REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8006180493 DOC.DATE: 80/06/12 NOTARIZED: NO DOCKET #
FACIL:50-261 H. B. Robinson Plant, Unit 2, Carolina Power and Ligh 05000261
AUTH.NAME AUTHOR AFFILIATION
UTLEY,E.E. Carolina Power & Light Co.
RECIP.NAME RECIPIENT AFFILIATION
VARGA,S. Operating Reactors Branch 1

SUBJECT: Forwards addl info to util 800318 ltr re facility fire protection.Addl info includes insulation of pipes, containment general area,reactor coolant pump bay area, electrical cable penetrations & fire water pipe rupture.

DISTRIBUTION CODE: A006S COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 37
TITLE: Fire Protection Information (After Issuance of OP. Lic.)

NOTES:

| | RECIPIENT ID CODE/NAME | | COPIES LTTR | COPIES ENCL | RECIPIENT ID CODE/NAME | | COPIES LTTR | COPIES ENCL |
|---|---|---|---|---|---|---|---|---|
| ACTION: | BC VARGA,S. | 05 | 4 | 4 | | | | |
| INTERNAL: | A/D MATL&QUAL | 13 | 1 | 0 | CHEM ENG BR | 12 | 1 | 1 |
| | I&E | 09 | 2 | 2 | NRC PDR | 02 | 1 | 1 |
| | OELD | | 1 | 0 | OR ASSESS BR | 14 | 1 | 1 |
| | REG FILE | 01 | 1 | 1 | WAMBACH,T. | 11 | 1 | 1 |
| EXTERNAL: | ACRS | 22 | 16 | 16 | LPDR | 03 | 1 | 1 |
| | NSIC | 04 | 1 | 1 | | | | |

JUN 19 1980

JUN 19 1980

TOTAL NUMBER OF COPIES REQUIRED: LTTR 31 ENCL 29

**CP&L**

**Carolina Power & Light Company**

June 12, 1980

File: NG-3514(R) Serial No.: NO-80-896

Office of Nuclear Reactor Regulation
Attention: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
United States Nuclear Regulatory Commission
Washington, D. C. 20555

H. B. ROBINSON STEAM ELECTRIC PLANT UNIT NO. 2
DOCKET NO. 50-261
LICENSE NO. DPR-23
FIRE PROTECTION PROGRAM

Dear Mr. Varga:

On March 18, 1980, Carolina Power & Light Company (CP&L) responded to NRC's letter of February 21, 1980 and provided information concerning fire protection at H. B. Robinson Unit No. 2. As committed to in that response, additional information is enclosed with this submittal with regard to the following items:

| | |
|---|---|
| Item 3.1.17 | Insulation of Pipes |
| Item 3.2.4 | Containment General Area |
| Item 3.1.21 | Reactor Coolant Pump (RCP) Bay Area |
| Item 3.1.24 | Electrical Cable Penetrations |
| Item 3.2.5 | Containment Penetration Areas (Inside Containment) |
| Item 3.2.7 | Fire Water Pipe Rupture |

If you have any questions on these items please contact our staff.

Yours very truly,

M. A. McDuffie
for E. E. Utley
Executive Vice President
Power Supply and
Engineering & Construction

JJS/jc (970-121)
Enclosure

cc: Mr. J. D. Neighbors (NRC)

A006
S
1/1

411 Fayetteville Street • P. O. Box 1551 • Raleigh, N. C. 27602

8006180493

3.1.17 Insulation of Pipes

Attached are calculations upon which the amount of insulation on the Diesel Generator Service Waterline is based.

Thermo-12, the insulation used in this application, is a hydrous calcium silicate. It is listed by the manufacturer, Johns-Manville for 1500°F, but some shrinkage occurs above 1200°F as shown in the calculations. The maximum shrinkage expected at the calculated temperature was confirmed with the manufacturer and that value used in the calculations.

The calculations assume that other than shrinkage, the other thermal properties remain the same. This is a conservative assumption since there is evidence that the thermal properties of this type of insulation actually improve as it starts to decompose. This is true because damage to the insulation at higher temperatures involves endothermic loss of bound water of hydration. Much of the imposed heat is removed by the dehydration reaction, and the brittle residue which is left is a better barrier to heat transmission than before. After the fire is over, the insulation has been sacrificed and has to be replaced, but it has accomplished its purpose of providing the required fire protection.

CLIENT: CAROLINA POWER & LIGHT ~ H.B. ROBINSON - 2

CALC. NO.: 5137-M-310 REV. 1

SUBJECT: INSULATION THICKNESS FOR SERVICE WATER IN DIESEL GEN. ROOM

**PROBLEM:**

TO ESTIMATE THE AMOUNT OF INSULATION REQUIRED TO PROTECT THE SERVICE WATER PIPING SO THAT THE WATER TEMPERATURE WILL NOT EXCEED 100°F DURING A FIRE IN THE DIESEL GENERATOR ROOM

AUDIT REMARKS:

CHECKER'S REMARKS: THIS CALC SUPERSEDES CALC 5137-M-310 DATED 9/15/78

**APPROACH/ASSUMPTIONS:**

1) CALCULATE THE TOTAL THERMAL RESISTANCE FOR A 6" PIPE INSULATED WITH 3" OF INSULATION.
2) CALCULATE THE HEAT TRANSFER.
3) CALCULATE THE TEMPERATURE RISE IN WATER.
4) IF THE FINAL WATER TEMPERATURE DOES NOT EXCEED 100°F, THEN THE INSULATION THICKNESS IS OK.

AUDIT REMARKS:

CHECKER'S REMARKS:

**SOURCES—DATA/EQUATIONS:**

LISTED ON PAGE 1 OF THE CALCULATION ARE THE REFERENCES AND DATA UPON WHICH THE CALCULATIONS ARE BASED.

AUDIT REMARKS:

CHECKER'S REMARKS:

**CONCLUSIONS:**

RESULTS SHOW THAT THREE INCHES OF JOHNS-MANSVILLE THERMO-12 INSULATION IS MORE THAN SUFFICIENT TO MAINTAIN THE WATER TEMPERATURE TO LESS THAN 100°F

AUDIT REMARKS:

CHECKER'S REMARKS: THERMO-12 WILL SHRINK AT 2000°F, BUT THERE WILL NOT BE AN APPRECIABLE LOSS OF INSULATION NOR WILL THE SERVICE WATER TEMPERATURE INCREASE.

| AUDIT SUMMARY | | | |
|---|---|---|---|
| CHECKS | CORRECTIVE ACTION TAKEN BY | CALCULATED BY: Robert H. Hall (signature) | DATE: 1/18/80 |
| INFRACTIONS | DATE | CHECKED BY: R. H. (signature) | DATE: 1/21/80 |
| | | AUDITED BY | DATE |

FORM #1

NUS CORPORATION



DATE JAN 21, 1980

CLIENT CAROLINA POWER & LIGHT FILE NO. 5137-M-310 REV. 1 BY R.W. FELL

SUBJECT H.B. ROBINSON - DIESEL GEN. RM. S.W. PIPING INSUL. Checked By [illegible]

OBJECTIVE: TO ESTIMATE THE AMOUNT OF INSULATION REQUIRED TO PROTECT THE SERVICE WATER PIPING AGAINST A FIRE IN THE DIESEL GENERATOR ROOM SO THAT THE WATER TEMPERATURE WILL NOT EXCEED 100°F

REFERENCES:


1) FRANK KREITH: "PRINCIPLES OF HEAT TRANSFER", 3RD EDITION, INTEXT EDUCATION PUBLISHERS, NEW YORK, N.Y. 1973

2) ASME STEAM TABLES: "THERMODYNAMIC AND TRANSPORT PROPERTIES OF STEAM COMPRISING TABLES AND CHARTS FOR STEAM AND WATER", 3RD EDITION, THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, NEW YORK, N.Y. 1977

