FLORIDA POWER & LIGHT COMPANY

RESPONSE TO I&E BULLETIN 79-01B

PHASE I (ACTION ITEMS 1-3)

FOR ST LUCIE UNIT NO. 1

ENVIRONMENTAL QUALIFICATION OF ELECTRICAL EQUIPMENT IN A HARSH ENVIRONMENT WHICH IS REQUIRED FOR ACCIDENT MITIGATION/MONITORING

JUNE 1, 1980

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Contents of Report

This report is submitted in response to IE Bulletin 79-01B as Phase I of a two phase effort, where Phase I responds to Action Items 1, 2 and 3. Phase II responds to Action Items 4 and 5 of the subject Bulletin and will be submitted two month from the date of this report.

Florida Power & Light Company (FP&L) responded to IE Bulletin 79-01 (via letter L-79-181 dated July 2, 1979) as regards equipment inside containment. This report therefore follows the format of the previous report but has been expanded to respond to the increased scope of IE Bulletin 79-01B, i.e., to address equipment located outside containment. In addition, in order to facilitate completion of the NRC evaluation of the St Lucie Unit 1 submittals, a "systems analysis" approach has been used as discussed in Section 1.3 infra.

This report consists of three major divisions: a main report containing descriptive and explanatory information; a Master List which delineates, by major system, the equipment which sees a harsh environment and is required to mitigate/monitor the accident, and the Component Evaluation Sheets which present detailed environmental parameters for each component exposed to the harsh environment.

1.2 Methodology

Equipment qualification by its very nature involves consideration of the "design basis accident" (DBA) scenario wherein the postulated accident results in the worst-case environmental conditions (e.g., pressure, temperature, humidity) to which the equipment is exposed and under which it must function. Therefore for equipment inside containment the DBA's are defined as the LOCA and the MSLB which give the worst environmental conditions with respect to containment pressure and/or temperature; the worst cases were identified per the FSAR analyses and are discussed in Sections 2.1 and 2.2 below. High energy line breaks (HELB) outside containment are defined and discussed in FSAR Appendices 3C and 3D. Whereas equipment inside containment sees the environment of the accident it is required to mitigate or to monitor, the equipment required for an HELB outside containment in most cases is not exposed to the harsh environment of the pipe break under consideration. Therefore the response to IE Bulletin 79-01B involved 1) a definition of the accident 2) a determination of equipment required to mitigate the accident, 3) a determination of equipment required to monitor recovery from the accident, 4) definition of the resultant environmental conditions and plant area(s) involved and 5) location of the equipment identified in steps (2), (3) and (4). Sources utilized for the above determinations included the FSAR, Technical Specifications, Emergency Operating Procedures, Piping Instrumentation Drawings, Electrical Equipment Lists, Valve Lists,

1.2 (Continued)

Cable and Conduit Lists, the previous response to 79-01, and onsite surveys.

1.3 Systems Analysis Approach

Table 1-1 is a list of the systems reviewed to determine whether any components within those systems were exposed to the accident environment and were required for accident mitigation (AM) or post-accident monitoring (PAM).

This approach ensured that all components exposed to the accident environment were considered for evaluation, even if such equipment had not been previously identified as safety-related, or Class 1E, or defined as an engineered safety feature. Conversely, this approach also identified systems which, although required for AM or PAM, are located in a plant area remote from the accident environment, and which are not subject to a harsh environment.

Using the systems analysis approach, systems were identified as serving an AM or PAM function. These systems were then investigated to determine what, if any, components were exposed to the accident environment; this investigation was done on a "loop" basis; that is the electrical loop from the accident area boundaries to the affected device was traced and each component evaluated. For example, if the Safety Injection System is actuated for a DBA-LOCA by a pressure transmitter inside containment, the entire electrical loop is evaluated, from the containment electrical penetration assembly via cables, splices, switches etc to the transmitter, for qualification to the DBA-LOCA environment inside containment. On the other hand a Component Cooling Water System pressure differential transmitter which is used to monitor CCW flow to the containment fan coolers, but which is located in the RAB in an area unaffected by the DBA-LOCA conditions (eg, unaffected by shine from piping recirculating radioactive sump fluid) need not be evaluated further. Similarly, equipment inside the Control Room, Electrical Equipment Rooms, and other plant areas unaffected by the accident under consideration, which sees an ambient environment is not evaluated further. Note that FP&L is evaluating, as a separate item under Phase II of the response to IE Bulletin 79-01B, the effects of radiation on equipment against the guidelines provided in Enclosure 4 of the Bulletin.

During the course of this review, using the sources described in Subsection 1.2 it was determined that some equipment, for example the reactor coolant pumps, did not serve as an accident mitigator or monitor, but instead were used in "best estimate" accident scenarios for operator convenience. Where it was determined that the operation of such equipment was not relied upon to mitigate the environmental

1.3 (Continued)

effects of the accident, or where such equipment was not the primary means to achieve safe shutdown, further evaluation was not performed. The Emergency Operating Procedures generally are based on a "best estimate" or realistic accident scenario and thus call out more equipment for operator use than is assumed available in the traditional DBA scenario. Since the DBA results in a worst-case accident environment, it governed the choice of AM and PAM equipment.

