$<br>(E) | 46, page 6<br>46, page 10<br>(E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 4.06 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to a 3" CVCS letdown line break in Room 1203 (Reference 29, Page 378). The analysis assumes Operator action should be taken in 30 minutes to isolate the break.

B. The design flood level for room 1203 is 48.7 inches, based on the isolation of the break in 40 minutes and is acceptable since it is below the level of safety related electrical equipment whose functionality would be adversely affected. Per Reference 55, Appendix 2, all the safety related equipment in this room is above the identified flood level.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F This room contains components with greater than (>) 4.4 wt. % (7000 ppm) boric acid solution and should be maintained at min. 75°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
55. Calculation FL-03

Figure 3.11(B)-15 Auxiliary Building HELB Temperature (Rooms 1203 and 1203A)

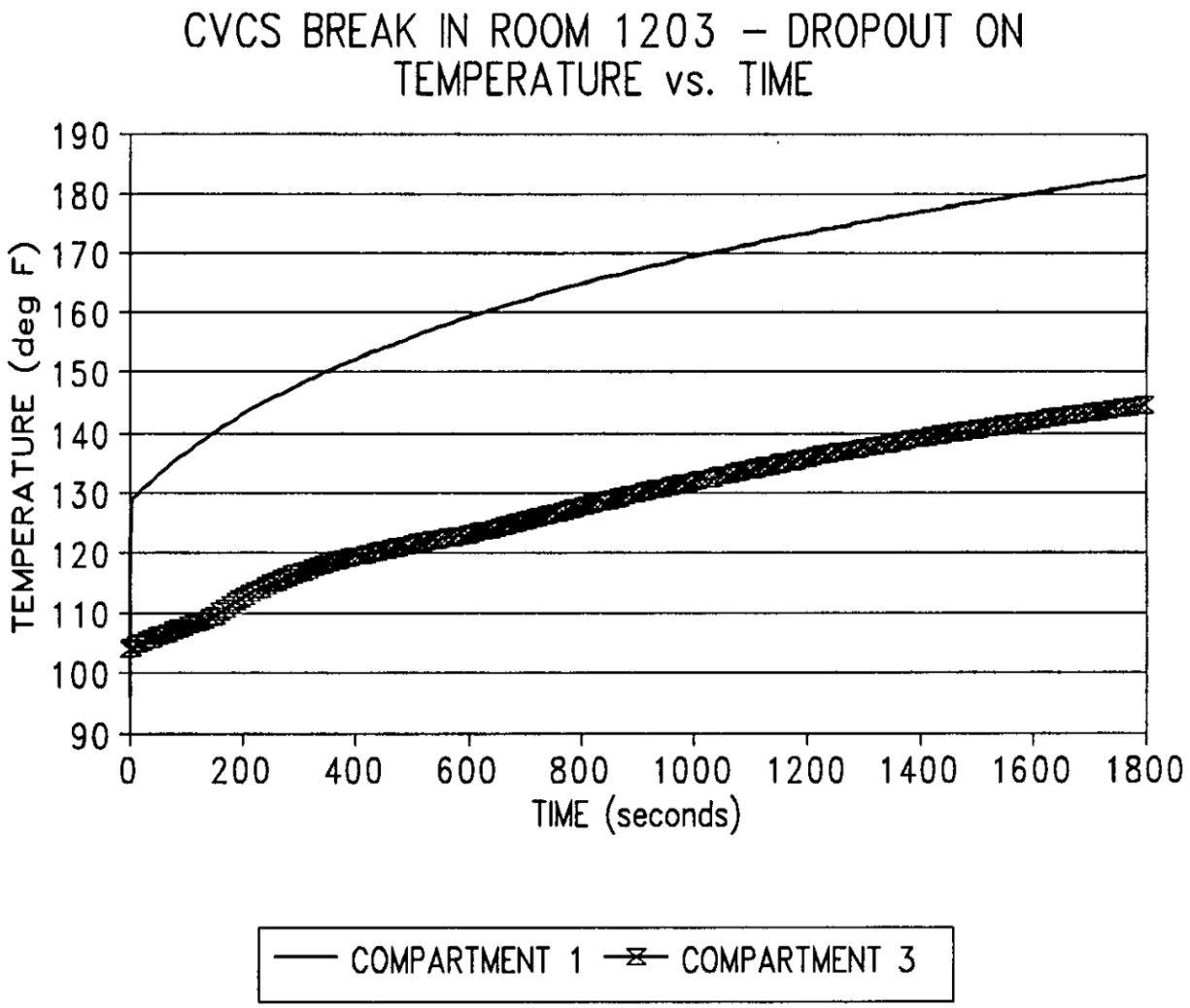
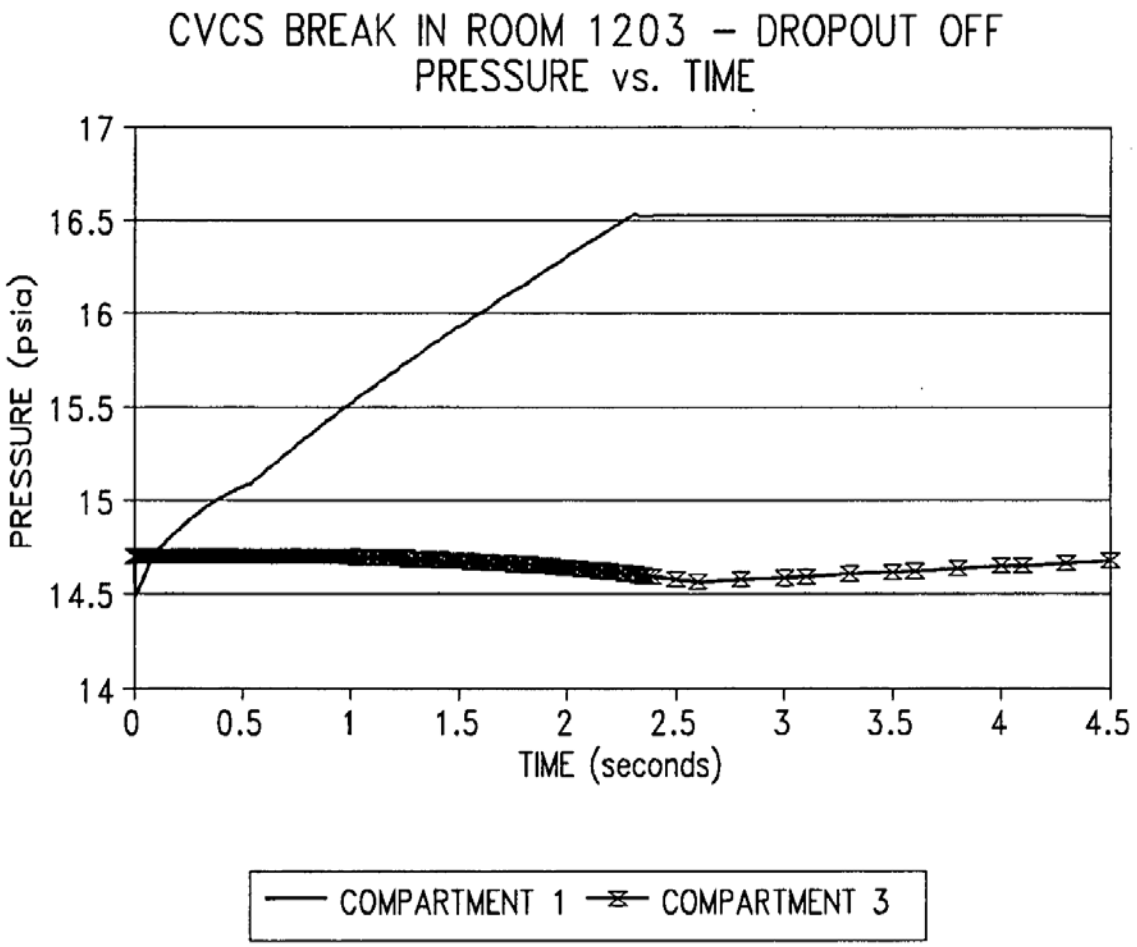


Figure 3.11(B)-32 Auxiliary Building HELB Pressure (Room 1203 & 1203A)



**BUILDING: AUXILIARY** **ROOM NUMBER 1204**
**ROOM DESCRIPTION: ELEVATION 1988 PIPE SPACE NORTH A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 116.6 (A) | 29, Pages 378 & 384 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.9 | 29, Pages 380 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 49 & (D) | $5.11 \times 10^6$ $2.61 \times 10^7$ (E) | 46, page 6 46, page 10 (E) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 49 | $2.39 \times 10^5$ $2.92 \times 10^5$ (E) | 46, page 6 46, page 10 (E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to a 3" CVCS letdown line break in Room 1203 (Reference 29, Page 380).

B. There is no water accumulation in this room. Therefore, all the safety related electrical equipment is protected from flooding effects.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F This room contains components with greater than (>) 4.4 wt. % (7000 ppm) boric acid solution and should be maintained at min. 75°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
55. Calculation FL-03

Figure 3.11(B)-16 Auxiliary Building HELB Temperature (Rooms 1204 – Compartment 2)

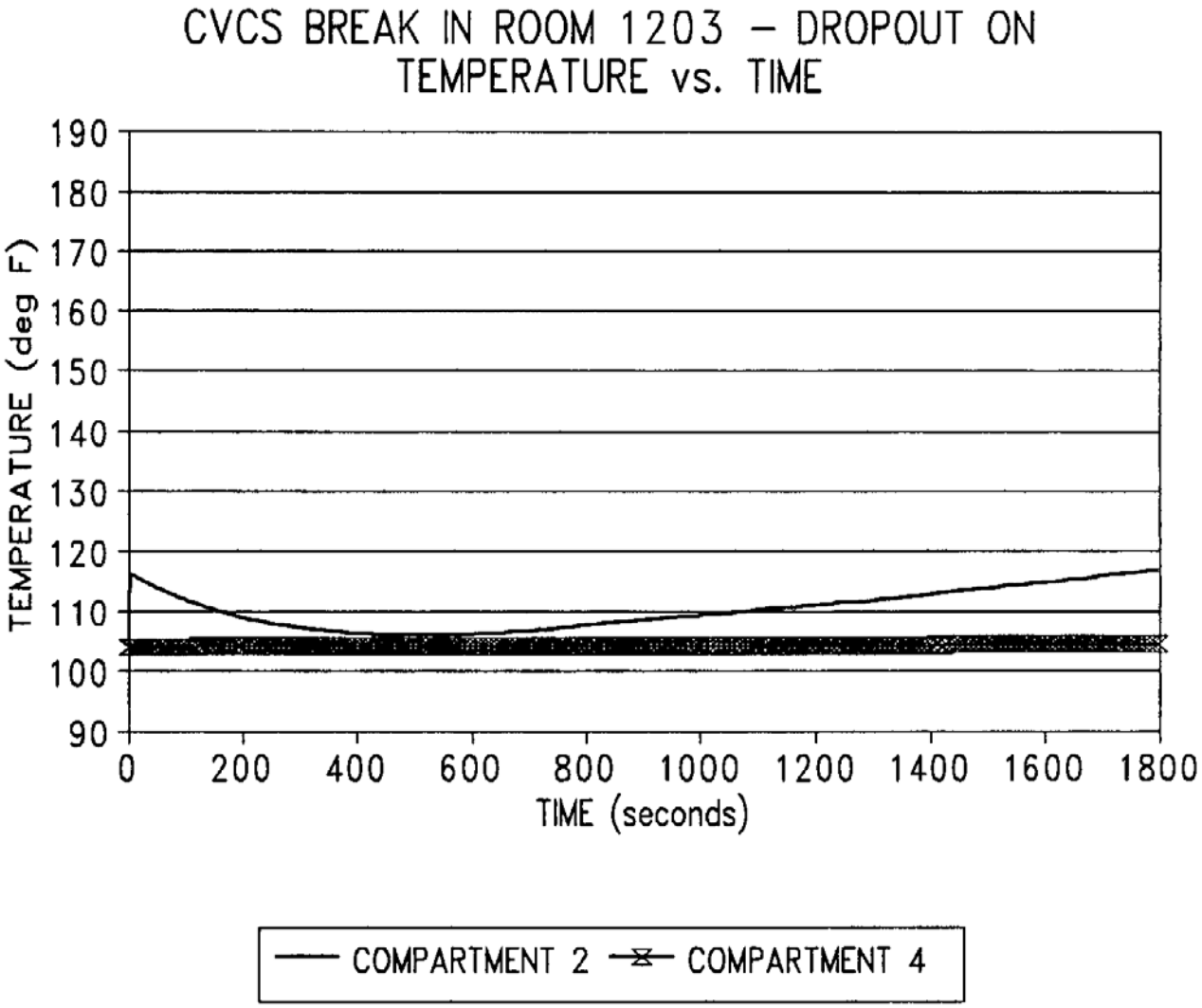


Figure 3.11(B)-33 Auxiliary Building HELB Pressure (Room 1204 – Compartment 2)

| JOB NUMBER | CALCULATION NUMBER | REV. NO. | SHEET NO. |
|---|---|---|---|
| 16577-232 | 525-39-10466 YY-49 | 1 | 380 |

| ORIGINATOR | DATE | CHECKED | DATE |
|---|---|---|---|
| F.M. Staszesky | 08/04/92 | [illegible] | 8-17-92 |

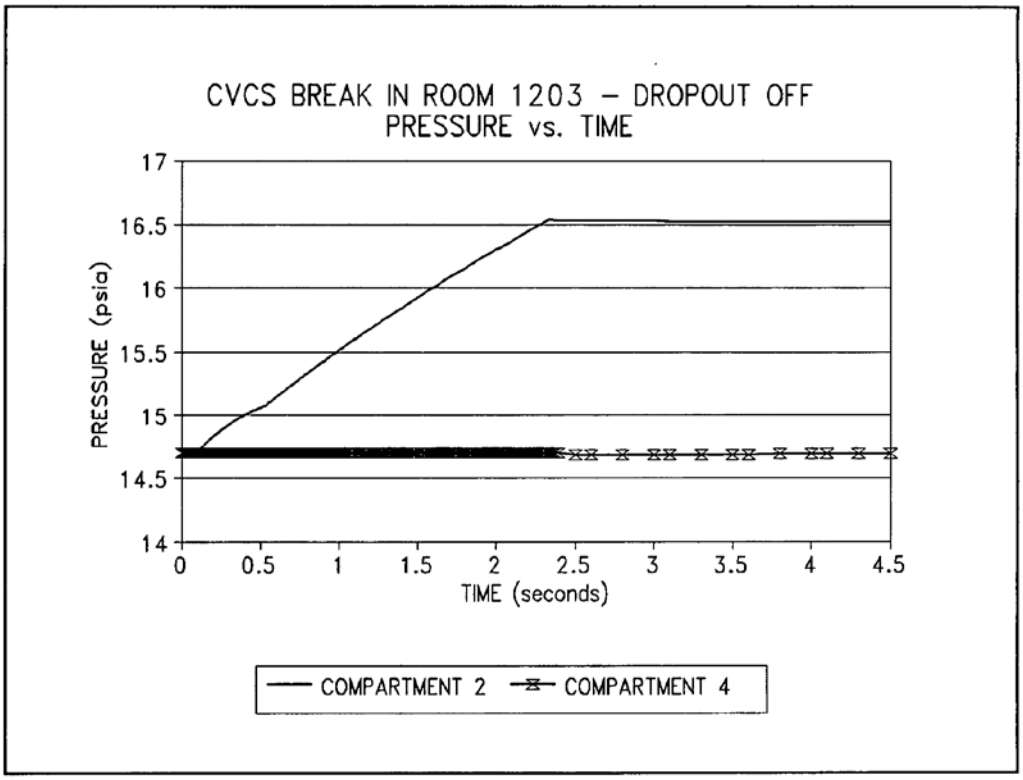



Figure A-33

**BUILDING: AUXILIARY** **ROOM NUMBER 1205**
**ROOM DESCRIPTION: ELEVATION 1988 PIPE SPACE ACCESS AREA A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 133.3 (A) | 57, Pages 9 & 11 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.9 | 57, Pages 9 & 12 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 57 |
| **INTEGRATED DOSE (RADS)** | 1314 | 49 & (D) | $2.70 \times 10^4$ | 47, Page 2 | NE | N/A |
| **DOSE RATE (R/hr)** | ≤2.5 mR/hr | 49 | 247.2 | (C) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (B) | 53, Pages 11 & 12 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition for Room 1122 was conservatively applied to this room. It is due to an 8" Auxiliary Steam line break in Room 1101 or Room1130 (Reference 57, page 9).

B. The design flood level is 0 feet. Given that there is no water accumulation in this room, all safety related electrical equipment will not be affected from flooding effects

C The dose rate was calculated by dividing the integrated dose by the following multiplication factors 21.36, 3.6 & 1.42. These factors were obtained from Calcs. XX-43 (Reference 46), XX-45 (Reference 45) & XX-F-014 (Reference 48) respectively

D The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant

**REFERENCE**

28. M-000 (Q)
47. Calculation XX-47
49. Radiation Zone Dwg. A-1701
53. Calculation FL-01
57. Calculation YY-57

Figure 3.11(B)-45 Auxiliary Building HELB Temperature (Room 1205)

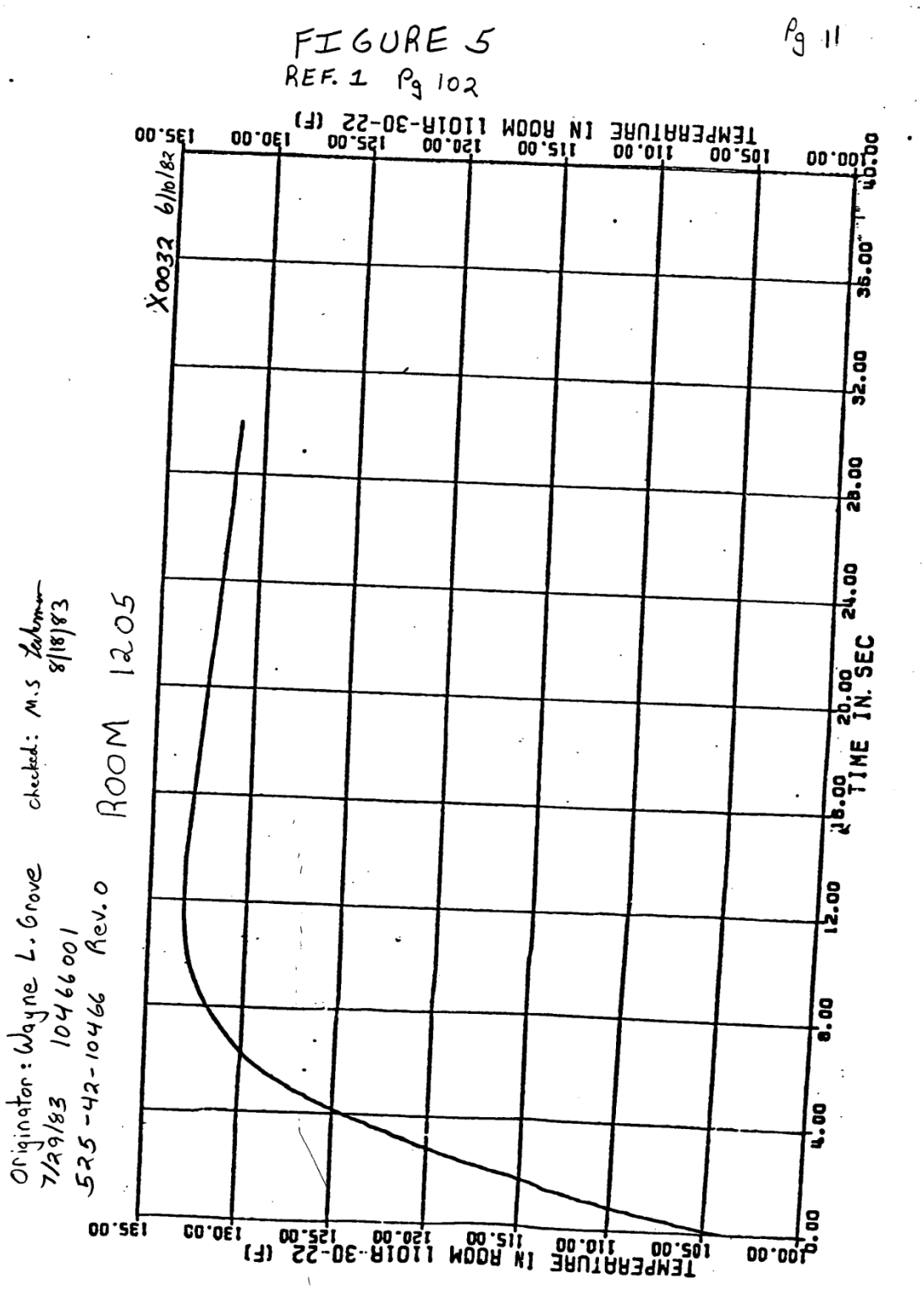
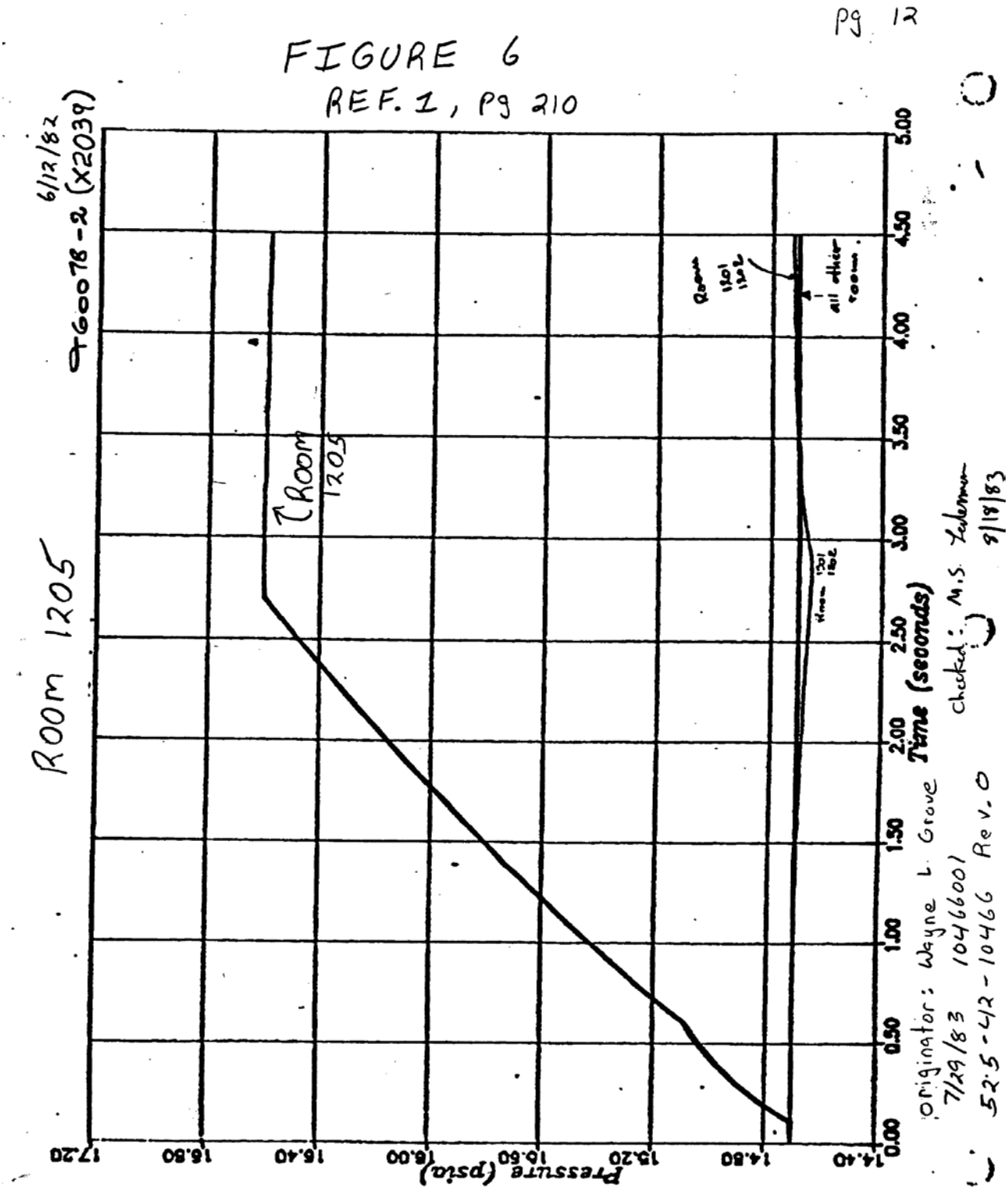


Figure 3.11(B)-46 Auxiliary Building HELB Pressure (Room 1205)



**BUILDING: AUXILIARY** **ROOM NUMBER 1206**
**ROOM DESCRIPTION: ELEVATION 1989 AREA 5 PIPE CHASE**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 106 (E) | 99, Page 6 | NE | N/A | 110 (A) | 82, Page 28 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 247 and 275 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 95 | 82, Page 27 |
| **INTEGRATED DOSE (RADS)** | 263 | 49 & (C) | 7350<br>$3.76 \times 10^4$<br>(D) | 46, page 6<br>46, page 10<br>(D) | (B) | NA |
| **DOSE RATE (R/hr)** | ≤0.5 mR/hr | 49 | 344<br>421<br>(D) | 46, page 6<br>46, page 10<br>(D) | (B) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 | 72, Page 7 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. Reference 82 provides analysis for the temperature in this room for a 4" line break in rooms 1206/1207. This break is considered to create a more severe environment than the 8" line break in room 1122 that is discussed, but not analyzed, in reference 29, Page 253 and 283.

B. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

C. The normal integrated dose was obtained by multiplying the dose rate of times 60 years life of the plant.

D. The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

E Calculation NAI-1878-001 case 25 provides analysis for the temperature in this room should door 13231 be open to room 1329 when a HELB occurs in the in the turbine building.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
72. Calculation LE-M-002
82. Calculation FB-M-002
99. Calculation GF-M-003

3.11(B)-9-Auxiliary Building HELB Temperature (Rooms 1128, 1129, 1206 & 1207)



### 6.2 Case #2 – Line 054-HBD-4 Line Break at Aux Steam Deaerator Feed Pump Discharge

Figure 6, Figure 7, and Figure 8 illustrate the temperature, pressure, and humidity responses for selected rooms for Case 2. The temperature for room 1129 peaks at 152.9°F at 241.2 seconds. The temperature for Room 1207 peaks at 110.8°F at 206.7 seconds. The peak room differential pressure is 0.5 psid.

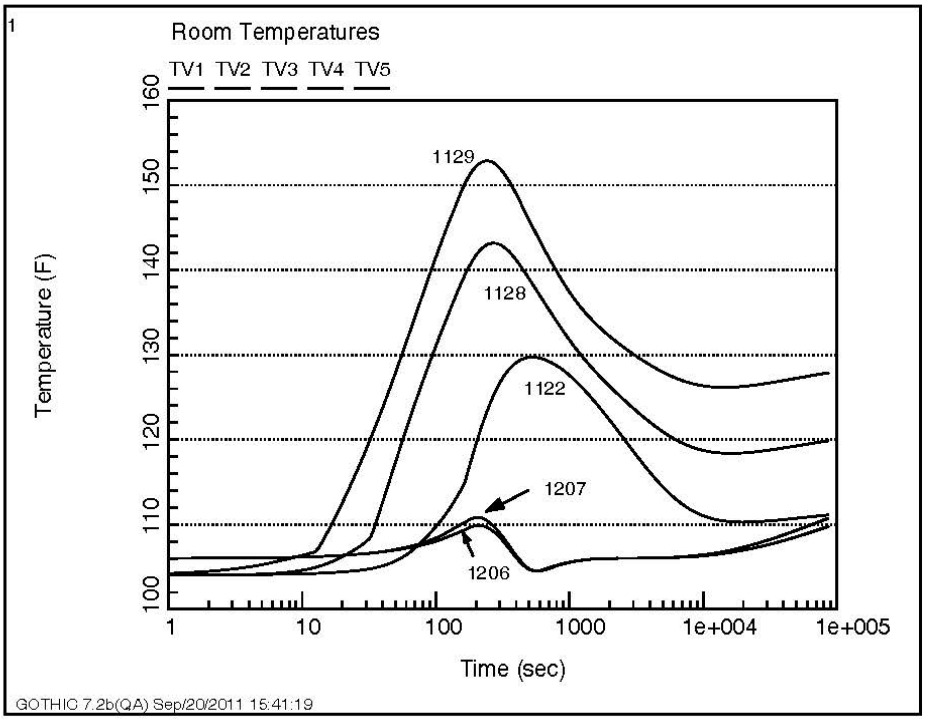
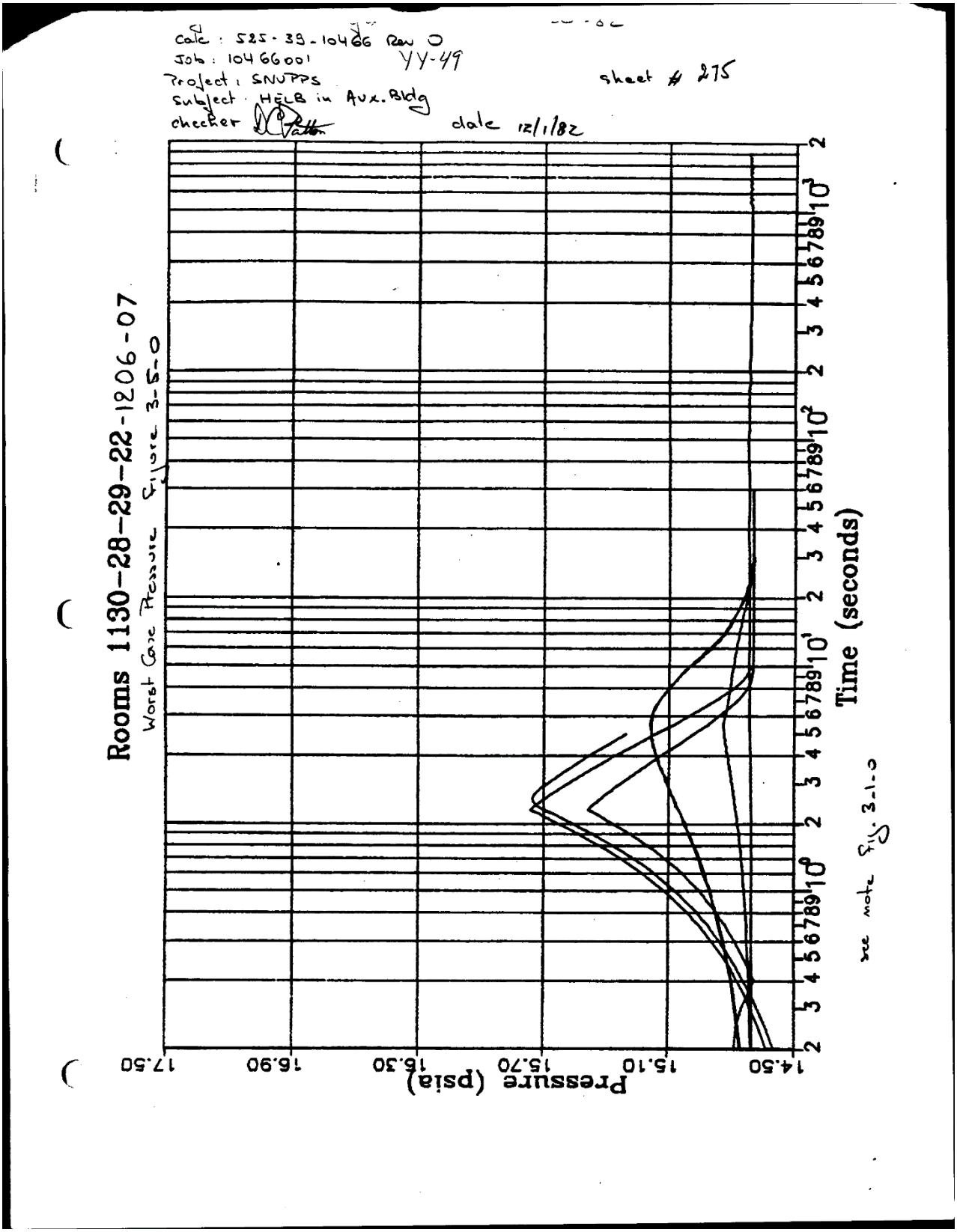



**Figure 6 Case 2 Room Temperatures**

Figure 3.11(B)-30 Auxiliary Building HELB Pressure (Rooms 1122, 1128, 1129, 1130, 1206 and 1207)



**BUILDING: AUXILIARY** **ROOM NUMBER 1207**
**ROOM DESCRIPTION: ELEVATION 1989 AREA 5 PIPE CHASE**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 106 | 81 | NE | N/A | 110.8 (A) | 82, Page 28 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 82, Page 26 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 95 | 82, Page 27 |
| **INTEGRATED DOSE (RADS)** | 263 | 49 & (C) | 7350<br>$3.76 \times 10^4$<br>(D) | 46, page 6<br>46, page 10<br>(D) | (B) | NA |
| **DOSE RATE (R/hr)** | ≤0.5 mR/hr | 49 | 344<br>421<br>(D) | 46, page 6<br>46, page 10<br>(D) | (B) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 | 72, Page 7 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. Reference 82 provides analysis for the temperature in this room for a 4" line break in rooms 1206/1207. This break is considered to create a more severe environment than the 8" line break in room 1122 that is discussed, but not analyzed, in reference 29, Page 253 and 283.

B. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

C The normal integrated dose was obtained by multiplying the dose rate of times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

E Calculation NAI-1878-001 case 25 provides analysis for the temperature in this room should door 13231 be open to room 1329 when a HELB occurs in the in the turbine building.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
49. Radiation Zone Dwg. A-1701
72. Calculation LE-M-002
82. Calculation FB-M-002

Figure 3.11(B)-9 Auxiliary Building HELB Temperature (Rooms 1128, 1129, 1206 & 1207)



### 6.2 Case #2 – Line 054-HBD-4 Line Break at Aux Steam Deaerator Feed Pump Discharge

Figure 6, Figure 7, and Figure 8 illustrate the temperature, pressure, and humidity responses for selected rooms for Case 2. The temperature for room 1129 peaks at 152.9°F at 241.2 seconds. The temperature for Room 1207 peaks at 110.8°F at 206.7 seconds. The peak room differential pressure is 0.5 psid.

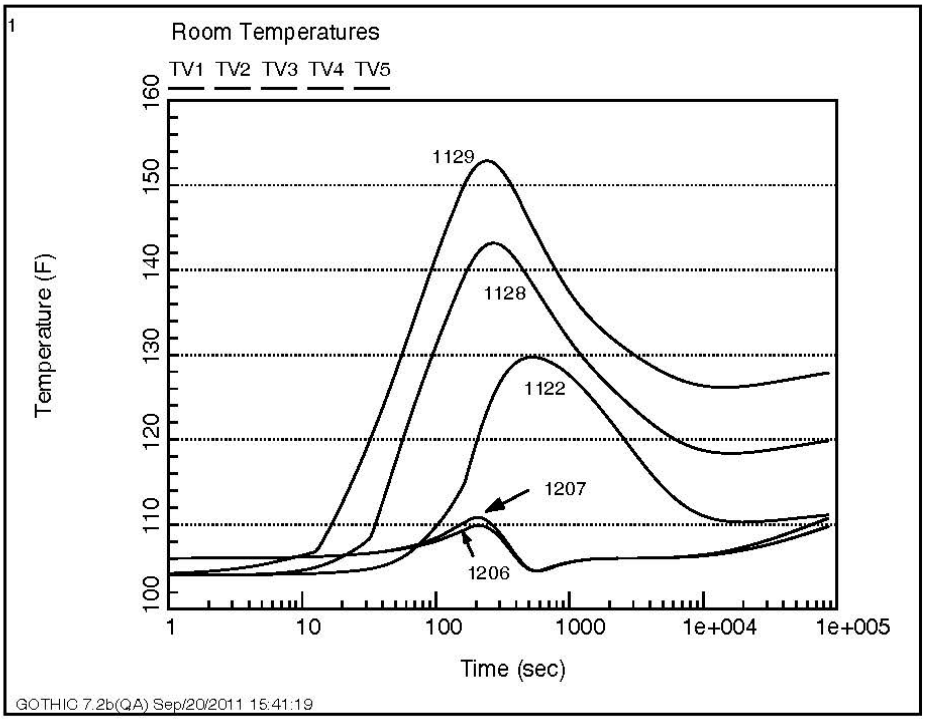
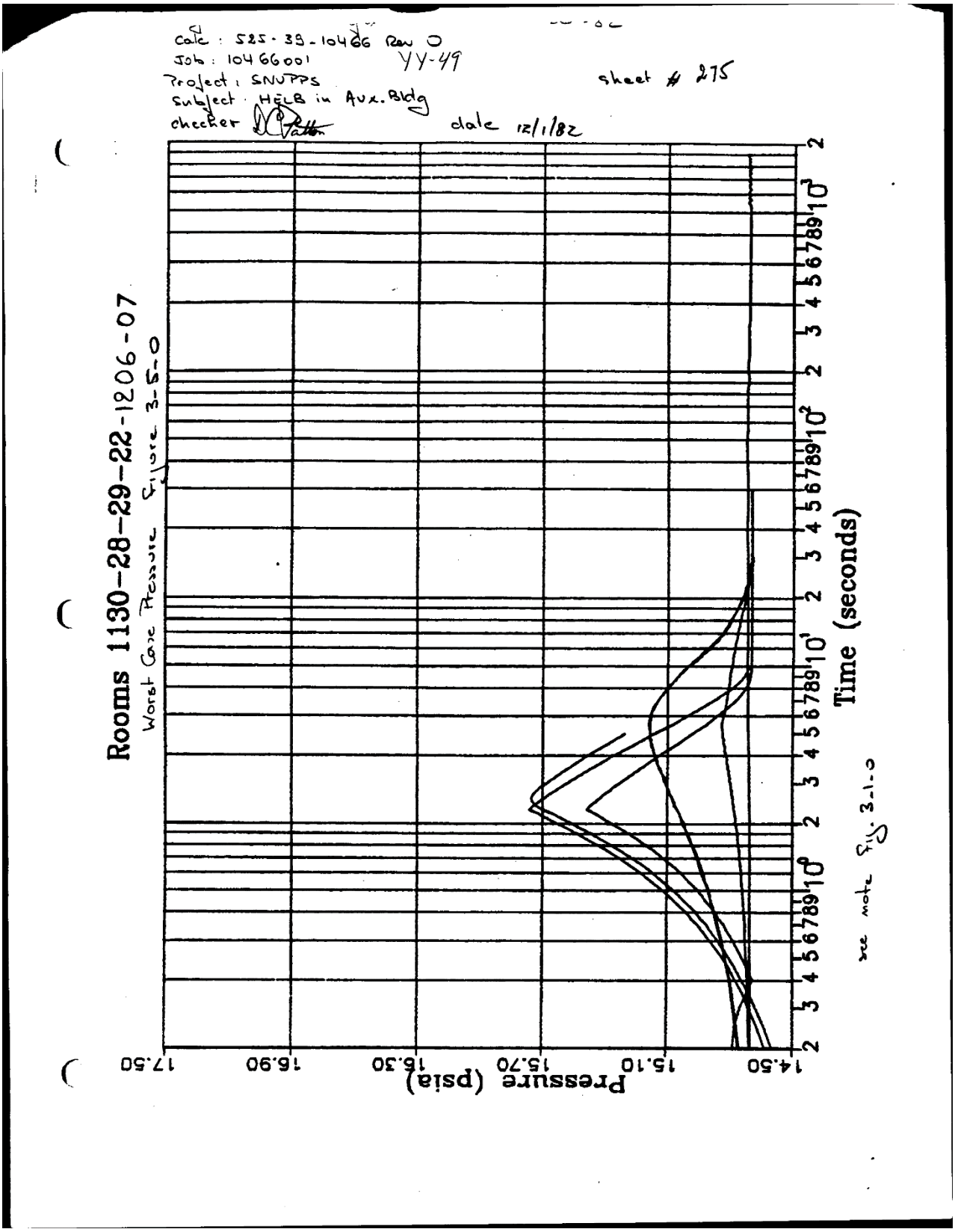



**Figure 6 Case 2 Room Temperatures**

Figure 3.11(B)-30 Auxiliary Building HELB Pressure (Rooms 1122, 1128, 1129, 1130, 1206 and 1207)



**BUILDING: AUXILIARY** **ROOM NUMBER 1301**
**ROOM DESCRIPTION: ELEVATION 2000 CORRIDOR NO. 1**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 180.1 /110 (A) | 29, Pages 161, 255 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 278 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 83 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 50 & (C) | 946<br>$4.84 \times 10^3$<br>(D) | 46, page 6<br>46, page 10<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤2.5 mR/hr | 50 | 44.3<br>54.2<br>(D) | 46, page 6<br>46, page 10<br>(D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 2.77 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301. The 180.1ºF maximum temperature is applicable to the north portion of the corridor and the 110ºF temperature is applicable to the west portion of the corridor (Reference 29, Page 255).