3) JAMES R. WELTY: "ENGINEERING HEAT TRANSFER", JOHN WILEY & SONS, INC., NEW YORK, N.Y. 1974


REFERENCE DWG: NUS DWG 5137-M-2016, 6/28/78

NUS CORPORATION



DATE JAN 21, 1980

CLIENT CAROLINA POWER & LIGHT FILE NO. 5137-M-310 REV. 1 BY R.W. FELL

SUBJECT H.B. ROBINSON - DIESEL GEN. RM. S.W. PIPING INSUL. Checked By [illegible]

DESIGN DATA: (AS TRANSMITTED BY ROBERT W. SPEIDEL)

SERVICE WATER TEMPERATURE, $T_{COLD} = 95°F$

MAXIMUM AMBIENT TEMPERATURE DURING FIRE ............., $T_{HOT} = 2000°F$

SERVICE WATER FLOW RATE:

| | |
|---|---|
| DIESEL GENERATOR | 650 gpm |
| SAFETY INJECTION SYS. | 60 gpm |
| TOTAL | 710 gpm |

SERVICE WATER PIPE SIZE: 6 INCH SCH. 40 & 60 FT. LONG

OD = 6.625 INCH

TH = 0.280 INCH

ID = 6.065 INCH

FLOW AREA = 0.2006 FEET$^2$

CLIENT CAROLINA POWER & LIGHT FILE NO. 5137-M-310 REV. 1 BY R.W. FELL

SUBJECT H.B. ROBINSON-DIESEL GEN. RM. S.W. PIPING INSUL. Checked By [illegible]

ANALYSIS:

PROPERTIES OF WATER (AT 100°F):

SPECIFIC VOLUME ($V_s$) = $0.01613 \frac{FT^3}{lb_m}$

ABSOLUTE VISCOSITY ($\mu$) = $14.23 \times 10^{-6}\ lb_F - \frac{SEC}{FT^2}$

SPECIFIC HEAT ($C_p$) = $0.998 \frac{BTU}{lb_m\,°F}$

THERMAL CONDUCTIVITY ($K$) = $0.3633 \frac{BTU}{hr-°F-FT}$

[ALL PROPERTIES AS SPECIFIED IN REFERENCE 2]

1. CONNECTIVE HEAT TRANSFER COEFFICIENT FOR FLOWING WATER $\bar{h}_i$

1.1 REYNOLDS NUMBER

$$Re = \frac{VD}{V_s \mu} \; ; \; V(FT/SEC) = \frac{Q}{A} \frac{(FT^3/SEC)}{(FT^2)}$$

$$V(FT/SEC) = \frac{710\ GAL/MIN \times \frac{1\ MIN.}{60\ SEC.} \times \frac{1\ FT^3}{7.51\ GAL}}{0.2006\ FT^2} = \frac{1.58\ FT^3/SEC}{0.2006\ FT^2}$$

$$Re = \frac{\frac{1.58\ FT^3/SEC}{0.2006\ FT^2} \times \frac{6.025\ FT}{12} \times}{0.01613\ FT^3/lb_m \times 14.23 \times 10^{-6}\ lb_F - \frac{SEC}{FT^2} \times \frac{32\ lb_m - FT/SEC^2}{1\ lb_F}}$$

$$Re = 5.41 \times 10^5 \text{ (MEANS TURBULENT FLOW)}$$

CLIENT CAROLINA POWER & LIGHT FILE NO. 5137-M-310 REV. 1 BY R.W. FELL

SUBJECT H.B. ROBINSON - DIESEL GEN. RM. S.W. PIPING INSUL. Checked By [illegible]

1.2 PRANDTL NUMBER, Pr

$$Pr = \frac{C_p \mu}{K}$$

$$= \frac{0.998 \frac{BTU}{lb_m {}^\circ F} \times 14.23 \times 10^{-6} \, lb_F - \frac{SEC}{FT^2} \times \frac{32.2 \, lb_m - FT/SEC^2}{lb_F}}{0.3633 \frac{BTU}{hr - {}^\circ F - FT} \times \frac{1 \, hr}{3600 \, SEC}}$$

$$= 4.50$$

1.3 NUSSELT NUMBER / CONNECTIVE HEAT TRANSFER COEFFICIENT.

FOR TURBULENT FLOW THROUGH A HEATED PIPE THE DITTUS-BOELTER EQUATION IS USED PROVIDED THE FOLLOWING CONDITIONS ARE SATISFIED:

$Re > 10^4$ (SATISFIED)

$0.7 < Pr < 100$ (SATISFIED)

$\frac{L}{D} > 60$

$$\frac{L}{D} = \frac{60 \, FT}{\frac{6.065}{12}} = 118.7 > 60$$

$$Nu = \frac{\overline{h_i} D}{K} = 0.023 \, Re^{0.8} \, Pr^{0.4}$$

(DITTUS - BOELTER EQUATION)

$$Nu = \frac{\overline{h_i} D}{K} = 0.023(5.41 \times 10^5)^{0.8} (4.50)^{0.4}$$

$$= 1620$$

$$\overline{h_i} = \frac{1620 \times 0.3633 \frac{BTU}{hr\text{-}°F\text{-}FT}}{\frac{6.025}{12} FT} = 1172 \frac{BTU}{hr\text{-}FT^2\text{-}°F}$$

2. HEAT TRANSFER COEFFICIENT AT OUTER SURFACE, $h_o$.

BECAUSE THE OUTSIDE TEMPERTURE IS VERY HIGH, $T_o = 2000°F$, THE CONVECTIVE HEAT TRANSFER COEFFICIENT FOR HIGH TEMPERATURE AIR FLOWING AROUND A PIPE CAN BE ON THE ORDER OF 15 TO 20 $\frac{BTU}{hr\text{-}FT^2\text{-}°F}$ (BASED ON BOILER TUBE DESIGN INFORMATION).

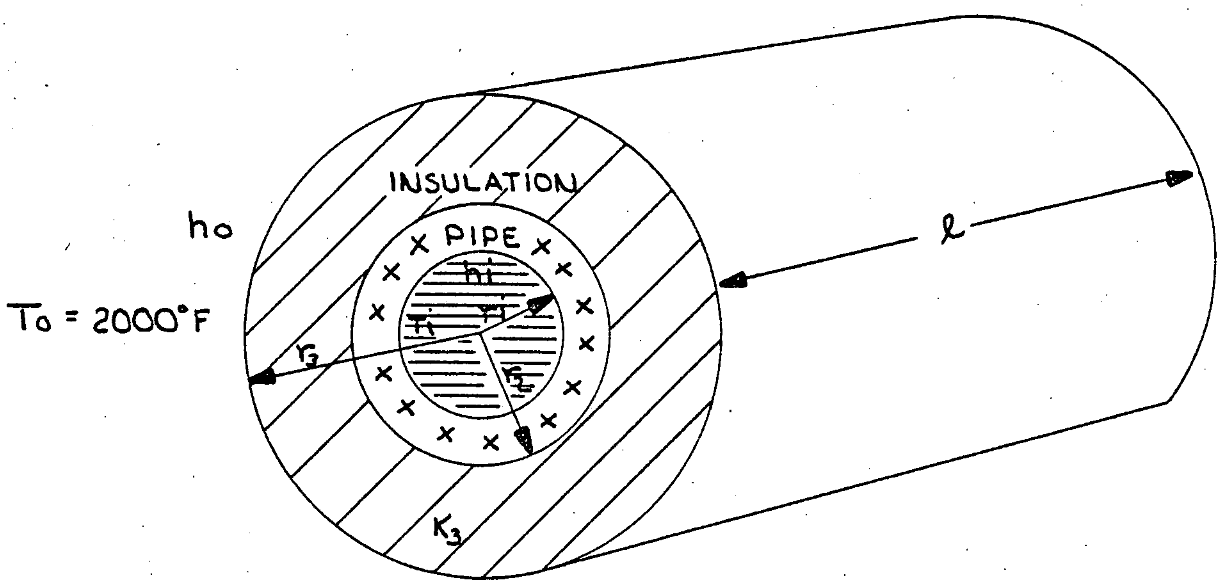
BECAUSE THE VELOCITIES AROUND THE PIPE ARE EXPECTED TO BE LOW, IT IS ASSUMED THAT THE OUTSIDE CONVECTIVE HEAT TRANSFER COEFFICIENT WILL BE :

$$h_o \approx 15 \frac{BTU}{hr\text{-}FT^2\text{-}°F}$$

CLIENT CAROLINA POWER & LIGHT FILE NO. 5137-M-310 REV. 1 BY R.W.FELL

SUBJECT H.B. ROBINSON - DIESEL GEN. RM. S.W. PIPING INSUL. Checked By [illegible]