TABLE 1-1
ENVIRONMENTAL REQUIREMENTS
ST LUCIE UNIT 1
SYSTEMS ANALYSED

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM
SAFETY INJECTION SYSTEM
CONTAINMENT COOLING SYSTEM
IODINE REMOVAL SYSTEM
CONTAINMENT SPRAY SYSTEM
HYDROGEN CONTROL SYSTEM
RADIATION MONITORING SYSTEM
ECCS AREA VENTILATION SYSTEM
CONTAINMENT PURGE SYSTEM
CONTAINMENT VACUUM RELIEF SYSTEM
SHIELD BUILDING VENTILATION SYSTEM
CONTROL ROOM AIR CONDITIONING SYSTEM
AUXILIARY FEEDWATER SYSTEM
BATTERY ROOM VENTILATION SYSTEM
ELECTRICAL EQUIPMENT ROOM VENTILATION SYSTEM
EMERGENCY DIESEL GENERATOR SYSTEM
SHUTDOWN COOLING SYSTEM
COMPONENT COOLING WATER SYSTEM
CHEMICAL VOLUME CONTROL SYSTEM
COOLING WATER SYSTEM
MAIN STEAM SYSTEM
MAIN FEEDWATER SYSTEM
WASTE MANAGEMENT SYSTEM
SAMPLING SYSTEM
ELECTRICAL EQUIPMENT
MISCELLANEOUS PENETRATIONS
REACTOR COOLANT SYSTEM
INSTRUMENT AIR SYSTEM

2.0 POST-ACCIDENT ENVIRONMENT

2.1 Post-LOCA Environmental Conditions

The plant environmental service conditions within the containment are classified in the following environmental design categories described in FSAR Section 3.11.1:

I-A Long term containment environment following LOCA or steam line break accident (up to one year).

I-B Short term containment environment following LOCA or steam line break accident (up to 15 minutes, or for certain ECCS components, up to initiation of recirculation).

The environmental conditions of temperature, pressure, humidity, and radiation for each of these two categories are presented in Table 3.11-1 of the FSAR and are repeated in Tables 2-1 and 2-2 herein. These Tables are presented as Attachment I to the Component Evaluation Sheets in Section 4.0.

The category I-A and I-B environmental conditions completely envelope the worst case loss of coolant accident (LOCA) considered in the FSAR. This worst case LOCA is a double ended slot rupture at the suction of the reactor coolant pump in the cold leg (9.82 ft^2 break area). This results in the highest peak containment pressure (38.4 psig) and coincident temperature (259°F). The postulated accident pressure and temperature time history curves are presented in Figures 6.2-1A and 6.2-1C of the FSAR and are included in Figures 2-1 and 2-2 of this Section respectively.

The containment radiation environment is based on a LOCA fission product release source consisting of 50 percent of the core halogen inventory, 100 percent of core inventory and 1 percent core solid fission product inventory.

In addition to the temperature, pressure, humidity, and radiation environments described in the above categories, the electrical equipment within the containment will be exposed to a chemical environment. The pH of the containment spray is maintained between about 8.5 and 10.5 during both injection and recirculation by the addition of sodium hydroxide. This chemical spray environment will exist for only a limited period following which the equipment in question will begin to dry.

2.2 Main Steam Line Break Environmental Conditions

The worst case MSLB accident occurs at 105% power with a 5.355 ft^2 break area. The postulated accident pressure and temperature time history curves are presented in Figures 6.2-14 and 6.2-12 of the FSAR and are included in Figure 2-3 and 2-4 of this section respectively. The same Figures are given as Attachment II to the Component Evaluation Sheets in Section 4.0.

The containment atmospheric temperature only exceeds that of categories I-A and I-B (see Tables 2-1 and 2-2) for the worst case main steam line break (MSLB) accident for approximately 40 seconds. This temperature (290°F) has not been used as a basis for environmental qualification of electrical equipment due to the extremely short time of the transient as discussed in the FSAR at Subsection 6.2.1.3.

2.3 High Energy Line Break Outside Containment - Environmental Conditions

A line is considered a high energy line if the service temperature is greater than 200°F or if the design pressure is greater than 275 psig; piping which is pressurized only during testing (eg, miniflow lines) is not considered high energy.