B. The design flood level for Room 1301 is 33.2 inches, based on isolation of the break in 40 minutes. The flood level exceeds several RP panels, however the safety function of the panels is protected due to the presence of redundant panels located in rooms 1402 and 1408. The flood level also exceeds waterproof pressure transmitters, and isolation valves that fail in their failsafe position. Therefore the flood level is acceptable. Per Reference 55, Appendix 2, Page 11 conduit1U1J3L and associated instrumentation EJFIS0610 is the lowest identified safety related equipment in this room, it is ~ 32 inches (2.66 ft) above the floor grade.

C The normal integrated dose was obtained by multiplying the dose rate of times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-18 Auxiliary Building HELB Temperature-Room 1 (Rooms 1301-North and 1320)

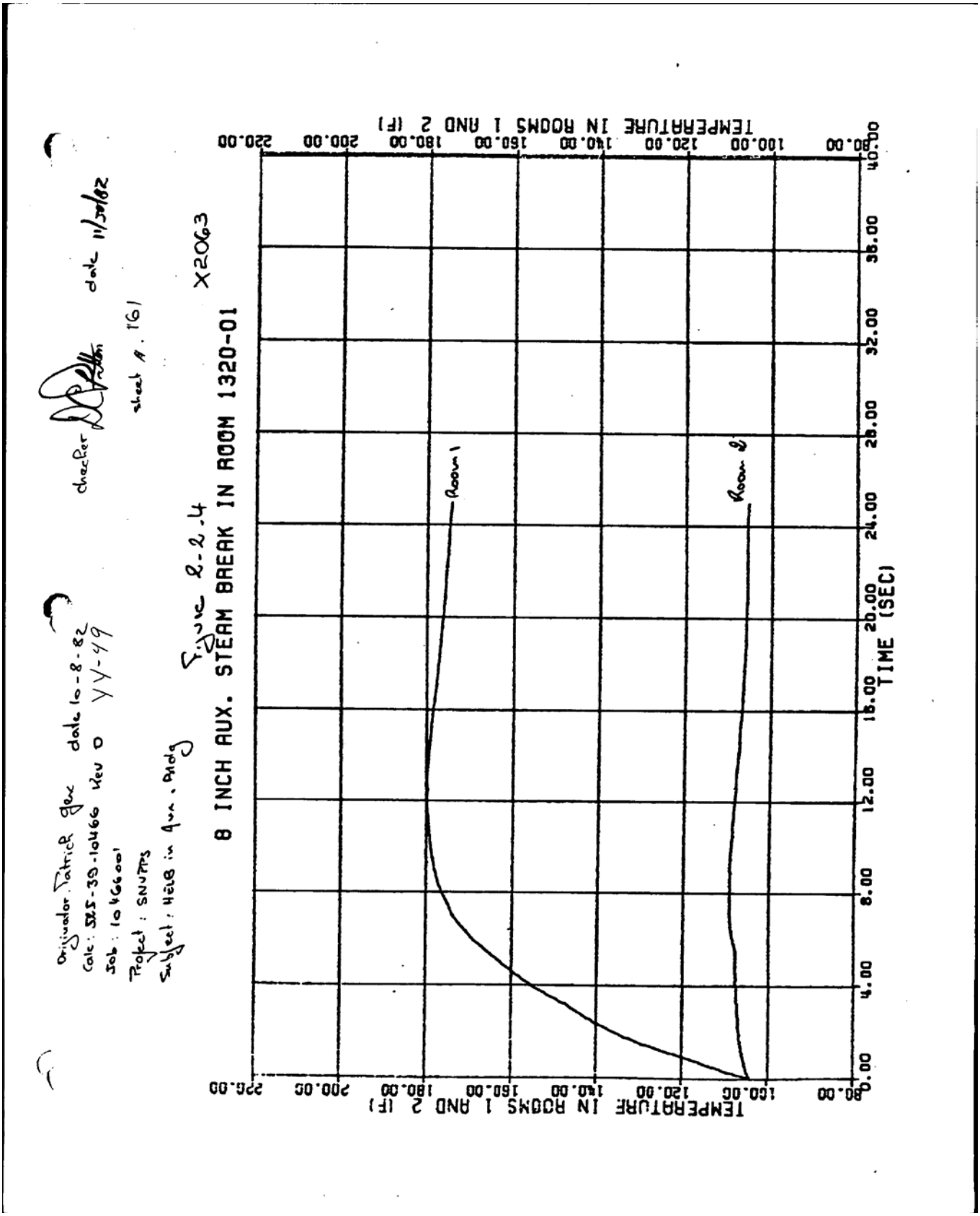
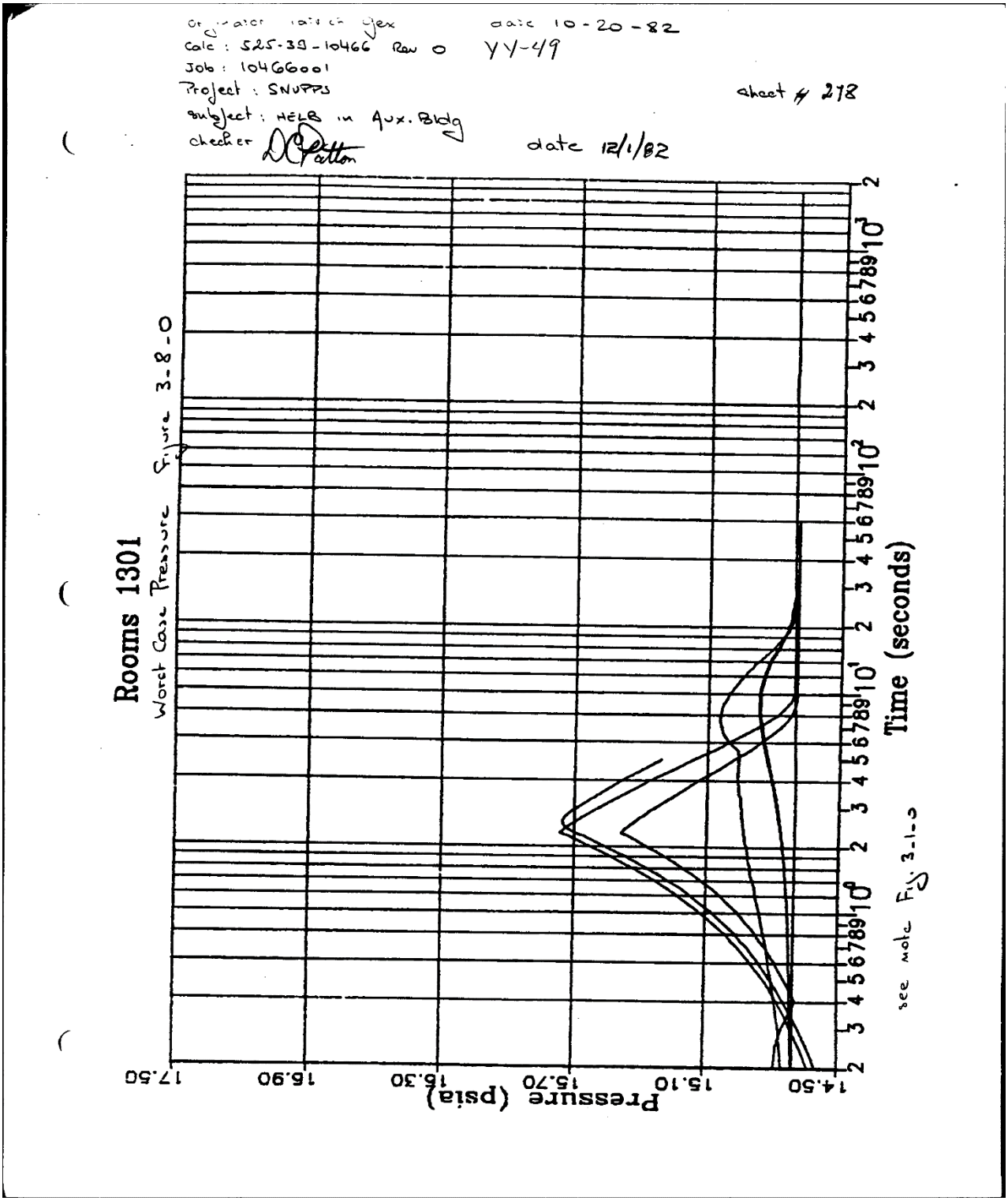


Figure 3.11(B)-34 Auxiliary Building HELB Pressure (Rooms 1301)



**BUILDING: AUXILIARY** **ROOM NUMBER 1302**
**ROOM DESCRIPTION: ELEVATION 2000 FILTER COMPARTMENTS**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 107.1 (A) | 57, Pages 13 & 15 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 57, Pages 13 & 16 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 57 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 50 & (D) | $2.78 \times 10^5$<br>$1.42 \times 10^6$<br>(E) | 46, page 6<br>46, page 10<br>(E) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 50 | $1.3 \times 10^4$<br>$1.59 \times 10^4$<br>(E) | 46, page 6<br>46, page 10<br>(E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (B) | 55, Page 10 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 (Reference 57, page 13).

B. This room is a water tight area, which includes demineralizer compartments. A flooding source within the compartments would be contained to the compartments, and all safety related equipment in the compartments is related to the demineralizers. Therefore, the potential of flooding hazard in the compartment is inconsequential as it will have no net effect on any safety related equipment not related to the demineralizers.

C. Radiological consequences of specific HELB/MEC's within these compartments was not required to be developed, as the equipment located in these compartments would not be required in this event.

D. The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

E. The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F This room contains components with greater than (>) 4.4 wt. % (7000 ppm) boric acid solution and should be maintained at min. 75°F.

**REFERENCE**

28. M-000 (Q)
46. Calculation XX-43
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03
57. Calculation YY-57

Figure 3.11(B)-19 Auxiliary Building HELB Temperature (Rooms 1302, 1306)

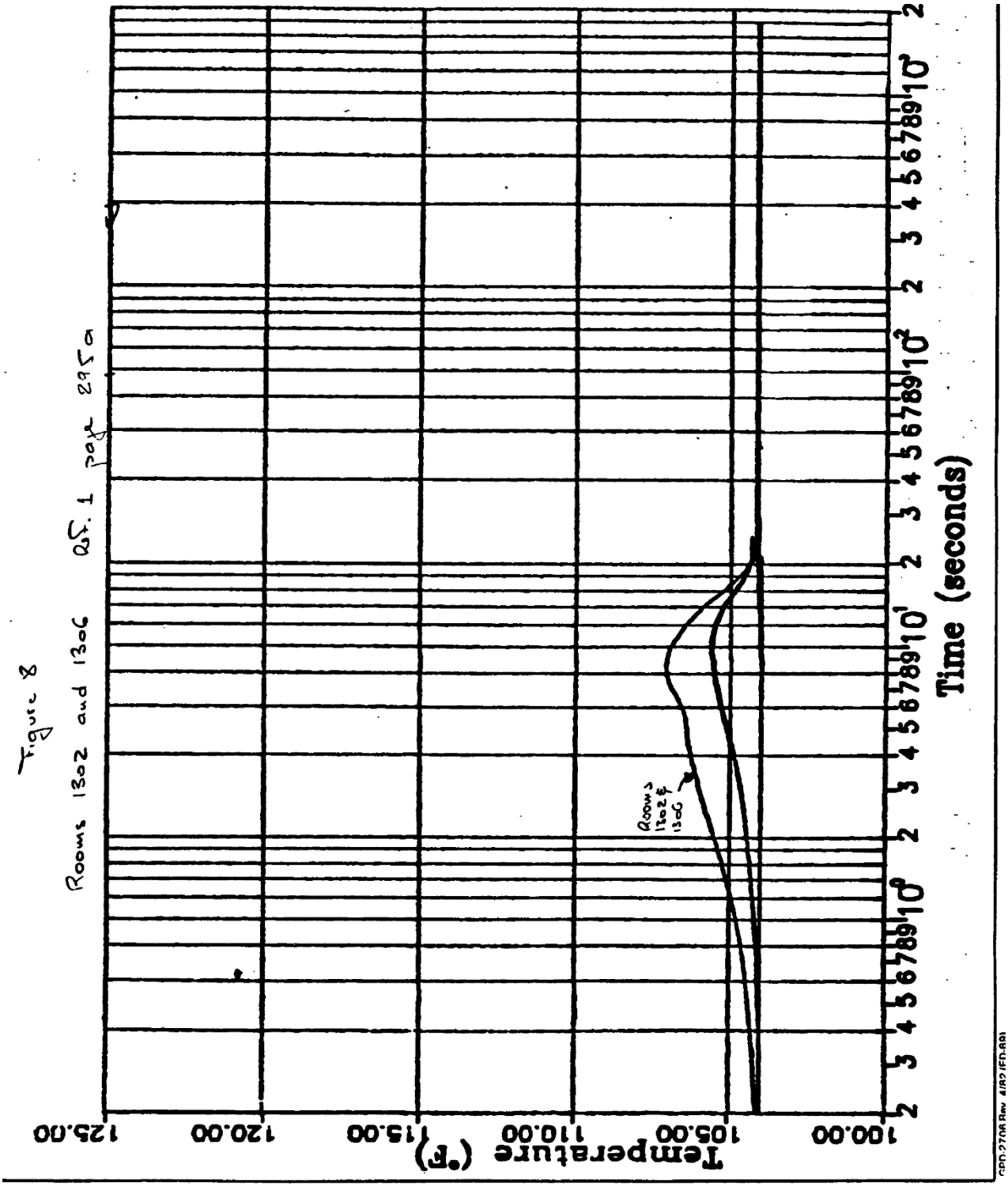
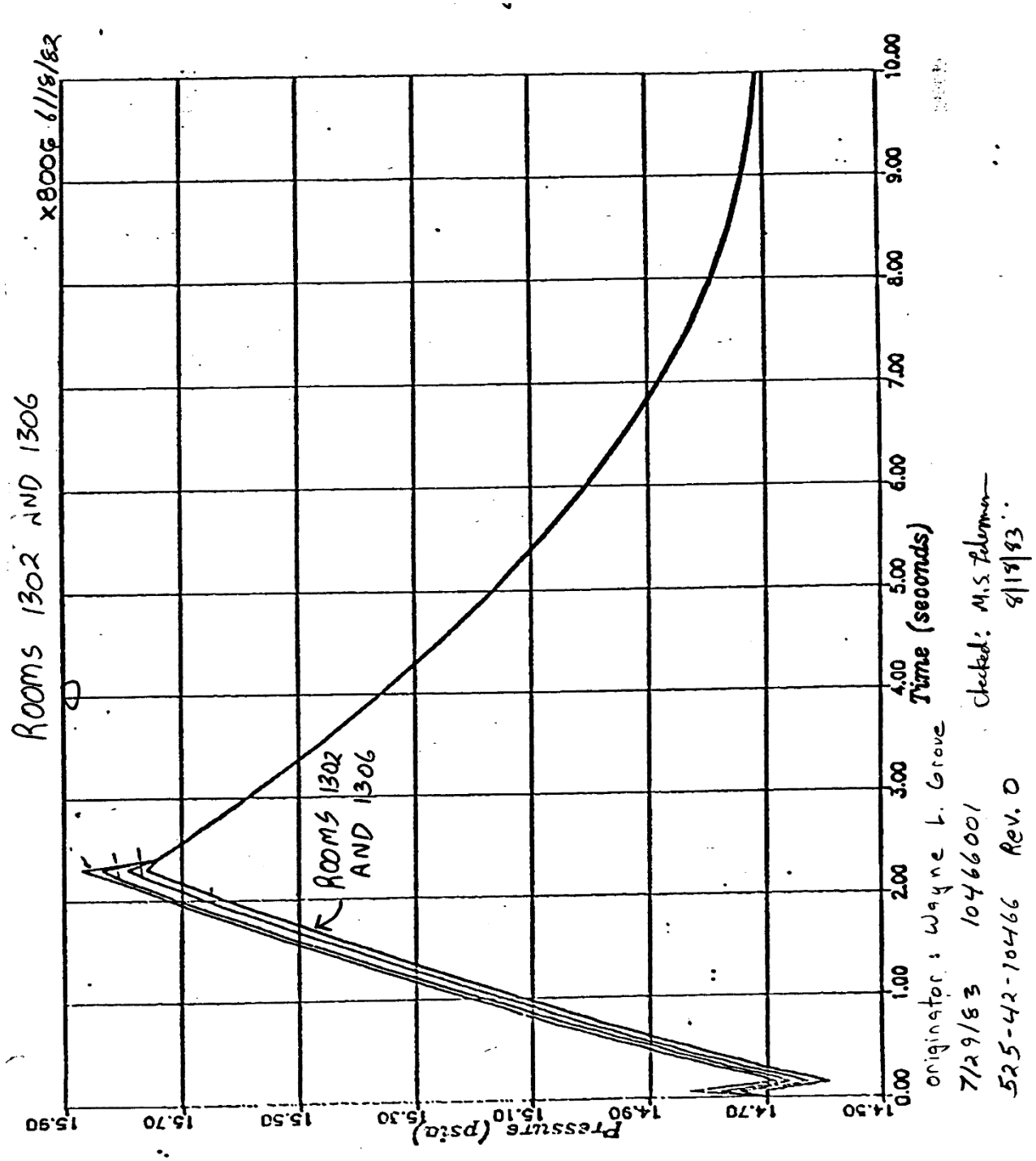


Figure 3.11(B)-35 Auxiliary Building HELB Pressure (Rooms 1302 and 1306)



**BUILDING: AUXILIARY** **ROOM NUMBER 1306**
**ROOM DESCRIPTION: ELEVATION 2000 FILTER VALVE COMPARTMENTS**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| PEAK TEMPERATURE (°F) | 104 | 28, Page 2-8 | NE | N/A | 107.1 (A) | 57, Pages 13 & 15 |
| PEAK PRESSURE (PSIG) | ATM | NA | NE | N/A | 1.06 | 57, Page 13 |
| HUMIDITY (%) | 70 | 28, Page 2-8 | NE | N/A | 71 | 57 |
| INTEGRATED DOSE (RADS) | $5.256 \times 10^5$ | 50 & (E) | $1.86 \times 10^6$ | 47, page 2 | (C) | NA |
| DOSE RATE (R/hr) | >100 mR/hr | 50 | $1.7 \times 10^4$ | (D) | (C) | NA |
| MAX. FLOOD LEVEL (FT) (above the floor) | NE | N/A | NE | N/A | 0 (B) | 55. Page 10 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 (Reference 57, page 13).

B. Per Reference 55, Appendix 2, Page 5, this room does not contain any safety related electrical equipment. Therefore, flooding analysis of this room is not required.

C. Radiological consequences of a specific HELB/MEC within these compartments was not required to be developed, as the equipment located in these compartments would not be required in this event.

D. The dose rate was calculated by dividing the integrated dose by the following multiplication factors 21.36, 3.6 & 1.42. These factors were obtained from Calcs. XX-43 (Reference 46), XX-45 (Reference 45) & XX-F-014 (Reference 48) respectively.

E. The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

F This room contains components with greater than (>) 4.4 wt. % (7000 ppm) boric acid solution and should be maintained at min. 75°F

**REFERENCE**

28. M-000 (Q)
47. Calculation XX-47
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03
57. Calculation YY-57

Figure 3.11(B)-19 Auxiliary Building HELB Temperature (Rooms 1302, 1306)

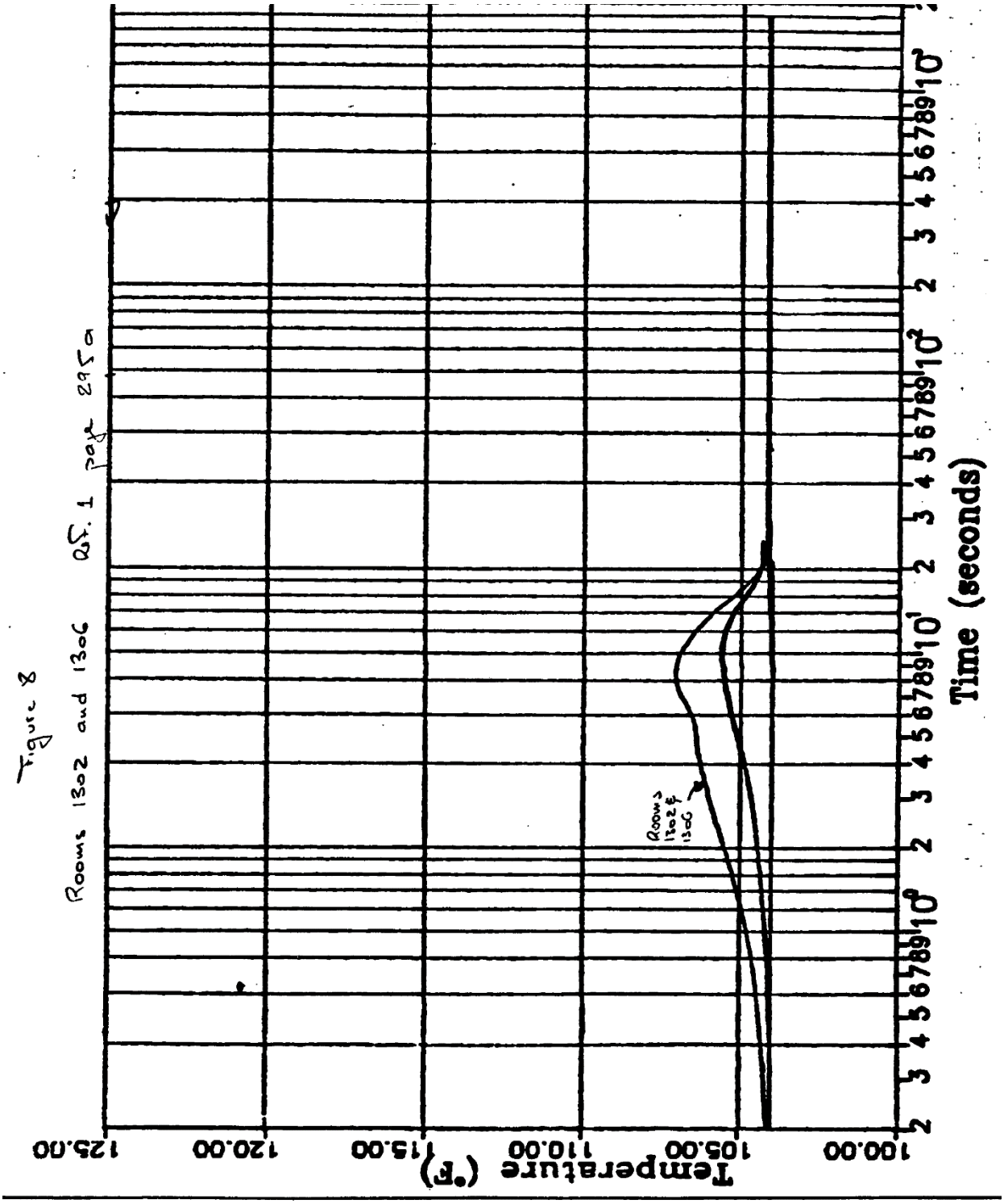
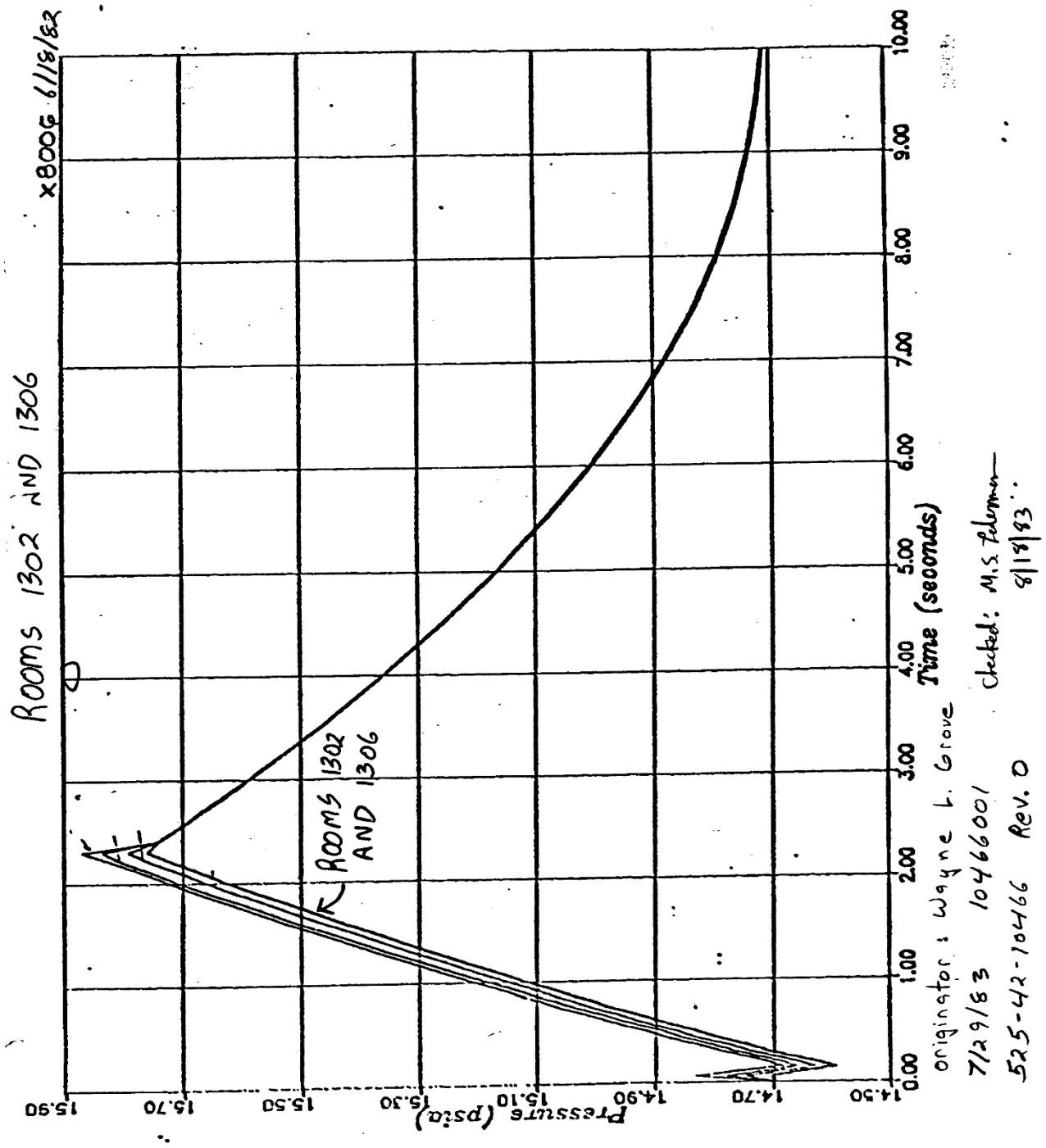


Figure 3.11(B)-35 Auxiliary Building HELB Pressure (Rooms 1302 and 1306)



**BUILDING: AUXILIARY** **ROOM NUMBER 1307**
**ROOM DESCRIPTION: ELEVATION 2000 DEMIN/FILTER COMPARTMENT CORRIDOR NO. 2** (B)

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 107.1 (A), (B) | 29, Page 162 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 282 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, Page 300 |
| **INTEGRATED DOSE (RADS)** | 7884 | 50 & (D) | $1.28 \times 10^5$ | 47, page 2 | NE | N/A |
| **DOSE RATE (R/hr)** | ≤15 mR/hr | 50 | 1172.2 | (C) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | (B) | 55, Page 6 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 North (Reference 29, Page 283).

B. Due to the absence of safety related equipment, flooding for this room was not required to be analyzed.

C The dose rate was calculated by dividing the integrated dose by the following multiplication factors 21.36, 3.6 & 1.42. These factors were obtained from Calcs. XX-43 (Reference 46), XX-45 (Reference 45) & XX-F-014 (Reference 48) respectively.

D The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

E This room contains components with greater than or equal to (≥) 4.0 wt. % (7000 ppm), but less than or equal to (≤) 4.4 wt. % (7000 ppm) boric acid solution should be maintained at min. 65°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
47. Calculation XX-47
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-19A Auxiliary Building HELB Temperature-Room 5 (Rooms 1307, 1309, 1310, 1311 & 1312)

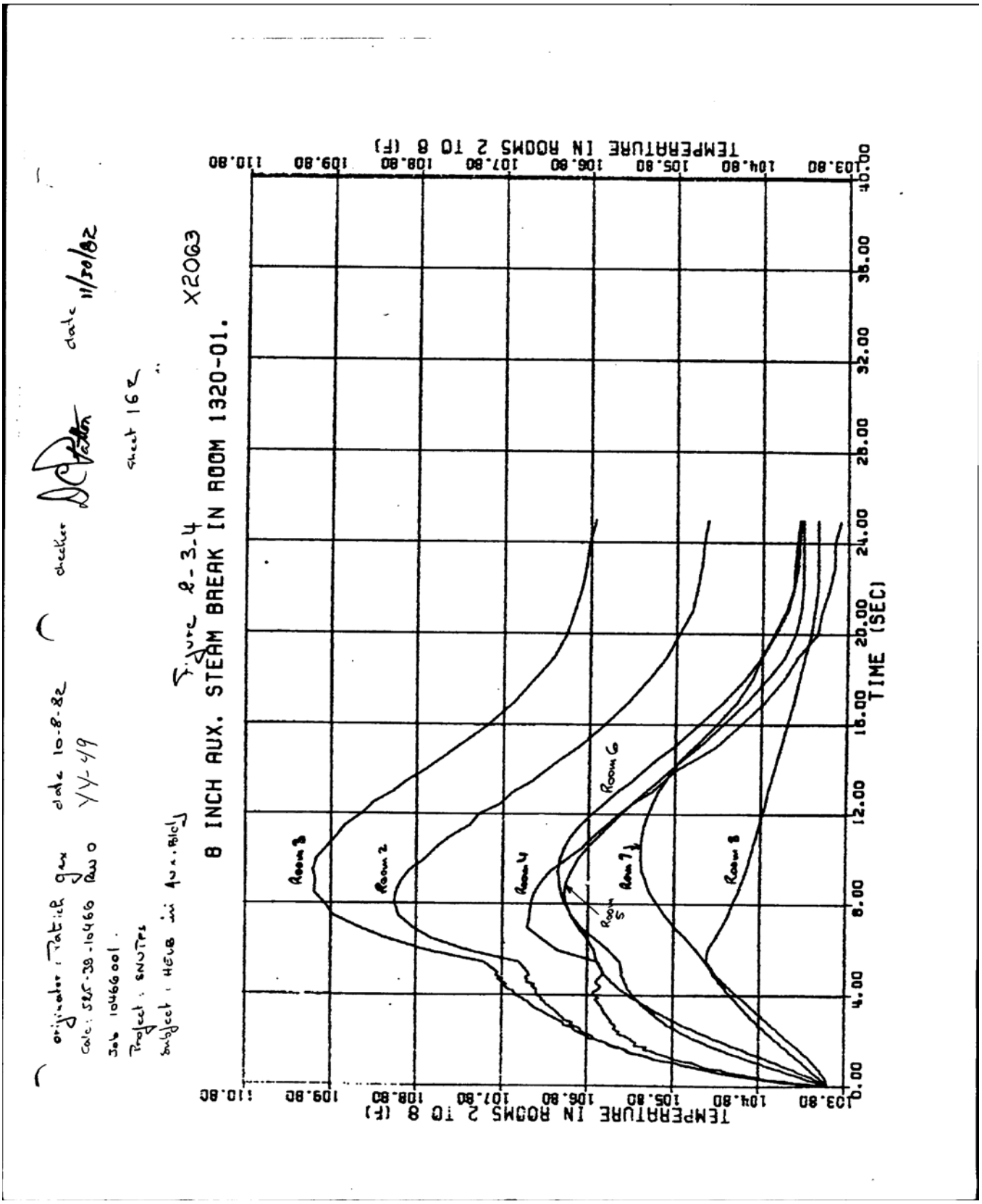
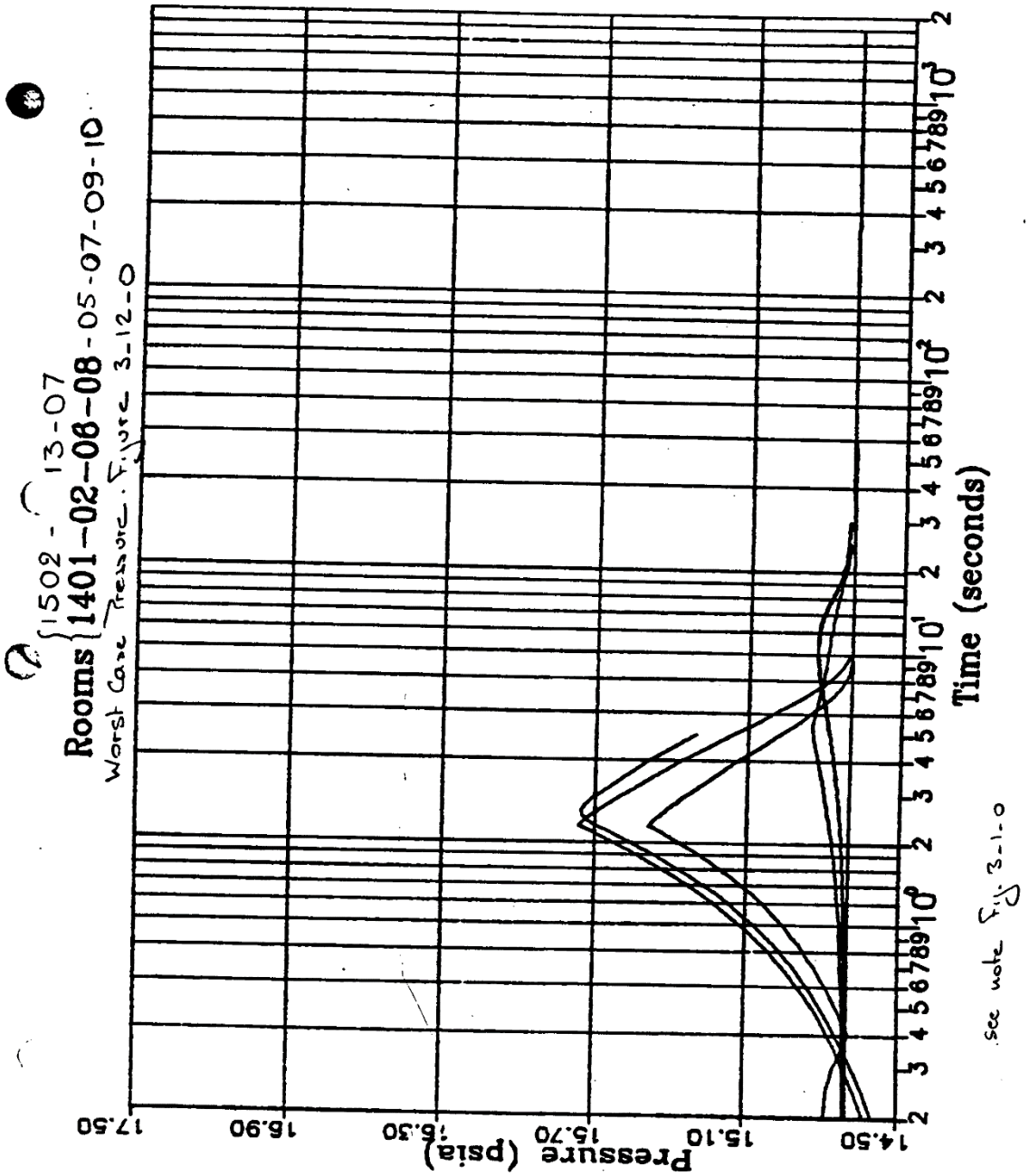


Figure 3.11(B)-35 Auxiliary Building HELB Pressure (Rooms 1307 through 1312, 1316 & 1317)

originator: Patrick Glex date 10-20-82
Calc: 525-39-10466 Rev 0 YY-49
Job: 10466001
Project: SNUPPS
Subject: HELB in Aux. Bldg
Checker [signature] date 12/1/82
sheet # 282



**BUILDING: AUXILIARY** **ROOM NUMBER 1308**
**ROOM DESCRIPTION: ELEVATION 2000 Valve Compartment A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 107.5 (A), (B) | 29, Pages 256 & 295a |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 281 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, Page 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 50 & (D) | $1.03 \times 10^4$ | 17, Table 7 (B) | NE | N/A |
| **DOSE RATE (R/hr)** | >100 mR/hr | 50 | 37.2 | (C) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (E) | 55, Page 10 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 North (Reference 29, Page 256).

B. The accident integrated dose listed was obtained by multiplying the accident dose documented in Ref. 17 for room 1308 (7230 Rads) times the multiplication factor of 1.42 from the power rerate (Ref. 48).

C The dose rate was calculated by dividing the integrated dose by the following multiplication factors 21.36, 3.6 & 1.42. These factors were obtained from Calcs. XX-43 (Reference 46), XX-45 (Reference 45) & XX-F-014 (Reference 48) respectively.

D The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

E Per Reference 55, Appendix 2, Page 6, this room does not contain any safety related electrical equipment. Therefore, flooding analysis of this room is not required.

F This room contains components with greater than (>) 4.4 wt. % (7000 ppm) boric acid solution and should be maintained at min. 75°F

**REFERENCE**

17. SLNRC-84-0013
28. M-000 (Q)
29. Calculation YY-49
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-19B Auxiliary Building HELB Temperature (Rooms 1308)

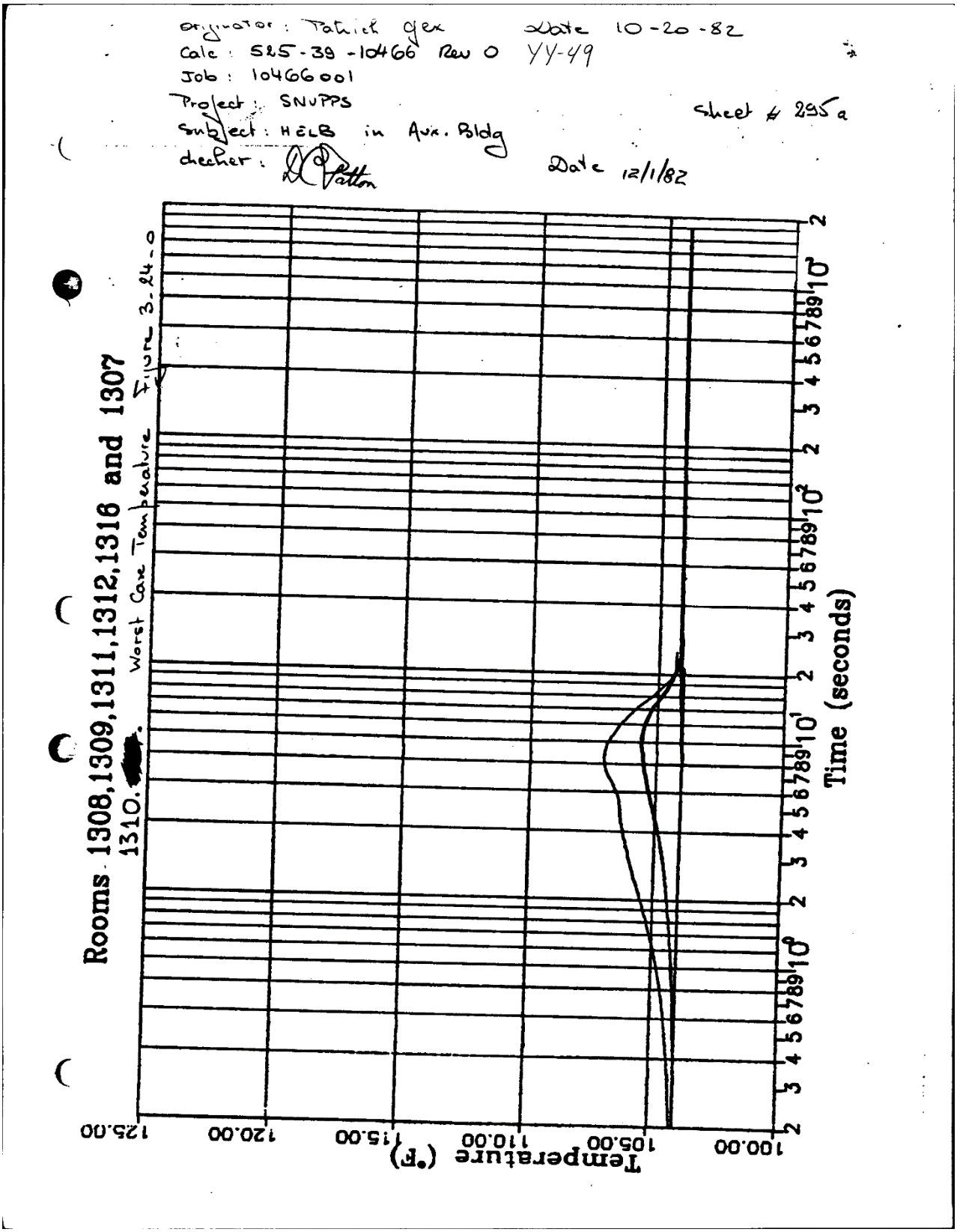
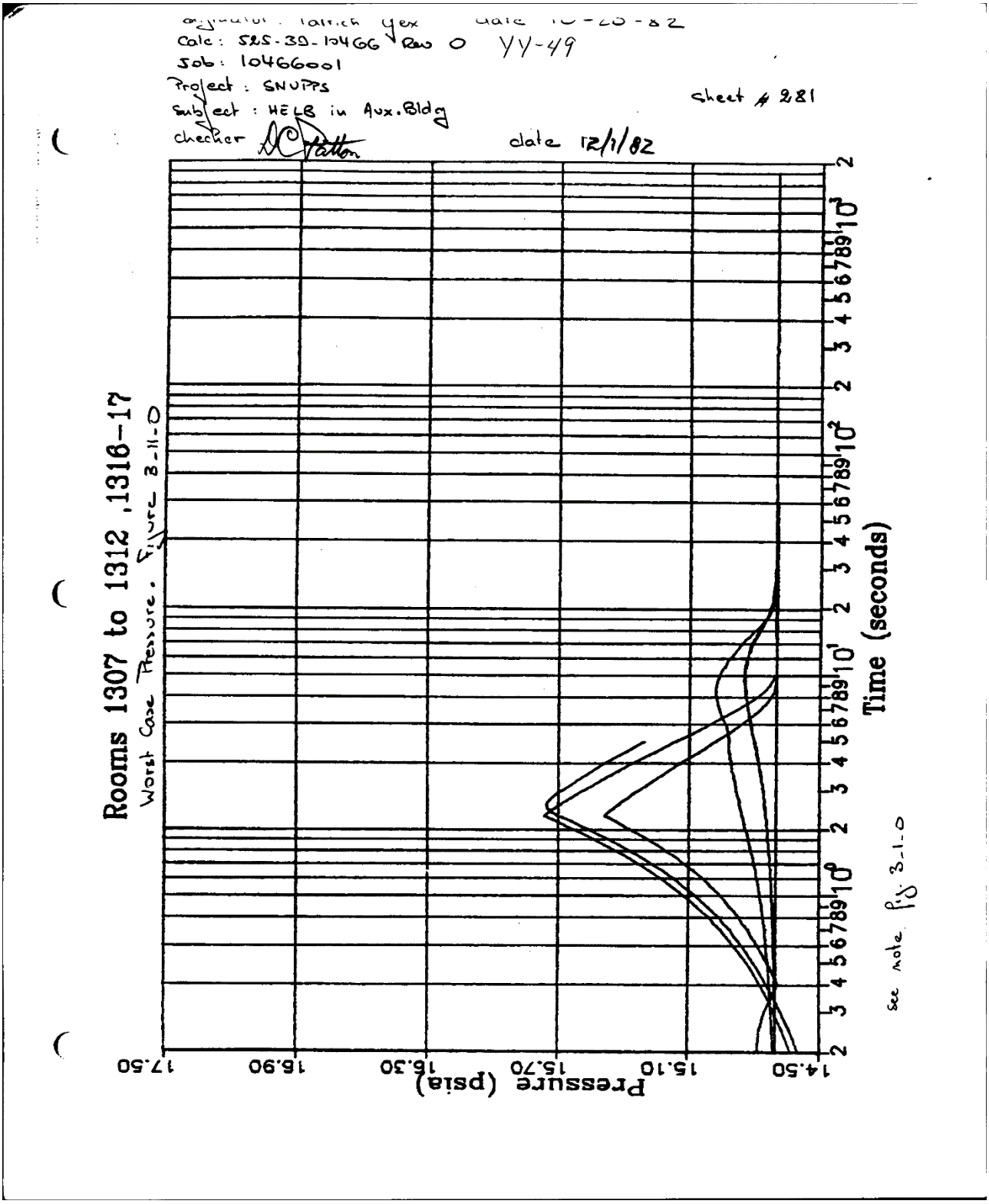


Figure 3.11(B)-35 Auxiliary Building HELB Pressure (Rooms 1307 through 1312, 1316 & 1317)



**BUILDING: AUXILIARY** **ROOM NUMBER 1309**
**ROOM DESCRIPTION: ELEVATION 2000 RHR HEAT EXCHANGER ROOM B**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 (F) | 28, Page 2-8 | NE | N/A | 107.1 (A) | 29, Pages 162 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 281 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | $5.256x10^5$ | 50 & (D) | $6.22x10^6$ $3.18x10^7$ (E) | 46, page 6 46,page 10 (E) | (C) | (C) |
| **DOSE RATE (R/hr)** | >100 mR/hr | 50 | $2.91x10^5$ $3.56x10^5$ (E) | 46, page 6 46,page 10 (E) | (C) | (C) |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ) 2.33 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 North (Reference 29, Page 283).