3. CALCULATION OF INSULATION THICKNESS TO KEEP WATER LESS THAN 100°F




3.1 OVERALL HEAT TRANSFER COEFFICIENT, $U$.

$$U = \frac{1}{\Sigma R}$$

$$\Sigma R = \frac{1}{2\pi r_3 \ell h_o} + \frac{\ln \frac{R_3}{R_2}}{2\pi K_3 \ell} + \frac{\ln \frac{R_2}{R_1}}{2\pi K_2 \ell} + \frac{1}{2\pi r_1 \ell h_i}$$

CLIENT CAROLINA POWER & LIGHT FILE NO. 5137-M-310 REV. 1 BY R.W. FELL

SUBJECT H.B. ROBINSON ~ DIESEL GEN. RM. S.W. PIPING INSUL. Checked By [illegible]

PIPE

THE LENGTH OF THE PIPE, $\ell$, IS GIVEN AS 60 FEET.

$K_2$ FOR STEEL FROM REFERENCE (1) IS APPROXIMATELY $25 \frac{BTU}{hr\text{-}FT\text{-}°F}$

INSULATION

AN INSULATING MATERIAL CONSIDERED FOR USE IS JOHNS-MANVILLE THERMO-12 HIGH TEMPERATURE HYDROUS CALCIUM SILICATE PIPE INSULATION. THE MANUFACTURERS CHARACTERISTICS ARE LISTED AS FOLLOWS:

| TEMPERATURE | $k \frac{BTU}{hr\text{-}FT\text{-}°F}$ |
|---|---|
| 100°F | .0317 |
| 500°F | .0433 |
| 700°F | .0517 |
| 229°F - 1500°F | $K_{AVE} = .0616 \frac{BTU}{hr\text{-}FT\text{-}°F}$ FOR CIRCULAR 2" THICK INSULATION |

THE K VALUE OF $0.0616 \frac{BTU}{hr\text{-}FT\text{-}°F}$ WILL BE USED FOR THIS INSULATION

DATE JAN. 21, 1980

CLIENT CAROLINA POWER & LIGHT FILE NO. 5137-M-310 REV. 1 BY R.W. FELL

SUBJECT H.B. ROBINSON - DIESEL GEN. RM. S.W. PIPING INSUL. Checked By [illegible]

ASSUME TWO LAYERS OF INSULATION EACH 1½" THICK.
THEREFORE:

$$r_3 = 3.312 + 3 = 6.312 \text{ INCHES}$$

$$r_2 = 3.312 \text{ INCHES}$$

$$r_1 = 3.032 \text{ INCHES}$$

$$\Sigma R = \frac{1}{2\pi\left(\frac{6.312}{12}\right) \times 60 \times 15} + \frac{\ln\frac{6.312}{3.312}}{2\pi(.0616)(60)} + \frac{\ln\frac{3.312}{3.032}}{2\pi(25)(60)} +$$

$$+ \frac{1}{2\pi\left(\frac{3.032}{12}\right)(60)(1172)}$$

$$\Sigma R = 0.000336 + .0278 + 9.37 \times 10^{-6} + 8.96 \times 10^{-6}$$

$$\Sigma R = 0.02815$$

$$U = \frac{1}{\Sigma R} = 35.5 \frac{\text{BTU}}{\text{hr-}^\circ\text{F}}$$

$$Q = U \Delta T$$

$$T_o = 2000^\circ F$$

ASSUME $\overline{T_i} = 95^\circ F$

$$Q = 35.5 \frac{\text{BTU}}{\text{hr-}^\circ\text{F}} \times (2000 - 95)^\circ F = 6.76 \times 10^4 \frac{\text{BTU}}{\text{hr}}$$

CLIENT CAROLINA POWER & LIGHT FILE NO. 5137-M-310 REV. 1 BY R.W. FELL

SUBJECT H.B. ROBINSON-DIESEL GEN. RM. S.W. PIPING INSUL. Checked By [initials]

RISE IN COOLANT WATER TEMPERATURE

$$\dot{Q} = \dot{m}\, C_p\, \Delta T_{WATER}$$

$$T_{WATER\ OUT} = \frac{\dot{Q}}{\dot{m} C_p} + T_{WATER\ IN}$$

$$= \frac{6.76 \times 10^4 \frac{BTU}{hr}}{710\ GAL/MIN \times \frac{60m}{hr} \times \frac{8.31\ lb}{GAL} \times \frac{9.98\ BTU}{lb_m\ ^\circ F}} + 95^\circ F$$

$$T_{WATER\ OUT} = .191^\circ F + 95^\circ F = 95.19^\circ F$$

THIS IS LESS THAN 100°F

NOTE:

THERMO-12 IS LISTED AT TEMPERATURES TO 1500°F BUT AT 1200°F AND UP SHRINKAGE OCCURS. PER TELECON @ J-M, MAXIMUM SHRINKAGE OF 20% WILL OCCUR AT 2000°F. IF THE OUTER LAYER SHRINKS 20%, THE OVERALL SHRINKAGE = 10%, AND $R_3 = 0.0278 \times (1.-.1) = 0.02502$ BTU/hr °F. ER = 0.0253, AND U WILL EQUAL 39.41 INSTEAD OF 35.5.

$$Q = 39.41 \times (2000-95) = 75076\ BTU/hr$$

$$T_{WATER\ OUT} = \frac{75076}{710\ GPM \times 500} + 95 = 95.21^\circ F$$

$$\text{SURFACE TEMPERATURE OF INNER LAYER OF INSUL.} = \left(\frac{1.0}{0.8}\right) \times \left(\frac{95+2000}{2}\right)$$

$$= 1308^\circ F$$

Items 3.2.4 Containment General Area
3.1.21 Reactor Coolant Pump Bays
3.2.5 Containment Penetration Area

Attached is a description of the fire water systems planned for inside the Containment.

System Description for
Containment Fire Protection System
for H. B. Robinson

## 1. SYSTEM FUNCTION

### 1.1 Description of Function

The Containment Fire Protection System will provide a reliable supply of water to manual hose stations to be used by station personnel and for semi-automatic pre-action deluge systems at the electrical penetration area and at the three reactor coolant pumps. The water supply is from the existing plant fire protection system. The piping, conduit, instruments, controls, and equipment located inside containment will be seismic 1 supported and restrained; however, the systems are not designed or required to function after a seismic event.

## 2. SCOPE OF THE SYSTEM

### 2.1 Water Supply

The water for the Containment Fire Protection system is provided by the existing plant fire protection system which is supplied by two 2500 gpm VS 125 PSI UL/FM Fire Pumps which take their water supply from Lake Robinson. The containment supply piping connects to the existing plant fire protection system near the penetrating piping area of the Reactor Auxiliary Building.

One connection is made near the Sample Area and supplies the Electrical Penetration Deluge System. The other connection is made near the Gas Analyzer Room and supplies the RCP Deluge System and Standpipe System.

### 2.2 Distribution System

The feed main for the Containment Fire Protection System extends to the pipe penetration area and penetrates the containment wall through an existing sleeve, S-18, and continues overhead in containment to supply four standpipes and three pre-action deluge spray systems. The "Electrical Penetration Area" sprinkler system has its related pre-action deluge valve with its electrical and control wiring located outside the containment building. The supply piping for the containment electrical penetration area branches off at the containment fire protection system feed main in the Reactor Auxiliary Building, and drops to the pre-action deluge valve, continuing from the valve where it penetrates the containment wall through sleeve S-18 and continues overhead to the containment electrical penetration area sprinkler system.