In general a high energy line break (HELB) outside containment does not result in jeopardizing the capability to maintain the plant in a safe condition, nor does an HELB outside containment seriously impair the capability to reach safe shutdown. For example, a break in an auxiliary steam line, or in a steam generator blowdown line, is immediately self-isolating and plant operation is unhindered; thus "accident mitigation" consists of line isolation only and "post-accident monitoring" is limited to ensuring that the line remains isolated until repairs are effected. It should be noted also that the "systems analysis" approach is, appropriately so, a functional review such that the question of whether there should be IE equipment on non-safety class lines is moot; the review was conducted to ensure that an AM or PAM function exists and that the equipment required for that function is qualified for the appropriate environment. FSAR Appendices 3C and 3D present a discussion of high energy line breaks (HELB) outside containment. The following HELB (and corresponding design conditions) were considered therein and were the basis for the review in this report of HELB outside containment:

a) Main steam lines (885 psig, 520°F)
b) Main feedwater lines (1050 psig, 440°F)
c) Shutdown Cooling System (450 psig, 300°F)
d) Steam generator blowdown lines (900 psig; 532°F)
e) Auxiliary steam lines (40 psig, 350°F)
f) Chemical & Volume Control System - letdown (2200 psig, 450°F) and charging (2300 psig, 120°F)

2.3 (Continued)

The shutdown cooling system is exempted from HELB based on the short operational period criterion of MEB 3-1 and in any case is enveloped by a CVCS HELB as discussed below.

In addition to the above HELBs outside containment, the Auxiliary Feedwater (AFW) System (985 psig, 120°F) was reviewed for adverse environmental effects on AM/PAM equipment, during the plant operational modes of startup and shutdown. As regards "accident mitigation" and "post-accident monitoring" in these modes, again effective isolation of the broken line is the paramount concern; following an AFW break the plant would be placed in the shutdown mode if in startup, or continued to shutdown utilizing the redundant AFW pump(s) if the break occurs at the onset of shutdown cooling.

The six systems identified above were reviewed for a postulated high-energy line break outside containment. The postulated accident environment was located on plant general arrangement drawings and AM/PAM equipment was reviewed to determine its inclusion on the Master List (reference Subsections 1.2 and 1.3). Per the discussions in FSAR Appendices 3C and 3D the resultant accident environments are given below:

a) main steam lines (the steam trestle area being the area of concern): up to 320°F for about 95 seconds (ie, MSIS occurs at 485 psig); 14.7 psia since this is an outdoor area; 100% relative humidity (RH) from the escaping steam, only if the break is oriented toward AM/PAM equipment.

b) main feedwater lines (steam trestle area): since the temperature is about 80°F lower this HELB is enveloped by the environmental conditions of item (a) <u>supra</u>; 320°F/95 seconds; 14.7 psia; 100% RH.

c) steam generator blowdown lines (piping penetration area of RAB being the area of concern): this HELB is enveloped by a CVCS letdown line HELB in the same RAB area, item (e) below, since the letdown line is assumed to release coolant at about 600°F; up to 175°F, less than 1 psig; up to 100% RH.

d) auxiliary steam lines (the only safety-related concern is the line 12-AS-1 running outdoors 12 feet from the control room north outside air intake): up to 350°F; 14.7 psia since an outdoor area; up to 100% RH if the HELB is directed toward AM/PAM equipment. Note that the CR ambient temperature rises only about 12°F above ambient conservatively assuming 750 cfm intake of 500°F steam per the FSAR.

2.3 (Continued)

e) CVCS - letdown line (piping penetration area): up to 175°F; less than 1 psig (blowdown is terminated in about 6 seconds); up to 100% RH.

CVCS - charging line (only that portion from the pump discharge is high energy): 120°F; 14.7 psia; up to 100% RH. Note that the charging pumps are of the reciprocating type thus no pressure buildup is postulated.

f) auxiliary feedwater system (lower steam trestle area being the area of concern): up to 120°F; 14.7 psia since an outdoor area; up to 100% RH only if AFW break is directed toward AM/PAM instruments. Note that loss of one of the three trains of AFW does not impair safe shutdown capability and that the AFW System is manually operated and closely monitored.

As indicated in Section 1.0, the harsh environment resulting from each of the three classes of breaks given above (LOCA, MSLB, HELB) was located during the review of systems/equipment required to mitigate that particular accident to determine whether such equipment was exposed to the harsh environment. The review assumed that no single failures occurred and that offsite power was available in order to maximize the kinds and quantities of components subject to review for environmental qualification. Results are presented in Sections 3.0 (Master List) and 4.0 (Component Evaluation Sheets) of this report.