B. The design flood level for room 1309 is 27.9 inches, based on isolation of the break in 40 minutes. This exceeds the lowest safety related electrical equipment in the room which is located approximately 21 inches above the floor grade. The safety function of the equipment in this room is preserved due to the availability of the opposite train in room 1310 located in a separate watertight area. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F The temperature in rooms 1309 and 1310 should not exceed 175°F following a loss of normal ventilation with the RHR heat exchangers in operation; this is considered an "anticipated abnormal" condition. The duration of loss of normal ventilation is considered short and, accordingly, the temperatures generated by the condition were not utilized in aging calculations in the NUREG-0588 review.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-19A Auxiliary Building HELB Temperature-Room 5 (Rooms 1307, 1309, 1310, 1311 & 1312)

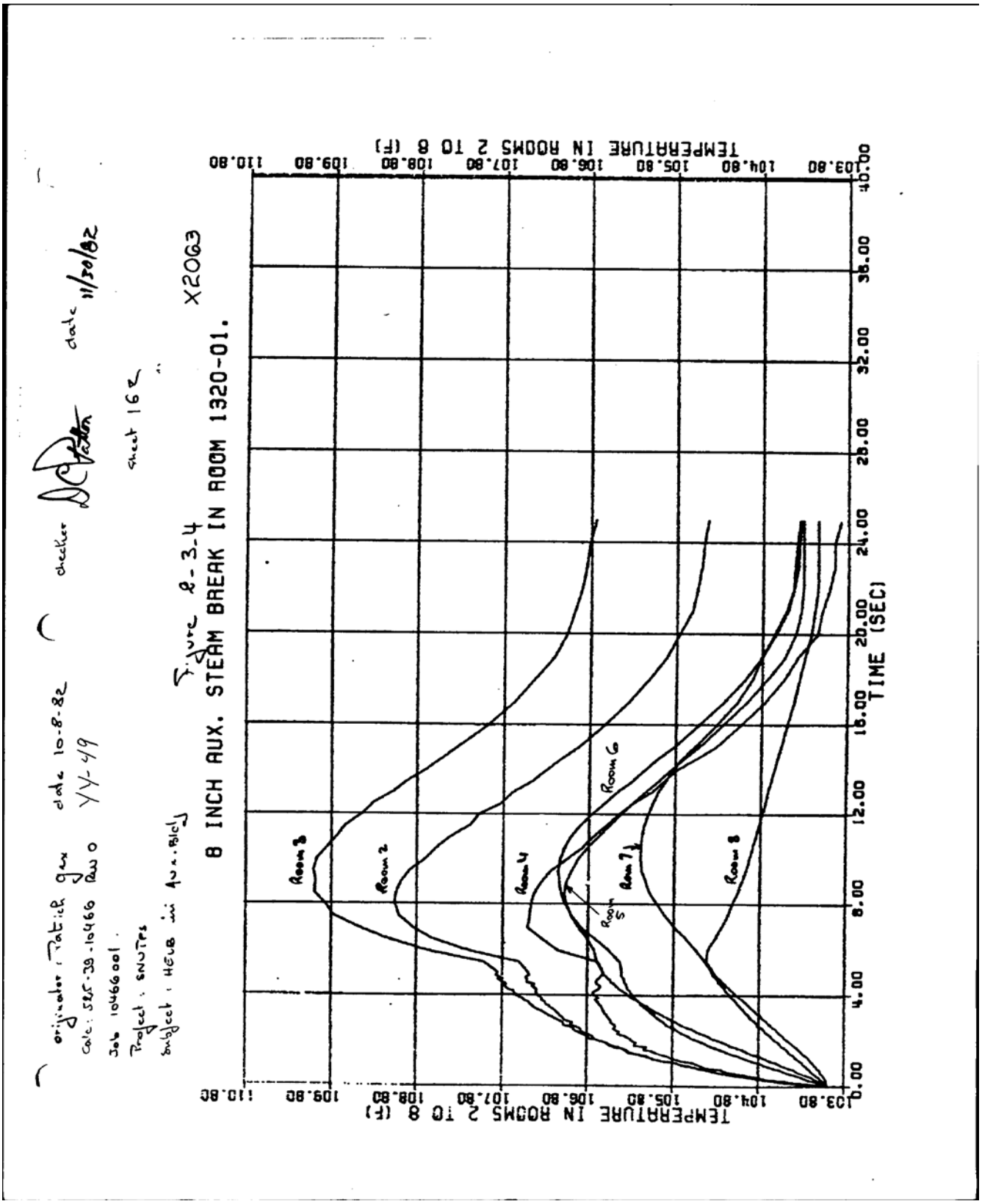
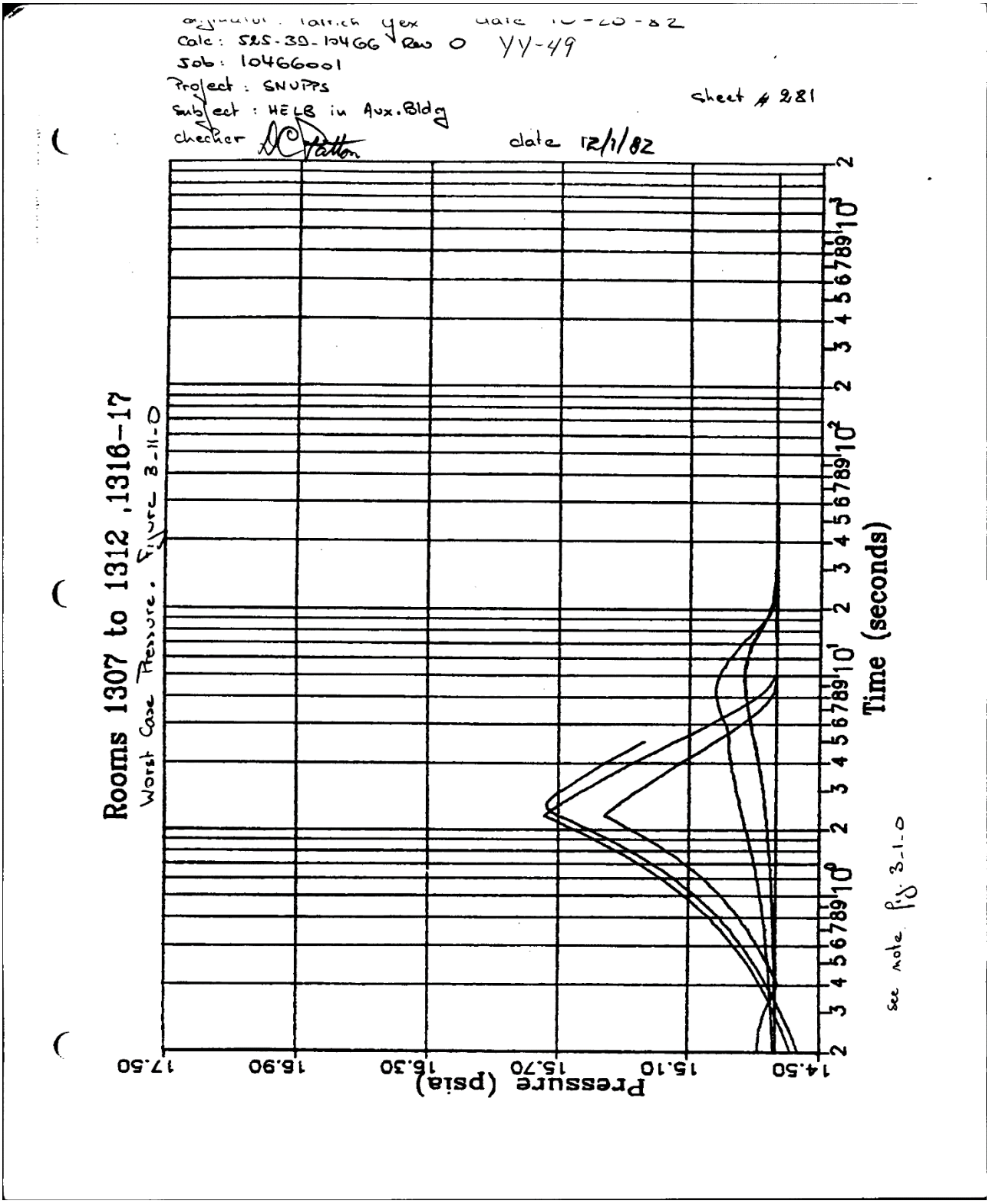


Figure 3.11(B)-35 Auxiliary Building HELB Pressure (Rooms 1307 through 1312, 1316 & 1317)



**BUILDING: AUXILIARY** **ROOM NUMBER 1310**
**ROOM DESCRIPTION: ELEVATION 2000 RHR HEAT EXCHANGER ROOM A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 (F) | 28 Page 2-8 | NE | N/A | 107.1 (A) | 29, Pages 162 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 281 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 50 & (D) | $5.85 \times 10^6$ $3.00 \times 10^7$ (E) | 46, page 7 46,page 11 (E) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 50 | $2.74 \times 10^5$ $3.35 \times 10^5$ (E) | 46, page 7 46,page 11 (E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.04 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 North (Reference 29, Page 283).

B. The design flood level for Room 1310 is 36.5 inches, based on the isolation of the break in 40 minutes and is acceptable since it is below the level of safety related electrical equipment whose functionality would be adversely affected. Per Reference 55, Appendix 2, Page 8 all safety related equipment in this room is above the flood level.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D. The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F The temperature in rooms 1309 and 1310 should not exceed 175°F following a loss of normal ventilation with the RHR heat exchangers in operation; this is considered an "anticipated abnormal" condition. The duration of loss of normal ventilation is considered short and, accordingly, the temperatures generated by the condition were not utilized in aging calculations in the NUREG-0588 review.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-19A Auxiliary Building HELB Temperature-Room 5 (Rooms 1307, 1309, 1310, 1311 & 1312)

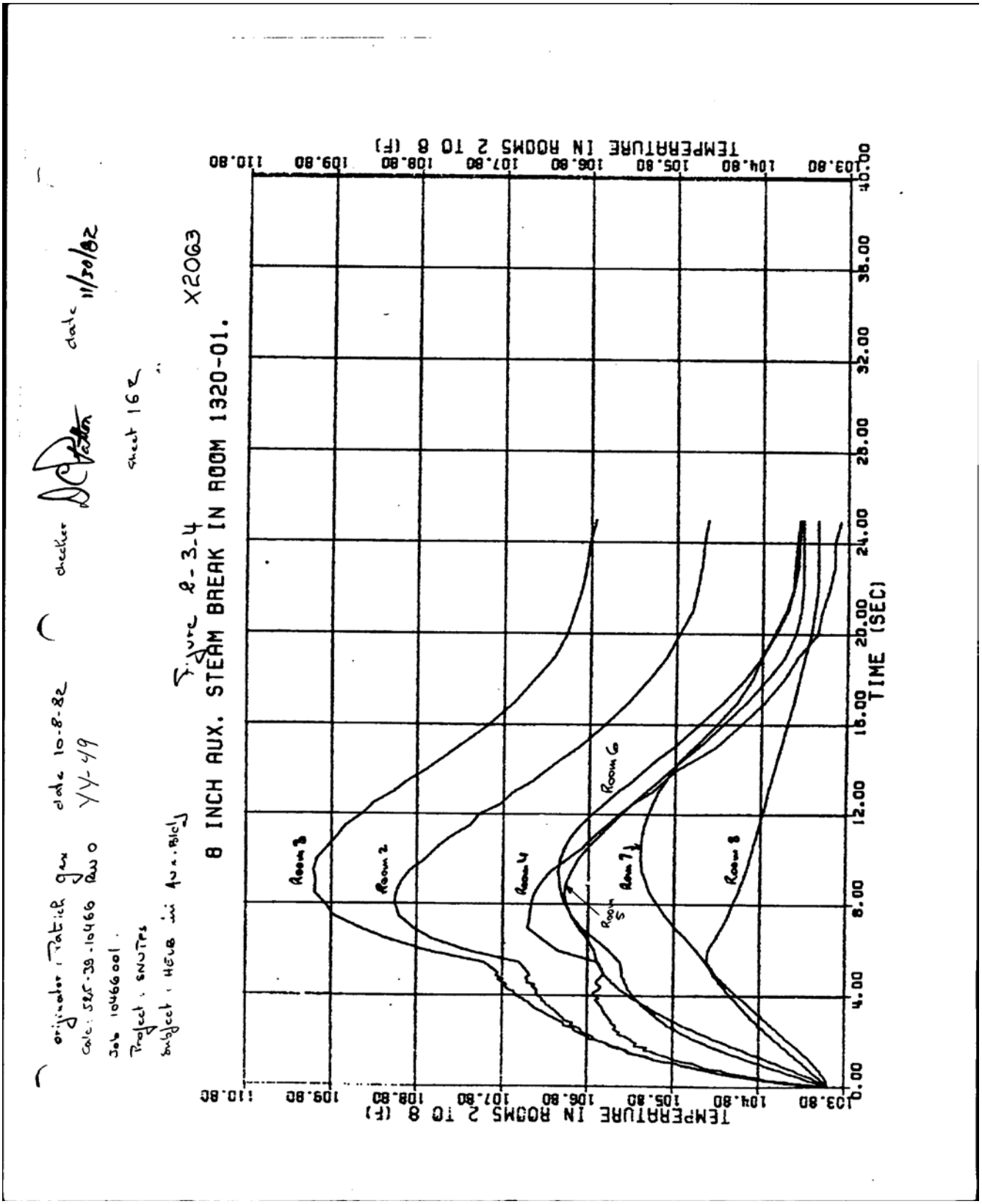
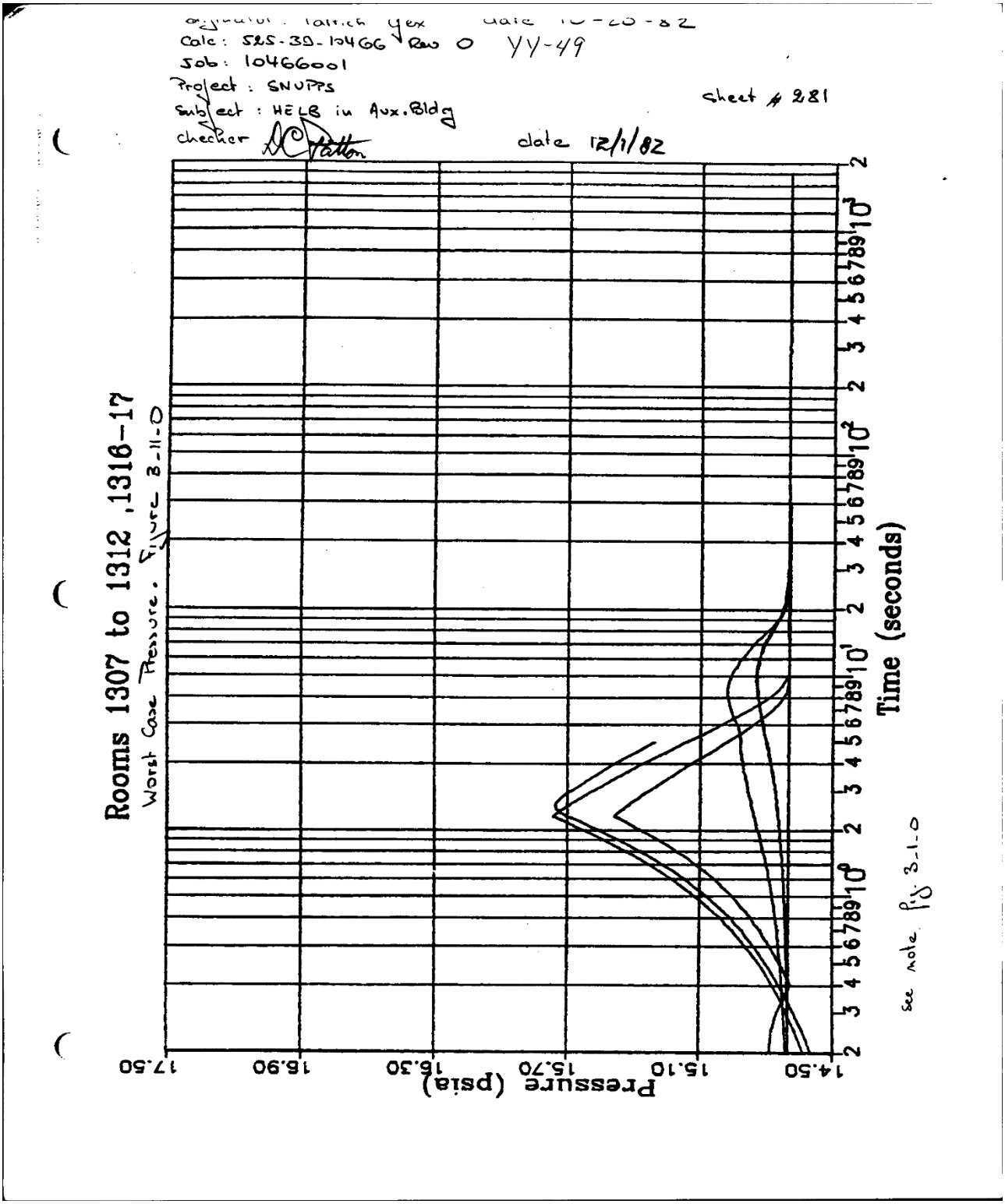


Figure 3.11(B)-35 Auxiliary Building HELB Pressure (Rooms 1307 through 1312, 1316 & 1317)



**BUILDING: AUXILIARY** **ROOM NUMBER 1311**
**ROOM DESCRIPTION: ELEVATION 2000 SAMPLING ROOM**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 107.1 (A) | 29, Pages 162 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 281 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 50 & (D) | $1.23 \times 10^4$ $6.28 \times 10^4$ (E) | 46, page 7 46,page 11 (E) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 50 | 575 703 (E) | 46, page 7 46,page 11 (E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.78 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 North (Reference 29, Page 283).

B. The design flood level for Room 1311 is 45.39 inches, based on the isolation of the break in 40 minutes and is acceptable since it is below the level of safety related electrical equipment whose functionality would be adversely affected. Per Reference 55, Appendix 2, Page 9 this room does not contain safety related equipment that could be made unavailable due the effects of flooding.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-19A Auxiliary Building HELB Temperature-Room 5 (Rooms 1307, 1309, 1310, 1311 & 1312)

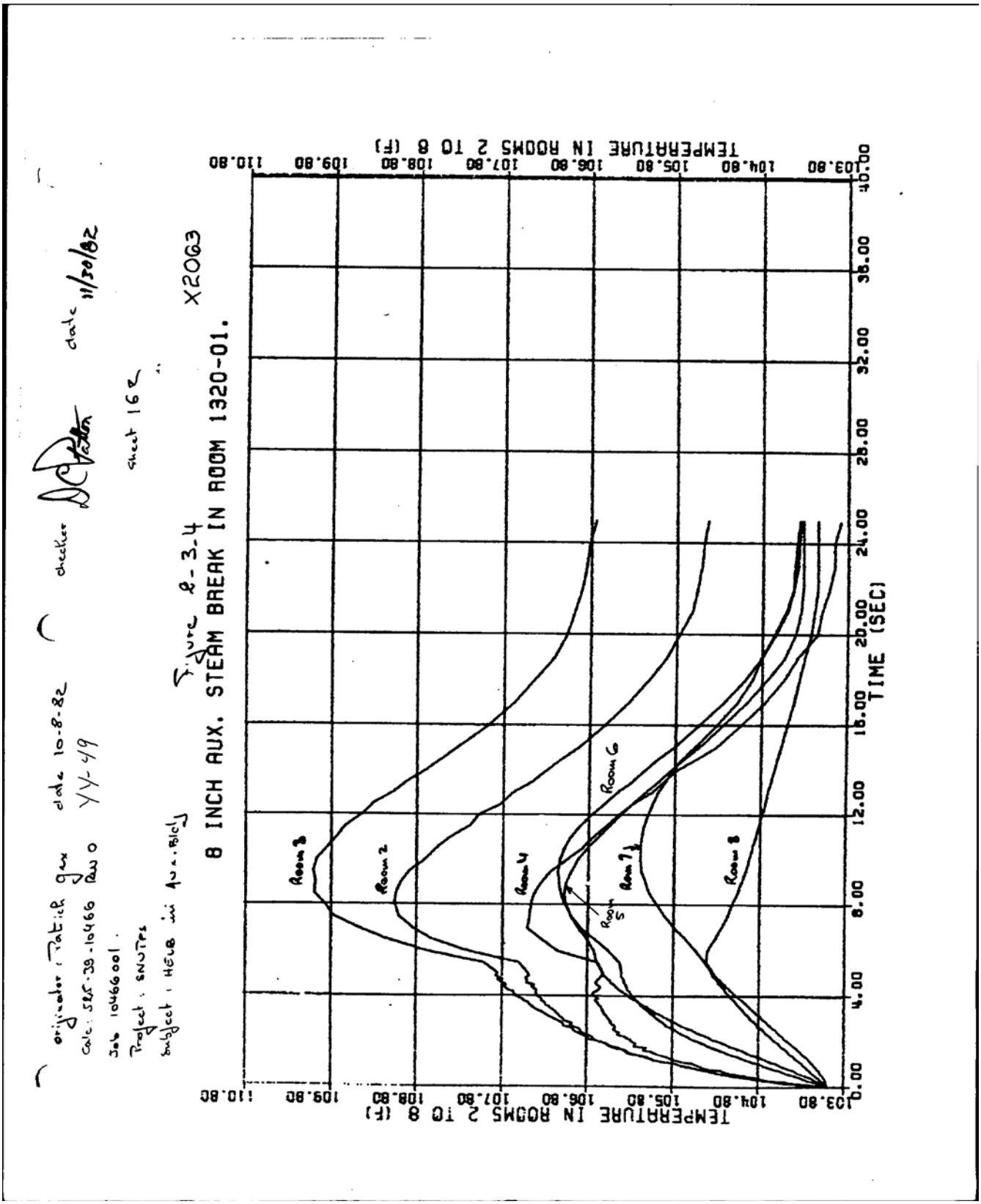
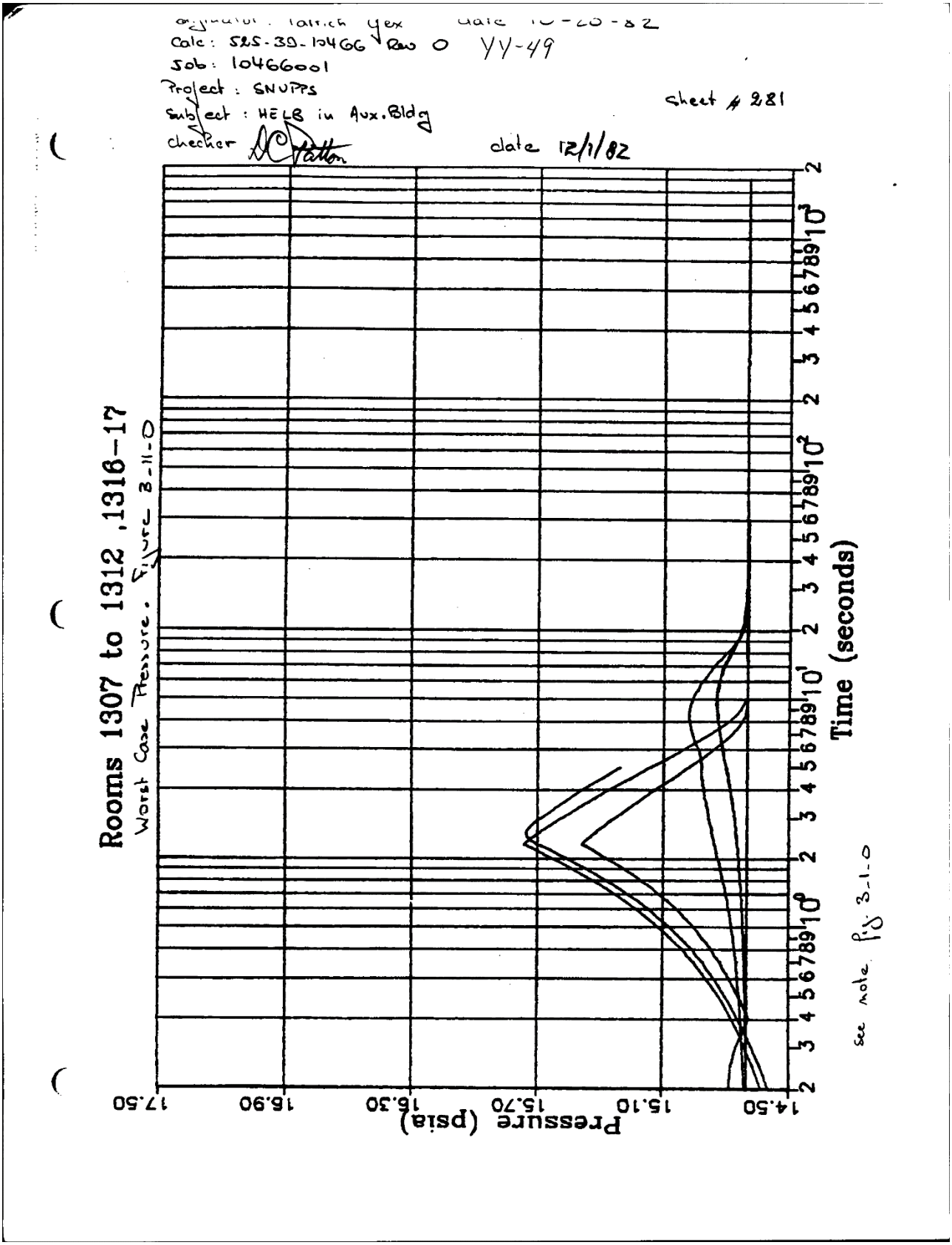


Figure 3.11(B)-35 Auxiliary Building HELB Pressure (Rooms 1307 through 1312, 1316 & 1317)



**BUILDING: AUXILIARY** **ROOM NUMBER 1312**
**ROOM DESCRIPTION: ELEV. 2000 PASS & BORON METER & RC ACTIVITY MONITOR ROOM**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 107.1 (A) | 29, Pages 162 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 281 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 50 & (E) | 848 $4.33 \times 10^3$ (D) | 36, page 5 36, page 5A (D) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 50 | 39.7 | 32, page 16 | (C) | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 3.78 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 North (Reference 29, Page 283).

B. The design flood level for Room 1312 is 45.39 inches, based on the isolation of the break in 40 minutes and is acceptable since it is below the level of safety related electrical equipment whose functionality would be adversely affected. Per Reference 55, Appendix 2, Page 10 this room does not contain safety related equipment that could be made unavailable due the effects of flooding.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D. The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

E The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
32. Calculation XX-49
36. Calculation XX-39
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-19A Auxiliary Building HELB Temperature-Room 5 (Rooms 1307, 1309, 1310, 1311 & 1312)

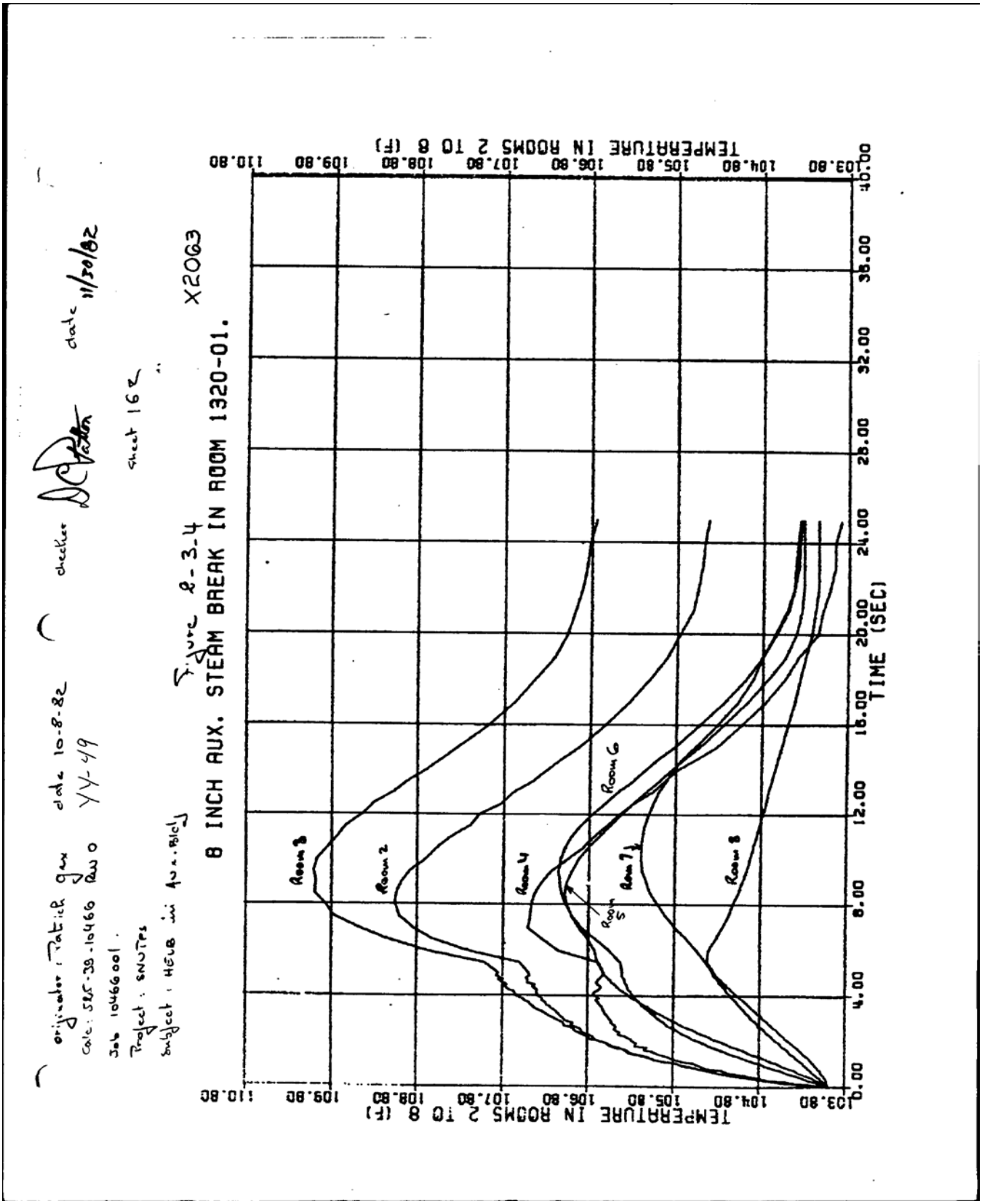
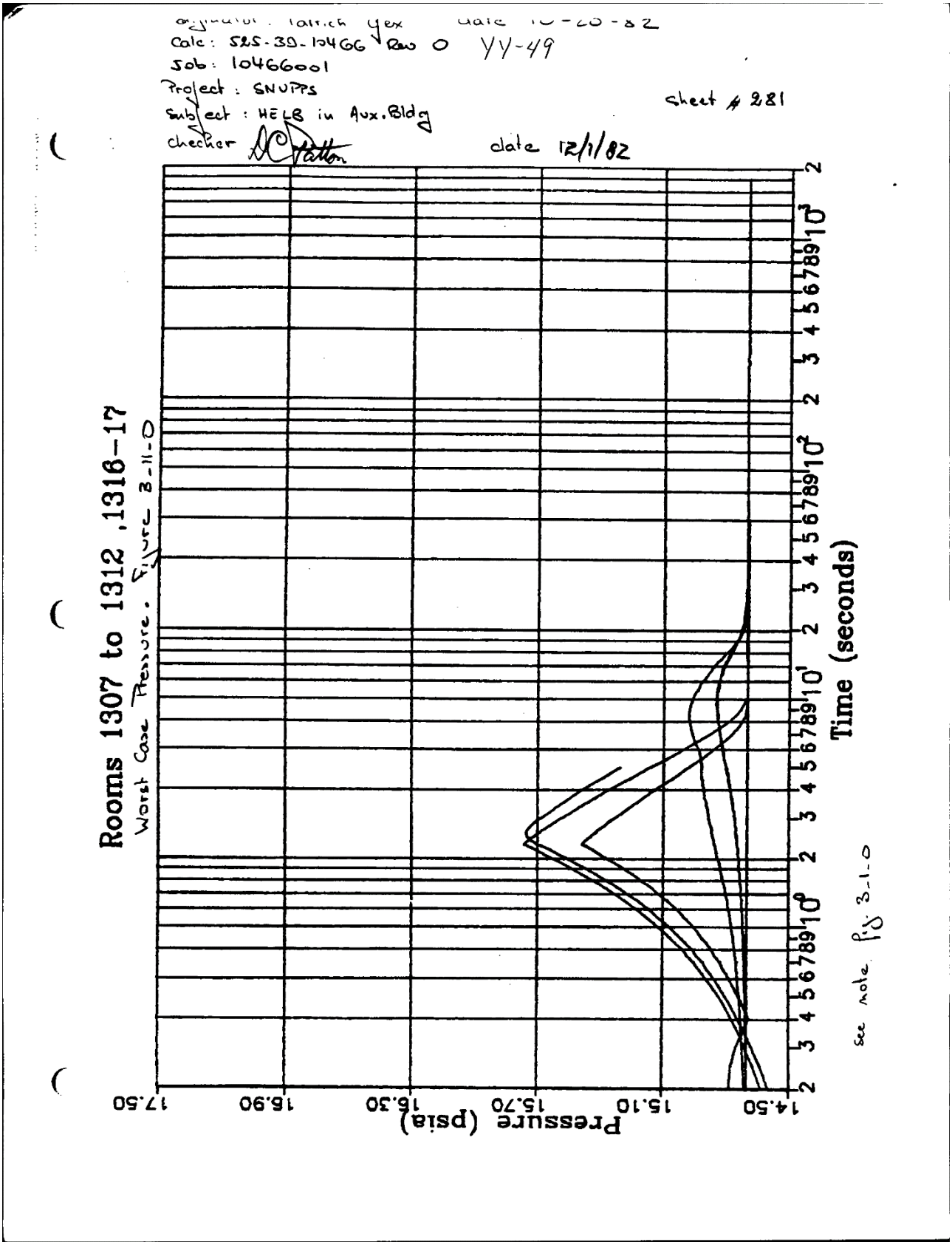


Figure 3.11(B)-35 Auxiliary Building HELB Pressure (Rooms 1307 through 1312, 1316 & 1317)



**BUILDING: AUXILIARY** **ROOM NUMBER 1313**
**ROOM DESCRIPTION: ELEVATION 2000 VOLUME CONTROL TANK ROOM**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 118.7 (A) | 29, Pages 257 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 270 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 50 & (D) | $1.06 \times 10^4$ $5.44 \times 10^4$ (E) | 46, page 7 46,page 11 (E) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 50 | 498 609 (E) | 46, page 7 46,page 11 (E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 1.98 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 North (Reference 29, page 257).