#### 2.2.1 Containment Isolation

The containment feed main and the containment electrical penetration sprinkler supply piping each has two (2) motor operated containment isolation valves in series in the pipe lines prior to entering the containment building, each capable of automatic closure or remote manual closure from the control room.

## 3. SYSTEM DESCRIPTION

### 3.1 Hose Stations

Each standpipe supplies two hose stations, one located at elevation 228 feet and one at elevation 251.5 feet. The hose station has a 1-1/2 inch manual control valve with 75 feet of 1-1/2 inch synthetic lined hose stored on a standpipe mounted hose reel. The 1-1/2 inch hose is suitable for station personnel to handle. The nozzle is approved for use on energized electrical equipment. The system is designed to provide a hose coverage to all parts of the two floors, elevations 228 and 251.5 (to be reached with 75 feet of hose and 30 feet of spray).

#### 3.1.1 Reactor Coolant Pump Pre-action Sprinkler System

CP&L will install a fixed fire suppression system in each reactor coolant pump bay in lieu of the previously proposed lube oil spill collection system. This is consistent with the NRC's position as stated in the draft of Appendix R to 10CFR50 which was reviewed by the ACRS Fire Protection Subcommittee on December 5, 1979.

Each of the three reactor coolant pump bays is protected by a pre-action system which functions as a dry pipe system, employing closed head sprinklers attached to a piping distribution system pressurized with instrument air. The system is designed so that a drop in air pressure will cause an alarm in the control room. In case of fire, heat detectors and flame detectors will confirm the fire, and the control room operator will charge the system with water by remotely activating the deluge valve. The deluge valve may also be locally activated by a manual operator located near the deluge valve in the containment. Flow into the system is confirmed with a pressure switch mounted downstream of the deluge valve. The switch will sense the fire system pressure, thereby confirming flow. Visual display of flow is made with indicating lights in the control room. The dry pressurized piping and the closed heads restrict the discharge of water into the containment in case of the accidental opening of a sprinkler head. The opening of the closed fused heads by heat will be limited to only those heads operating in a fire area, thus concentrating the water flows to the fire area and limiting water damage in the non-fire areas.

The piping and sprinkler heads will be arranged around the reactor coolant pumps to provide directional flows of water in the horizontal and vertical planes to cover the pumps, adjacent reactor coolant piping, and pump bay floor area. The system will provide a minimum of 0.30 gpm of water per square foot of coolant pump surface.

#### 3.1.2 The Electrical Penetration Area Pre-action Sprinkler System

The electrical penetration area in the containment will be protected by a pre-action deluge system which will function as a dry pipe system with closed heads and pressurized with instrument air. The deluge valve and all local activating controls are located outside of containment. The opening of a sprinkler head will cause a drop in air pressure which will

set off an alarm in the control room and in containment. The system deluge valve will be remotely activated by the control room operator upon confirming that a fire exists by observation or by confirming alarm from detectors in the penetration area. A manual deluge valve operator is located at the deluge valve in the Reactor Auxiliary Building near the personnel entry. Only the opened heads will discharge water, thereby concentrating the water in the fire area and limiting the water damage in non-fire areas. Flow into the system is confirmed with a pressure switch mounted downstream at the deluge valve. The switch will sense the fire system pressure thereby confirming flow. Visual display of flow is made with indicating lights in the control room. The piping distribution system is arranged to cover the electrical area providing added heads around obstructions to cover the cable trays, bus ducts, the penetration area wall and floor. The system will provide a minimum of 0.30 gpm of water per square foot to the entire electrical penetration area.

3.1.3 Deluge Valve

Each deluge valve station includes a manual OS&Y gate valve, a deluge valve, a check valve, and auxiliary piping required to operate the valve.

3.2 Supervision of System

All system shut-off valves, excluding the containment isolation valves, are OS&Y gate valves, sealed open, and will be verified during the monthly plant inspections.

3.3 Instruments and Controls

A pressure switch is located downstream of each deluge valve to detect an open sprinkler head. Depressurization of any of these lines will be annunciated in the main control room to indicate a possible fire condition. The normal pressure will be a minimum of 20 psig with all heads closed.

A second pressure switch located downstream of each deluge valve will detect flow to sprinklers. Pressurization of the line to greater than 30 psig will operate this switch.

Each motor operated containment isolation valve will be controlled by a switch located on the RTG board. A containment Isolation Signal will automatically close each valve. Four Status Lights will be located on the existing Containment Isolation Valve Status Light Module to provide the status of each valve.

Each deluge valve will be operated by a solenoid pilot valve. A signal to operate a solenoid pilot valve will be provided by a Containment Fire Protection System Panel mounted control switch. Solenoid integrity will be supervised by means of a status light above the appropriate control switch. Local operation of each deluge valve may be accomplished by means of a manual operator located near the valve.

The instrument air system will be utilized to pressurize the Containment Fire Protection System downstream of each deluge valve. A pressure switch in this system will annunciate low air pressure in the main control room. A pressure reducing station is provided in the line tapping the instrument air in order to reduce the line pressure from 100-120 psig to 14 psig. An entry filter is also provided.

All Main Control Room annunciation and deluge valve control switches required for this system will be incorporated into the new "Containment Fire Protection System Panel" located near the existing Fire Detection Panels FAP "A" and FAP "B".

Pressure gauges are supplied on the instrument air header upstream and downstream at the reducing valve and are also supplied with the deluge valve.

Excess flow check valves are provided in each of the air lines serving the four (4) dry pipe systems. The check valves will serve to limit air pressure drop in any other dry pipe system due to a loss in pressure in the remaining system. By-passes are provided around the valves to allow resetting of the excess flow valve.

## 4. MATERIALS

### 4.1 Standpipe Hose System

The hose stations are conspicuously located and marked. The complete station meets all requirements of NFPA-14 for a Class II hose station. Each station is equipped with a UL pipe mounted, swing reel, a UL 1-1/2 inch manual control valve, 75 feet of 1-1/2 inch ID 100% synthetic double jacket and lined hose, a cast brass adjustable nozzle UL approved for use on energized electrical equipment.

### 4.2 Reactor Coolant Pump Pre-action Sprinkler System

The system is composed of UL listed and/or FM approved equipment including the OS&Y shut-off valve, the solenoid operated deluge valve, the required accessories, pressure alarms, pressure switches, drains, check valves, horizontal side wall sprinkler heads with temperature ranges of 175° and 225°F, 1/2 inch orifice size, instrument air, manifold, low pressure alarm and pressure regulating valve, inspectors test stations, and system drains.

### 4.3 Containment Electrical Penetration Area Pre-action Sprinkler System

The system is composed of all UL listed and/or FM approved equipment including the OS&Y shut-off valve, the solenoid operated deluge valve, the required accessories, pressure alarm, pressure switches, drains, check valves, upright sprinkler heads with temperature ranges at 175° to 225°F, 1/2-inch orifice size, inspectors test stations, and system drains.

### 4.4 Valves

Gate valves, Globe valves, and check valves 3/4 inch to 2 inches shall be carbon steel ASTM-105 for socket weld. Gate valves and check valves 2-1/2 inch to 4 inches shall be carbon steel ASTM-216 WCB for butt weld and flanged connections. Deluge valves shall be gray iron castings ASTM-126, Class B for flanged connections. The pressure regulating angle valve shall be cast brass UL listed and/or FM approved with screwed connections.

### 4.5 Motor Operated Isolation Valves

The motor operated isolation valves will be ASME Section III Class 2 nuclear grade valves, 150 pound pressure class with butt weld ends. Valves shall be seismically qualified and functional after an event.