TABLE 2-1
ENVIRONMENTAL REQUIREMENTS
ST LUCIE UNIT 1
LICENSING COMMITMENTS

Category I-A (Long-term)

Time	Temperature (^{o}F)	Pressure (psig)	Humidity (%)	Radiation (R/hr)
0 - 2 hr	270	44	100	2×10^6
2 - 24 hr	240	27	100	1×10^6
1 - 31 day	150	5	100	3×10^3
31 day - 1 yr	130	1	100	10

NOTES:

(1) Integrated Accident Dose (R): 2.8×10^7
40 years of Normal Operation (R): 3.5×10^5
Total Integrated Dose (R) 2.8×10^7

(2) For Main Steam Break Qualification see Section 2.2

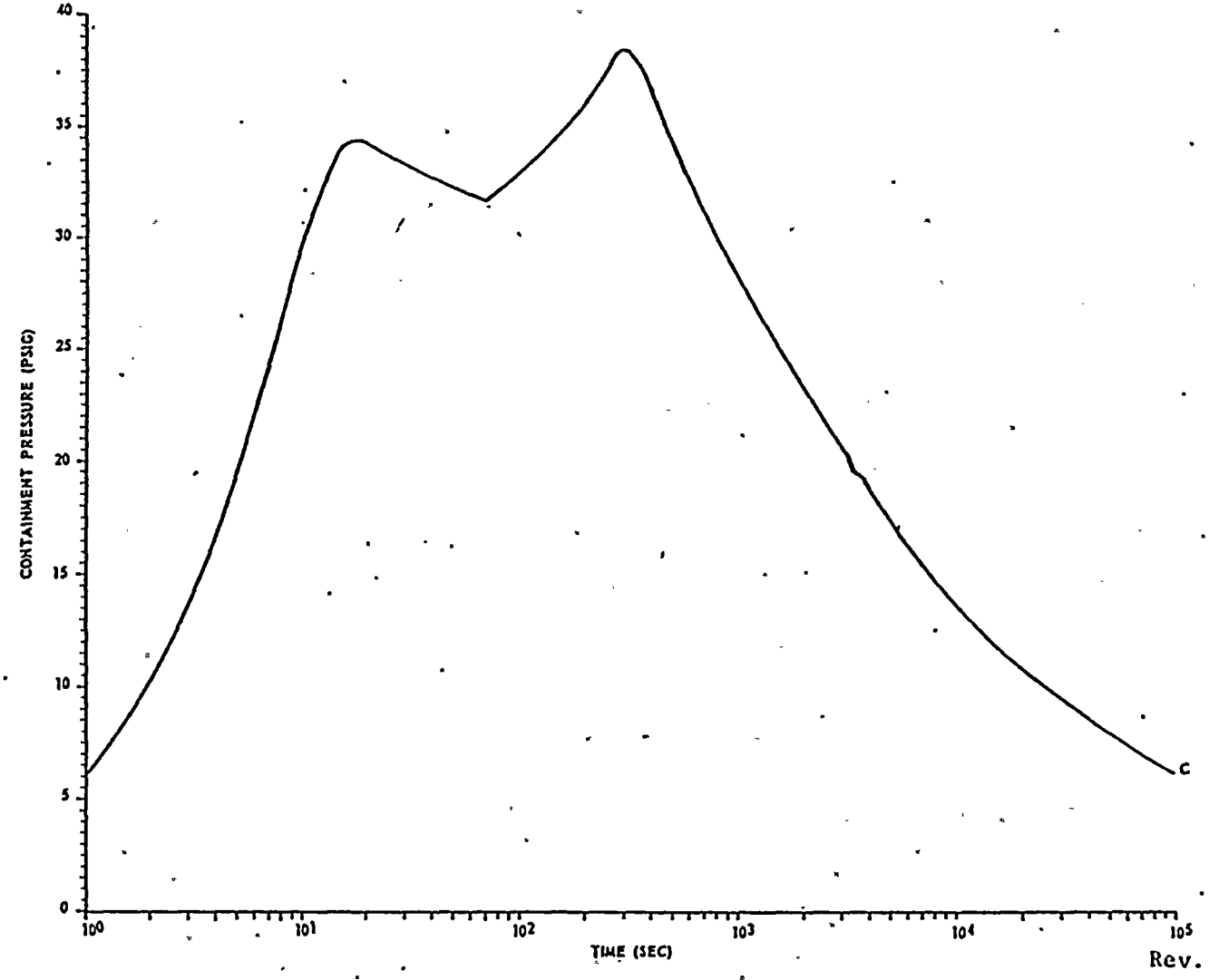
TABLE 2-2
ENVIRONMENTAL REQUIREMENTS
ST LUCIE UNIT 1
LICENSING COMMITMENTS

Category I-A (Short-term)

Time (min.)	Temperature (^{o}F)	Pressure (psig)	Humidity (%)	Radiation (R)
15	270	44	100	7.6×10^5

NOTE:

Integrated Accident Dose (R):	7.6×10^5
40 years of Normal Operation (R):	3.5×10^5
Total Integrated Dose (R)	1.1×10^6