B. The design flood level for Room 1313 is 23.74 inches, based on the isolation of the break in 40 minutes and is acceptable since it is below the level of safety related electrical equipment whose functionality would be adversely affected. Per Reference 55, Appendix 2, Page 11 below a height of 4 feet.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D. The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

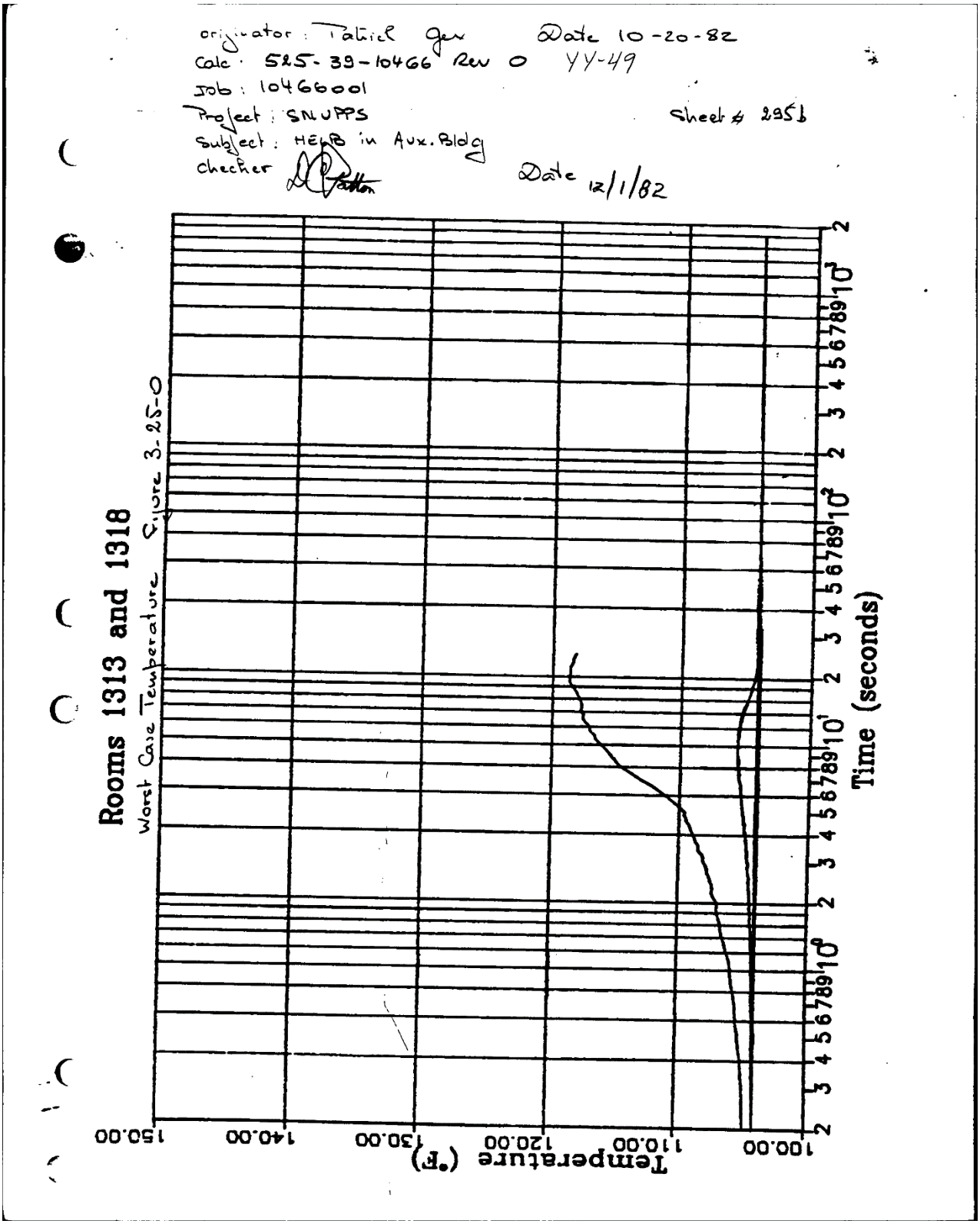
The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

E Calculation YY-49 divides Room 1314 into two parts: 1314 Corridor is the part adjacent to Rooms 1321 and 1322, 1314 (West) is the part adjacent to room 1315. The maximum temperature of 190°F is for the 1314 Corridor and results from a 3" steam line break in Room 1321. The maximum temperature of 1314 (West) is below 110°F and results from an 8" auxiliary steam line break in Room 1311.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50 Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-20 Auxiliary Building HELB Temperature (Room1313)



**BUILDING: AUXILIARY** **ROOM NUMBER 1314**
**ROOM DESCRIPTION: ELEVATION 2000 CORRIDOR NO. 3**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 109.13 (A) | 29, Pages 162 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 279 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 90 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 50 & (C) | $5.98x10^5$ $3.05x10^6$ (D) | 46, page 7 46,page 11 (D) | NE | N/A |
| **DOSE RATE (R/hr)** | 2.5 mR/hr | 50 | 28000 $3.42x10^4$ (D) | 46, page 7 46,page 11 (D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 2.77 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature of 110 F is from an 8' break from room 1301 (Reference 29, Page 162).

B. The design flood level for Room 1314 is 33.24 inches, based on isolation of the break in 40 minutes. The flood level exceeds several RP panels; however the safety function of the panels is protected due to the presence of redundant panels located in rooms 1402 and 1408. The flood level also exceeds waterproof pressure transmitters, and isolation valves that fail in their failsafe position. Therefore the flood level is acceptable. Per Reference 55, Appendix 2, Page 12 EGFT0108 is the lowest identified safety related equipment in this room; it is ~ 36 inches (3.0 ft) above the floor grade.

C. The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D. The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

E Calculation YY-49 divides Room 1314 into two parts: 1314 Corridor (South – room 4) is the part adjacent to Rooms 1321 and 1322, 1314 (North – room 2) is the part adjacent to room 1315. The maximum temperature of 1314 (North) is below 110°F and results from an 8" auxiliary steam line break in Room 1311.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50 Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-13 Auxiliary Building HELB Temperatures
(Room 1301(south), 1314, 1314 (south - room 4), 1323, 1502, 1503, 1504, 1505, 1506, 1507 & 1513)

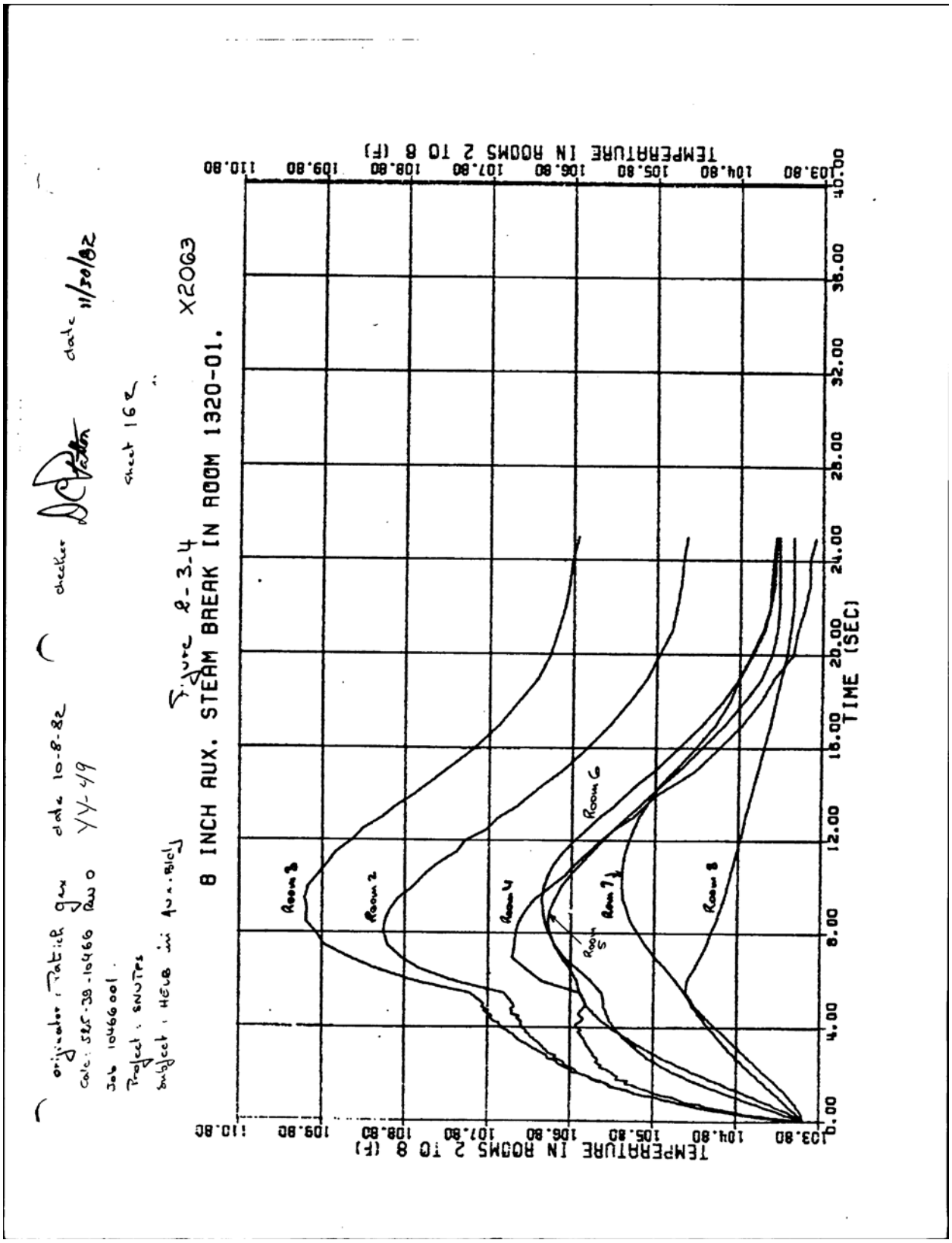
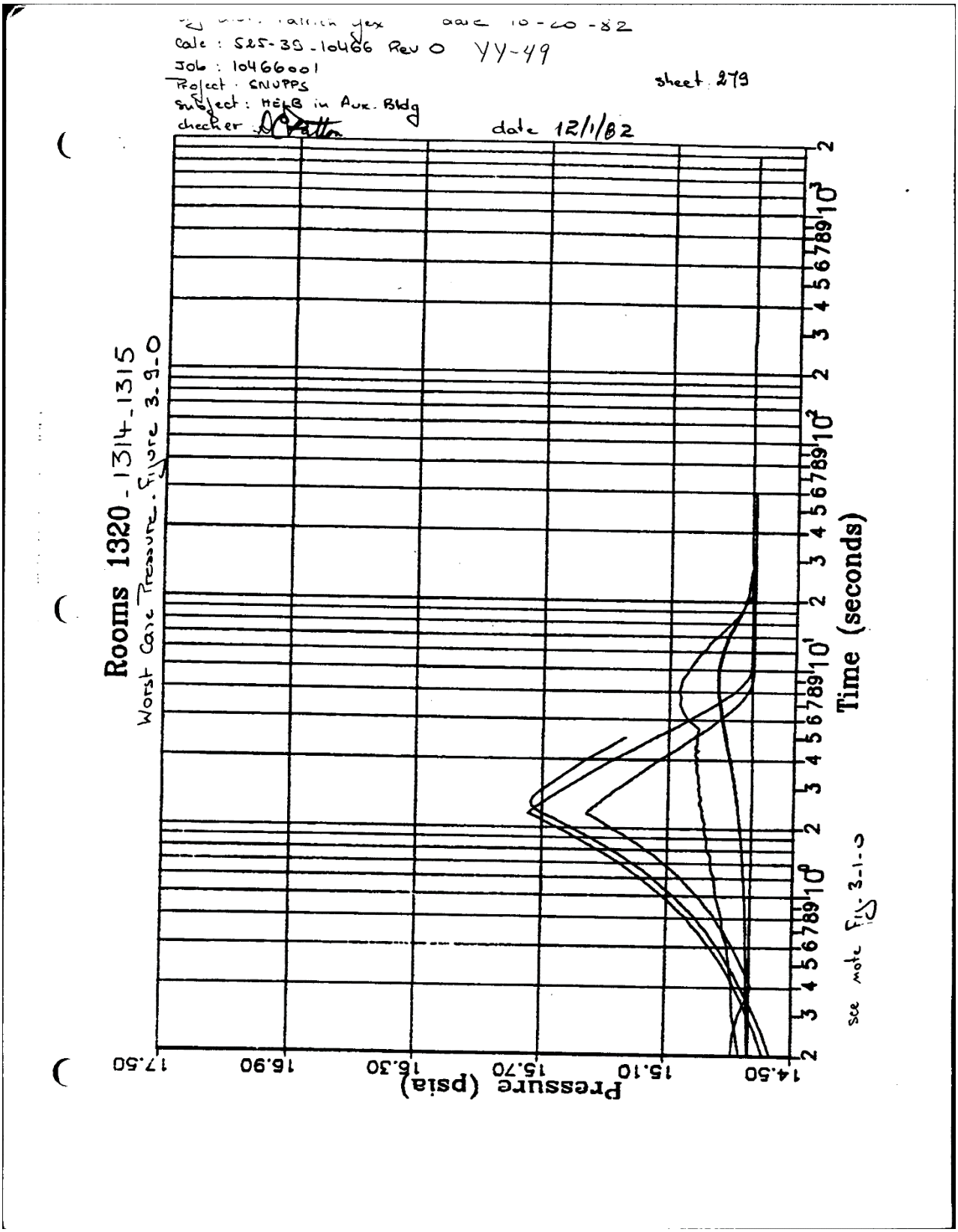


Figure 3.11(B)-36 Auxiliary Building HELB Pressure (Rooms 1314,1315 and 1320)



**BUILDING: AUXILIARY** **ROOM NUMBER 1315**
**ROOM DESCRIPTION: ELEVATION 2000 CONTAINMENT SPRAY ADDITIVE TANK AREA**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| PEAK TEMPERATURE (°F) | 104 | 28, Page 2-8 | NE | N/A | 109.1 (A) | 29, Pages 161, 256 & 283 |
| PEAK PRESSURE (PSIG) | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 279 |
| HUMIDITY (%) | 70 | 28, Page 2-8 | NE | N/A | 77 | 29, page 300 |
| INTEGRATED DOSE (RADS) | 1314 | 50 & (D) | $1.79 \times 10^4$<br>$9.16 \times 10^4$<br>(E) | 36, page 5<br>36, page 5A<br>(E) | (C) | NA |
| DOSE RATE (R/hr) | ≤2.5 mR/hr | 50 | 839 | 36, Page 5 | (C) | NA |
| MAX. FLOOD LEVEL (FT) (above the floor) | NE | N/A | NE | N/A | 2.77 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 (Reference 29, Page 283).

B. The design flood level for Room 1315 is 33.24 inches, based on isolation of the break in 40 minutes. The flood level exceeds several RP panels; however the safety function of the panels is protected due to the presence of redundant panels located in rooms 1402 and 1408. The flood level also exceeds waterproof pressure transmitters, and isolation valves that fail in their failsafe position. Therefore the flood level is acceptable. Per Reference 55, Appendix 2, Page 13 valve ENHV0016 is the lowest identified safety related equipment in this room; it is ~ 36 inches (3.0 ft) above the floor grade.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
36. Calculation XX-39
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-17 Auxiliary Building HELB Temperature-Room 2 (Room 1315)

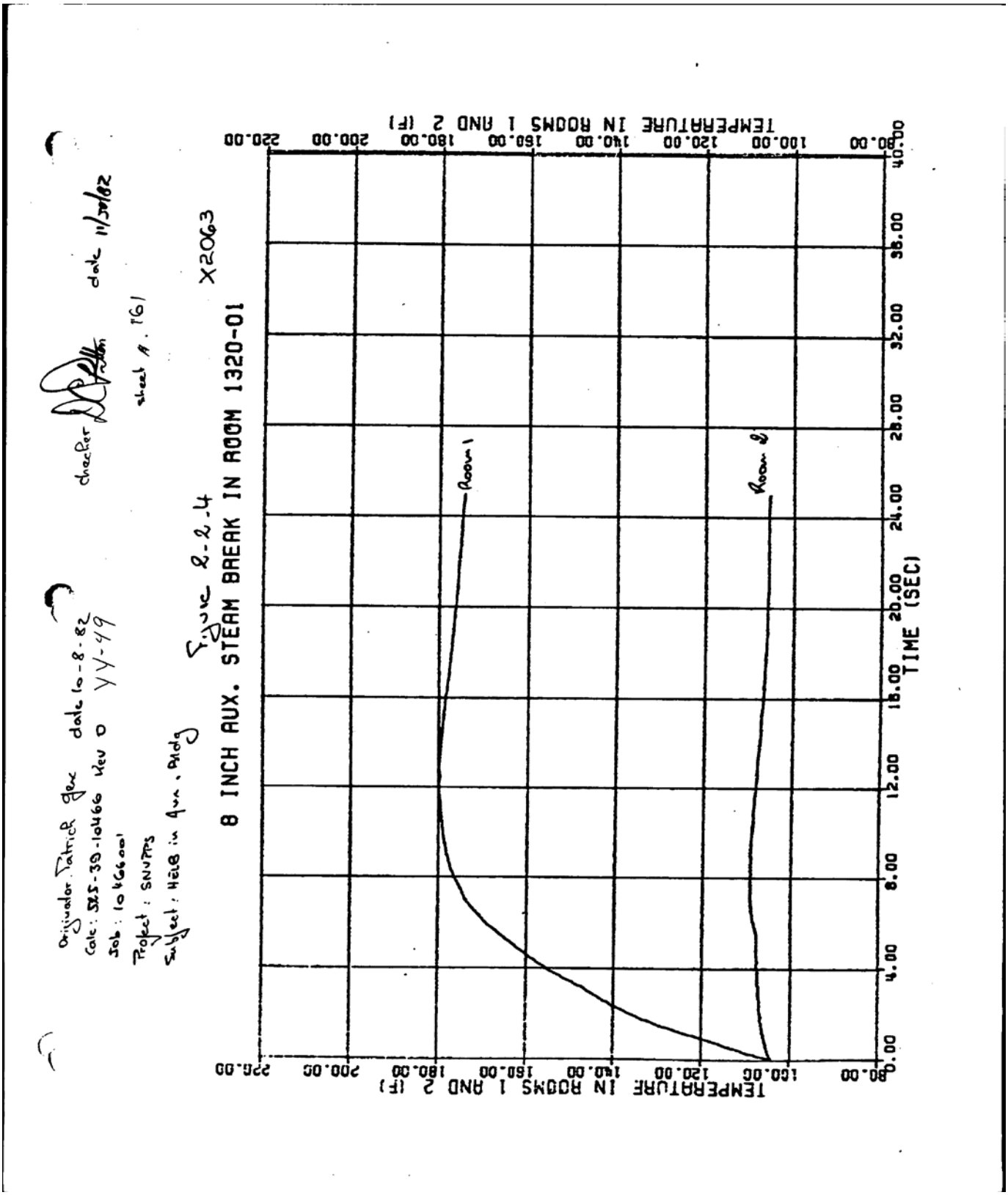
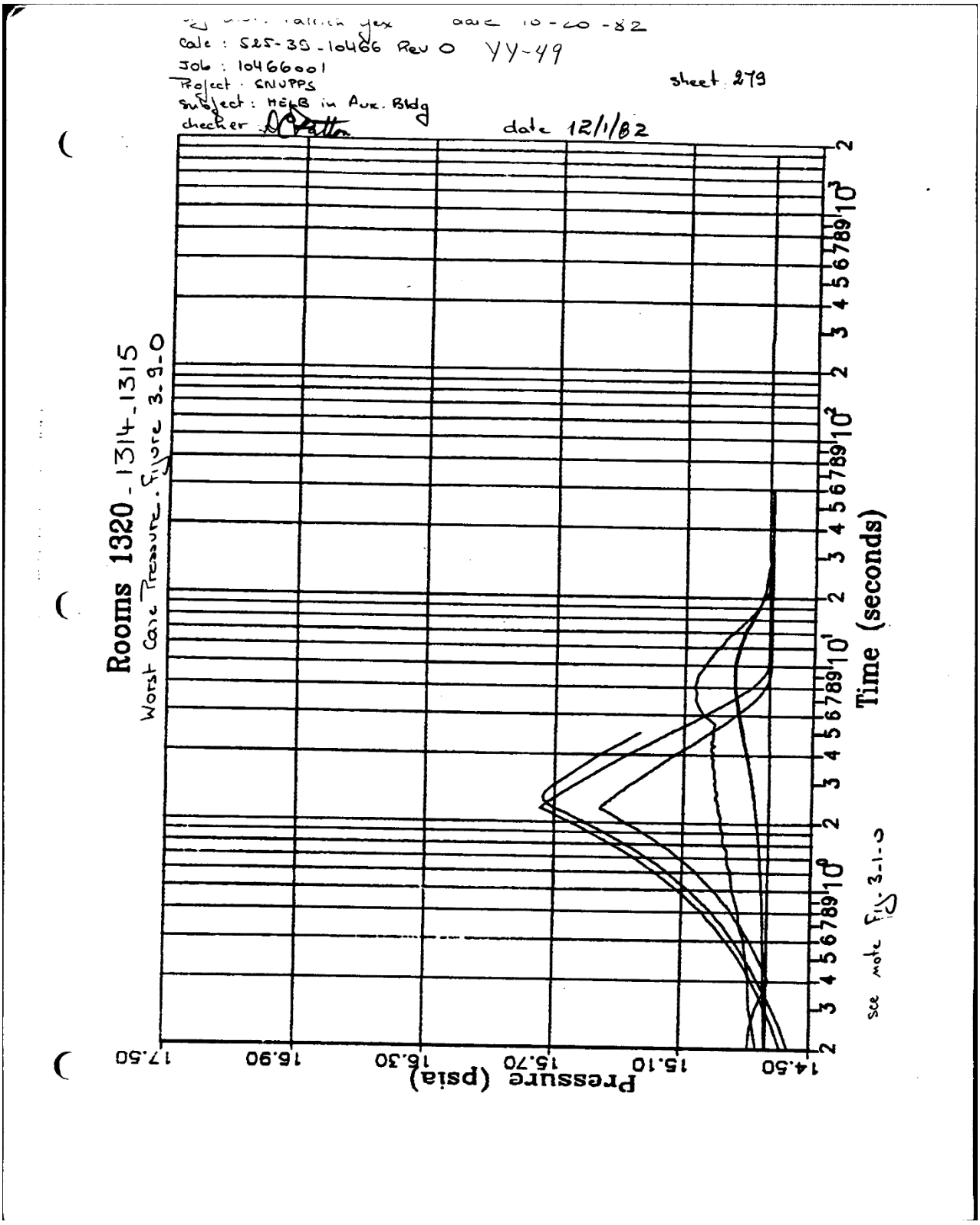


Figure 3.11(B)-36 Auxiliary Building HELB Pressure (Rooms 1314, 1315 and 1320)



**BUILDING: AUXILIARY** **ROOM NUMBER 1316**
**ROOM DESCRIPTION: ELEV. 2000 SEAL WATER HEAT EXCHANGER VALVE COMPARTMENT**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 107.1 (A) | 29, Page 162 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 281 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 50 & (D) | 4210<br>$2.16 \times 10^4$<br>(E) | 46, page 7<br>46, page 11<br>(E) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 50 | 197<br>240<br>(E) | 46, page 7<br>46, page 11<br>(E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 (Reference 29, page 283).

B. For Room 1316 the design flood level is 0 feet. Given that there is no water accumulation in this room, all safety related electrical equipment will not be affected from flooding effects.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-21 Auxiliary Building HELB Temperature-Room 6 (Rooms 1316, 1317, 1322 & 1323)

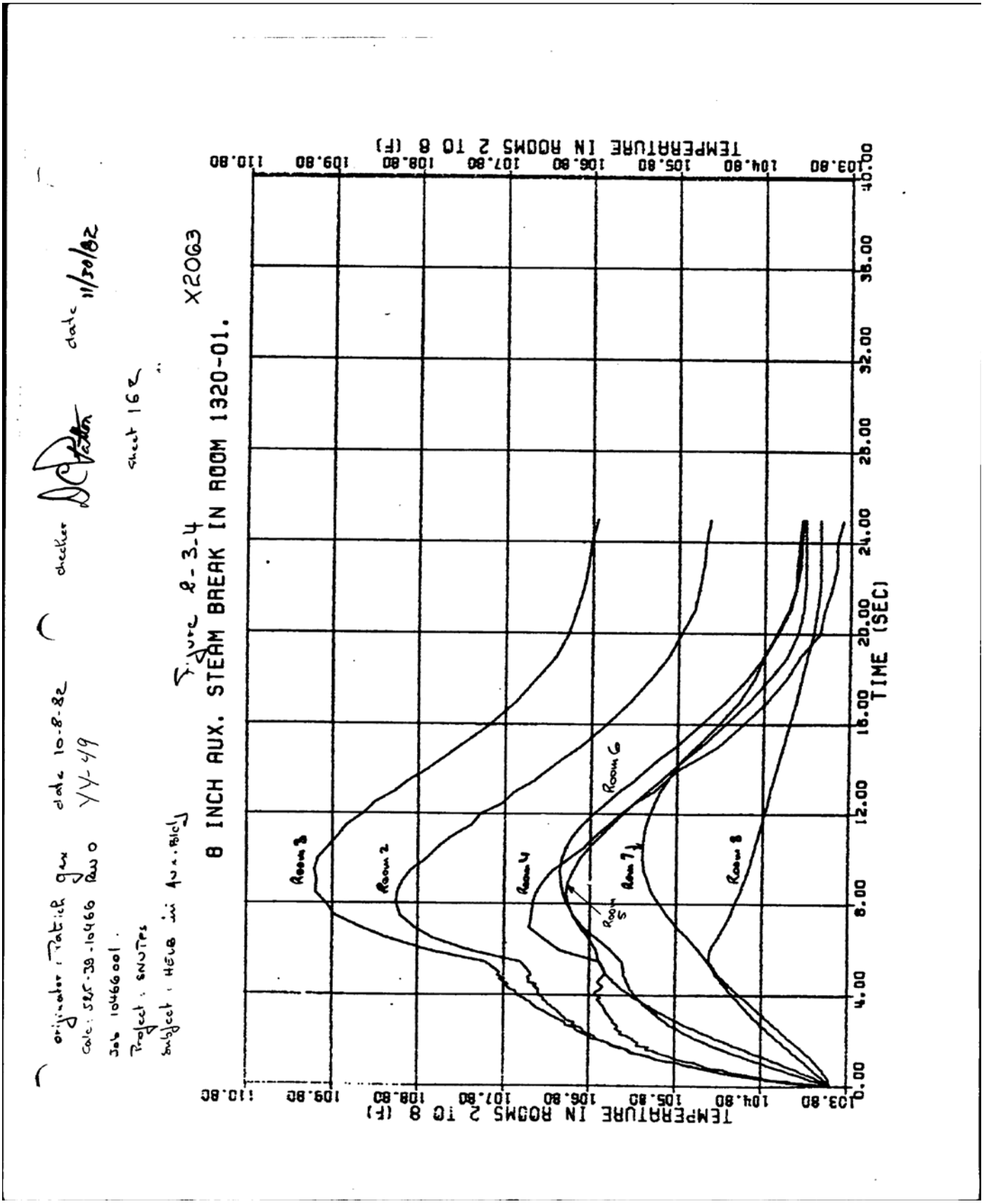
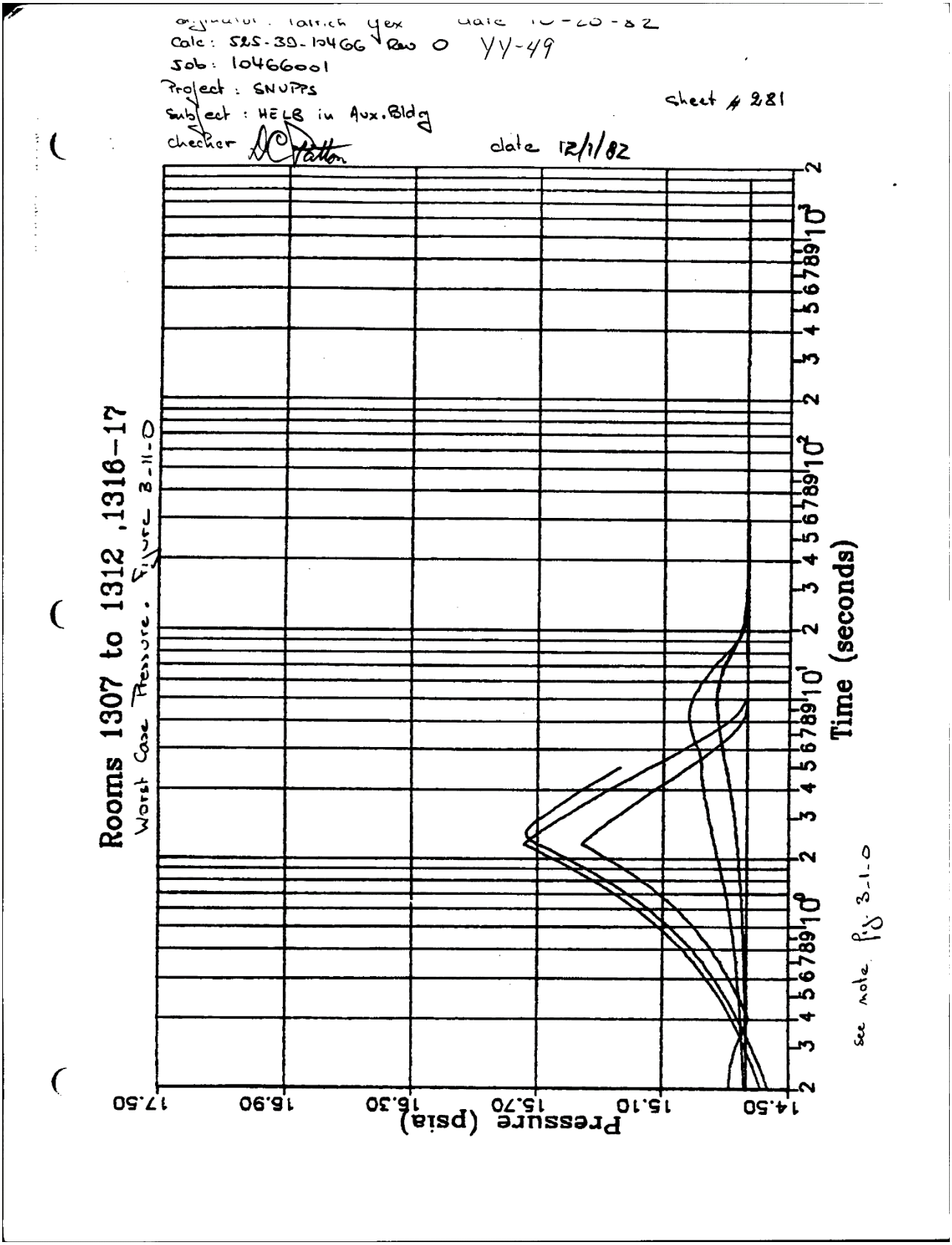


Figure 3.11(B)-35 Auxiliary Building HELB Pressure (Rooms 1307 through 1312, 1316 & 1317)



**BUILDING: AUXILIARY** **ROOM NUMBER 1317**
**ROOM DESCRIPTION: ELEV. 2000 SEAL WATER HEAT EXCHANGER ROOM**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 107.1 (A) | 29, Pages 162 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | N/A | NE | N/A | 1.06 | 29 Pages 270, 281 & 57, page 22 |
| **HUMIDITY (%)** | 70 | 1, Page 2-8 | NE | N/A | 71 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 50 & (D) | 4210 $2.16 \times 10^4$ (E) | 46, page 7 46, page 11 (E) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 50 | 197 240 (E) | 46, page 7 46, page 11 (E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 (Reference 29, page 283). This room is connected to room 1316 (Reference 57, page 19)

B. For Room 1317 the design flood level is 0 feet. Given that there is no water accumulation in this room, all safety related electrical equipment will not be affected from flooding effects.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F This room contains components with greater than or equal to (≥) 4.0 wt. % (7000 ppm), but less than or equal to (≤) 4.4 wt. % (7000 ppm) boric acid solution should be maintained at min. 65°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03
57. Calculation YY-57

Figure 3.11(B)-21 Auxiliary Building HELB Temperature Room 6 (Room 1316, 1317, 1322 & 1323)

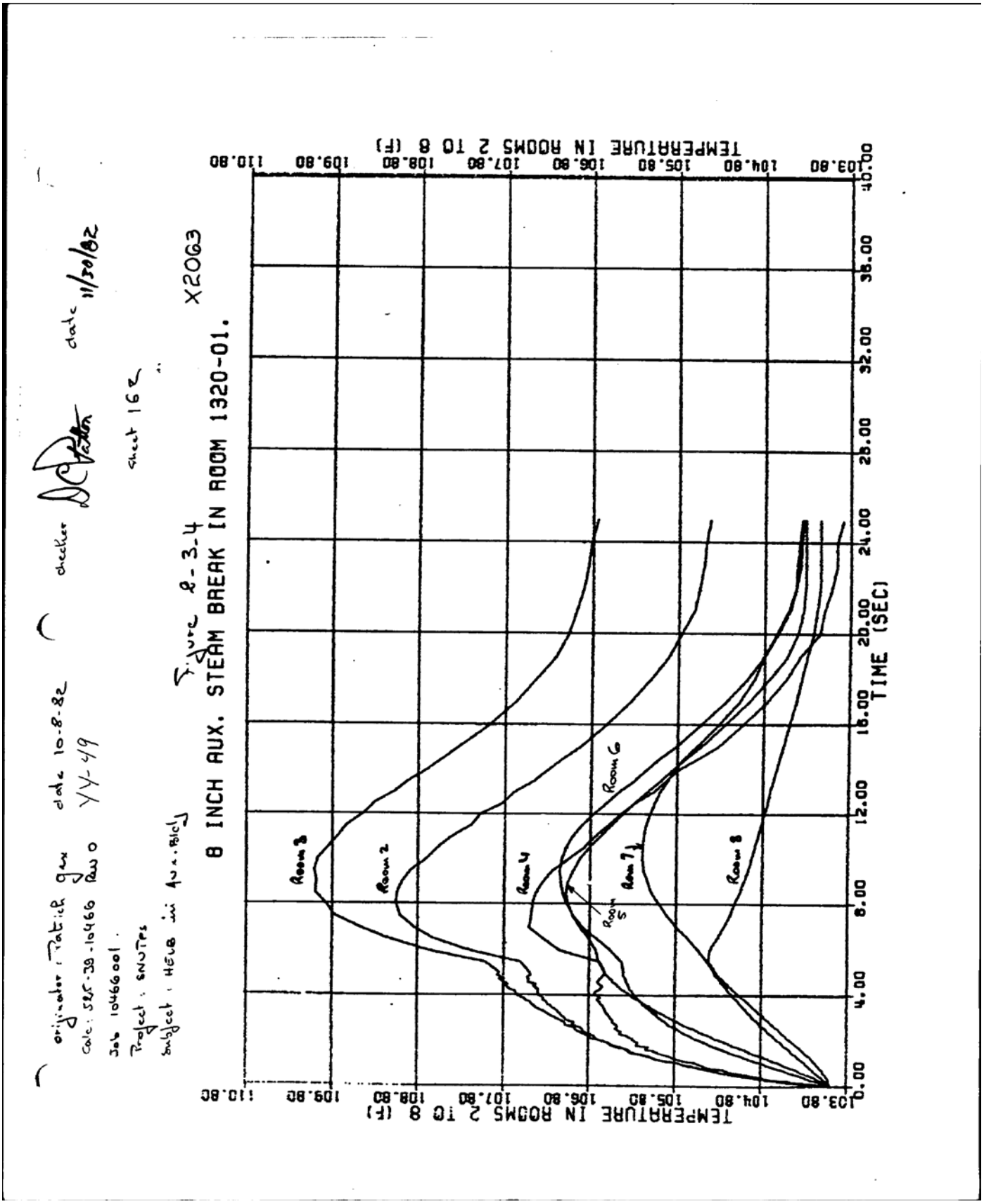
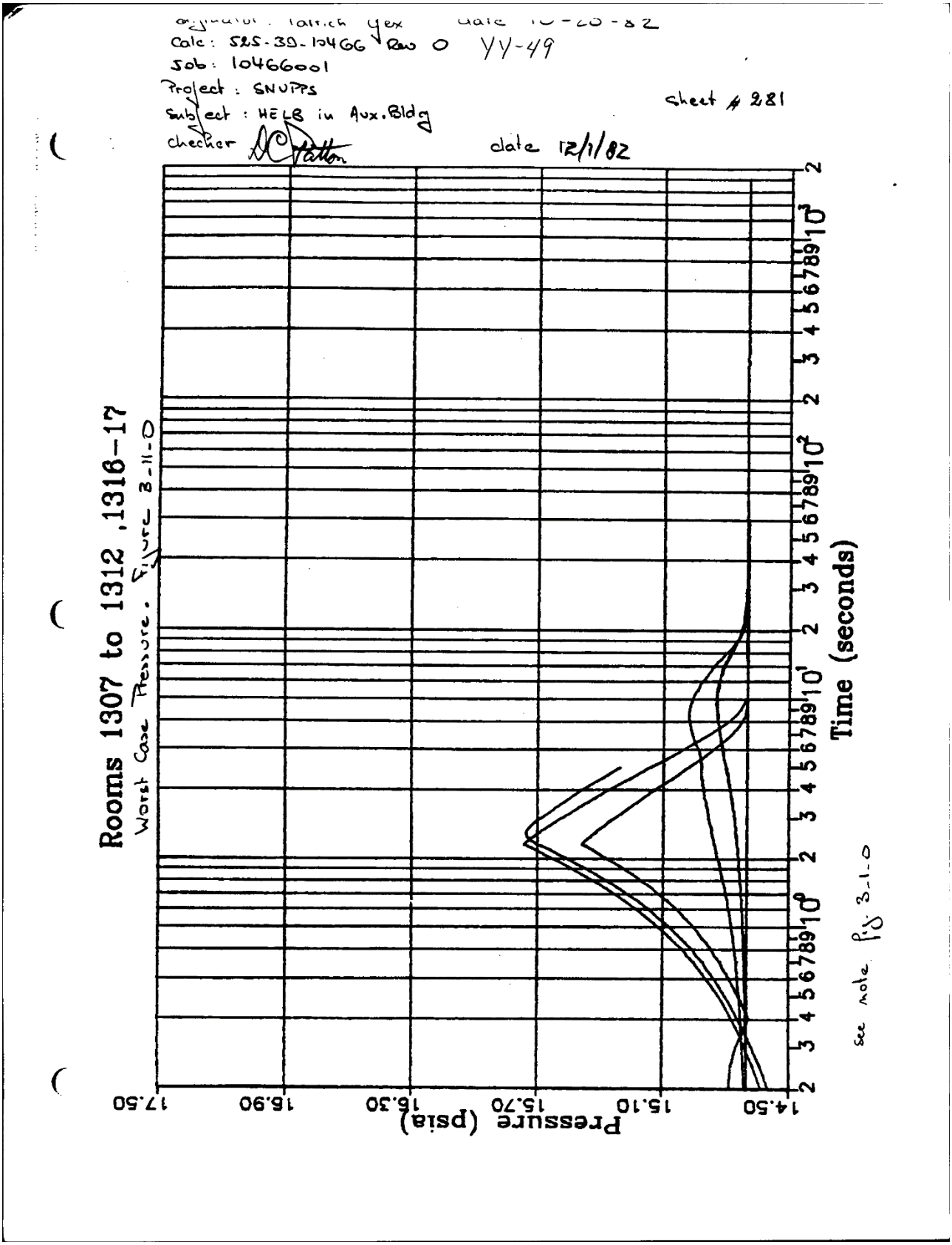


Figure 3.11(B)-35 Auxiliary Building HELB Pressure (Rooms 1307 through 1312, 1316 & 1317)



**BUILDING: AUXILIARY** **ROOM NUMBER 1318**
**ROOM DESCRIPTION: ELEV. 2000 VOLUME CONTROL TANK VALVE COMPARTMENT**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 118.7 (A) | 29, Pages 163, 257 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 281 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 50 & (D) | $8.97 \times 10^5$<br>$4.59 \times 10^6$<br>(E) | 46, page 7<br>46, page 11<br>(E) | (C) | NA |
| **DOSE RATE (R/hr)** | >100 mR/hr | 50 | $4.2 \times 10^4$<br>$5.14 \times 10^4$<br>(E) | 46, page 7<br>46, page 11<br>(E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 1.98 (B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 (Reference 29, page 257).

B. The design flood level for Room 1318 is 23.74 inches, based on the isolation of the break in 40 minutes and is acceptable since it is below the level of safety related electrical equipment whose functionality would be adversely affected. Per Reference 55, Appendix 2, Page 14 instrument BGLT0112 is the lowest identified safety related equipment in this room; it is ~ 44.5 inches (3.7 ft) above the floor grade.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

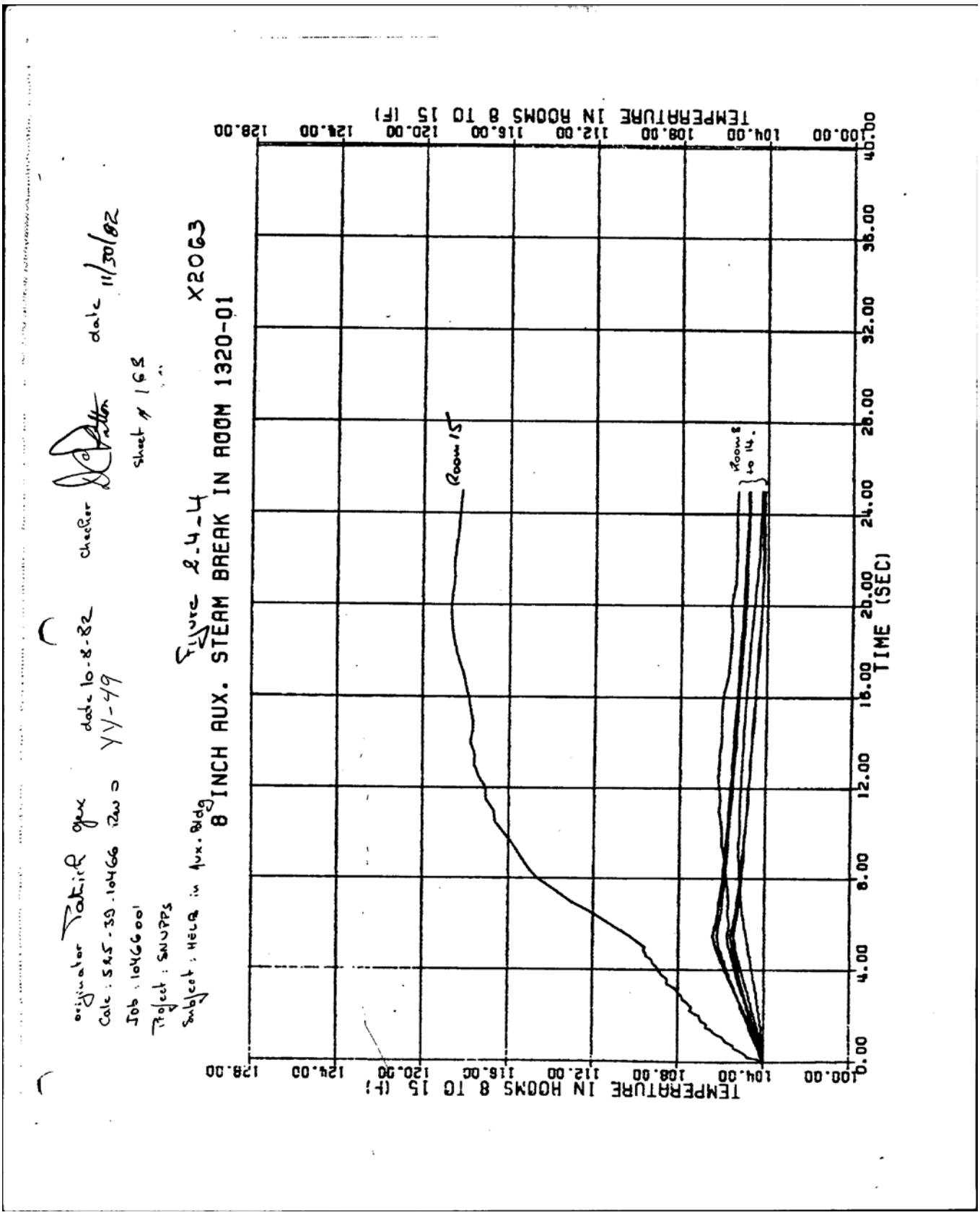
E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F This room contains components with greater than or equal to (≥) 4.0 wt. % (7000 ppm), but less than or equal to (≤) 4.4 wt. % (7000 ppm) boric acid solution should be maintained at min. 65°F.