### 4.6 Piping and Fittings

All piping in the standpipe system, distribution system, and the feed mains with the exception of that portion of the system in the contained "Penetration Area," will be welded seamless carbon steel conforming to ASTM A-106 Grade B. Piping 3/4 inch to 2 inches shall be Schedule 80 with 3000 pound socket weld fittings conforming to ASTM-105 in accordance

with ANSI B16.11. Piping 2-1/2 inch to 4 inches shall be Schedule 40 with seamless carbon steel fittings conforming to ASTM A-234 Grade WPB in accordance with ANSI B16.9. Flanges 3/4 inch to 4 inches shall be carbon steel ASTM A-105 butt weld and socket weld in accordance with ANSI B16.5.

4.7 Pipe and Conduit Supports

Supports are arranged to sustain the dead weight loads and retain the pipe and conduit securely in position during a seismic event.

## 5. TESTING

### 5.1 Containment Standpipe System

The standpipe system will be hydrostatically tested at a minimum pressure of 200 psi for 2 hours.

### 5.2 Containment Pre-action Sprinkler System

The containment pre-action sprinkler systems are hydrostatically tested at a minimum of 200 psi measured at the low point of each individual system. All systems will be tested for flow and response time as required in NFPA-13.

3.1.24 Electrical Cable Penetrations

Based on the information requested in the NRC's letter of February 21, 1980, Carolina Power & Light Company (CP&L) has determined that further testing of electrical cable penetrations will be required. Based on discussions with our consultants and various research laboratories, CP&L is commissioning the required test program and anticipates that the requested information will be available for the NRC's review by November 1, 1980.

ITEM 3.2.7

FIRE WATER PIPE RUPTURE ANALYSIS

3.2.7 Fire Water Pipe Rupture

NRC Position

The fire protection SER, Section 3.2.7, indicates that our evaluation of the effect of rupture of fire water system piping on safety-related system or components has not been completed.

By letter dated April 28, 1978, the licensee contended that fire protection piping inside safety-related areas in H. B. Robinson, Unit 2 facility meets Class I seismic criteria; thus, Paragraph B.3.d of Branch Technical Position APCSB 3-1 is not applicable. Consequently, the licensee provided no analysis for the subject issue.

General Design Criterion 3 in Appendix A to 10 CFR 50 requires, among other things, that firefighting systems be designed to assure that their rupture or inadvertent operation does not impair the capability of safety-related structures, systems, and components. We will require the licensee to provide the results of analyses to demonstrate that fire protection systems in H. B. Robinson facility meet such requirement.

CP&L Response

Containment Building

The fire water piping inside containment is seismically designed. The fire water supply to the Containment Building will be isolated during normal power operation; therefore, rupture or inadvertent operation will not impair the capability of safety-related structures and components inside the building.

Reactor Auxiliary Building

The fire water system piping has been analyzed to determine the effect of a pipe rupture on safety-related equipment. A detailed analysis for inadvertent actuation was not considered necessary for two reasons. First, a double failure (actuation signal from two independent detector trains, in addition to the spurious or accidental opening of one or more sprinkler heads) in the actuation system would be required for an inadvertent actuation to occur; and second, the only safety-related equipment affected would be the service water booster pumps, which are not part of the safe shutdown system. In addition, inadvertent actuation by spurious actuation of the deluge valve would be alarmed in the control room via the flow alarm and total water flow could be limited by operator action. The following description and associated analysis summarize the effects of various postulated fire water system pipe ruptures on safety-related equipment.

The pipe rupture analysis was performed by considering three separate pipe break scenarios in the Auxiliary Building. These scenarios consisted of a 4-inch pipe break in the hallway on elevation 246, a 4-inch pipe break in the pipe tunnel on elevation 226, and a 4-inch pipe break in the hallway near MCC No. 5 on elevation 226. The postulated break locations were selected to typify the areas with water-filled pipe in the Auxiliary Building.

The following scenario descriptions and analyses show that the floor drain system is essential for protection of electrical safety-related equipment on the second floor. The 4-inch break in the hallway on elevation 226 is the more severe accident, since it can damage safety-related equipment by direct water impingement. All other breaks cause equipment damage by flooding and allow time for corrective action to be taken by operators. Figures H and I show the primary and secondary flood areas for pipe ruptures on the 246' and the 226' elevations, respectively.

Scenario I - Four-Inch Pipe Break on Elevation 246

A 4-inch fire protection line passes up through the second level floor at elevation 246 in the main hallway near the ventilation fans. A break of this line at the floor level will result in the largest flow release (1275 gpm) to this floor. Due to the fire pipe location, impingement on safety-related equipment is not possible; therefore, in order to minimize pipe flow resistance and to maximize the flow to the 246' elevation, a floor level break is assumed.

Initial conditions affecting the amount of isolated floor space and availability of floor drains will affect the severity of this accident. The most credible set of initial conditions for the second floor elevations are: all rooms on elevation 246 are isolated by closed doors; all doors leading outside or to the Turbine Building are closed; and the floor drains in the remaining hallways and electrical equipment area are free of obstructions.

The floor drains on this second level perform a very important mitigating function. There are seven 3-inch floor drains in the hallway area served by five 3-inch downcomers to the first floor, and one floor drain served by one downcomer in the 230 KV protective relay area. When the fire protection line breaks releasing 1275 gpm onto the floor in the hallway, these floor drains will direct the water to the floor drain distribution system serving the first floor (elevation 226). The estimated flow through each downcomer serving the hallway area is 228 gpm; and because the elevation of the protective relay area is four feet below the 246 elevation and it is the farthest point from the break, the remainder of the break flow (203 gpm) will be handled by the protective relay area floor drain. Therefore, before any significant flooding can occur on the second level, the inlet pipe break flow rate must exceed 1343 gpm (5 downcomers at 228 gpm each and 1 downcomer at 203 gpm each). Because the estimated second level pipe line break flow rate (1275 gpm) is less than the 1343 gpm floor drain removal rate, significant flood level buildup on the second level is not expected to occur in the safety-related electrical equipment and relay area. However, local flooding will occur in the hallway in the break area and may reach levels of 4 to 6 inches.

As mentioned, the 1275 gpm second level pipe break flow will be carried to the floor drain distribution system serving the first floor (elevation 226). This water will first fill up the 375 gallon sump tank before it backs up through the drains onto most of the first floor. The diesel generator area will not fill up because these floor drains are independent and discharge to the storm drain system and not to the liquid waste floor drain system that serves the balance of the Auxiliary Building. The first floor free area, estimated to be approximately 13,100 square feet, will gradually fill up until the pipe break flow can be terminated. The time and depth of fill relationship of Figure A shows that it will take approximately 25 minutes for the first floor free area to fill to a depth of 4 inches.

Effect

This 4-inch break will cause no damage to safety-related equipment as long as the elevation 246 floor drains are clear and free flowing. If the break is isolated in 25 minutes or less, it should not damage any equipment on elevation 226. If the elevation 246 floor drains are plugged, then the protective relay panels on elevation 242 and the emergency busses E-1 and E-2 on elevation 246 would be endangered by flooding.

Scenario II - Four-Inch Pipe Break in the Elevation 226 Pipe Tunnel

The 4-inch fire line is assumed to break just inside the south end of the pipe tunnel. This break location will result in the highest water flow to the tunnel and it is estimated that 2475 gpm will discharge into the tunnel. The average depth of water on elevation 226 will be a function of time and the number of floor drains available to redistribute the water throughout elevation 226.

Initial conditions for this scenario are assumed to be all rooms isolated by closed doors, the primary flood area is 5550 square feet, and 16 floor drains are available to redistribute the water to the isolated rooms.

This break will initially flood the pipe tunnel and then flow into the main hallway at the waste condensate tanks near MCC No. 5. The average water depth versus time in the primary flood area is shown on Figure B and Figure C, and shows the equilibrium depth on elevation 226 after termination of the water flow from the break.