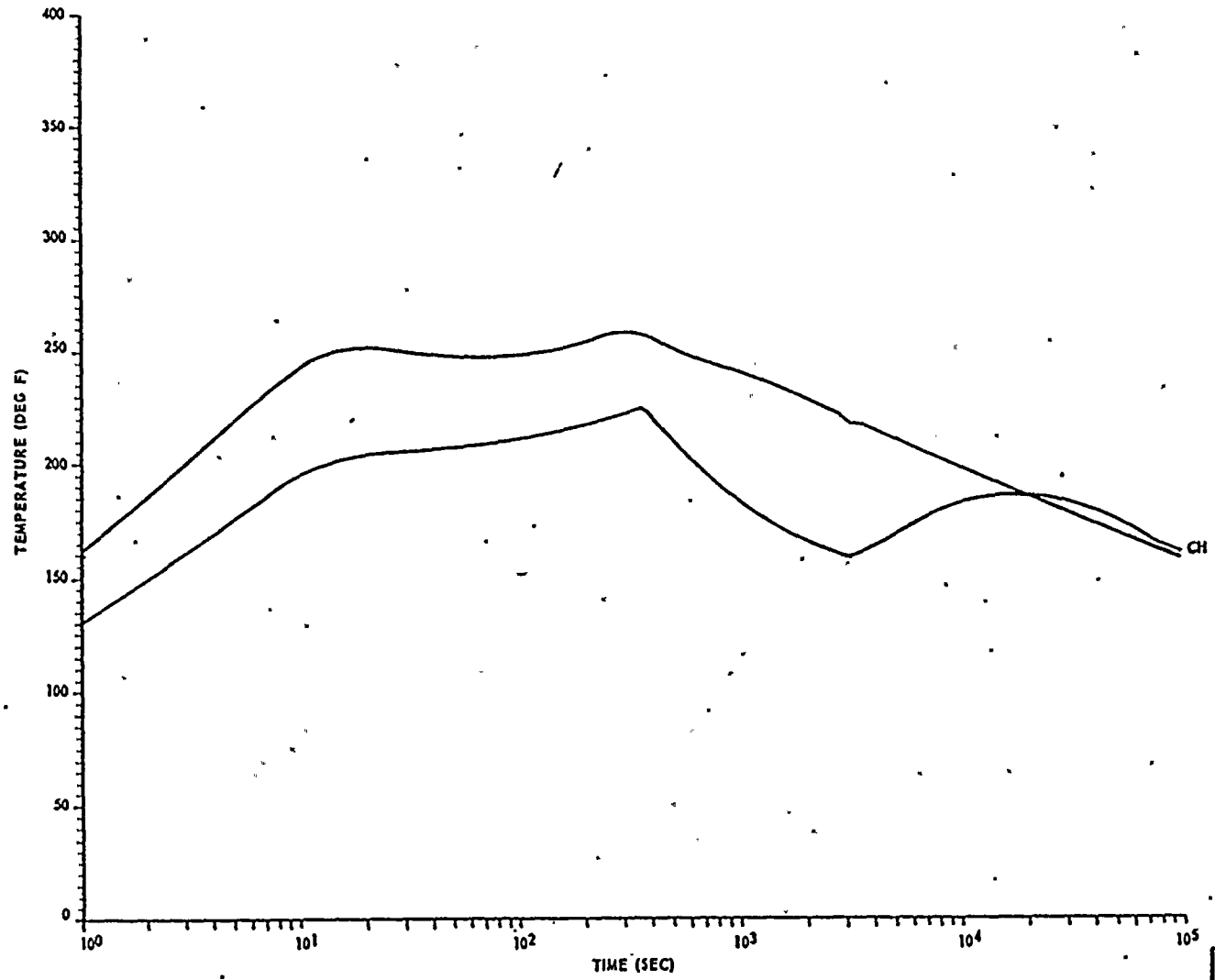
Rev. 32 - 9/6/74

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 1

CONTAINMENT PRESSURE VS. TIME FOR 9.82 FT^2 SLOT BREAK

FIGURE 6.2-1A

Figure 2-1

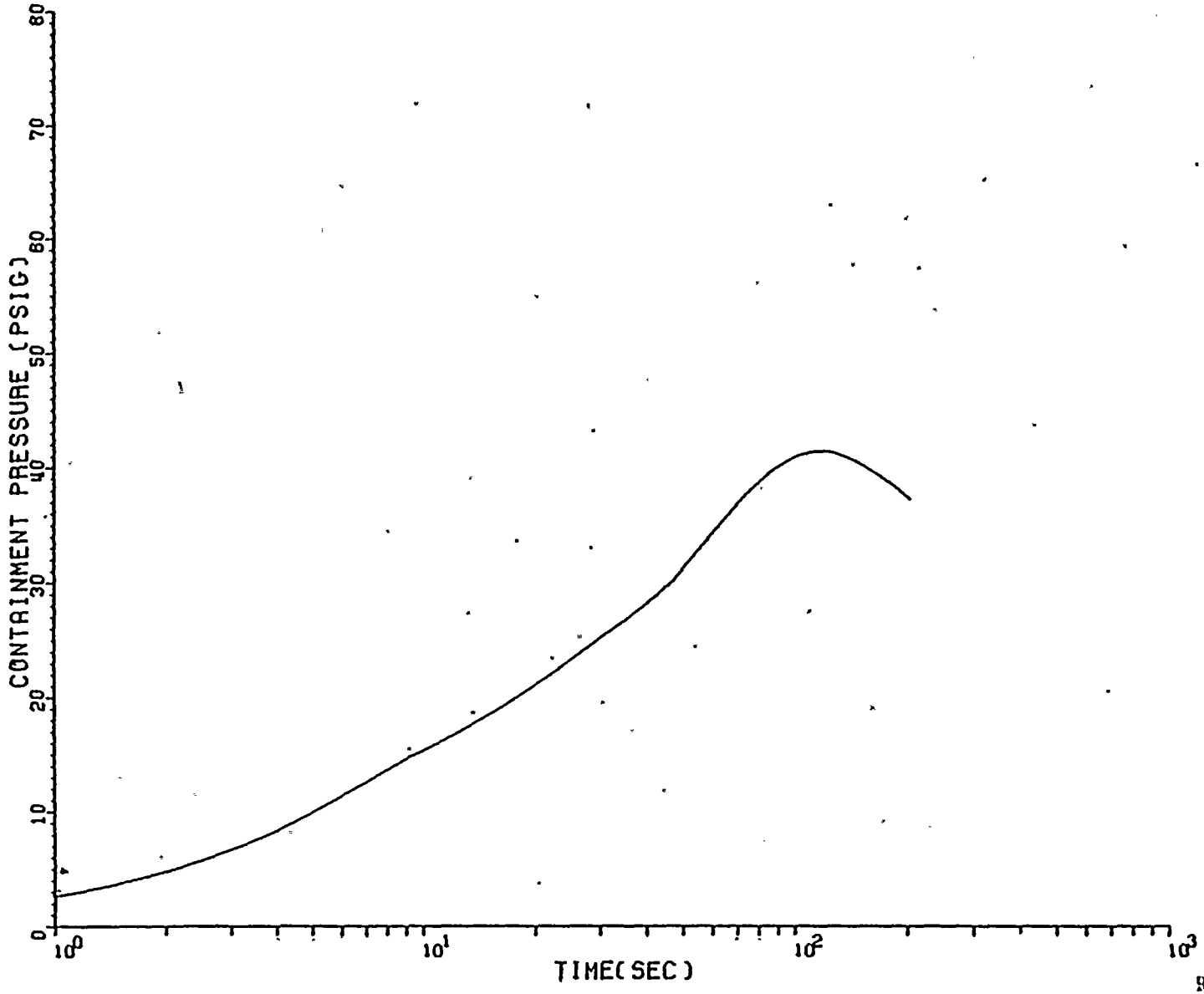


FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 1

CONTAINMENT ATMOSPHERE AND SUMP WATER TEMPERATURES VS. TIME FOR 9.82 FT^2 SLOT BREAK

FIGURE 6.2-1C

Figure 2-2



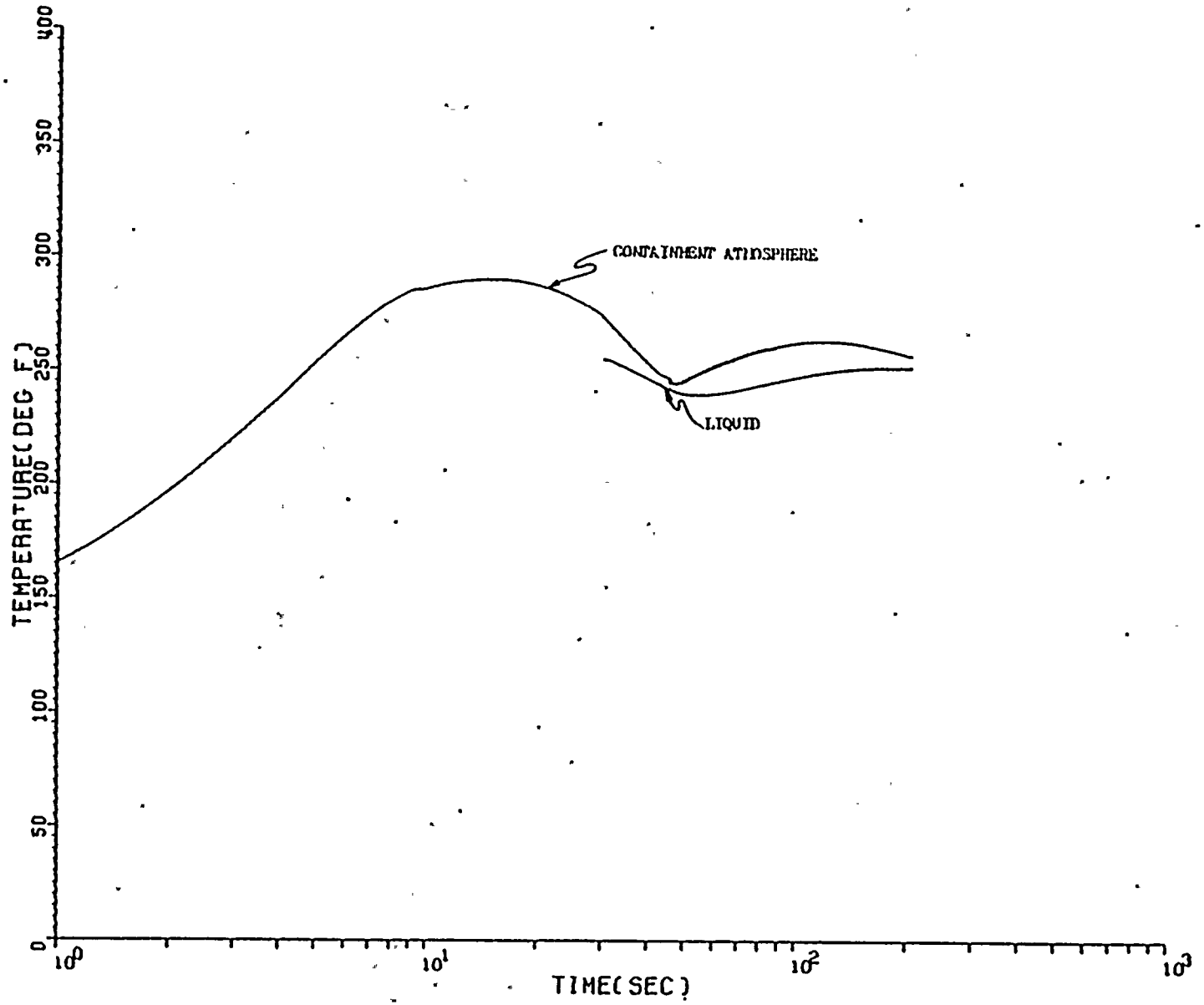
Rev. 32 - 9/6/74

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 1

CONTAINMENT PRESSURE VS. TIME FOR A 105% POWER (2698 MWT) 85% BREAK AREA (5.355 FT²) STEAM LINE BREAK

FIGURE 6.2-14

Figure 2-3



Rev. 32 - 9/6/74

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT UNIT 1

CONTAINMENT ATMOSPHERE AND LIQUID TEMPERATURES VS. TIME FOR A 105% POWER (2698 MWT) 85% BREAK AREA (5.355 FT^2) STEAMLINE BREAK

FIGURE 6.2-12

Figure 2-4

3.0 MASTER LIST

Per Action Item 1 of IE Bulletin 79-01B equipment and components were identified, using the Systems Analysis methodology described in Section 1.0, as required to mitigate (AM) or to monitor (PAM) the course of an accident. Based on the harsh environment resulting from each accident, as described in Section 2.0, equipment required for AM/PAM and exposed to the harsh environment was entered on the Master List of systems/equipment which is appended hereto. The Master List follows the general format of Enclosure 2 of IE Bulletin 79-01B.