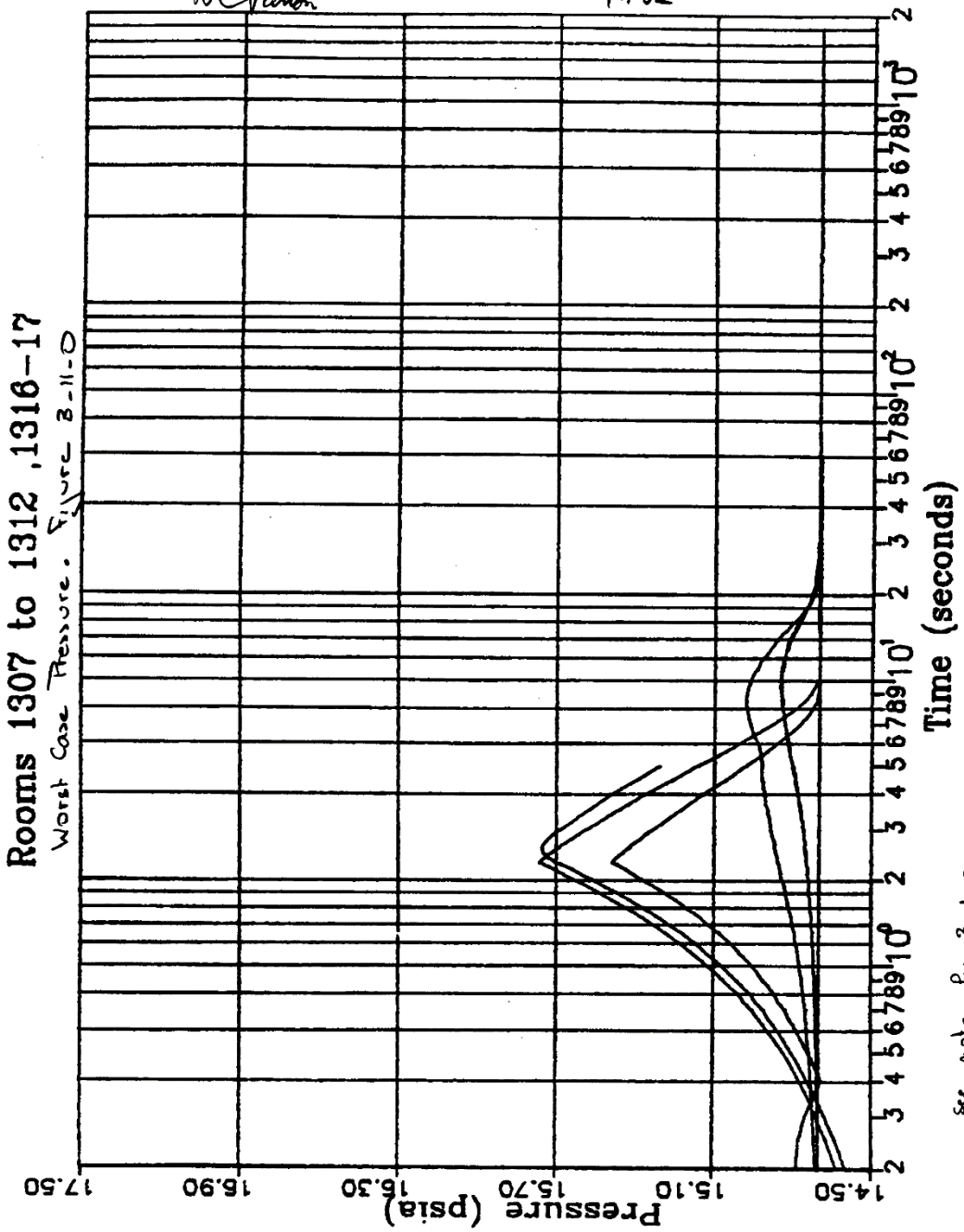
**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-20A Auxiliary Building HELB Temperature-Room 15 (Room 1318)



originator: Patrick Yex date 10-20-82
Calc: 525-39-10466 Rev 0 YY-49
Job: 10466001
Project: SNUPPS
Subject: HELB in Aux. Bldg
checker DC Patton date 12/1/82
sheet # 281



**BUILDING: AUXILIARY** **ROOM NUMBER 1320**
**ROOM DESCRIPTION: ELEV. 2000 CORRIDOR NO. 4**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 180.07 (A) | 29, Page 161 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 279 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 50 & (C) | 5130<br>$2.63 \times 10^4$<br>(D) | 46, page 7<br>46, page 11<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 2.5 mR/hr | 50 | 240<br>293.5<br>(D) | 46, page 7<br>46, page 11<br>(D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ)<br>2.77<br>(B) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301.

B. The design flood level for Room 1320 is 33.24 inches caused by a KC system line break not a HELB and is based on isolation of the break in 40 minutes. The flood level exceeds several RP panels; however the safety function of the panels is protected due to the presence of redundant panels located in rooms 1402 and 1408. The flood level also exceeds waterproof pressure transmitters, and isolation valves that fail in their failsafe position. The HELB in the associated room 1301 is identified in reference 55, Appendix 1, note 5 is from the HELB, it is stated that the pressure in this line and the resulting flow will drastically decrease until the system reaches its new equilibrium point. Thus it is not analyzed since it will be significantly less. Several MEC lines are analyzed instead in section 4-C.3.4 of reference 55 and that flooding is less than 11% of the KC line break. Therefore, the flood level for EQ qualification is zero (ref. CR 112040). Therefore the flood level is acceptable.

C The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50. Radiation Zone Dwg. A-1702
55. Calculation FL-03

Figure 3.11(B)-18 Auxiliary Building HELB Temperature-Room 1 (Rooms 1301-North and1320)

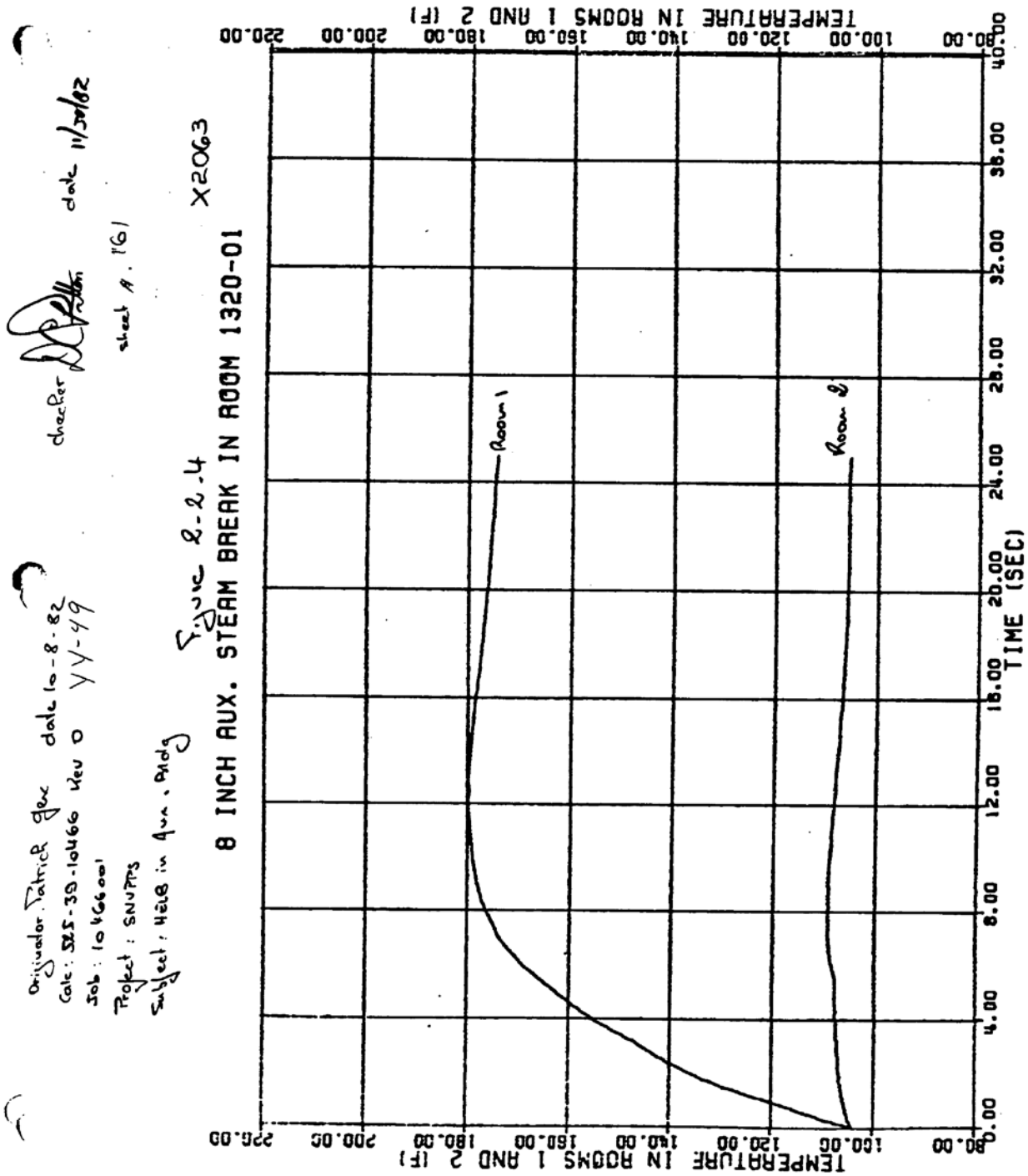
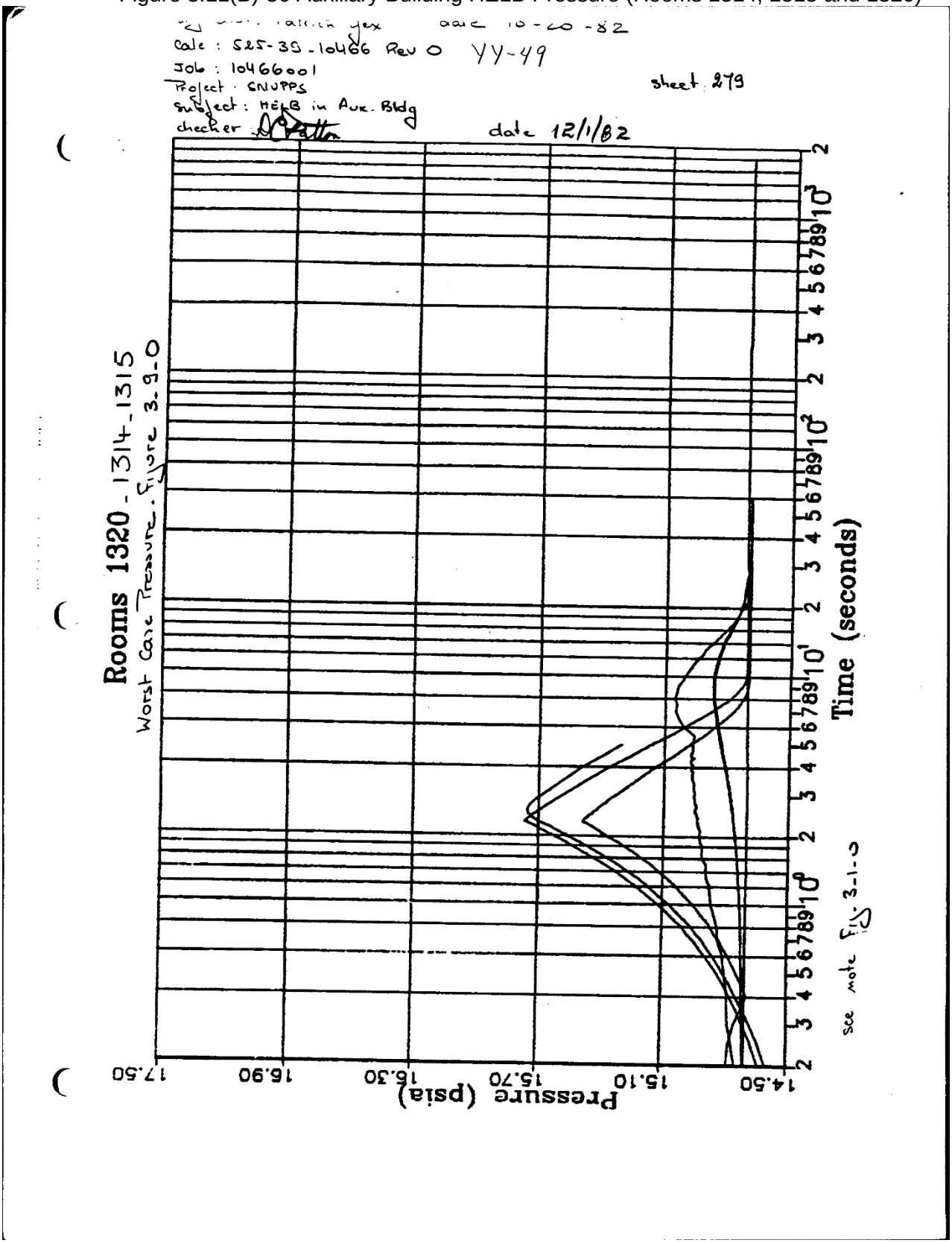


Figure 3.11(B)-36 Auxiliary Building HELB Pressure (Rooms 1314, 1315 and 1320)



**BUILDING: AUXILIARY** **ROOM NUMBER 1321**
**ROOM DESCRIPTION: ELEV. 2000 EXIT VESTIBULE**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 106.2 (A), (B) | 29, Page162 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 E | 29, Page 247 and 270 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 | 29, Page 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 50 & (C) | 114.5<br>585<br>(D) | 46, page 7<br>46, page 11<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 2.5 mR/hr | 50 | 5.36<br>6.56<br>(D) | 46, page 7<br>46, page 11<br>(D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | (B) | 56, Page 8 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature of 110 F is from 8" break in room 1301 (Reference 29, Page 162, room 7).

B. Due to the absence of safety related equipment, flooding for this room was not required to be analyzed.

C The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

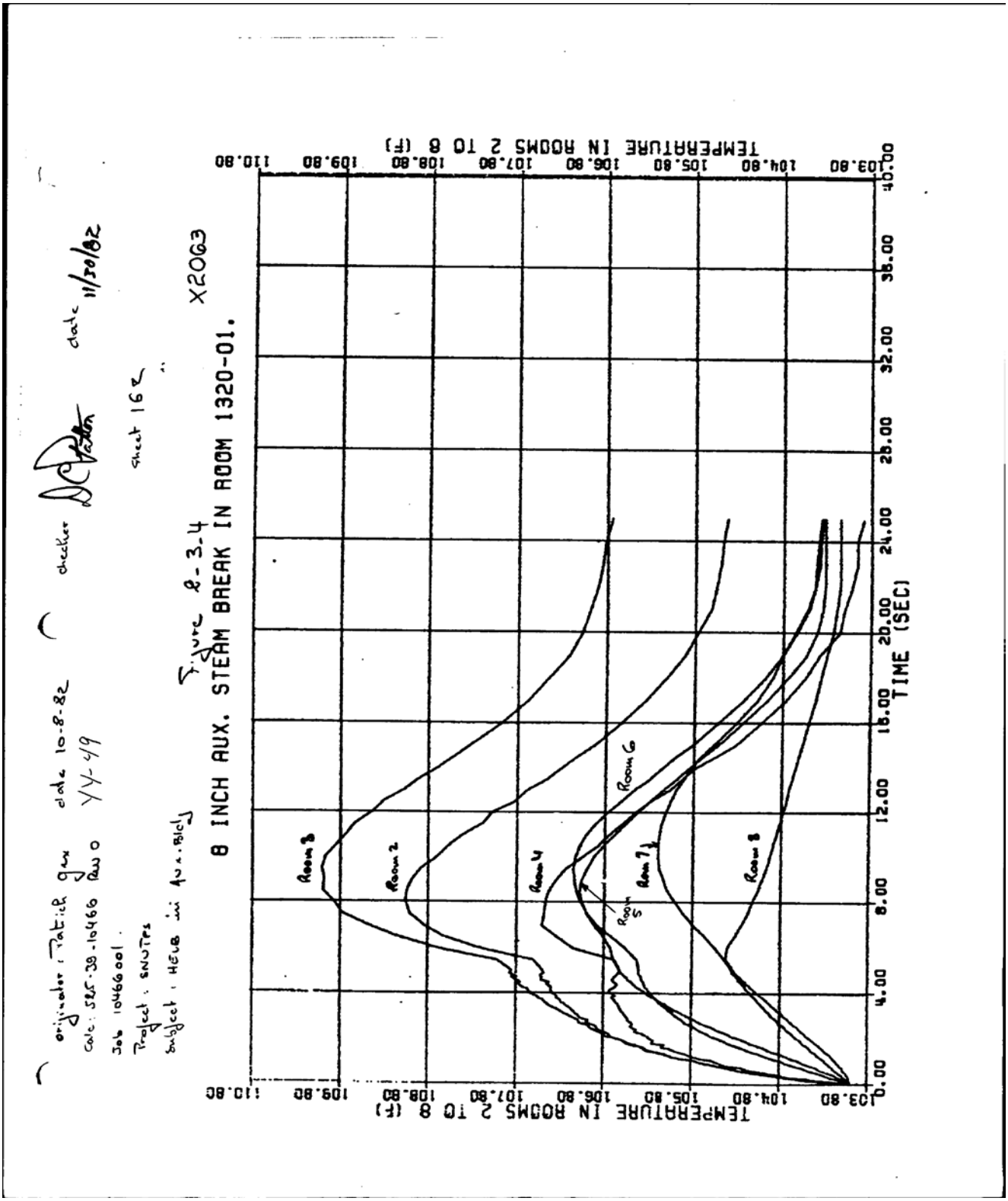
D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

E No pressure figure exists for RM 1321

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50. Radiation Zone Dwg. A-1702
56. Calculation FL-04

Figure 3.11(B)-13 Auxiliary Building HELB Temperatures
(Room 1301(south), 1314, 1314 (south – room 4), 1321, 1323, 1502, 1503, 1504, 1505, 1506, 1507 & 1513)



**BUILDING: AUXILIARY** **ROOM NUMBER 1322**
**ROOM DESCRIPTION: ELEVATION 2000 SOUTH PIPE PENETRATION ROOM B**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 107.1 (A) | 29, Pages 162, 257 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 280 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 75 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 50 & (D) | $1.88 \times 10^6$<br>$7.24 \times 10^6$<br>(E) | 46,page 7<br>46, page 11<br>(E) | (C) | NA |
| **DOSE RATE (R/hr)** | > 100 mR/hr | 50 | $1.50 \times 10^5$<br>$1.63 \times 10^5$<br>(E) | 46,page 7<br>46, page 11<br>(E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 2.06 (B) | 60, Pages 10 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 North (Reference 29, Page 283).

B. The design flood level for Room 1322 is 2.06 ft based on isolation of the break in 40 minutes and is acceptable since it is below the level of safety related equipment whose functionality would be adversely affected. Per Reference 60, Appendix 2, Page 1 the containment isolation valve HBHV7136 is the lowest safety related equipment in this room, it is ~ 26.5 inches (2.20 ft ) above the floor grade, which is installed above flood level.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F This room contains components with greater than or equal to (≥) 4.0 wt. % (7000 ppm), but less than or equal to (≤) 4.4 wt. % (7000 ppm) boric acid solution should be maintained at min. 65°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50. Radiation Zone Dwg. A-1702
60. Calculation FL-11

Figure 3.11(B)-21 Auxiliary Building HELB Temperature-Room 6 (Rooms 1316, 1317, 1322 and 1323)

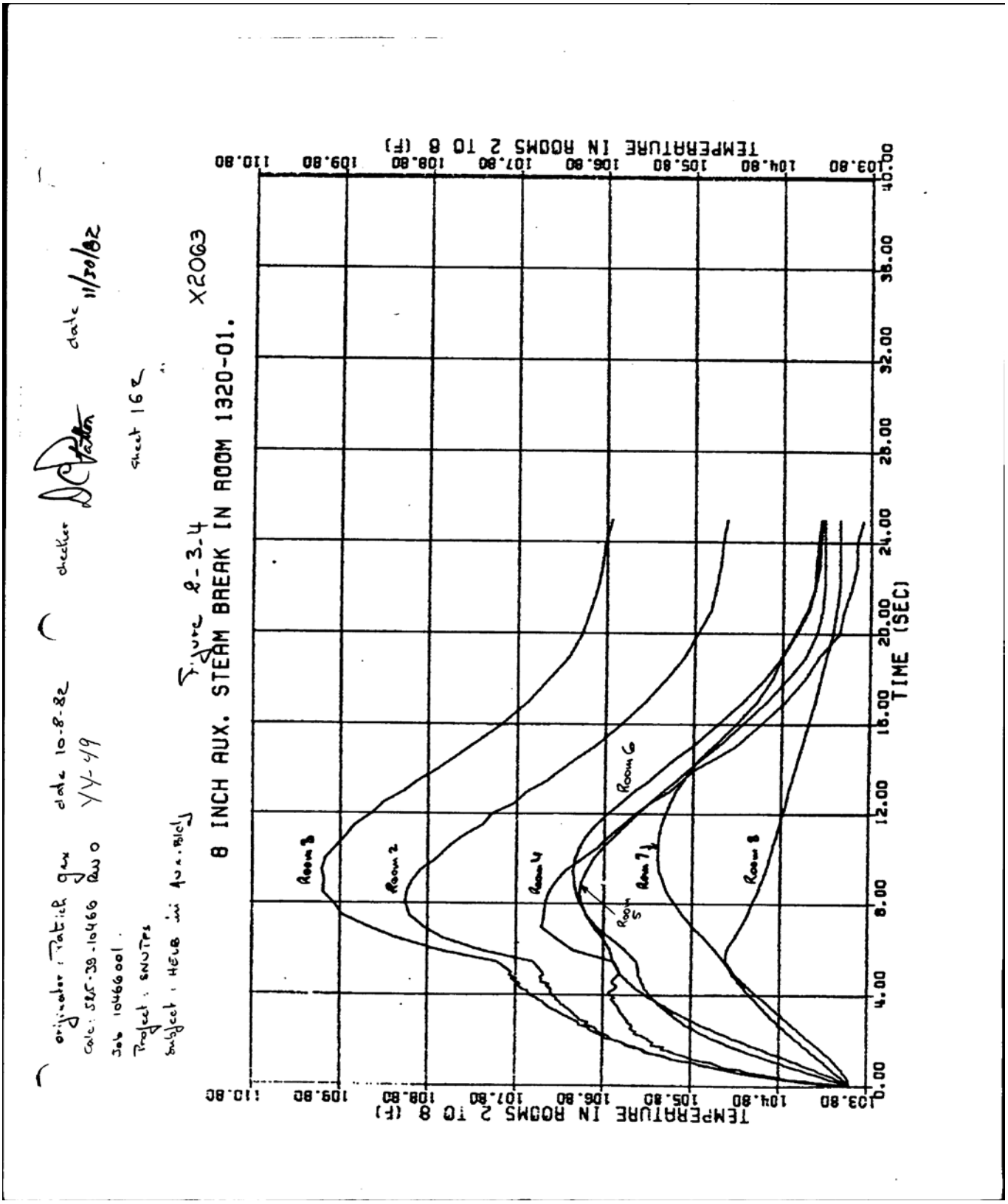
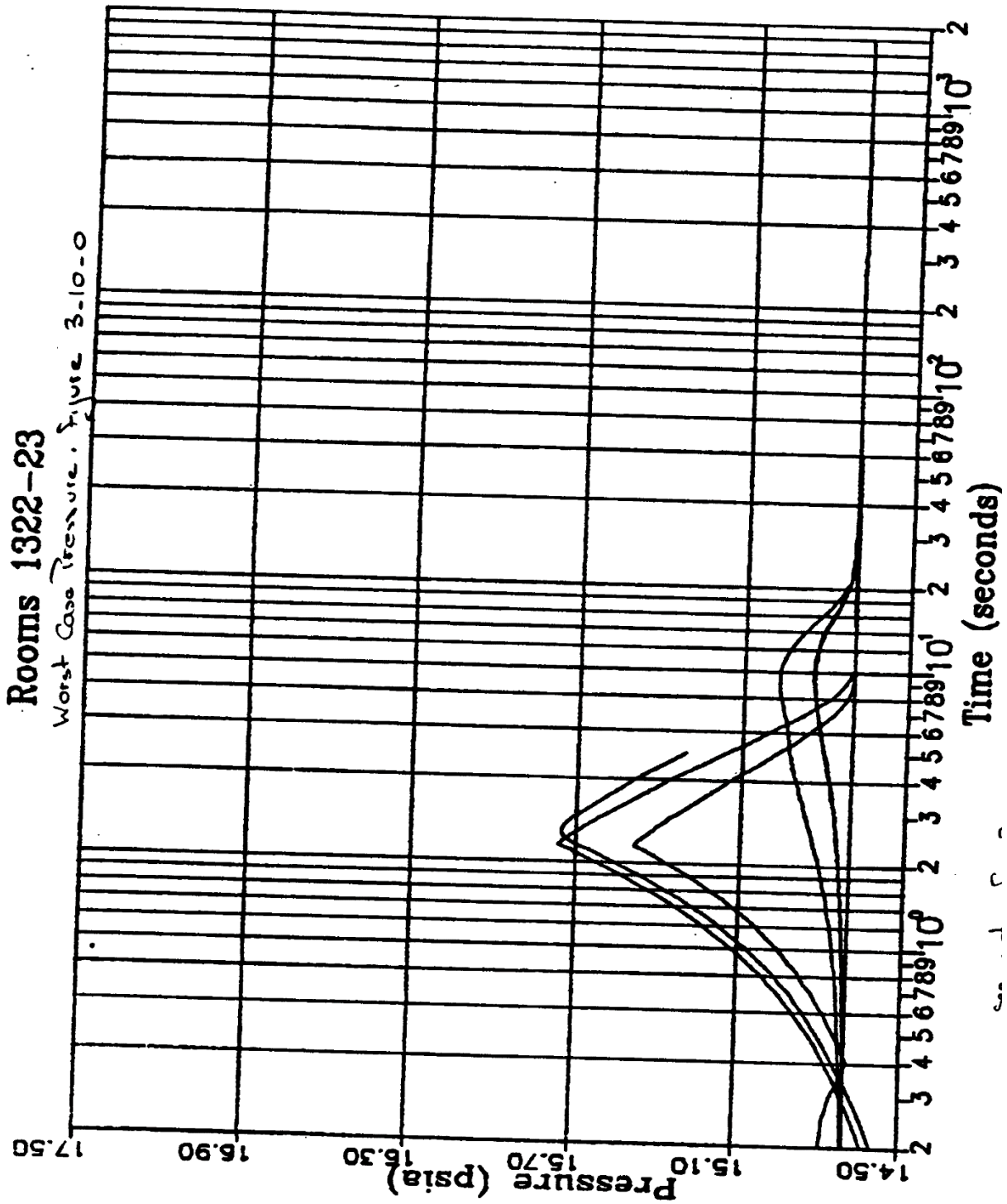


Figure 3.11(B)-37 Auxiliary Building HELB Pressure (Rooms 1322 & 1323)



**BUILDING: AUXILIARY** **ROOM NUMBER 1323**
**ROOM DESCRIPTION: ELEVATION 2000 NORTH PIPE PENETRATION ROOM A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 107.1 (A) | 29, Pages 162, 257 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 280 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 75 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | $5.256 \times 10^5$ | 50 & (D) | $2.39 \times 10^6$<br>$9.70 \times 10^6$<br>(E) | 46, page 7<br>46, page 11<br>(E) | (C) | NA |
| **DOSE RATE (R/hr)** | > 100 mR/hr | 50 | $1.78 \times 10^5$<br>$1.96 \times 10^5$<br>(E) | 46, page 7<br>46, page 11<br>(E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | | 1.93 (B) | 60, Pages 8 & 9 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 North (reference 29, Page 283).

B. The design flood level for Room 1323 is 1.93 ft based on isolation of the break in 40 minutes and is acceptable since it is below the level of safety related equipment whose functionality would be adversely affected. Per Reference 60, Appendix 2, Page 3 the pump discharge isolation valve EMHV8802A is the lowest safety related equipment in this room, it is ~ 34 inches (2.83 ft ) above the floor grade, which is installed above flood level.

C. Radiological consequences of specific HELB/MEC's were not required to be developed, since the LOCA conditions are more severe.

D The normal integrated dose was obtained by multiplying the dose rate of 1 Rad/hr times 60 years life of the plant.

E The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

F This room contains components with greater than or equal to (≥) 4.0 wt. % (7000 ppm), but less than or equal to (≤) 4.4 wt. % (7000 ppm) boric acid solution should be maintained at min. 65°F.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
50. Radiation Zone Dwg. A-1702
60. Calculation FL-11

Figure 3.11(B)-21 Auxiliary Building HELB Temperature-Room 6 (Rooms 1316, 1317,1322 and 1323)

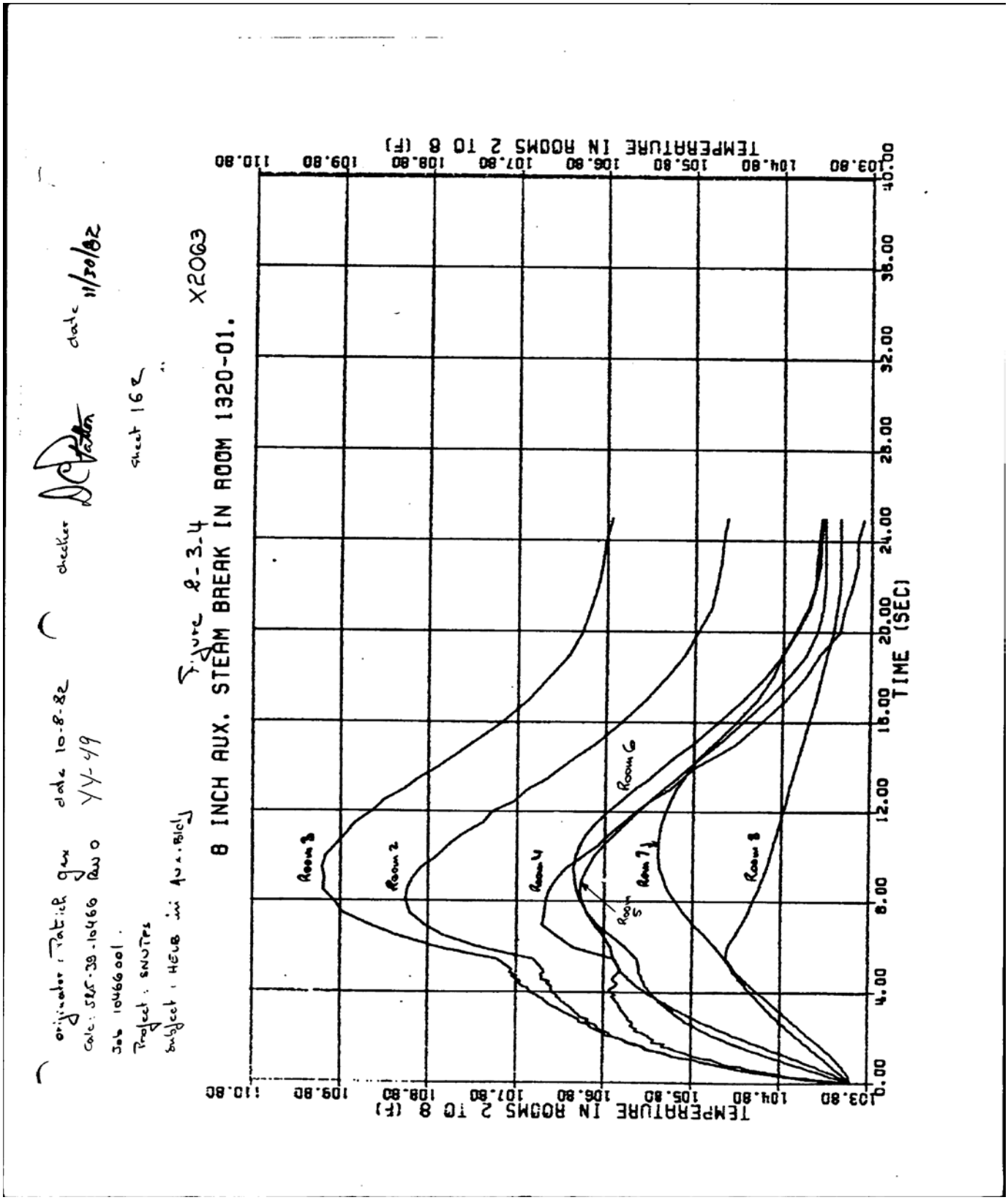
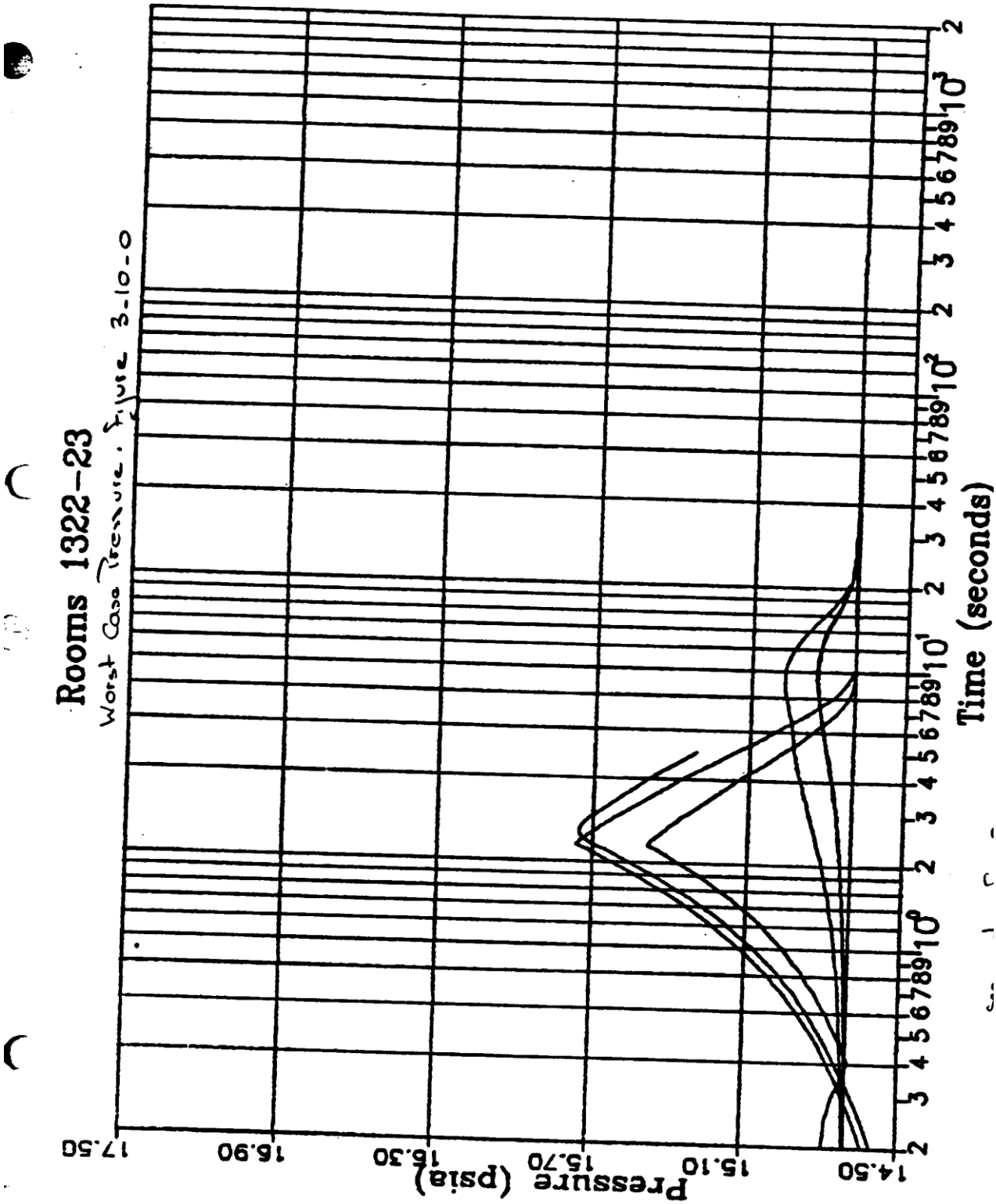


Figure 3.11(B)-37 Auxiliary Building HELB Pressure (Rooms 1322 and 1323)



**BUILDING: AUXILIARY** **ROOM NUMBER 1324**
**ROOM DESCRIPTION: ELEV. 2000 AUX. FEEDWATER PUMP VALVE COMPARTMENT NO. 1**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 (A) | 28, Page 2-8 | NE | N/A | N/A | |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | ATM | 58, Tables 1 & 3 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 70 | 58 |
| **INTEGRATED DOSE (RADS)** | 263 | 50 & (C) | 257<br>$1.25 \times 10^3$<br>(D) | 36. page 5<br>36, page 5A<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 0.5 mR/hr | 50 | 13.8 | 36, Page 5 | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ)<br>13.67<br>(B) | 59, Pages 7 & 9 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. Abnormal maximum temperature 124°F and pressure conditions that are not considered to be a HELB can be due to a N2 Accumulator rupture in room 1305 (Reference 58, Table 1 & 3).

B. The design flood level for this room in Calculation FL-13 exceeds the height of the safety related equipment installed in this room. However, the safety function of all systems are preserved due to the availability of the opposite train separate room which has been shown not to be affected by a postulated single pipe failure. This is consistent with USAR Section 3.6.1.1 (g) guidance that states postulated failures are preclude, by design, from affective the opposite train and that single failures of components in other trains are not assumed when the postulated piping failure results in damage to of the redundant trains. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero.