The worst set of initial circumstances is for all the rooms to be isolated by their closed doors, leaving for the primary flow path the following areas:

- Diesel generator hallway
- Instrument air/station air compressor area
- Pipe tunnel area
- Entrance corridor

This primary flood area is estimated to be approximately 5550 square feet.

There are 16 floor drains in this primary flood area that will help redistribute the water into the balance of the floor area (except for the diesel generator rooms). These isolated areas contain safety injection pumps, containment spray pumps, charging pumps, component cooling pumps, and radioactive waste processing equipment. The flow rate from the 16 drains in the primary flood area into the isolated rooms is estimated to be approximately 512 gpm total.

Once the inlet pipe break flow is terminated, the floor drains will continue to distribute the water into the isolated rooms until all areas are at the same water level.

Effect

The highest water levels from this break will be in the pipe tunnel itself since the flow path out of the tunnel is limited to the hallway and six floor drains. The maximum depth in the tunnel is expected to be 1-1/2 to 2 times the average depth in the 5550 square foot primary flood area. This should not cause any major problem with safety-related equipment

since only pipe, valves, and conduit are located above the floor in this area. Figures D and E show the average water depth versus time and the equilibrium water depth versus break flow time, respectively, for this break.

Even though the floor drains will act as a distribution system, they will not be very effective in quickly redistributing the water throughout the total floor space. This is because the low differential head available would only allow for a floor drain flow of approximately 30-50 gpm.

Scenario III - Four-Inch Pipe Break on Elevation 226 Near MCC No. 5

The 4-inch break on elevation 226 near MCC No. 5 will discharge approximately 1375 gpm into the hallway in this area. The primary flood area will again cover the 5550 square foot area consisting of the diesel generator hallway, air compressor area, pipe tunnel, and entrance corridor. Doors to adjoining rooms are assumed to be closed at the time of the break and the floor drains are assumed to act as a distribution system.

The water from this pipe rupture will initially flood the hallway near MCC No. 5 and then flow into the pipe tunnel, air compressor area, and the hallway leading to the auxiliary feedwater pump room.

This break flow will result in the time versus depth curve shown in Figure F and an equilibrium depth as shown on Figure G. The equilibrium depth is again dependent on the duration of the flow.

Effect

The break postulated in this scenario is one of the most damaging to safety-related equipment. In addition to the possible damage caused by flooding (the same as in Scenario II), this break may result in direct impingement of water on MCC No. 5 and/or the boric acid evaporator equipment panels. Impingement on either of these pieces of electrical equipment will most likely result in their failure. The

flooding effects of this break are the least severe of any break on elevation 226 due to the lower flow rate and the maximum time available for corrective action by the operator.

Summary

The results of the analysis of the effects of an inadvertent actuation of, or pipe rupture in, the fire water system in the Auxiliary Building indicate that damage to safety-related equipment may occur. Inadvertent actuation of the fire system does not pose a threat to safety-related equipment since a double failure is required for actuation and the low flow rate through any open spray heads would not cause building flooding. Pipe ruptures can cause damage to safety-related equipment by both direct impingement and building flooding. All equipment damage that would be caused by building flooding can be eliminated or minimized by prompt operator action to terminate the water flow into the Auxiliary Building by closing the appropriate post indicator valve. However, one pipe rupture may cause immediate damage to MCC No. 5 by direct water impingement. Operator action cannot mitigate the consequences of this rupture. (CP&L is initiating an investigation to determine methods of protecting MCC No. 5 from direct water impingement. The results of this investigation will be forwarded to NRC when available.) The floor drain system is very important in preventing safety-related equipment damage for a pipe rupture on elevation 246 but acts as a water distribution system on elevation 226 due to low (20 gpm) sump pump flow rate and the small sump.