AM/PAM equipment inside containment required for a DBA-LOCA, or a DBA-MSLB inside containment, is included on the Master List. In addition AM/PAM equipment inside containment required for an HELB outside containment is included on the Master List and is reviewed on the Component Evaluation Sheets (Section 4.0) against the normal 40-year containment environment (eg, integrated radiation exposure; up to 120°F; up to 100% RH). AM/PAM equipment outside containment, required for an HELB outside containment, is entered on the Master List if such equipment is also exposed to the harsh environment of the accident which it mitigates and/or monitors. AM/PAM equipment outside containment which sees an ambient environment is not included on the Master List per the guidance contained in IE Bulletin 79-01B and the Supplement Information thereto. For the purposes of this report and in accordance with the St Lucie Unit 1 FSAR, ambient environment is defined as up to 104°F (120°F inside containment), atmospheric pressure, and relative humidities ranging up to 100 percent.

During the review and evaluation of the Master List the Engineered Safety Features Actuation System (Table 1-1) was identified within the context of specific components within the major system which were actuated by the ESFAS. For example a Reactor Coolant System solenoid valve actuated by a CIS is included in the RCS list and not enumerated separately under a containment isolation "system" since such a system does not exist per se. Similarly the Iodine Removal System components are listed under the Containment Spray System. Refer to the first page of the Master List for identification of the System numbering and the functional components, ie, mechanical, instrumentation, ventilation or electrical. Note that cross-referencing to the Component Evaluation Sheets (Section 4.0) is provided by System/function coding.

4.0 COMPONENT EVALUATION SHEETS

Per Action Items 2 and 3 of IE Bulletin 79-01B each component identified in the Master List (Section 3.0)was evaluated for its required environmental qualification. The Component Evaluation Sheets (CES) appended hereto follow the same format and content as Enclosure 3 to IE Bulletin 79-01B and as such each sheet is self-explanatory. In order to facilitate the NRC review and to eschew obfuscation of the St Lucie Unit 1 submittals thus far, however, the CES information is elucidated below.