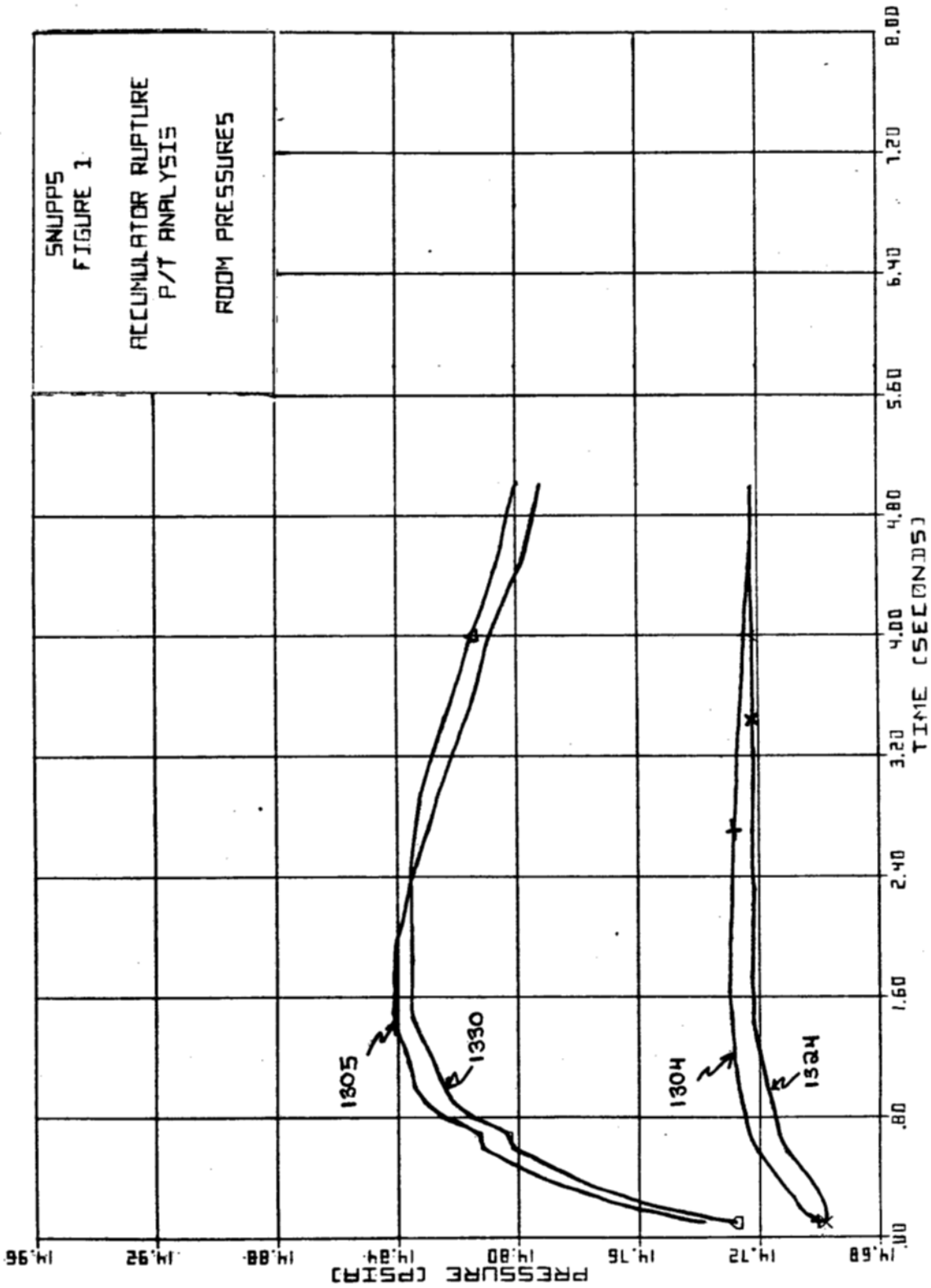
C. The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D. The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
36. Calculation XX-39
50. Radiation Zone Dwg. A-1702
58. Calculation YY-47
59. Calculation FL-13

Auxiliary Building Temperature Room 1324 (YY-47)



**BUILDING: AUXILIARY** **ROOM NUMBER 1325**
**ROOM DESCRIPTION: Auxiliary Feedwater Pump Room B**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 (D) | 28, Page 2-8 | NE | N/A | NE | N/A |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | NE | N/A |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | NE | NA |
| **INTEGRATED DOSE (RADS)** | 263 | 50 & (A) | $1.03 \times 10^3$ (B) | 36, page 5A (B) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 0.5 mR/hr | 50 | 11.8 | 36, Page 5 | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ) 4.9 (C) | 59, Pages 7 & 9 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

B The integrated dose rate for 6 months is from 50% Cesium sump source and containment airborne source.

C The design flood level for this room in Calculation FL-13 exceeds the height of the safety related equipment installed in this room. However, the safety function of all systems are preserved due to the availability of the opposite train separate room which has been shown not to be affected by a postulated single pipe failure. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero.

D With the Feedwater pump operating, the room temperature and humidity are limited to 122ºF and 95% during loss of normal ventilation

**REFERENCE**

28. M-000 (Q)
36. Calculation XX-39
50. Radiation Zone Dwg. A-1702
59. Calculation FL-13

**BUILDING: AUXILIARY** **ROOM NUMBER 1326**
**ROOM DESCRIPTION: Auxiliary Feedwater Pump Room A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 & (D) | 28, Page 2-8 | NE | N/A | NE | N/A |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | NE | N/A |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | NE | NA |
| **INTEGRATED DOSE (RADS)** | 263 | 50 & (A) | $1.03 \times 10^3$ (B) | 36, page 5A (B) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 0.5 mR/hr | 50 | 11.8 | 36, Page 5 | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ) 8.69 (C) | 59, Pages 7 & 9 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

B The integrated dose rate for 6 months is from 50% Cesium sump source and containment airborne source.

C The design flood level for this room in Calculation FL-13 exceeds the height of the safety related equipment installed in this room. However, the safety function of all systems are preserved due to the availability of the opposite train separate room which has been shown not to be affected by a postulated single pipe failure. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero. .

D With the Feedwater pump operating, the room temperature and humidity are limited to 122ºF and 95% during loss of normal ventilation

**REFERENCE**

28. M-000 (Q)
36. Calculation XX-39
50. Radiation Zone Dwg. A-1702
59. Calculation FL-13

**BUILDING: AUXILIARY** **ROOM NUMBER 1327**
**ROOM DESCRIPTION: Feedwater Pump Valve Compartment No. 2**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | NE | N/A |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | NE | N/A |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | NE | NA |
| **INTEGRATED DOSE (RADS)** | 263 | 50 & (A) | $1.25 \times 10^3$ (B) | 36, page 5A (B) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 0.5 mR/hr | 50 | 13.8 | 36, Page 5 | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ) 19.4 (C) | 59, Pages 7 & 9 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

B The integrated dose rate for 6 months is from 50% Cesium sump source and containment airborne source.

C The design flood level for this room in Calculation FL-13 exceeds the height of the safety related equipment installed in this room. However, the safety function of all systems are preserved due to the availability of the opposite train separate room which has been shown not to be affected by a postulated single pipe failure. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero.

**REFERENCE**

28. M-000 (Q)
36. Calculation XX-39
50. Radiation Zone Dwg. A-1702
59. Calculation FL-13

**BUILDING: AUXILIARY** **ROOM NUMBER 1328**
**ROOM DESCRIPTION: Feedwater Pump Valve Compartment No. 3**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | NE | N/A |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | NE | N/A |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | NE | NA |
| **INTEGRATED DOSE (RADS)** | 263 | 50 & (A) | $1.25 \times 10^3$ (B) | 36, page 5A (B) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 0.5 mR/hr | 50 | 13.8 | 36, Page 5 | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ) 21.16 (C) | 59, pages 7 & 9 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

B The integrated dose rate for 6 months is from 50% Cesium sump source and containment airborne source.

C The design flood level for this room in Calculation FL-13 exceeds the height of the safety related equipment installed in this room. However, the safety function of all systems are preserved due to the availability of the opposite train separate room which has been shown not to be affected by a postulated single pipe failure. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero.

**REFERENCE**

28. M-000 (Q)
36. Calculation XX-39
50. Radiation Zone Dwg. A-1702
59. Calculation FL-13

**BUILDING: AUXILIARY** **ROOM NUMBER 1330**
**ROOM DESCRIPTION: ELEV. 2000 AUX. FEEDWATER VALVE COMPARTMENT NO. 4**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 (A) | 28, Page 2-8 | NE | N/A | NE | N/A |
| **PEAK PRESSURE (PSIG)** | ATM | 28, Page 2-8 | NE | N/A | 0.13 | 58, Tables 1 & 3 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | NE | N/A |
| **INTEGRATED DOSE (RADS)** | 263 | 50 & C | 257<br>$1.25 \times 10^3$<br>(D) | 36, page 5<br>36, Page 5A<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 0.5 mR/hr | 50 | 13.8 | 36, Page 5 | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ)<br>36.76<br>(B) | 59, Pages 7 & 9 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. Abnormal maximum temperature of 121º F and pressure conditions are due to a $N_2$ Accumulator rupture in Room 1305 (Reference 58, Tables 1 & 3).

B. The design flood level for this room in Calculation FL-13 exceeds the height of the safety related equipment installed in this room. However, the safety function of all systems are preserved due to the availability of the opposite train separate room which has been shown not to be affected by a postulated single pipe failure. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero.

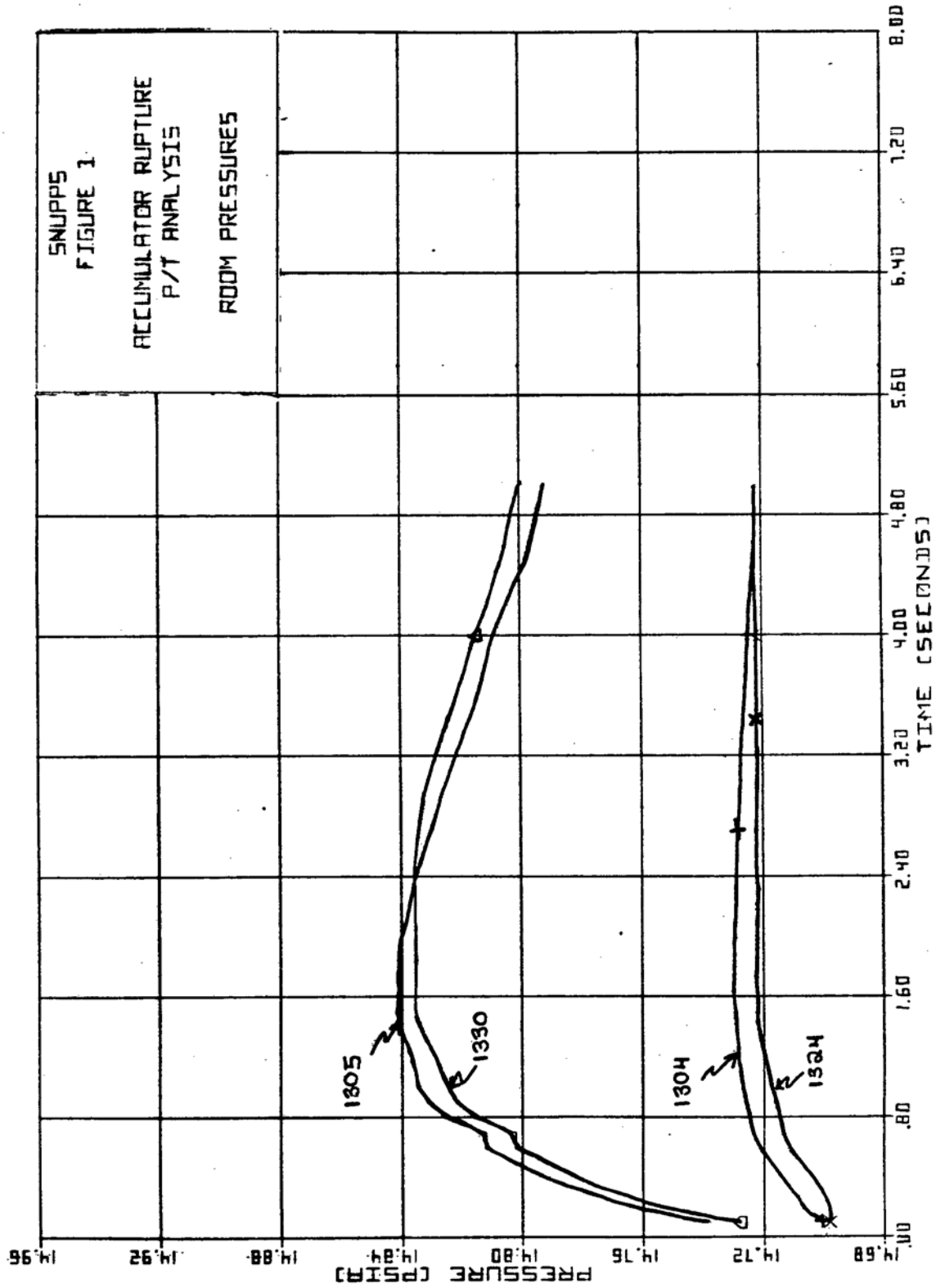
C The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
36. Calculation XX-39
50. Radiation Zone Dwg. A-1702
58. Calculation YY-47
59. Calculation FL-13

Auxiliary Building HELB Pressure Room 1330 (YY-47)



**BUILDING: AUXILIARY** **ROOM NUMBER 1331**
**ROOM DESCRIPTION: Auxiliary Feedwater Pump Room C**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| PEAK TEMPERATURE (°F) | 115 (C & E) | 28, Page 2-8 | N/A | N/A | 122 (F) | 71, page 6 |
| PEAK PRESSURE (PSIG) | ATM | NA | NE | N/A | NE | N/A |
| HUMIDITY (%) | 70 | 28, Page 2-8 | NE | N/A | NE | NA |
| INTEGRATED DOSE (RADS) | 263 | 50 & (A) | $1.26 \times 10^2$ (B) | 36, page 5A (B) | NE | N/A |
| DOSE RATE (R/hr) | ≤ 0.5 mR/hr | 50 | 1.3 | 36, Page 5 | NE | N/A |
| MAX. FLOOD LEVEL (FT) (above the floor) | NE | N/A | NE | N/A | 46.75 (D) | 59, Pages 7 & 9 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

B The integrated dose rate for 6 months is from 50% Cesium sump source and containment airborne source.

C The temperature in room 1331 following a loss of normal ventilation will not exceed the rated 150ºF with the Turbine Driven Auxiliary Feedwater pump operating and will not exceed 146ºF with the pump not operating. (Reference 28 Table 2-3 sheet 3)

D The design flood level for this room in Calculation FL-13 exceeds the height of the safety related equipment installed in this room. However, the safety function of all systems are preserved due to the availability of the opposite train separate room which has been shown not to be affected by a postulated single pipe failure. The flood level is caused by HELB, however, the function of the SR electrical EQ equipment in the room is the same function of the HELB line that causes the flooding. Thus, for the EQ equipment in this room the NUREG 0588 category in the HELB column is "C". The identified flooding condition does not affect the EQ qualification.

E When the pump operates, the room temperature will be limited to 122°F (normal ventilation operating). (Reference 71)

F Calculation NAI-1878-001 case 10 provides information on the temperatures in this room if door 13311 is open to room 1329, and a HELB occurs in this room. Reference 131 section 7.3.4 and 8.1.21 show justification on why qualification is not required in 1331.

**REFERENCE**

28. M-000 (Q)
36. Calculation XX-39
50. Radiation Zone Dwg. A-1702
59. Calculation FL-13
71. Calculation GF-M-002
131. Calculation NAI-1878-001

**BUILDING: AUXILIARY** **ROOM NUMBER 1408**
**ROOM DESCRIPTION: Corridor**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 106.4 | 29, Page 163 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 282 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | 7884 | 51 & (A) | $1.03 \times 10^3$ (B) | 46, Page 12 (B) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 15 mR/hr | 51 | 105 | 46, page 8 | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0.53 (C) | 55, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

B The total integrated accident dose is from 50% Cesium sump source and containment airborne source.

C The design flood level for Room 1408 is 6.32 inches, based on the isolation of the break in 40 minutes and is acceptable since it is below the level of safety related electrical equipment whose functionality would be adversely affected. Per Reference 55, Appendix 2, Page 23 electrical cabinet RP-331 is the lowest identified safety related equipment in this room, it is ~ 8 inches (0.66 ft) above the floor grade, which is installed above flood level.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
51. Radiation Zone Dwg. A-1703
55. Calculation FL-03

Figure 3.11(B)-22 Auxiliary Building HELB Temperature (Rooms 1408 - Room 12)

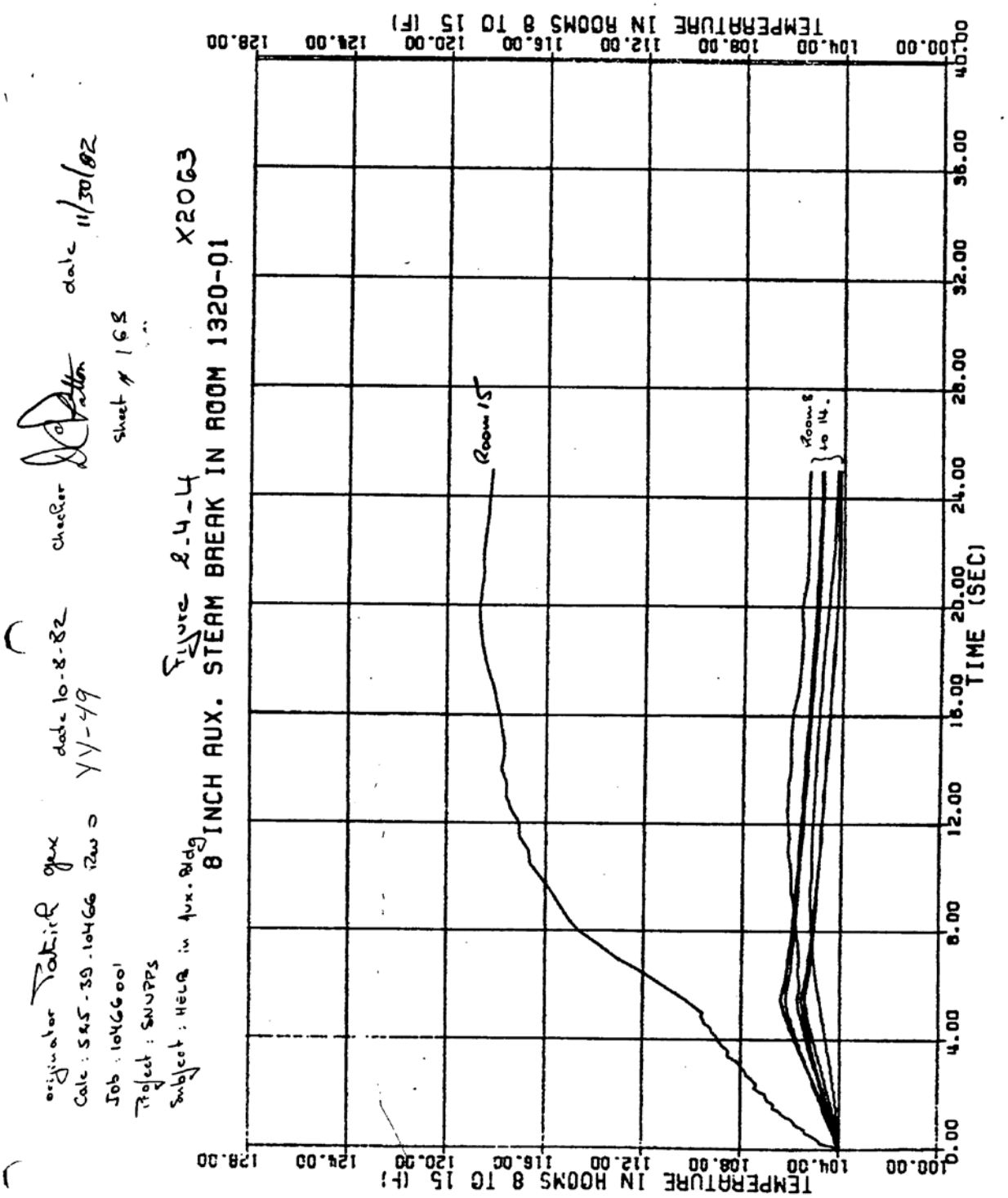
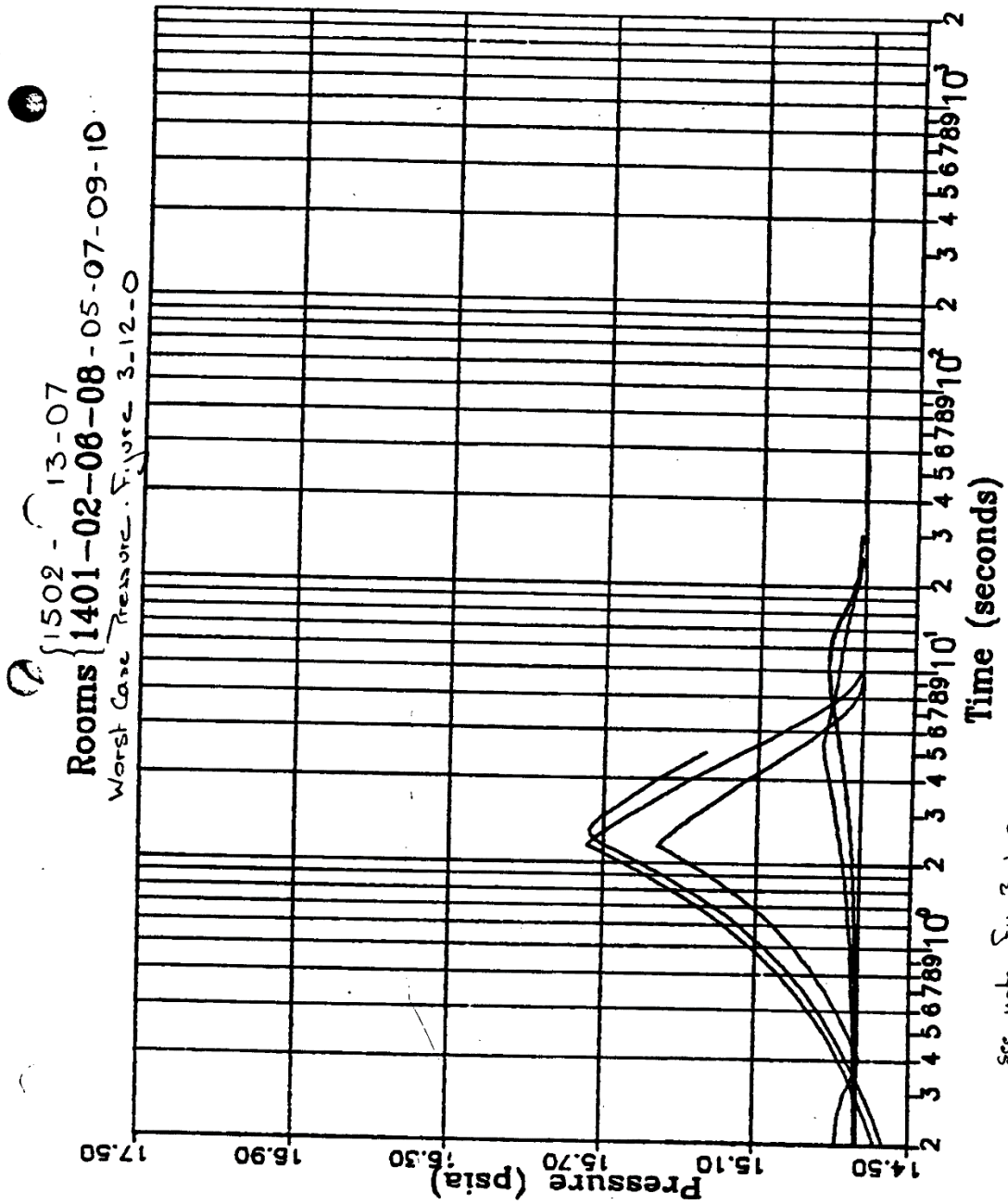


Figure 3.11(B)-38 Auxiliary Building HELB Pressure
(Rooms 1401, 1402, 1405 through 1410, 1502 through 1507 and 1513)

originator: Patrick gex date 10-20-82
Calc: 525-39-10466 Rev 0 YY-49
Job: 10466001
Project: SNUPPS sheet # 282
Subject: HELB in Aux. Bldg
Checker date 12/1/82



**BUILDING: AUXILIARY** **ROOM NUMBER 1409**
**ROOM DESCRIPTION: ELEV. 2026 ELECTRICAL PENETRATION ROOM B**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 (E) | 28, Page 2-8 | NE | N/A | 105.6 (A) | 29, Page 163 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 282 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | 7884 | 51 & (C) | $1.18x10^6$<br>$1.68x10^6$<br>(D) | 46, page 8<br>46, Page 12<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 15 mR/hr | 51 | $1.70x10^5$<br>$1.70x10^5$<br>(D) | 46, page 8<br>46, Page 12<br>(D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (B) | 60, Page 8 & 9 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 (Reference 29, Page 283).

B. For Room 1409 the design flood level is 0 feet. Given that there is no water accumulation in this room, all safety related electrical equipment will not be affected from flooding effects.

C. The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D. The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

E. With the abnormal condition of an ESF cooler out of service the room temperature should not exceed 139ºF; this is considered an "anticipated abnormal" condition and accordingly, the temperatures generated by the condition were not utilized in aging calculations in the NUREG-0588 review.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
51. Radiation Zone Dwg. A-1703
60. Calculation FL-11

Figure 3.11(B)-23 Auxiliary Building HELB Temperature-Room 13 (Rooms 1409 and 1410)

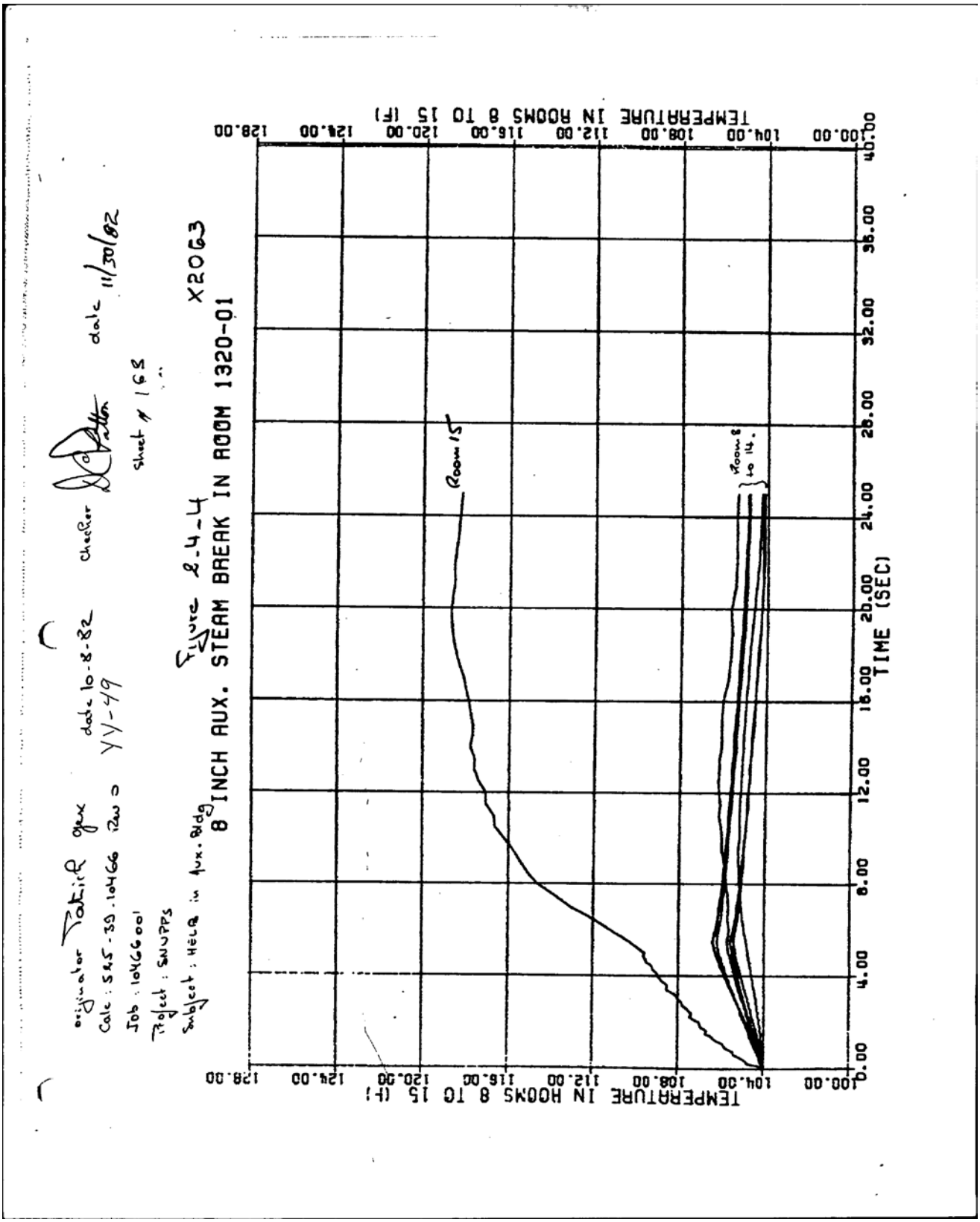
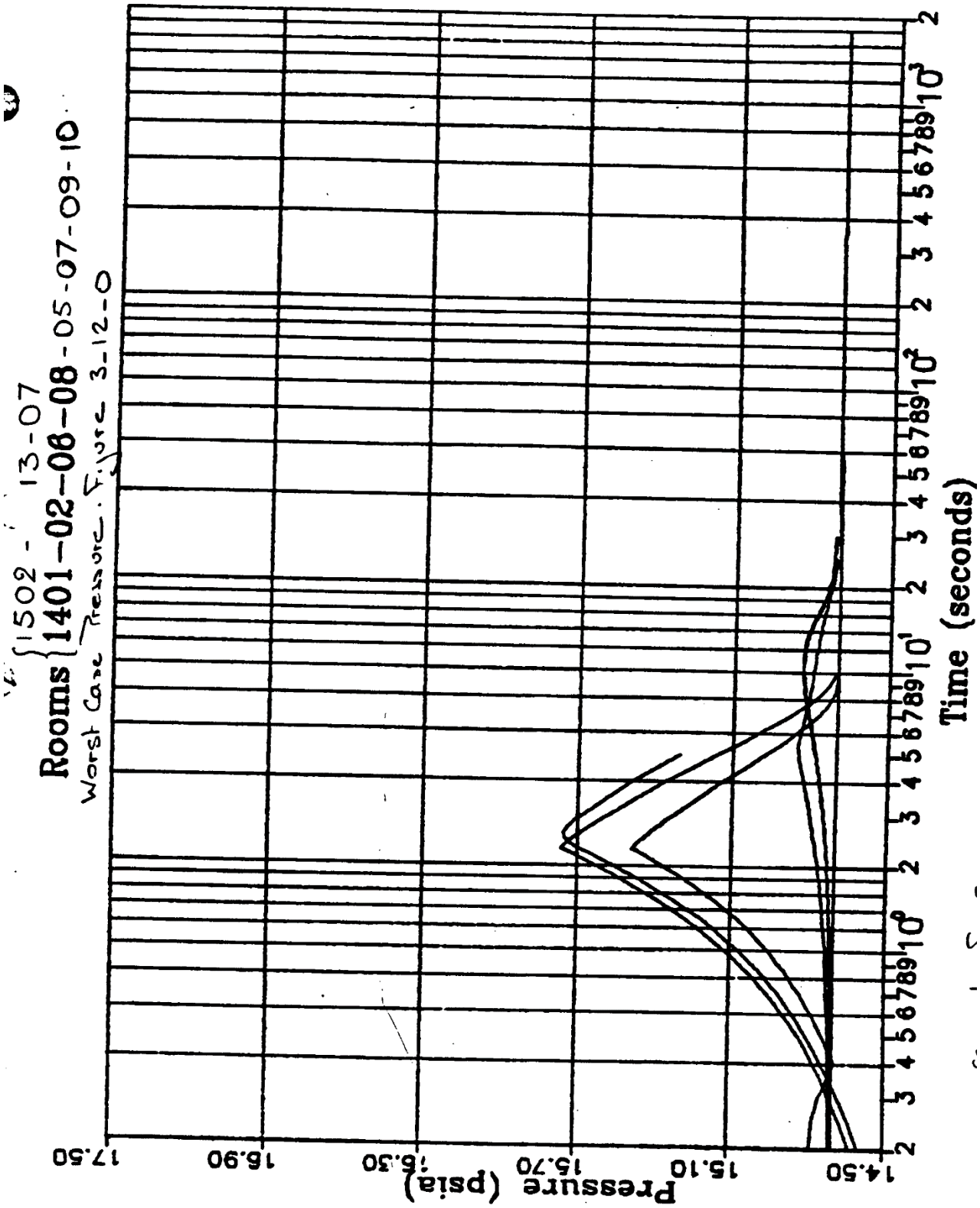


Figure 3.11(B)-38 Auxiliary Building HELB Pressure
(Rooms 1401, 1402, 1405 through 1410, 1502 through 1507 and 1513)



**BUILDING: AUXILIARY** **ROOM NUMBER 1410**
**ROOM DESCRIPTION: ELEV. 2026 ELECTRICAL PENETRATION ROOM A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 105.6 (A) | 29, Page 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 & 282 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | 7884 | 51 & (C) | $1.61 \times 10^6$<br>$2.29 \times 10^6$<br>(D) | 46, page 8<br>46, Page 12<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 15 mR/hr | 51 | $2.33 \times 10^5$<br>$2.33 \times 10^5$<br>(D) | 46, page 8<br>46, Page 12<br>(D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (EQ)<br>0.17<br>(B) | 60, Pages 8 & 9 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to 8" Auxiliary Steam line break in Room 1301 (Reference 29, Page 283).

B. The design level for Room 1410 is 0.17 ft. based on isolation of the break in 40 minutes. This exceeds the Train A motor control centers (MCCs), switchgears and plant computer cabinets mounted in the room at or near floor grade. However, the safety function of the electrical equipment in this room is preserved due to the availability of the opposite train in Room 1409 located in a separate watertight area. There are no HELB in this room (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero.

C The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

E With the abnormal condition of an ESF cooler out of service the room temperature should not exceed 139ºF; this is considered an "anticipated abnormal" condition and accordingly, the temperatures generated by the condition were not utilized in aging calculations in the NUREG-0588 review.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
51. Radiation Zone Dwg. A-1703
60. Calculation FL-11

Figure 3.11(B)-23 Auxiliary Building HELB Temperature-Room 13 (Rooms 1409 and 1410)

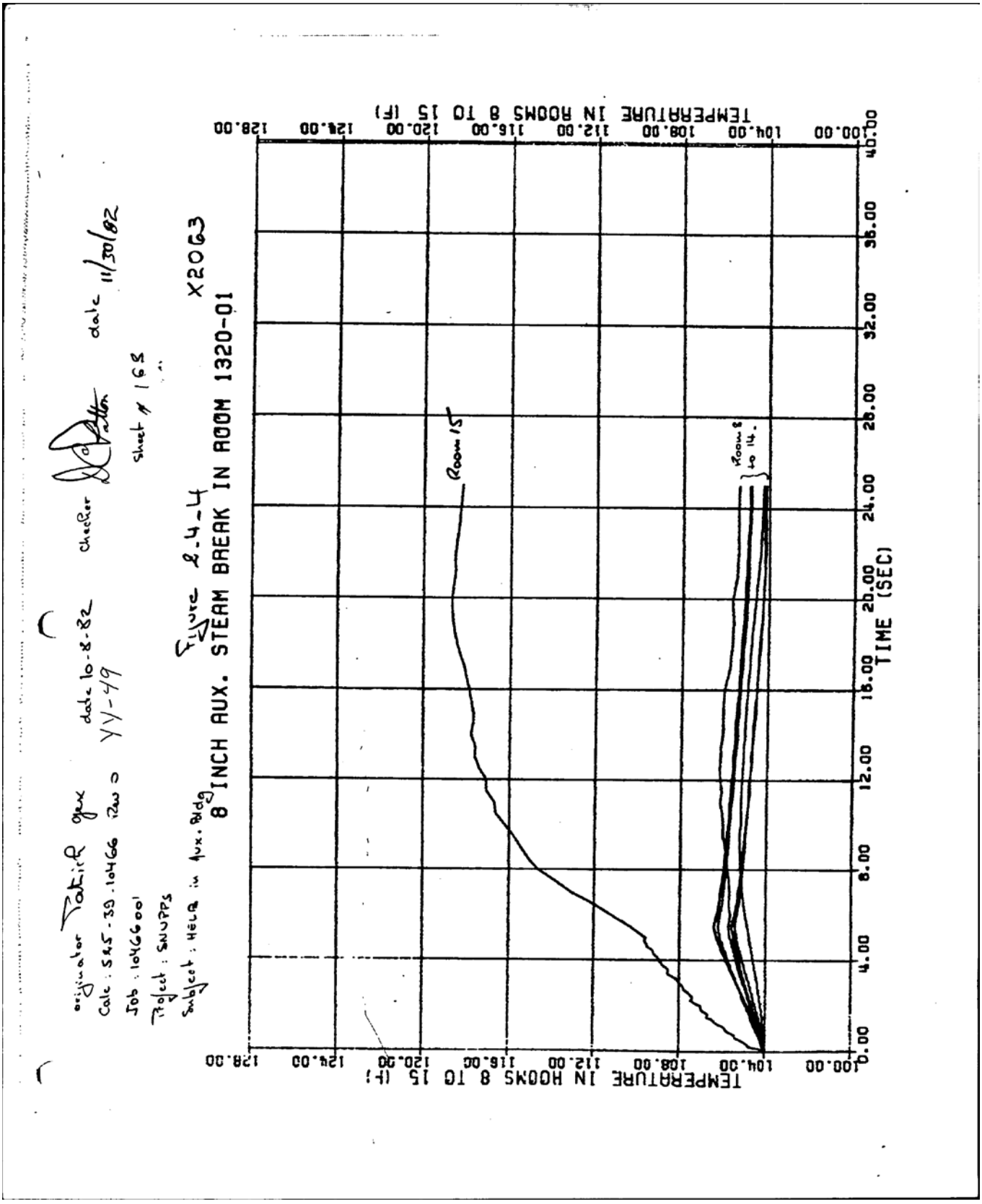
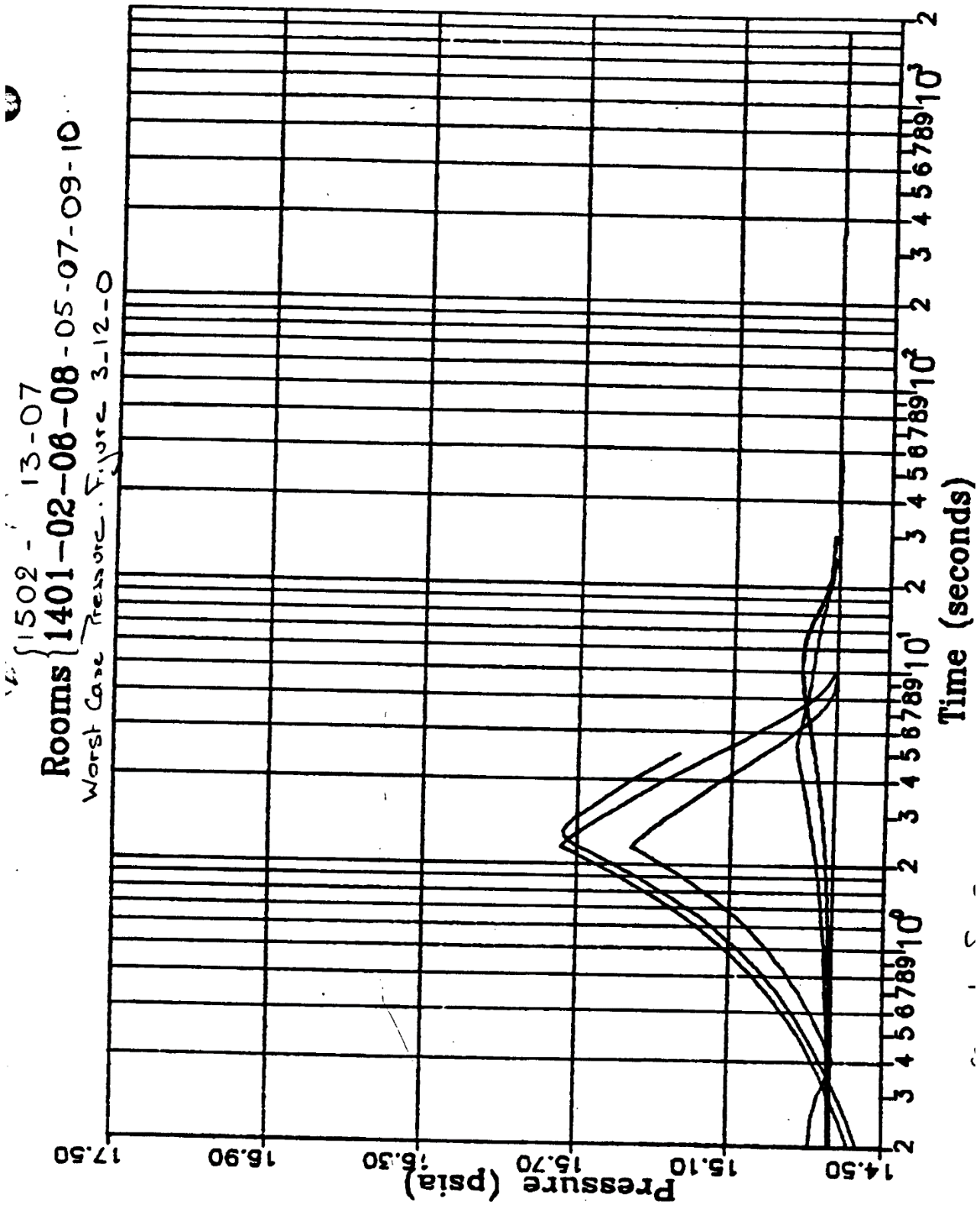


Figure 3.11(B)-38 Auxiliary Building HELB Pressure
(Rooms 1401, 1402, 1405 through 1410, 1502 through 1507 and 1513)



**BUILDING: AUXILIARY** **ROOM NUMBER 1411**
**ROOM DESCRIPTION: ELEV. 2026 MAIN FEEDWATER ROOM NO. 1**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 120 | 28, Page 2-8 | NE | N/A | 436 (A) | 100, Page 8 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 6.3 (A) | 62, Page 11 & Att. 3 Page 21 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 (A) | 61 |
| **INTEGRATED DOSE (RADS)** | 263 | 51 & (D) | $1.07x10^6$ $1.52x10^6$ (E) | 46, page 8 46, Page 12 (E) | (C) | NA |
| **DOSE RATE (R/hr)** | ≤ 0.5 mR/hr | 51 | $1.54x10^5$ $1.54x10^5$ (E) | 46, page 8 46, Page 12 (E) | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 1.3 (B) | 63, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature, pressure, and humidity conditions are due to a Main Steam line break in this room. As identified in M-000, the design of components to be installed in Rooms 1411, 1412, 1508 and 1509, Main Steam line break (MSLB) superheat effects must be considered. The environmental conditions associated with this even are presented in calculation AN-06-021. If component design is not consistent with the MSLB superheat environmental conditions, a justification similar to the one presented in SLNRC 86-06, dated April 4, 1986 should need to be made. AN-06-021 represents the limiting case with respect to maximum temperature, and AB-X-001 represents the limiting case with respect to maximum pressure. The primary difference between these two calculations is whether or not superheating the steam via uncovered steam generator tubes is considered. In AB-X-001, no superheating is considered as per the methodology in WCAP-8822. In AN-06-021, superheating is considered as per the methodology in WCAP-10961. The compartment where the break does not occur has a peak temperature of 384.5°F

B. The maximum flood rate is due to a 14" Main Feedwater line break in this room. The flowrate given is the steady state flowrate which follows a higher peak flowrate. The maximum flood level is based on drain flow through the 20" pipe to the Turbine Building and flow into Room 1412.