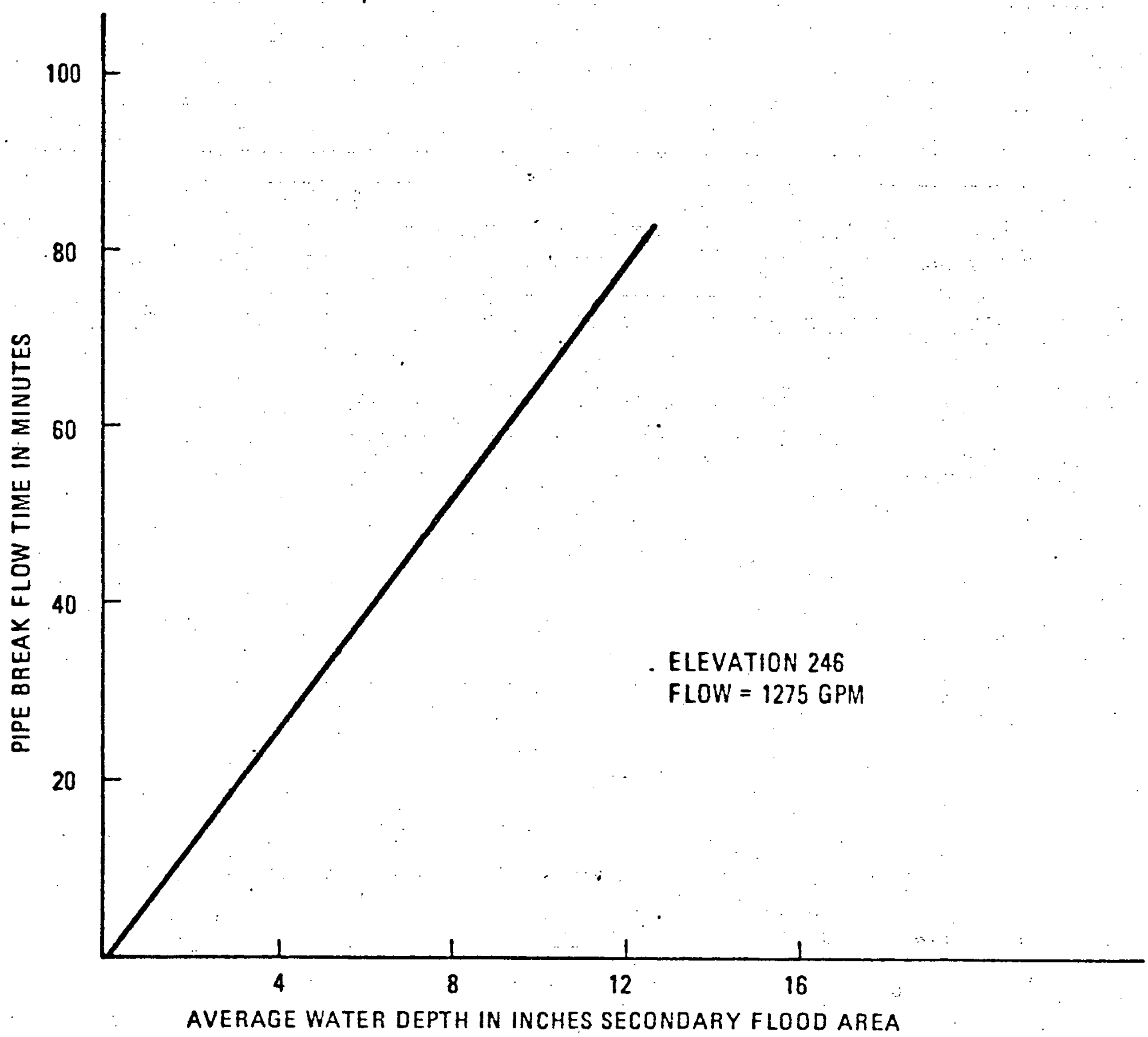



FIGURE A
TIME VS WATER DEPTH OF FILL ON THE 1st FLOOR
FROM THE 1275 GPM 2nd FLOOR 4" PIPE BREAK

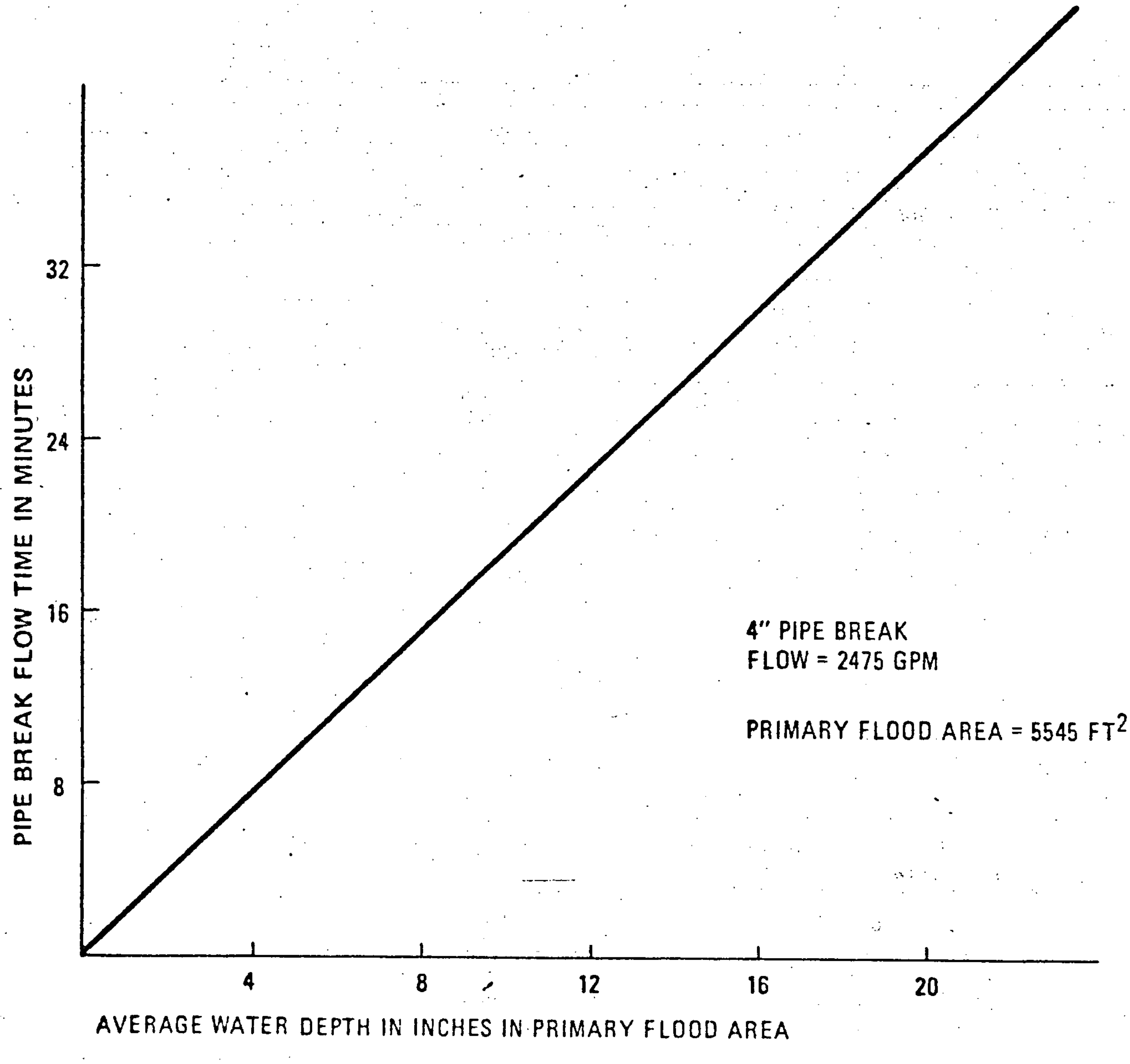



FIGURE B
TIME VS WATER DEPTH OF FILL IN ELEVATION 226
PRIMARY FLOOD AREA FOR 4" PIPE BREAK IN PIPE TUNNEL

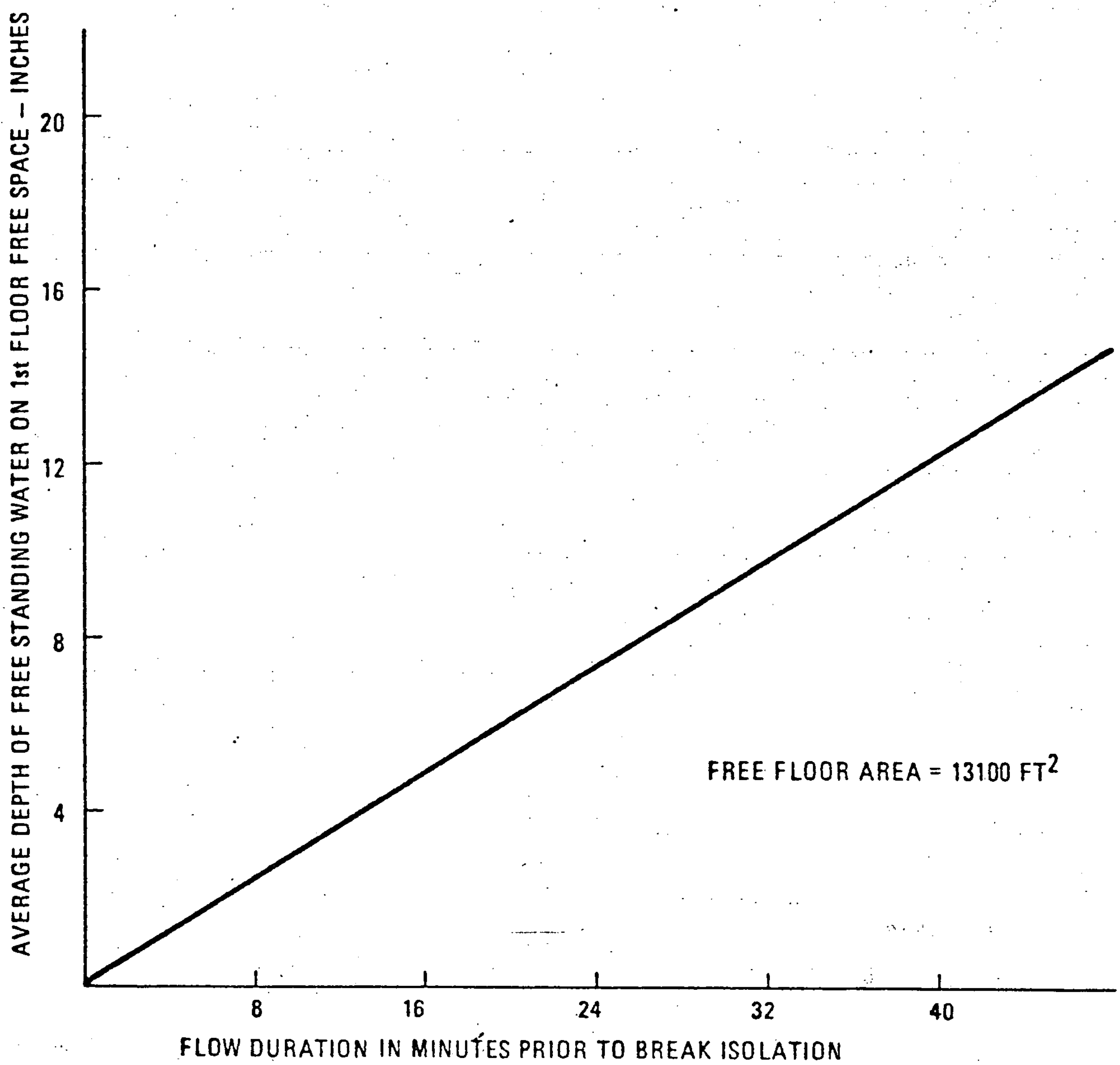



FIGURE C
AVERAGE WATER DEPTH IN ELEVATION 226
PRIMARY AND SECONDARY FLOOD AREAS VERSUS
DURATION OF 4" BREAK FLOW IN PIPE TUNNEL