Environment Parameters

a) Operating Time: in general the component operating time requirements are given in the FSAR as "long-term" or "short-term"; also refer to Section 2.1 of this report. Per FSAR Sections 3.11, 6.2 and 7.5, the long-term generally refers to a period of time up to one year post-accident, as the time required for post-accident monitoring instrumentation to function. "Short-term" is delineated in the CES (and Attachment I to the CES) as 15 minutes, with the understanding that a majority of instruments actuated by ESFAS are required to function for only the first few seconds following an accident and are then not relied upon further. For example, a pressure transmitter will send a high-containment-pressure (5 psig) signal for CIS on or before about 0.8 seconds (refer to Figure 2-1 supra) and thence have served its function. Engineering judgement is used in some cases to infer required operating time and this is so noted on the CES by a footnote.

b) Temperature: given as the ultimate temperature peak reached in the specified operating time or as a function of time per Attachments I and II. Engineering judgement is used in some instances to infer resultant operating temperature and is so noted on the CES. Also see Section 2.2.

c) Pressure: similar to temperature, is given as the peak expected or as Attachment I or II to the CES. Engineering judgement is noted if used.

d) Relative Humidity: 100 percent is generally given as the ultimate expected even though this value may not be attained during the course of some accidents, notably HELB in an outdoor area separated many feet from AM/PAM equipment. Note that up to 100 percent RH is defined as an ambient condition because of the semi-tropical environment of St Lucie Unit 1.

4.0 (Continued)

e) Chemical spray: St Lucie Unit 1 utilizes a sodium hydroxide additive to the containment spray system as an iodine removal agent; the Iodine Removal System is discussed in FSAR Subsection 6.2.6. The pH of the containment spray at the spray nozzle is maintained between 10.0 - 10.5 and the equilibrium pH of the sump is greater than or equal to 8.5. Thus a range of chemistry pH of 8.5 - 10.5 is indicated in the CES. A range of ppm boron is also indicated which depends on the amount of boric acid present in the RCS and injected from the Refueling Water Storage Tank.

f) Radiation: For a DBA-LOCA the radiation exposure is given by Attachment I, which is based on a LOCA release as described in Section 2.1 above. AM/PAM equipment inside containment is thus enveloped by the LOCA source term. For equipment outside containment the dose rate maps contained in FSAR Section 12.1 were used in conjunction with engineering analysis/judgement to infer equipment radiation exposure. In the ECCS area values of up to 10^7 rads were used per FSAR Subsection 6.3.3.3. Note that FP&L will address the subject of post-LOCA radiation effects upon submittal of the Phase II report two months hence.

g) Aging: FP&L will address aging bases and criteria at the Phase II report submittal. Although "aging" was not a requirement for Class 1E electrical equipment during the operating license review period for St Lucie Unit 1, this parameter is identified as an "open item" in the CES for the majority of the equipment reviewed.

h) Submergence: Per 1E Bulletin 79-01B and the Supplement Information thereto, submergence is a criterion for AM/PAM equipment inside containment only.

Environment Specification is given as the FSAR requirement for all parameters; if inferred from FSAR data (eg, operating time requirements) this fact is so noted on the CES.

Environment Qualification is test report data as indicated in the Documentation Reference column; if engineering judgement/analysis as to FSAR equivalency is in process this fact is noted on the CES. Where environmental qualification specifics were not available a letter to the vendor has been issued and noted on the CES. FP&L is attempting to obtain responses to these letters within the next 60 days. Information derived from the Electric Power Research Institute (EPRI) compendium of qualification data from 27 power plants is so identified.

4.0 (Continued)

Documentation Reference - Specification is the FSAR Section or Subsection wherein the environmental parameters are set forth. If such parameters are inferred by engineering judgement this is noted on the CES.

Documentation Reference - Qualification delineates the test result parameters; if engineering judgement was used this is so noted, and if analyses as to equivalency are ongoing this fact appears as a footnote on the CES. Information derived from the EPRI data is identified as such and efforts are presently underway to obtain the actual test report(s).

Qualification Method is indicated as the vendor's simultaneous or sequential test and/or engineering analysis; if ongoing engineering analyses are being performed by FP&L or our architect-engineer or NSSS vendor this is so noted on the CES.

Outstanding Items are indicated in this column where additional information (eg, vendor test reports, EPRI-listed test reports) is presently being pursued, where engineering analyses are under way, where additional information is being developed and/or where a parameter will be addressed during the Phase II report.

Note that FP&L will address all open items identified as such in this report, in the Phase II report to be submitted within two month. During this interval additional clarification on items such as operating time, radiation environment etc will be developed and presented in the Phase II report, and the status of expediting vendor replies to the CES open items will be given.

A "none" in the Outstanding Items column indicates that either 1) the qualification test data meet the environmental parameter required by the St Lucie Unit 1 FSAR or 2) the parameter is not construed as a "harsh" environment; or 3) the parameter is not applicable. Thus a "none" indicates no further action is required.