C. Radiological consequences of a SGTR have not been specifically generated for this room. However, the radiation levels associated with a SGTR are approximately a factor of 1E6 less than LOCA dose. Therefore, the room should be accessible following a SGTR.

D. The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

E. The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
46. Calculation XX-43
51. Radiation Zone Dwg. A-1703
61. Calculation YY-63
62. Calculation AB-X-001
63. Calculation LF-FH-002
100. Calculation AN-06-021

Figure 3.11(B)-25 Auxiliary Building HELB Temperature (Rooms 1411, 1412, 1508 and 1509)

WCNOC Proprietary Information

FORM APF 05D-001-01, REV. 05

| CALCULATION SHEET | CALCULATION NO. AN-06-021 |
|---|---|
| | REVISION NO. 0 |
| | Page 10 |

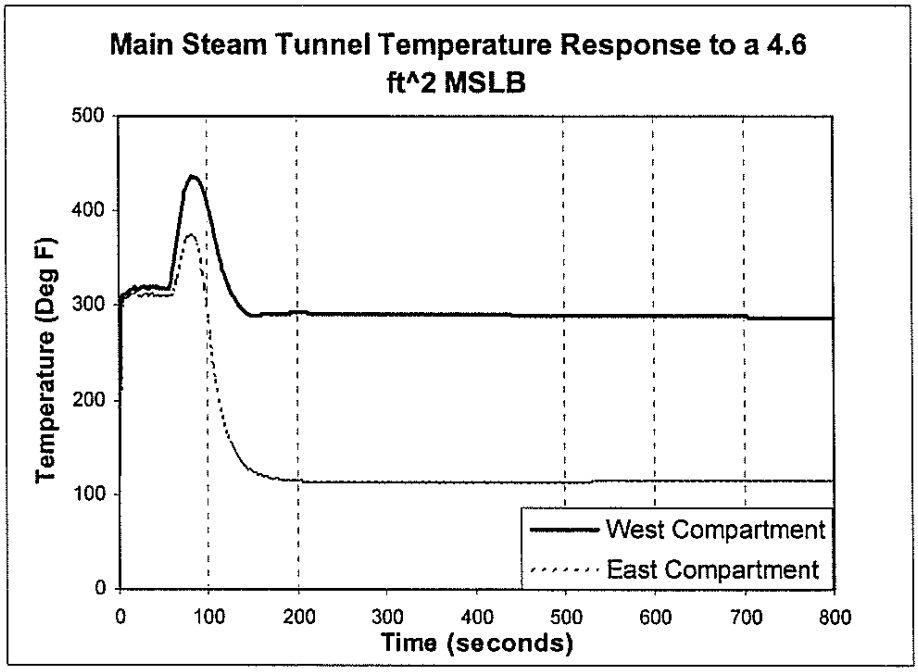



Figure 2.1-1 Main Steam Tunnel Temperature Transient for a 4.6 $ft^2$ Steamline Rupture

Figure 3.11(B)-39 Auxiliary Building HELB Pressure (Rooms 1411, 1412, 1508 and 1509)

FORM KEF-E-303-2, REV. 9/90

**CALCULATION SHEET**

CALC NO. AB-X-001
REV. 0
PMR NO. N/A
SHEET 13 OF 13

ORIGINATOR: JH DATE: 6-20-94 VERIFIED BY: WEB DATE: 6-20-94

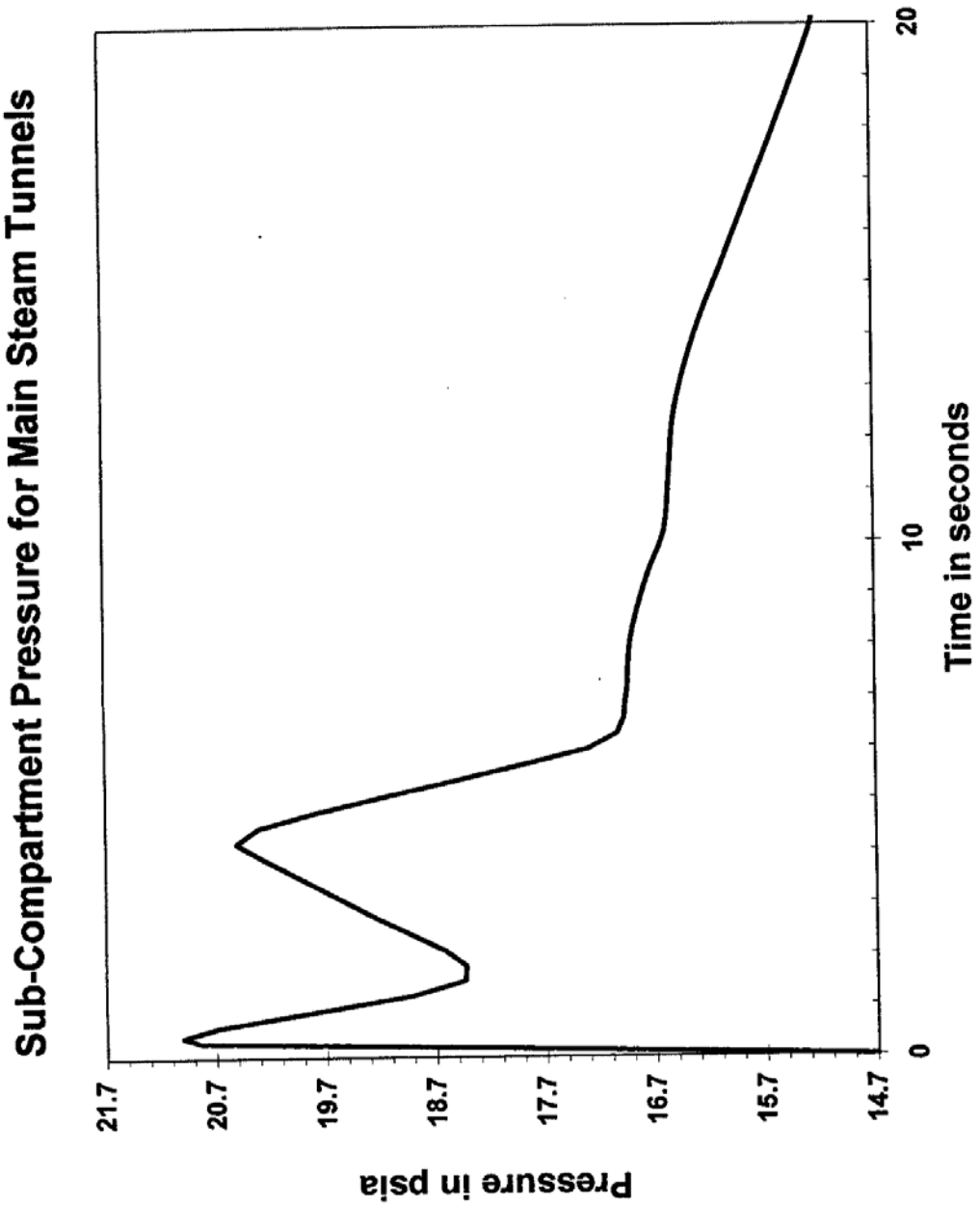



Figure 4. Pressure transient in Sub-Compartment 1 representing the bounding pressures for all other compartments.

**BUILDING: AUXILIARY** **ROOM NUMBER 1412**
**ROOM DESCRIPTION: ELEV. 2026 MAIN FEEDWATER ROOM NO. 2**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 120 | 28, Page 2-8 | NE | N/A | 436 (A) | 100, Page 9 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 6.3 (A) | 62, Page 11 & Att. 3 Page 21 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 (A) | 61 |
| **INTEGRATED DOSE (RADS)** | 263 | 51 & (D) | $1.094 \times 10^6$<br>$1.55 \times 10^6$<br>(E) | 46, page 8<br>46, Page 12<br>(E) | (C) | N/A |
| **DOSE RATE (R/hr)** | ≤ 0.5 mR/hr | 51 | $1.58 \times 10^5$<br>$1.58 \times 10^5$<br>(E) | 46, page 8<br>46, Page 12<br>(E) | (C) | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 1.3 (B) | 63, Page 11 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature, pressure, and humidity conditions are due to a Main Steam line break in this room. As identified in M-000, the design of components to be installed in Rooms 1411, 1412, 1508 and 1509, Main Steam line break (MSLB) superheat effects must be considered. The environmental conditions associated with this even are presented in calculation AN-06-021. If component design is not consistent with the MSLB superheat environmental conditions, a justification similar to the one presented in SLNRC 86-06, dated April 4, 1986 should need to be made. AN-06-021 represents the limiting case with respect to maximum temperature, and AB-X-001 represents the limiting case with respect to maximum pressure. The primary difference between these two calculations is whether or not superheating the steam via uncovered steam generator tubes is considered. In AB-X-001, no superheating is considered as per the methodology in WCAP-8822. In AN-06-021, superheating is considered as per the methodology in WCAP-10961. The compartment where the break does not occur has a peak temperature of 384.5°F

B. The maximum flood rate is due to a 14" Main Feedwater line break in this room. The flowrate given is the steady state flowrate which follows a higher peak flowrate. The maximum flood level is based on drain flow through the 20" pipe to the Turbine Building and flow into Room 1411.

C. Radiological consequences of a SGTR have not been specifically generated for this room. However, the radiation levels associated with a SGTR are approximately a factor of 1E6 less than LOCA dose. Therefore, the room should be accessible following a SGTR.

D. The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

E. The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
46. Calculation XX-43
51. Radiation Zone Dwg. A-1703
61. Calculation YY-63
62. Calculation AB-X-001
63. Calculation LF-FH-002
100. Calculation AN-06-021

Figure 3.11(B)-25 Auxiliary Building HELB Temperature (Rooms 1411, 1412, 1508 and 1509)

WCNOC Proprietary Information

FORM APF 05D-001-01, REV. 05

| CALCULATION SHEET | CALCULATION NO. AN-06-021 |
|---|---|
| | REVISION NO. 0 |
| | Page 10 |

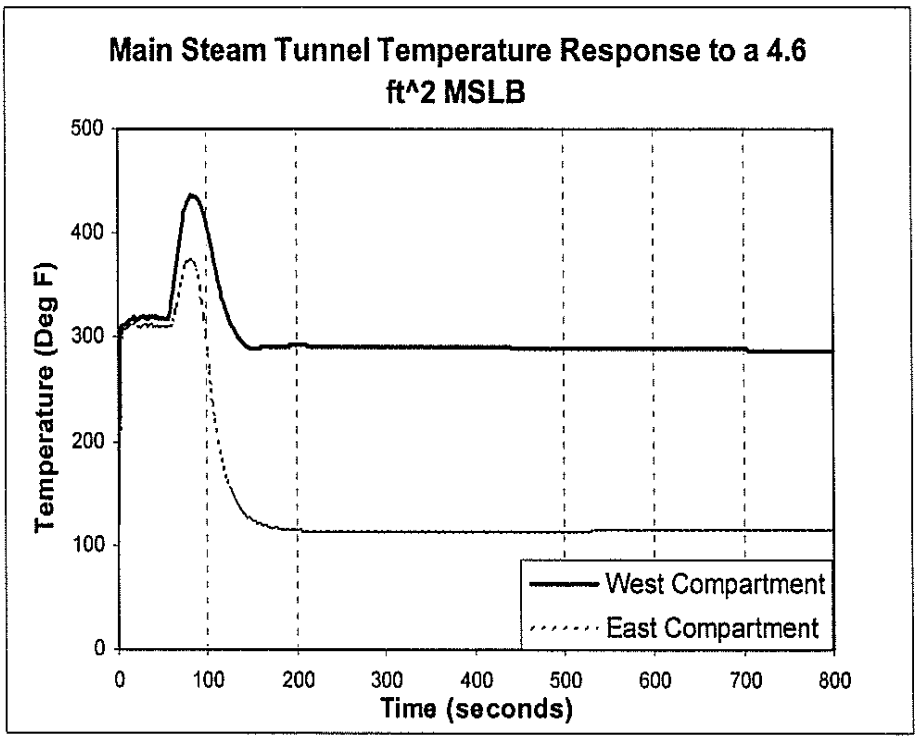



Figure 2.1-1 Main Steam Tunnel Temperature Transient for a 4.6 $ft^2$ Steamline Rupture

Figure 3.11(B)-39 Auxiliary Building HELB Pressure (Rooms 1411, 1412, 1508 and 1509)

FORM KEF-E-303-2, REV. 9/90

**CALCULATION SHEET**

CALC NO. AB-X-001
REV. 0
PMR NO. N/A
SHEET 13 OF 13

ORIGINATOR: DATE: 6-20-94 VERIFIED BY: DATE: 6-20-94

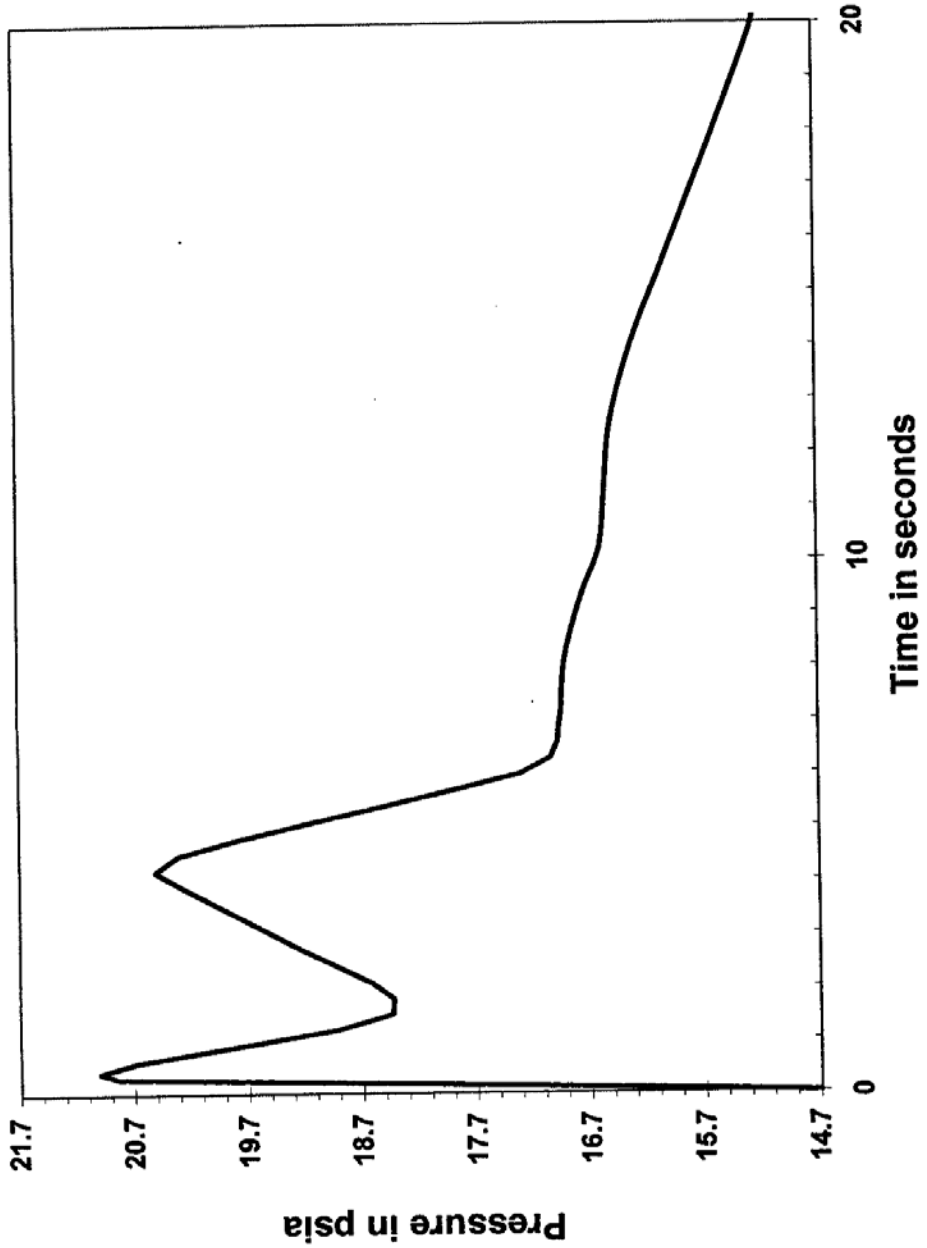



Figure 4. Pressure transient in Sub-Compartment 1 representing the bounding pressures for all other compartments.

**BUILDING: AUXILIARY** **ROOM NUMBER 1506**
**ROOM DESCRIPTION: ELEV. 2047-6 CTMT. PURGE SUPPLY AIR HANDLING UNIT ROOM A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 105.4 (A) | 29, Page 163 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Page 270 and 282 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 52 & (C) | $7.22 \times 10^5$<br>$1.025 \times 10^6$<br>(D) | 46, page 8<br>46, Page 12<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 2.5 mR/hr | 52 | $1.04 \times 10^5$<br>$1.04 \times 10^5$<br>(D) | 46, page 8<br>46, Page 12<br>(D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0.11 (B) | 65, Pages 8 & 9 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301, (Reference 29, Page 163). Case 6 as identified on page 283 of Reference 29 does not include this room as noted so Case 4 is correct case.

B. The design flood level for Room 1506 is 1.31 inches based on the volume of the CCW Surge Tanks. This is below the level of the lowest safety related electrical equipment. Per Reference 65, Appendix 2, Page 7 containment air monitor 0-GT-RE-32 is the lowest identified safety related equipment in this room, it is ~5 inches (0.41 ft) above the floor grade.

C The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
52. Radiation Zone Dwg. A-1704
65. Calculation FL-07

Figure 3.11(B)-24 Auxiliary Building HELB Temperature (Rooms 1506 and 1507)

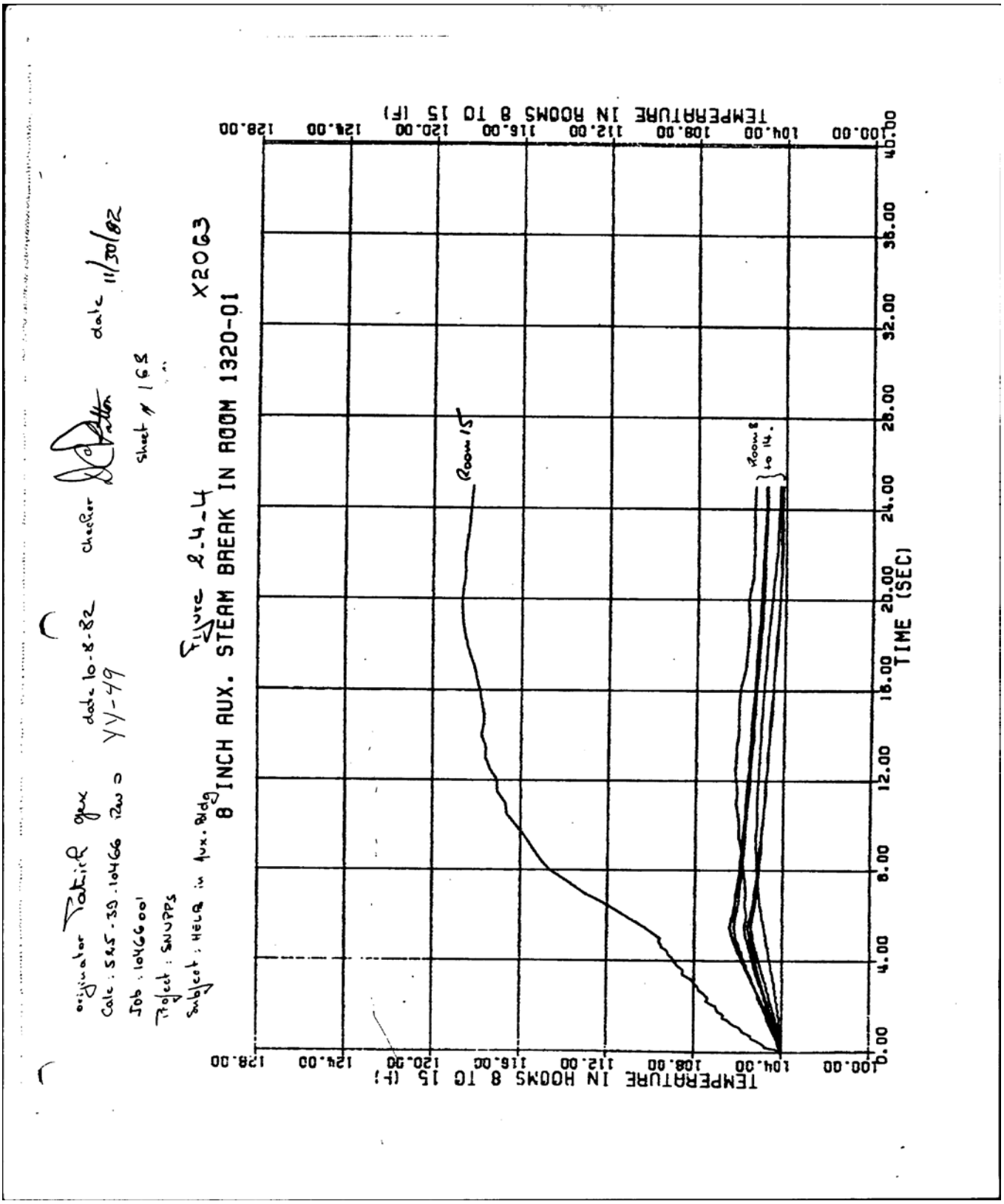
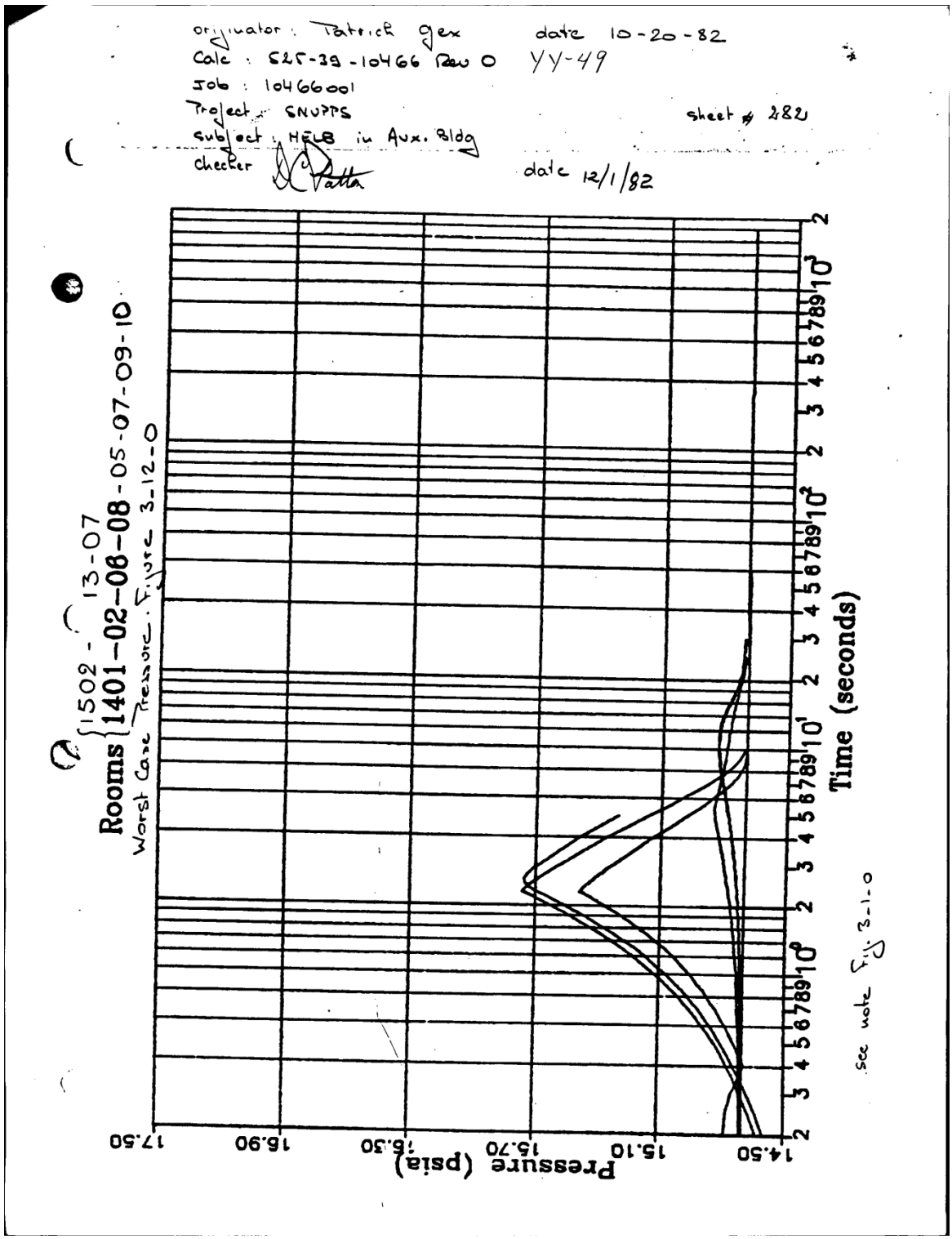


Figure 3.11(B)-38 Auxiliary Building HELB Pressure
(Rooms 1401, 1402, 1405 through 1410, 1502 through 1507 and 1513)



**BUILDING: AUXILIARY** **ROOM NUMBER 1507**
**ROOM DESCRIPTION: ELEV. 2047-6 PERSONNEL HATCH AREA**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 104 | 28, Page 2-8 | NE | N/A | 105.4 (A) | 29, Page 163 & 283 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 1.06 | 29, Pages 270 and 282 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 71 | 29, page 300 |
| **INTEGRATED DOSE (RADS)** | 1314 | 52 & (C) | $1.014 \times 10^6$<br>$1.44 \times 10^6$<br>(D) | 46, page 8<br>46, page 12<br>(D) | NE | N/A |
| **DOSE RATE (R/hr)** | ≤ 2.5 mR/hr | 52 | $1.46 \times 10^5$<br>$1.46 \times 10^5$<br>(D) | 46, page 8<br>46, page 12<br>(D) | NE | N/A |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0.11 (B) | 65, Pages 8 & 9 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature condition is due to an 8" Auxiliary Steam line break in Room 1301 (Reference 29, Page 81). Case 6 as identified on page 283 of Reference 29 does not include this room as noted so Case 4 is correct case.

B. The design flood level for Room 1507 is 1.31 inches based on the volume of the CCW Surge Tanks. This is below the level of the lowest safety related electrical equipment.

C The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

D The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
29. Calculation YY-49
46. Calculation XX-43
52. Radiation Zone Dwg. A-1704
65. Calculation FL-07

Figure 3.11(B)-24 Auxiliary Building HELB Temperature (Rooms 1506 and 1507)

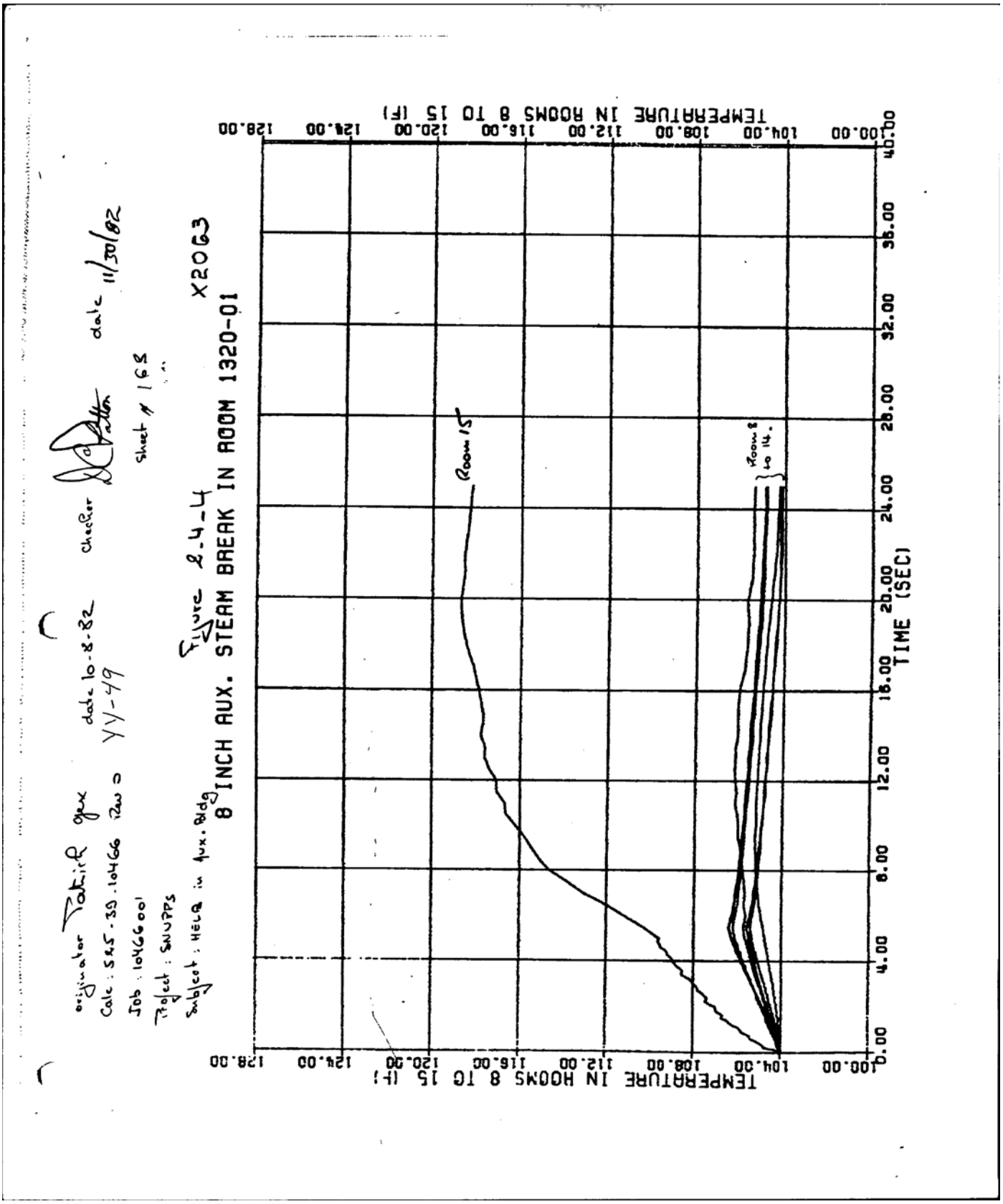
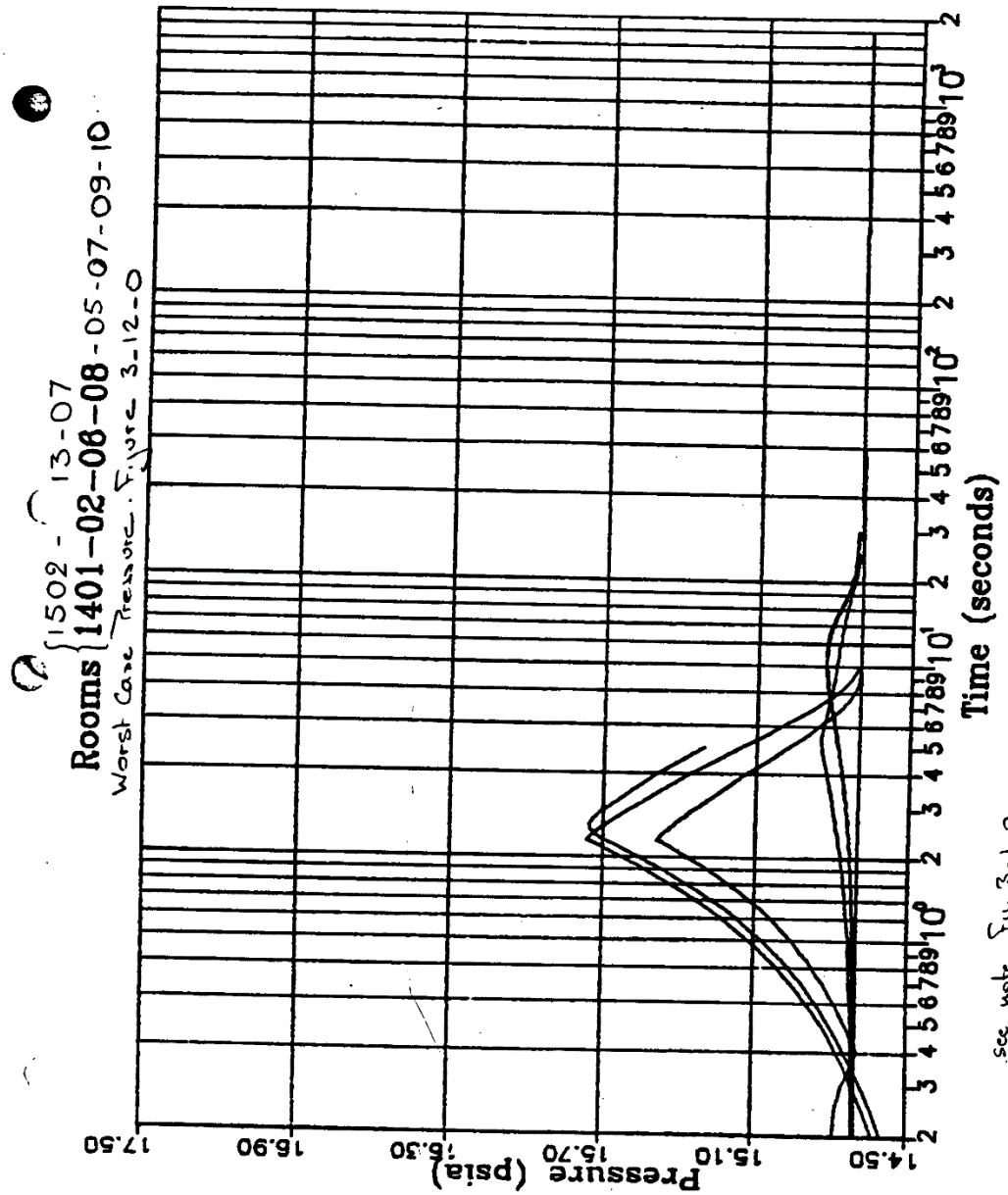


Figure 3.11(B)-38 Auxiliary Building HELB Pressure
(Rooms 1401, 1402, 1405 through 1410, 1502 through 1507 and 1513)

originator: Patrick Gex date 10-20-82
Calc: 525-39-10466 Rev 0 YY-49
Job: 10466001
Project: SNUPPS sheet # 282
Subject: HELB in Aux. Bldg
checker date 12/1/82



**BUILDING: AUXILIARY** **ROOM NUMBER 1508**
**ROOM DESCRIPTION: ELEV. 2047-6 MAIN STEAM ISOLATION VALVE ROOM NO. 1**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 120 | 28, Page 2-8 | NE | N/A | 436 (A) | 100, Page 9 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 6.3 (A) | 62, Page 11 & Att. 3 Page 21 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 (A) | 61 |
| **INTEGRATED DOSE (RADS)** | 1314 | 52 (D) | $1.07 \times 10^6$ $1.52 \times 10^6$ (E) | 36, page 5 36, Page 5A (E) | (C) | NA |
| **DOSE RATE (R/hr)** | ≤ 2.5 mR/hr | 52 | $1.54 \times 10^5$ | 36, Page 5 | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (B) | 56, Page 8 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature, pressure, and humidity conditions are due to a Main Steam line break in this room. As identified in M-000, the design of components to be installed in Rooms 1411, 1412, 1508 and 1509, Main Steam line break (MSLB) superheat effects must be considered. The environmental conditions associated with this even are presented in calculation AN-06-021. If component design is not consistent with the MSLB superheat environmental conditions, a justification similar to the one presented in SLNRC 86-06, dated April 4, 1986 should need to be made. AN-06-021 represents the limiting case with respect to maximum temperature, and AB-X-001 represents the limiting case with respect to maximum pressure. The primary difference between these two calculations is whether or not superheating the steam via uncovered steam generator tubes is considered. In AB-X-001, no superheating is considered as per the methodology in WCAP-8822. In AN-06-021, superheating is considered as per the methodology in WCAP-10961. The compartment where the break does not occur has a peak temperature of 384.5°F.

B. Refer to Room 1411 for flooding effects for this room. Room 1508 drains to room 1411.

C. Radiological consequences of a SGTR have not been specifically generated for this room. However, the radiation levels associated with a SGTR are approximately a factor of 1E6 less than LOCA dose. Therefore, the room should be accessible following a SGTR.

D. The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

E. The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
36. Calculation XX-39
52. Radiation Zone Dwg. A-1704
56. Calculation FL-04
61. Calculation YY-63
62. Calculation AB-X-001
100. Calculation AN-06-021

Figure 3.11(B)-25 Auxiliary Building HELB Temperature (Rooms 1411, 1412, 1508 and 1509)

WCNOC Proprietary Information

FORM APF 05D-001-01, REV. 05

| CALCULATION SHEET | CALCULATION NO. AN-06-021 |
|---|---|
| | REVISION NO. 0 |
| | Page 10 |

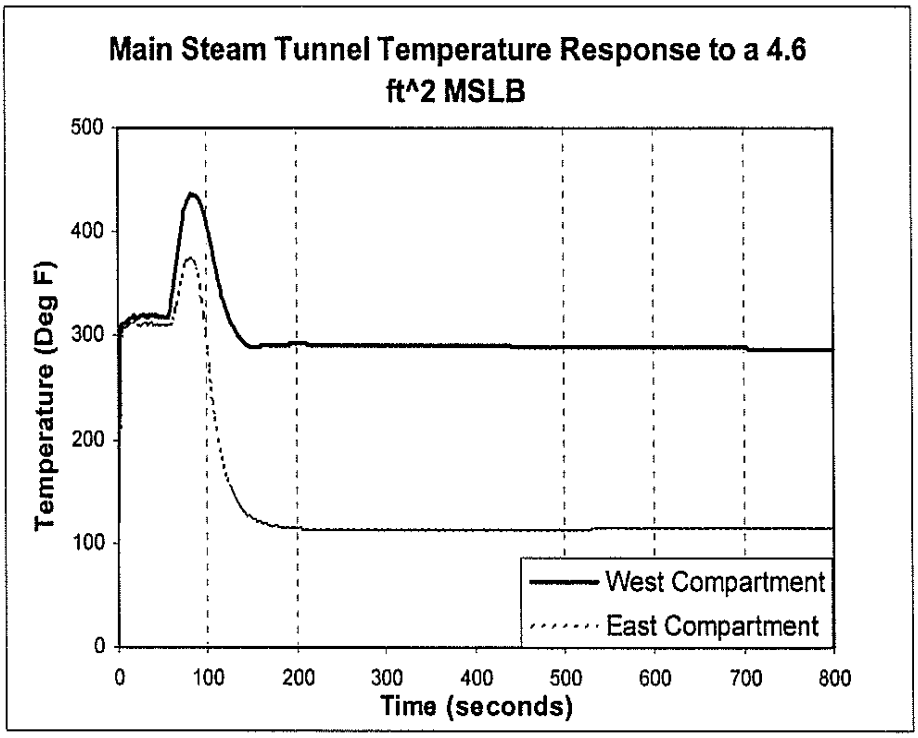



Figure 2.1-1 Main Steam Tunnel Temperature Transient for a 4.6 $ft^2$ Steamline Rupture

Figure 3.11(B)-39 Auxiliary Building HELB Pressure (Rooms 1411, 1412, 1508 and 1509)

FORM KEF-E-303-2, REV. 9/90

**CALCULATION SHEET**

CALC NO. AB-X-001
REV. 0
PMR NO. N/A
SHEET 13 OF 13

ORIGINATOR: DATE: 6-20-94 VERIFIED BY: DATE: 6-20-94

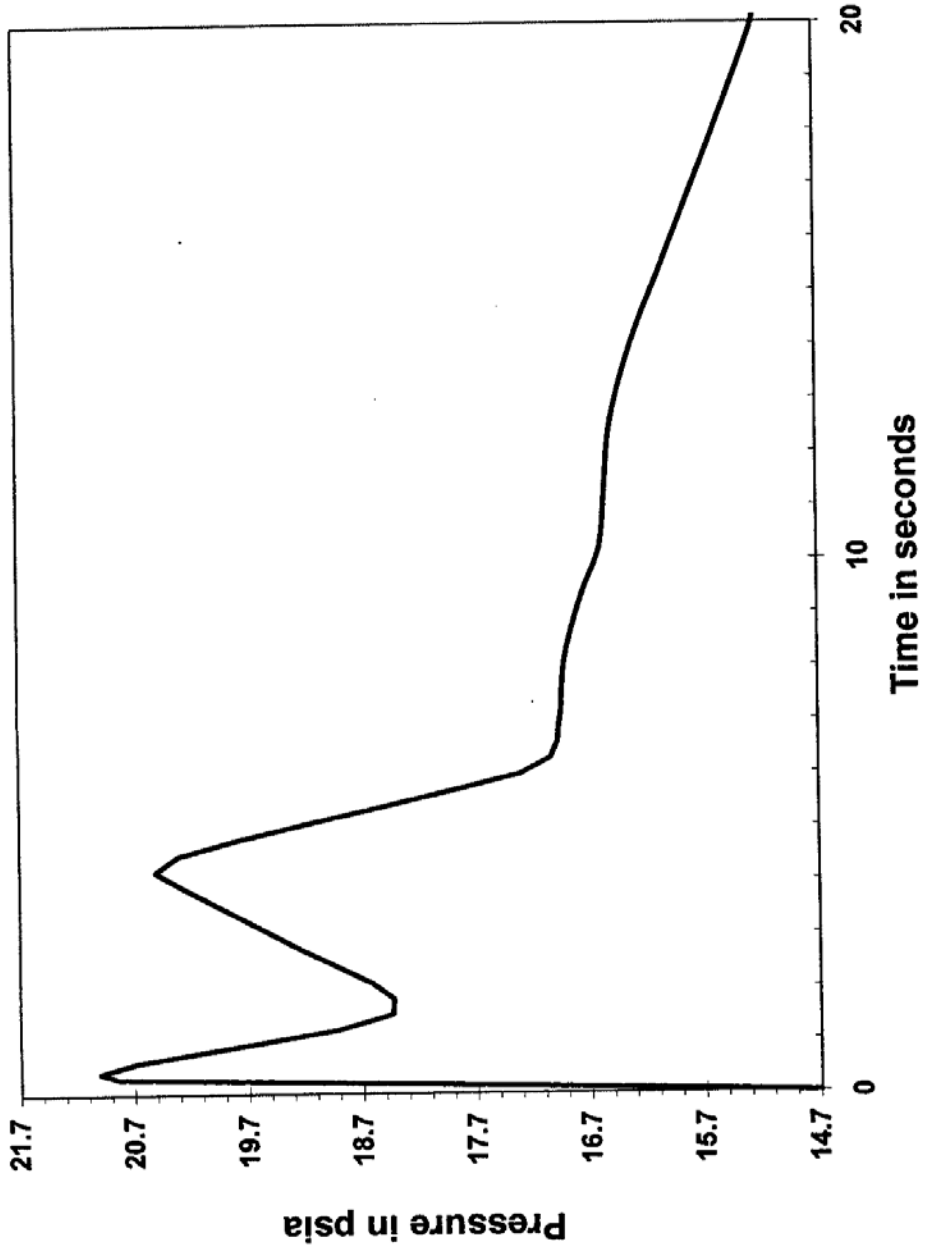



Figure 4. Pressure transient in Sub-Compartment 1 representing the bounding pressures for all other compartments.

**BUILDING: AUXILIARY** **ROOM NUMBER 1509**
**ROOM DESCRIPTION: ELEV. 2047-6 MAIN STEAM ISOLATION VALVE ROOM NO. 2**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| **PEAK TEMPERATURE (°F)** | 120 | 28, Page 2-8 | NE | N/A | 436 (A) | 100, Page 9 |
| **PEAK PRESSURE (PSIG)** | ATM | NA | NE | N/A | 6.3 (A) | 62, Page 11 & Att. 3 Page 21 |
| **HUMIDITY (%)** | 70 | 28, Page 2-8 | NE | N/A | 100 (A) | 61 |
| **INTEGRATED DOSE (RADS)** | 1314 | 52 & (D) | $1.09 \times 10^6$ $1.55 \times 10^6$ (E) | 36, page 5 36, Page 5A (E) | (C) | NA |
| **DOSE RATE (R/hr)** | ≤ 2.5 mR/hr | 52 | $1.58 \times 10^5$ | 36, Page 5 | (C) | NA |
| **MAX. FLOOD LEVEL (FT) (above the floor)** | NE | N/A | NE | N/A | 0 (B) | 56, Page 8 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. HELB/MEC maximum temperature, pressure, and humidity conditions are due to a Main Steam line break in this room. As identified in M-000, the design of components to be installed in Rooms 1411, 1412, 1508 and 1509, Main Steam line break (MSLB) superheat effects must be considered. The environmental conditions associated with this even are presented in calculation AN-06-021. If component design is not consistent with the MSLB superheat environmental conditions, a justification similar to the one presented in SLNRC 86-06, dated April 4, 1986 should need to be made. AN-06-021 represents the limiting case with respect to maximum temperature, and AB-X-001 represents the limiting case with respect to maximum pressure. The primary difference between these two calculations is whether or not superheating the steam via uncovered steam generator tubes is considered. In AB-X-001, no superheating is considered as per the methodology in WCAP-8822. In AN-06-021, superheating is considered as per the methodology in WCAP-10961. The compartment where the break does not occur has a peak temperature of 384.5°F.

B. Refer to Room 1412 for flooding effects for this room. Room 1509 drains to room 1412.

C. Radiological consequences of a SGTR have not been specifically generated for this room. However, the radiation levels associated with a SGTR are approximately a factor of 1E6 less than LOCA dose. Therefore, the room should be accessible following a SGTR.

D. The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

E. The first dose rate & integrated dose number is from 1% Cesium Source plus containment airborne source, the 2nd number is from 50% Cesium sump source and containment airborne source.

**REFERENCE**

28. M-000 (Q)
36. Calculation XX-39
52. Radiation Zone Dwg. A-1704
56. Calculation FL-04
61. Calculation YY-63
62. Calculation AB-X-001
100. Calculation AN-06-021

Figure 3.11(B)-25 Auxiliary Building HELB Temperature (Rooms 1411, 1412, 1508 and 1509)

WCNOC Proprietary Information

FORM APF 05D-001-01, REV. 05

| CALCULATION SHEET | CALCULATION NO. AN-06-021 |
|---|---|
| | REVISION NO. 0 |
| | Page 10 |

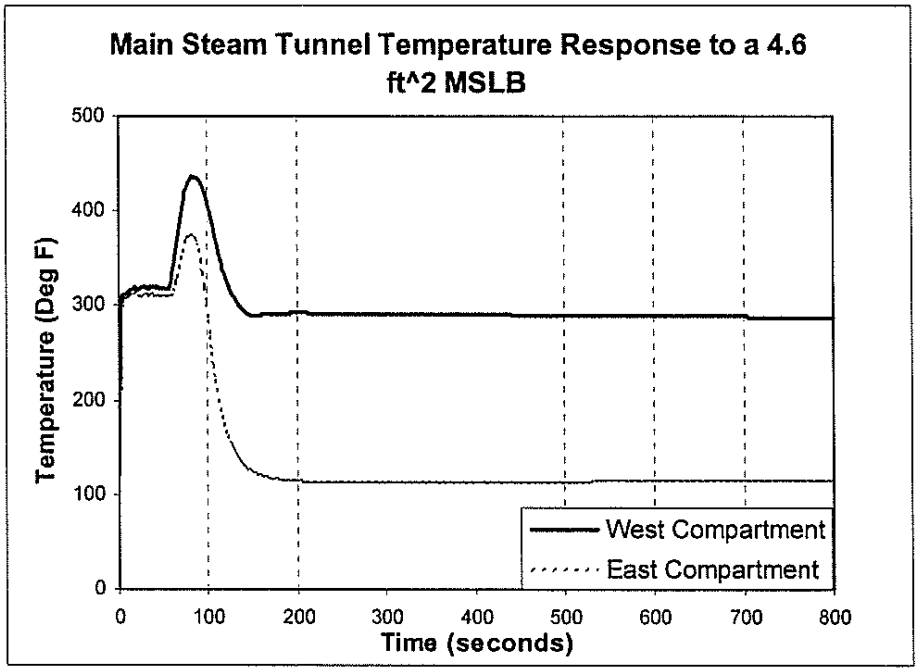



Figure 2.1-1 Main Steam Tunnel Temperature Transient for a 4.6 $ft^2$ Steamline Rupture

Figure 3.11(B)-39 Auxiliary Building HELB Pressure (Rooms 1411, 1412, 1508 and 1509)

FORM KEF-E-303-2, REV. 9/90

**CALCULATION SHEET**

CALC NO. AB-X-001
REV. 0
PMR NO. N/A
SHEET 13 OF 13

ORIGINATOR: [illegible] DATE: 6-20-94 VERIFIED BY: [illegible] DATE: 6-20-94

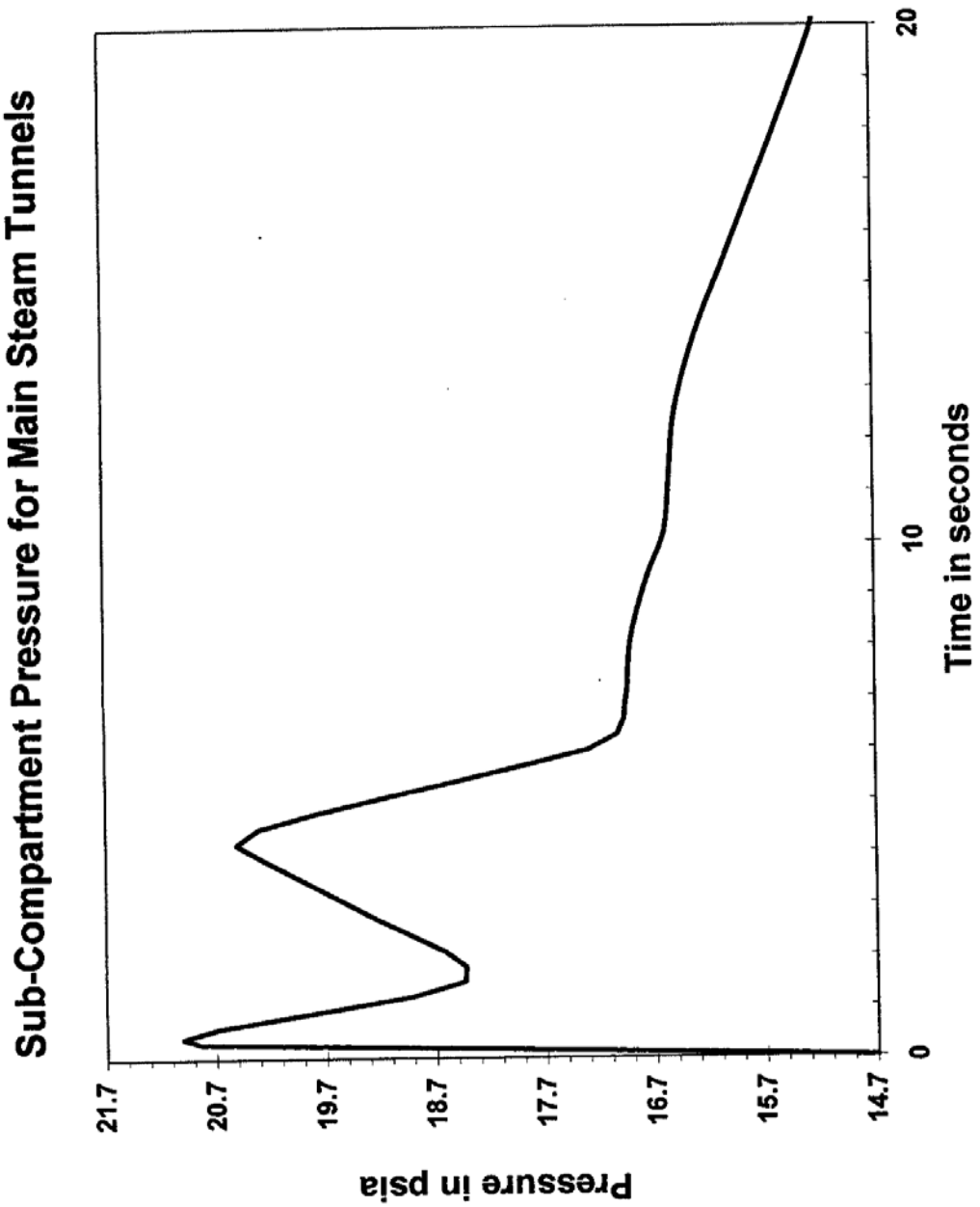



Figure 4. Pressure transient in Sub-Compartment 1 representing the bounding pressures for all other compartments.

**BUILDING: FUEL** **ROOM NUMBER 6104 (F)**
**ROOM DESCRIPTION: ELEV. 2000 FUEL POOL COOLING HEAT EXCHANGER ROOM B**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| PEAK TEMPERATURE (°F) | 122 | 28, page 2-8 | (E) | 80 | N/A | N/A |
| PEAK PRESSURE (PSIG) | ATM | NA | NE | N/A | ATM | NA |
| HUMIDITY (%) | 95 | 28, page 2-8 | NE | N/A | N/A | N/A |
| INTEGRATED DOSE (RADS) | 7884 | 50 & (D) | NE | N/A | (C) | NA |
| DOSE RATE (R/hr) | ≤ 15 mR/hr | 50 | (B) | N/A | (C) | NA |
| MAX. FLOOD LEVEL (FT) (above the floor) | NE | N/A | NE | N/A | 1.42 (A) | 68, Page 7 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. The maximum flood rate is due to a 4" Plant Heating line break in Room 6104. The maximum flood level is based on Operator action being taken in 40 minutes to isolate the break.

B. A specific LOCA dose rate is not available for this room.

C. Radiological consequences of specific MEC's have not been developed.

D The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

E The temperature may reach 133ºF with a full core off load in the pool and following a loss of cooling for two hours. This temperature may also reach 132ºF when cooling to the pool is re-established after 4 hours following a LOCA.

F Per GG-M-005, Attachment 2; this room has been evaluated as a mild environment room.

**REFERENCE**

28. M-000
50. Radiation Zone Dwg. A-1702
68. Calculation FL-09
80. Calculation GG-M-005

**BUILDING: FUEL** **ROOM NUMBER 6105 (F)**
**ROOM DESCRIPTION: ELEV. 2000 FUEL POOL COOLING HEAT EXCHANGER ROOM A**

| ENVIRONMENTAL CONDITIONS | NORMAL | REF | LOCA | REF | HELB/ MEC | REF |
|---|---|---|---|---|---|---|
| PEAK TEMPERATURE (°F) | 122 | 28, page 2-8 | (E) | 80 | N/A | N/A |
| PEAK PRESSURE (PSIG) | ATM | NA | NE | N/A | ATM | NA |
| HUMIDITY (%) | 95 | 28, page 2-8 | NE | N/A | N/A | N/A |
| INTEGRATED DOSE (RADS) | 7884 | 50 & (D) | NE | N/A | (C) | NA |
| DOSE RATE (R/hr) | ≤ 15 mR/hr | 50 | (B) | N/A | (C) | NA |
| MAX. FLOOD LEVEL (FT) (above the floor) | NE | N/A | NE | N/A | 1.42 (A) | 68, Page 7 |

NE = The mode or event has no environmental condition effect
ATM = Atmospheric

**NOTES**

A. The maximum flood rate is due to a 4" Plant Heating line break in Room 6104. The maximum flood level is based on Operator action being taken in 40 minutes to isolate the break.

B. A specific LOCA dose rate was not developed for this room.

C. Radiological consequences of specific MEC's have not been developed.

D The normal integrated dose was obtained by multiplying the dose rate times 60 years life of the plant.

E The temperature may reach 133ºF with a full core off load in the pool and following a loss of cooling for two hours. This temperature may also reach 132ºF when cooling to the pool is re-established after 4 hours following a LOCA.

F Per GG-M-005, Attachment 2; this room has been evaluated as a mild environment room.

**REFERENCE**

28. M-000
50. Radiation Zone Dwg. A-1702
68. Calculation FL-09
80. Calculation GG-M-005

# WOLF CREEK GENERATING STATION EQUIPMENT QUALIFICATION DESIGN BASES DOCUMENT

## EQSD-I - ATTACHMENT B

### Mild Environments Normal and Accident Environments

This attachment provides the temperature, relative humidity (RH), Pressure, Dose Rate and radiation (for 60 years) for normal environment conditions for the mild environment rooms. This information was previously identified in the USAR in table 1.

This attachment provides the temperature, relative humidity (RH), Pressure and radiation (for 6 Months) for accident conditions for the mild environment rooms. These are the Equipment qualification parameters for SNUPPS NUREG-0588 Review (LOCA, MSLB, and HELB). This information was previously identified in the USAR in table 2.

Note:

1) The environment values provided in this attachment with this note are the values that existed in the USAR table 3.11(B)-1 & 3.11(B)-2 and the EQSD-IV document. This document has taken the place of those documents and as such the information has been transferred directly from them. It is noted that if other design documents were identified at the time, which provided documentation of where the information can be found in design documents those references are listed.

2) With the exception of the RHR heat exchanger rooms, the auxiliary feedwater turbine-driven pump room, and the main steam/ main feedwater isolation valve rooms, the ambient temperature outside of the containment in rooms and corridors which do not have ESF coolers will not exceed 120°F during loss of normal ventilation conditions, because of the lack of heat sources. Also, rooms and corridors which are not served by ESF coolers may experience relative humidity up to 95 percent following a loss of normal ventilation. The RHR heat exchanger rooms will not exceed 175°F, the auxiliary feedwater turbine-driven pump room will not exceed 146°F (pump not operating), and the main steam/ main feedwater isolation valve rooms will not exceed 166°F during a loss of normal ventilation.

3) Plant Environmental Normal Conditions environmental pH is 7.0 for all the building areas identified in Attachment A & B (Reactor, Auxiliary, Control, Turbine, Diesel Generator, Fuel, ESW Pump House, Radwaste and etc. Buildings) at WCNOC. (Reference 17, Table 1)

4) When both the 1E room cooler and the non-1E fan coil unit are operating, the temperature for the rooms 1401 and 1406 will be limited to 104°F with one pump running and 122°F and 95 percent, respectively, following a loss of normal ventilation with the major components in the room operating (e.g. both pumps running) for extended periods.

5) Room 1407 (Boric Acid Batching Tank Area) components located inside this room that have potential for boric acid precipitation if the room temperature drops below 75°F. The room does not contain system or components required to mitigate the consequences of a DBA or to provide for hot or cold shutdown from the control room.

6) Qualification temperature is 104°F.

7) The rooms in the control building referenced to this note have ESF coolers which maintain the temperature and relative humidity at or below 90°F and 70 percent, respectively, for all conditions except during loss of offsite power or a single nonfunctioning SGK05A or SGK05B unit concurrent with accident condition (LOCA) heat loading. During a loss of offsite power, when Class 1E equipment is powered by the emergency diesels, Class 1E room temperatures may reach 92°F, due to the possibility of the fan running slower because of variation in the diesel generator frequency/voltage. With a single nonfunctional SGK05A or SGK05B unit concurrent with accident condition (LOCA) heat loading as well as maximum outdoor ambient temperature, the room temperature in the rooms may increase to a maximum of 104°F (Reference 28).

8) The applicable flood calculation for the rooms/ areas identified in Attachment B can be found using the WCRE-35 “Boundary Matrix” Appendix A. There is no HELB in room 1501 (reference 29, appendix 1) and thus for LOCA and MSLB accidents the EQ flood level EQ qualification is zero.

## Table 1 - NORMAL ENVIRONMENTS

### Auxiliary Building (Note 2)

| AREA | TEMP | REF. | RH | REF. | PRESS. | REF. | DOSE RATE | REF. | RAD-60yr | REF. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1304 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 1305 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 1326 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 1329 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 1401 | 104 (Note 4) | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0025 R/hr | 10466-A-1703 | 1314 rads | 10466-A-1703 |
| 1402 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1703 | 262 rads | 10466-A-1703 |
| 1405 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.015 R/hr | 10466-A-1703 | 7884 rads | 10466-A-1703 |
| 1406 | 104 (Note 4) | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0025 R/hr | 10466-A-1703 | 1314 rads | 10466-A-1703 |
| 1407 (Note 5) | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0025 R/hr | 10466-A-1703 | 1314 rads | 10466-A-1703 |
| 1413 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0025 R/hr | 10466-A-1703 | 1314 rads | 10466-A-1703 |
| 1501 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1704 | 262 rads | 10466-A-1704 |
| 1502 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0025 R/hr | 10466-A-1704 | 1314 rads | 10466-A-1704 |
| 1503 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0025 R/hr | 10466-A-1704 | 1314 rads | 10466-A-1704 |
| 1504 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.015 R/hr | 10466-A-1704 | 7884 rads | 10466-A-1704 |
| 1512 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1704 | 262 rads | 10466-A-1704 |
| 1513 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1704 | 262 rads | 10466-A-1704 |

### Control Bldg. (Note 2)

| AREA | TEMP | REF. | RH | REF. | PRESS. | REF. | DOSE RATE | REF. | RAD-60yr | REF. |
|---|---|---|---|---|---|---|---|---|---|---|
| 3101 | 104 | NOTE 1 | 70 | NOTE 1 | ATM | NOTE 1 | 0.0025 R/hr | 10466-A-1701 | 1314 rads | 10466-A-1701 |
| 3105 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1701 | 262 rads | 10466-A-1701 |
| 3106 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1701 | 262 rads | 10466-A-1701 |
| 3202 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0025 R/hr | 10466-A-1701 | 1314 rads | 10466-A-1701 |
| 3211 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1701 | 262 rads | 10466-A-1701 |
| 3218 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1701 | 262 rads | 10466-A-1701 |
| 3222 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1701 | 262 rads | 10466-A-1701 |
| 3224 | 78 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1701 | 262 rads | 10466-A-1701 |
| 3229 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1701 | 262 rads | 10466-A-1701 |
| 3230 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1701 | 262 rads | 10466-A-1701 |

| AREA | TEMP | REF. | RH | REF. | PRESS. | REF. | DOSE RATE | REF. | RAD-60yr | REF. |
|---|---|---|---|---|---|---|---|---|---|---|
| 3301 | 90 (Note 7) | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3302 | 90 (Note 7) | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3403 | 90 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3404 | 90 (Note 7) | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3405 | 90 (Note 7) | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3407 | 90 (Note 7) | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3408 | 90 (Note 7) | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3409 | 90 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3410 | 90 (Note 7) | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3411 | 90 (Note 7) | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3413 | 90 (Note 7) | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3414 | 90 (Note 7) | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3415 | 90 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3416 | 90 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |
| 3501 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1703 | 262 rads | 10466-A-1703 |
| 3601 | 78 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1704 | 262 rads | 10466-A-1704 |
| 3605 | 78 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1704 | 262 rads | 10466-A-1704 |
| 3609 | 74 | M-000 M-10GK | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1704 | 262 rads | 10466-A-1704 |
| 3613 | 78 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1704 | 262 rads | 10466-A-1704 |
| 3801 | 104 | M-000 | 70 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1704 | 262 rads | 10466-A-1704 |

**Turbine Bldg**

| AREA | TEMP | REF. | RH | REF. | PRESS. | REF. | DOSE RATE | REF. | RAD-60yr | REF. |
|---|---|---|---|---|---|---|---|---|---|---|
| 4401 | 110 | M-000 | 95 | NOTE 1 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |

**Diesel Building (Note 2)**

| AREA | TEMP | REF. | RH | REF. | PRESS. | REF. | DOSE RATE | REF. | RAD-60yr | REF. |
|---|---|---|---|---|---|---|---|---|---|---|
| 5000 | 122 | M-000 | 95 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |

**Fuel Bldg. (Note 2)**

| AREA | TEMP | REF. | RH | REF. | PRESS. | REF. | DOSE RATE | REF. | RAD-60yr | REF. |
|---|---|---|---|---|---|---|---|---|---|---|
| 6000 | 104 | M-000 | 95 | M-000 | ATM | NOTE 1 | 0.0005 R/hr | 10466-A-1702 | 262 rads | 10466-A-1702 |

**ESW Pump House**

| AREA | TEMP | REF. | RH | REF. | PRESS. | REF. | DOSE RATE | REF. | RAD-60yr | REF. |
|---|---|---|---|---|---|---|---|---|---|---|
| General Areas | 110 | NOTE 1 | 95 | NOTE 1 | ATM | NOTE 1 | 0.0005 R/hr | NOTE 1 | 262 rads | NOTE 1 |
| K104 | 110 | NOTE 1 | 95 | NOTE 1 | ATM | NOTE 1 | 0.0005 R/hr | NOTE 1 | 262 rads | NOTE 1 |
| K105 | 110 | NOTE 1 | 95 | NOTE 1 | ATM | NOTE 1 | 0.0005 R/hr | NOTE 1 | 262 rads | NOTE 1 |

**Radwaste Bldg.**

| AREA | TEMP | REF. | RH | REF. | PRESS. | REF. | DOSE RATE | REF. | RAD-60yr | REF. |
|---|---|---|---|---|---|---|---|---|---|---|
| 7133 | 104 | M-000 | 95 | M-000 | ATM | NOTE 1 | 0.0025 R/hr | 10466-A-1701 | 1314 | 10466-A-1701 |

**Other**

| AREA | TEMP | REF. | RH | REF. | PRESS. | REF. | DOSE RATE | REF. | RAD-60yr | REF. |
|---|---|---|---|---|---|---|---|---|---|---|
| 9101 | 120 | NOTE 1 | 95 | NOTE 1 | ATM | NOTE 1 | 0.0005 R/hr | NOTE 1 | 262 rads | NOTE 1 |
| 9102 | 120 | NOTE 1 | 95 | NOTE 1 | ATM | NOTE 1 | 0.0005 R/hr | NOTE 1 | 262 rads | NOTE 1 |

## Table 2 - ACCIDENT ENVIRONMENTS

### Auxiliary Bldg.

| AREA | TEMP | REF | PRESS. | REF. | RH | REF. | RAD-6 Months | REF. |
|---|---|---|---|---|---|---|---|---|
| 1304 | 104 | M-000 | ATM | M-000 | 70 | M-000 | 1603 rads | XX-47 |
| 1305 | 104 | M-000 | 0.14 | M-000 | 70 | M-000 | 37.3 rads | XX-39 |
| 1326 | 104 | NOTE 1 | ATM | NOTE 1 | 70 | NOTE 1 | 94.6 rads | XX-39 |
| 1329 | 110 | YY-57 | 1.06 | YY-57 | N/A | N/A | 1250 rads | XX-39 |
| 1401 | 106 | YY-49 | 1.06 | YY-49 | 71 | YY-49 | 63.6 rads | XX-39 |
| 1402 | 109.9 | YY-49 | 1.06 | YY-49 | 71 | YY-49 | 220 rads | XX-39 |
| 1405 | 105.60 | YY-49 | 1.06 | YY-49 | 71 | YY-49 | N/A | N/A |
| 1406 | 109.9 | YY-49 | 1.06 | YY-49 | 71 | YY-49 | 689 rads | XX-39 |
| 1407 | 105.60 | YY-49 | 1.06 | YY-49 | 71 | YY-49 | N/A | N/A |
| 1413 | 106 | YY-49 | 1 | YY-49 | 71 | YY-49 | 156 rads | XX-39 |
| 1501 | 105 | NOTE 1 | ATM | NOTE 1 | 71 | NOTE 1 | 101 rads | XX-39 |
| 1502 | 105.4 | M-000 | 1.06 | YY-49 | 71 | YY-49 | 892 rads | XX-39 |
| 1503 | 105.4 | M-000 | 1.06 | YY-49 | 71 | YY-49 | 958 rads | XX-39 |
| 1504 | 105.4 | M-000 | 1.06 | YY-49 | 71 | NOTE 1 | 1210 rads | XX-43 |
| 1512 | 105 | NOTE 1 | ATM | NOTE 1 | 71 | NOTE 1 | 444 rads | XX-39 |
| 1513 | 105.4 | M-000 | 1.06 | YY-49 | 71 | YY-49 | 444 rads | XX-39 |

**Control Bldg.**

| AREA | TEMP | REF | PRESS. | REF. | RH | REF. | RAD-6 Months | REF. |
|---|---|---|---|---|---|---|---|---|
| 3101 | 107.7 | M-000<br>GK-M-013 | ATM | M-000 | 95 | M-000 | 2.5 rads | NOTE 1 |
| 3105 | 110 | M-000 | ATM | M-000 | 95 | M-000 | 2.5 rads | NOTE 1 |
| 3106 | 110 | M-000 | ATM | M-000 | 95 | M-000 | 2.5 rads | NOTE 1 |
| 3222 | 114.3 | M-000<br>GK-M-013 | ATM | M-000 | 95 | M-000 | 2.5 rads | NOTE 1 |
| 3224 | 114.3 | M-000<br>GK-M-013 | ATM | M-000 | 95 | M-000 | 2.5 rads | NOTE 1 |
| 3229 | 110 | M-000 | ATM | M-000 | 95 | M-000 | 2.5 rads | NOTE 1 |
| 3230 | 110 | M-000 | ATM | M-000 | 95 | M-000 | 2.5 rads | NOTE 1 |
| 3301 | 90<br>(Note 7) | M-000<br>GK-M-014 | ATM | M-000 | 70 | M-000<br>GK-M-014 | 2.5 rads | NOTE 1 |
| 3302 | 90<br>(Note 7) | M-000<br>GK-M-015 | ATM | M-000 | 70 | M-000<br>GK-M-015 | 2.5 rads | NOTE 1 |
| 3404 | 90<br>(Note 7) | M-000<br>GK-M-015 | ATM | M-000 | 70 | M-000<br>GK-M-015 | 2.5 rads | NOTE 1 |
| 3405 | 90<br>(Note 7) | M-000<br>GK-M-015 | ATM | M-000 | 70 | M-000<br>GK-M-015 | 0.0005 rads | NOTE 1 |
| 3407 | 90<br>(Note 7) | M-000<br>GK-M-014 | ATM | M-000 | 70 | M-000<br>GK-M-014 | 0.0005 rads | NOTE 1 |
| 3408 | 90<br>(Note 7) | M-000<br>GK-M-014 | ATM | M-000 | 70 | M-000<br>GK-M-014 | 2.5 rads | NOTE 1 |
| 3410 | 90<br>(Note 7) | M-000<br>GK-M-015 | ATM | M-000 | 70 | M-000<br>GK-M-015 | 2.5 rads | NOTE 1 |
| 3411 | 90<br>(Note 7) | M-000<br>GK-M-015 | ATM | M-000 | 70 | M-000<br>GK-M-015 | 0.0005 rads | NOTE 1 |
| 3413 | 90<br>(Note 7) | M-000<br>GK-M-014 | ATM | M-000 | 70 | M-000<br>GK-M-014 | 0.0005 rads | NOTE 1 |
| 3414 | 90<br>(Note 7) | M-000<br>GK-M-014 | ATM | M-000 | 70 | M-000<br>GK-M-014 | 2.5 rads | NOTE 1 |
| 3415 | 104 | M-000 | ATM | M-000 | 70 | M-000 | 2.5 rads | NOTE 1 |
| 3416 | 104 | M-000 | ATM | M-000 | 70 | M-000 | 2.5 rads | NOTE 1 |
| 3501 | 104 | M-000<br>GK-M-013 | ATM | M-000 | 95 | M-000 | 2.5 rads | NOTE 1 |
| 3601 | 84<br>(Note 6) | M-000 | >ATM | M-000 | 70 | M-000 | 2.5 rads | NOTE 1 |
| 3605 | 84<br>(Note 6) | M-000 | ATM | M-000 | 70 | M-000 | 2.5 rads | NOTE 1 |
| 3609 | 84 | M-000 | ATM | M-000 | 70 | M-000 | 2.5 rads | NOTE 1 |
| 3801 | 120 | M-000 | ATM | M-000 | 70 | GK-M-015 | 2.5 rads | NOTE 1 |

**Diesel Building**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5000 | 122 | NOTE 1 | ATM | NOTE 1 | 70 | NOTE 1 | <500 rads | NOTE 1 |

**Fuel Bldg.**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6000 | 122 | NOTE 1 | ATM | NOTE 1 | 95 | NOTE 1 | <1000 rads | NOTE 1 |

**ESW Pump House**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| General Areas | 122 | NOTE 1 | ATM | NOTE 1 | 95 | NOTE 1 | <500 rads | NOTE 1 |
| K104 | 122 | NOTE 1 | ATM | NOTE 1 | 95 | NOTE 1 | <500 rads | NOTE 1 |
| K105 | 122 | NOTE 1 | ATM | NOTE 1 | 95 | NOTE 1 | <500 rads | NOTE 1 |

**Radwaste Bldg.**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7133 | 120 | NOTE 1 | ATM | NOTE 1 | 95 | NOTE 1 | 2.5 rads | NOTE 1 |

**Other**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 9101 | 120 | NOTE 1 | ATM | NOTE 1 | 95 | NOTE 1 | <500 rads | NOTE 1 |
| 9102 | 120 | NOTE 1 | ATM | NOTE 1 | 95 | NOTE 1 | <500 rads | NOTE 1 |

# WOLF CREEK GENERATING STATION
## EQUIPMENT QUALIFICATION
## DESIGN BASIS DOCUMENT
## EQSD-I - ATTACHMENT C
## Exemptions From NUREG-0588 Qualification and Post Accident Operating Time (PAOT)

**Note:**
**Attachment C was formerly USAR TABLE 3.11(B)-8 (Reference CCP 014582) and is part of USAR by reference.**

The equipment listed under this attachment does not need to be qualified under the Licensing requirements of NUREG-0588 per the exceptions provided in the attachment.

**Table C.1 - Exemptions From NUREG-0588 Qualification**
**Table C.2 - EXEMPTIONS FROM 180 DAY POST ACCIDENT OPERATING TIME (PAOT)**

## TABLE C.1 EXEMPTIONS FROM NUREG-0588 QUALIFICATION

| SPECIFICATION | DESCRIPTION | EXPLANATION FOR EXCLUSION |
|---|---|---|
| E-009 | Switchgear Potential Transformer Cubicles | These devices provide anticipatory RCP trip functions only. They sense RCP bus voltage and frequency and provide RCP trips to prevent flow coast-down accidents. These trips are redundant to the reactor trip. However, no credit is taken for the RCP trip in any accident analysis. If a DBA occurs, these devices provide no additional function. Additionally, failure of these devices during a LOCA should not provide any adverse effects since the RCPs are not required during a LOCA. |
| E-060 | Triaxial Cable Assembly (Nuclear Detectors) | Refer to Specification W(ESE-8) for an explanation of exemption. |
| J-601A | Air Operated Control Valve Limit Switches | Limit switches, ABZS0005, ABZS0006, ABZS0048, ABZS0049, AEZS0043, AEZS0044, AEZS0045, AEZS0046, are assigned a category C for MSLB. Per analysis in CCP05018 and SLNRC 86-06 (validated by with CR 112775), the only post-accident function of the listed limit switches is to indicate the valves position. Failure of these limit switches has been demonstrated to have no impact on plant safety, since the indication of SG isolation can be determined by use of alternate equipment. Therefore, these limit switches are asssigned a category C MSLB and are exempt from the EQ Program. |
| M-021 | Turbine Driven Auxiliary Feedwater Pump | This component and its associated auxiliaries are located in a room that is isolated from the rest of the Auxiliary Building. The room has a blow-out panel to the Turbine Building to prevent a HELB in that room from over pressurizing the room walls and pressurizing the adjacent Auxiliary Building rooms. The environment in this room, as a result of the HELB, would preclude equipment operation. However, the HELB would not affect the remaining two trains of auxiliary feedwater. Therefore, the turbine-driven auxiliary feedwater pump need not function during or following this HELB. |
| M-221 | Valve Limit Switch | The limit switch for valve EN-V-97 is on the discharge line from the containment spray additive tank. This valve is a locked open manual gate valve. The failure of the limit switch post-LOCA should not adversely affect this valve or any other part of the containment spray system. The limit switch provides indication to the ESF status panel. The limit switch is used to verify the valve position following maintenance on the valve. Therefore, this limit switch is not required for a LOCA. |
| M-236 | Auxiliary Feed Pumps Suction Valve from ESW | These valves are not required post LOCA as, recovery is accomplished utilizing the ECCS from ESW systems and containment spray. |

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| M-628 | Hydraulic Actuator for Main Steam Isolation Valve | The position element and position transmitter together provide functionality of the existing limit switch. The existing limit switches are assigned a category C for LOCA & MSLB. The same classification is applicable to the replacement position element and position transmitter. Per analysis in CCP 09952 & 11608, the only post-accident function of the MSIV limit switches is to indicate the valves position. Failure of these limit switches has been demonstrated to have no impact on plant safety, since the indication of SG isolation can be determined by use of alternate equipment. Therefore, these limit switches are asssigned a category C for LOCA & MSLB. |
| M-630 | Hydraulic Actuator for Main Feedwater Isolation Valves | The position element and position transmitter together provide functionality of the existing limit switch. The existing limit switches are assigned a category C for LOCA & MSLB. The same classification is applicable to the replacement position element and position transmitter. Per analysis in CCP 09952 & 11608, the only post-accident function of the MFIV limit switches is to indicate the valve's position. Failure of these limit switches has been demonstrated to have no impact on plant safety since indication of feedwater isolation can be determined by use of alternate equipment. Therefore, these limit switches are assigned a Category C for LOCA & MSLB." |
| W(AE-3) | Canned Safety Related Pump Motors | Two sets of pumps are covered by this package.<br><br>a. The boron injection recirculation pumps are not required as 2400-2500 ppm boron is used versus a concentration of 20,000 ppm boron. Therefore, this system, including the boron injection pumps has been permanently disabled from operation. Accordingly, these pumps provide no safety-related function.<br><br>b. The boric acid transfer pumps are not utilized as a source of boron during a LOCA. The source of borated water is the refueling water storage tank (RWST). The boric acid transfer pumps are utilized as a source of boron in the event of a failure of the RWST during a tornado. A LOCA and tornado are not postulated to occur simultaneously. Therefore, these pumps are not required to operate during a LOCA. |

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| W(ESE-8) | Two Section Power range Excore Neutron Detectors | Power range high neutron flux trips are not assumed in the mitigation of a LOCA or main Detectors steam line breaks. These detectors may fail in any manner after an LOCA or MSLB, because reactor trip should occur as a result of a low pressurizer pressure or safety injection signal, with over temperature delta-T as a backup. Rod control system interactions have been investigated for the limiting case of a double-ended small steam line rupture with subsequent rod withdrawal. It has been concluded that the effects of this rod withdrawal prior to reactor trip are insignificant. Therefore, the power range detectors are not required to be qualified to a harsh environment. |
| W(ESE-40A) | Bit Injection Path Flow Switches EMFS0917C & EMFS0917D | These flow switches are inter- locked to control the Centrifugal, Charging Pump (CCP) miniflow isolation valves. Following a LOCA, an SIS should open the BIT path to the RCS so that safety injection can proceed. During this injection phase, the flow switches are not exposed to accident dose radiation. They should operate normally in this mild environment, protecting the CCP's against deadheading and providing the required flow to the RCS. Upon initiation of cold leg recirculation (a maximum of 4.6 hours after LOCA) the RCS pressure should have dropped enough that the CCP's cannot dead head themselves. Therefore, should the flow switches failure (due to the high radiation from the recirculation from the containment sump, ECCS flow delivered to the RCS should exceed the required flow. During this mode the RHR pumps supply the CCP's and SI pumps. Should the flow switches failure cause the miniflow valves to fail open a maximum of 60 gpm per CCP should be recirculated through the minimum flow piping back to the CCP suction. However, the required flow should still be delivered to the RCS. |
| W(ESE-47) | Flux Doubling Equipment | These components are not required following a LOCA or MSLB because the Flux Doubling Equipment is not required to mitigate a LOCA or an MSLB and a boron dilution event is not postulated to occur concurrent with these DBAs. (The flux doubling equipment provides an alarm that is additional information to the operator. Boron dilution mitigation is by manual action following a Hi VCT Level Alarm.) |

## Table C.2 - EXEMPTIONS FROM 180 DAY POST ACCIDENT OPERATING TIME (PAOT)

| SPECIFICATION | DESCRIPTION COMPONENT | EXPLANATION FOR EXCLUSION |
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| J-481 | Containment Normal Sumps Level Elements<br>LFLE09A<br>LFLE09B<br>LFLE10A<br>LFLE10B | Containment Normal Sumps Level Elements (LFLE0009A/09B and LFLE 0010A/10B) post-accident mission time is less than 10 hours based on the document and bases provided in CP 20361 (Reference 135). |
| J-601B | Atmospheric Relief Valve I/P Converter<br>ABPY0001<br>ABPY0002<br>ABPY0003<br>ABPY0004<br><br>Atmospheric Relief Valve Limit Switches<br>ABZS0001<br>ABZS0002<br>ABZS0003<br>ABZS0004 | The Atmospheric Relief Valves ABPV0001, ABPV0002, ABPV0003, and ABPV0004, 8-hour mission time includes maintaining the RCS at Hot Standby (NOP/NOT) condition for 4 hours and then cooldown the RCS at 50°F per hour to Hot Shutdown (350°F) condition. This supports the licensing basis MSLB dose analysis identified in Calculation AN-99-019 (Reference 133), which assumes that Residual Heat Removal (RHR) system is placed in service in 8 hours. In addition, KA-03-W (Reference 134) determined that the accumulators have sufficient capacity to provide valve operation for the 8-hours mission time, see CP 20361 (Reference 135). |