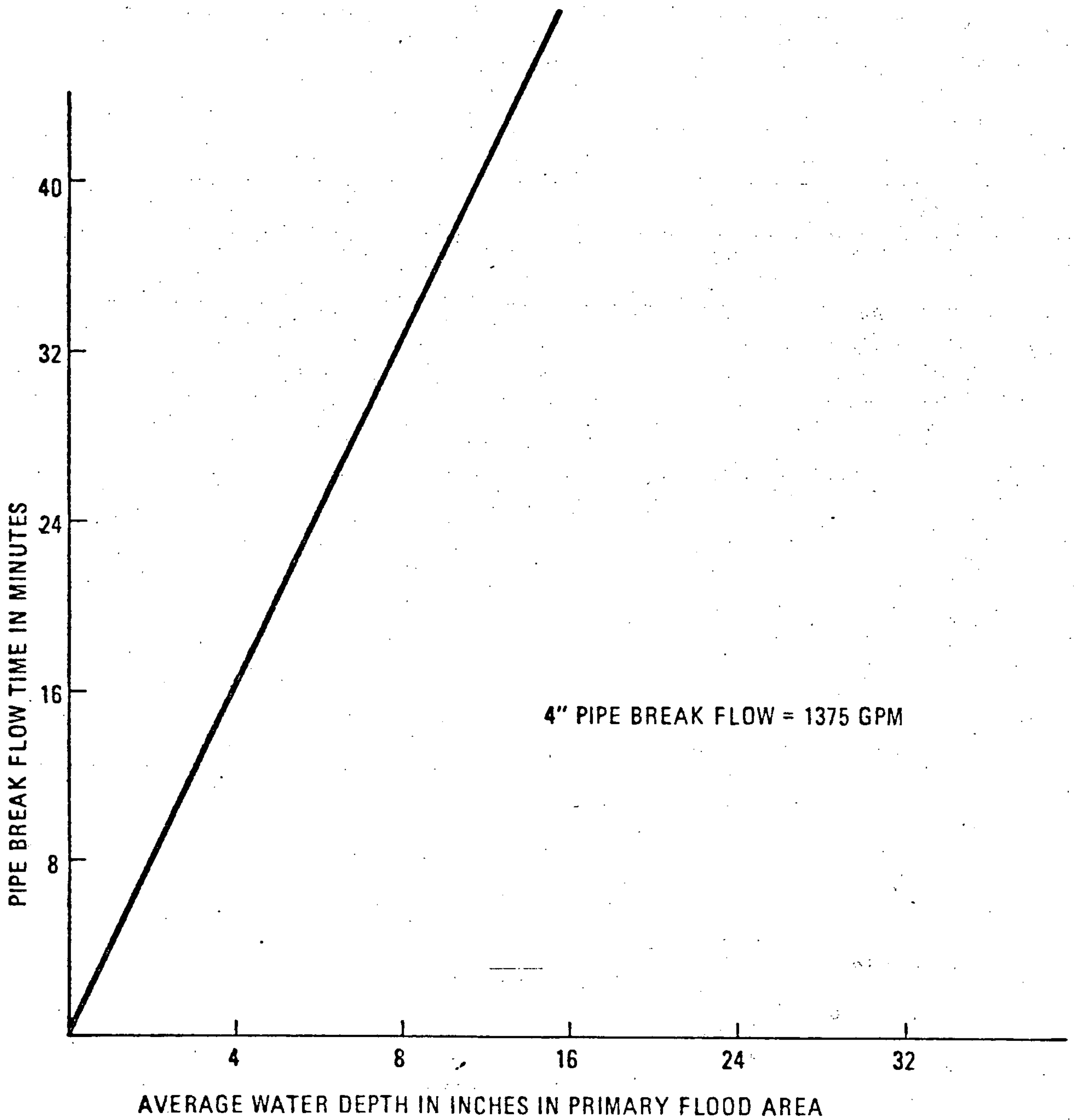



FIGURE D
TIME VS WATER DEPTH OF FILL IN ELEVATION 226
PRIMARY FLOOD AREA FOR 4" PIPE BREAK
IN HALLWAY AT MCC 5

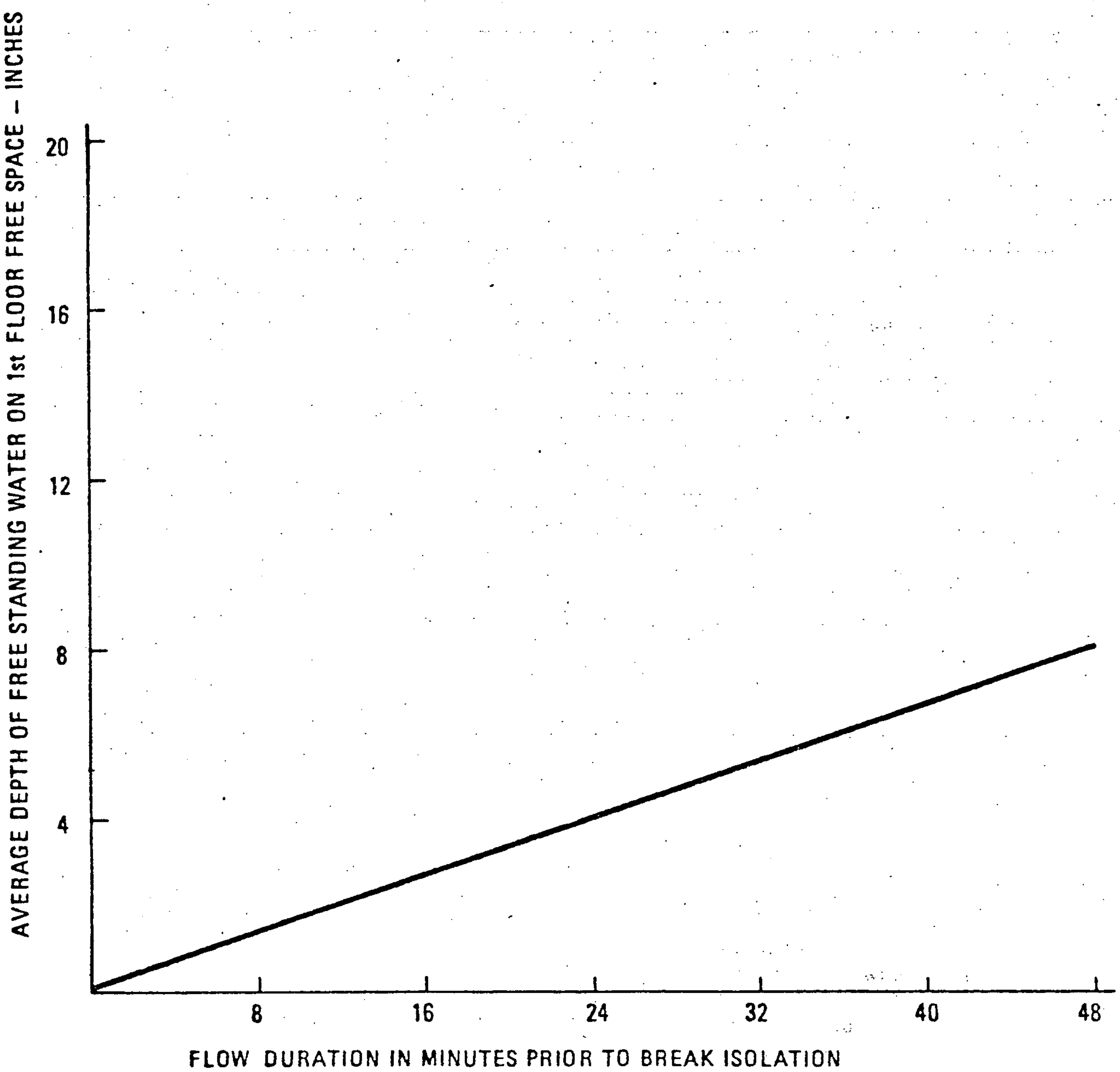
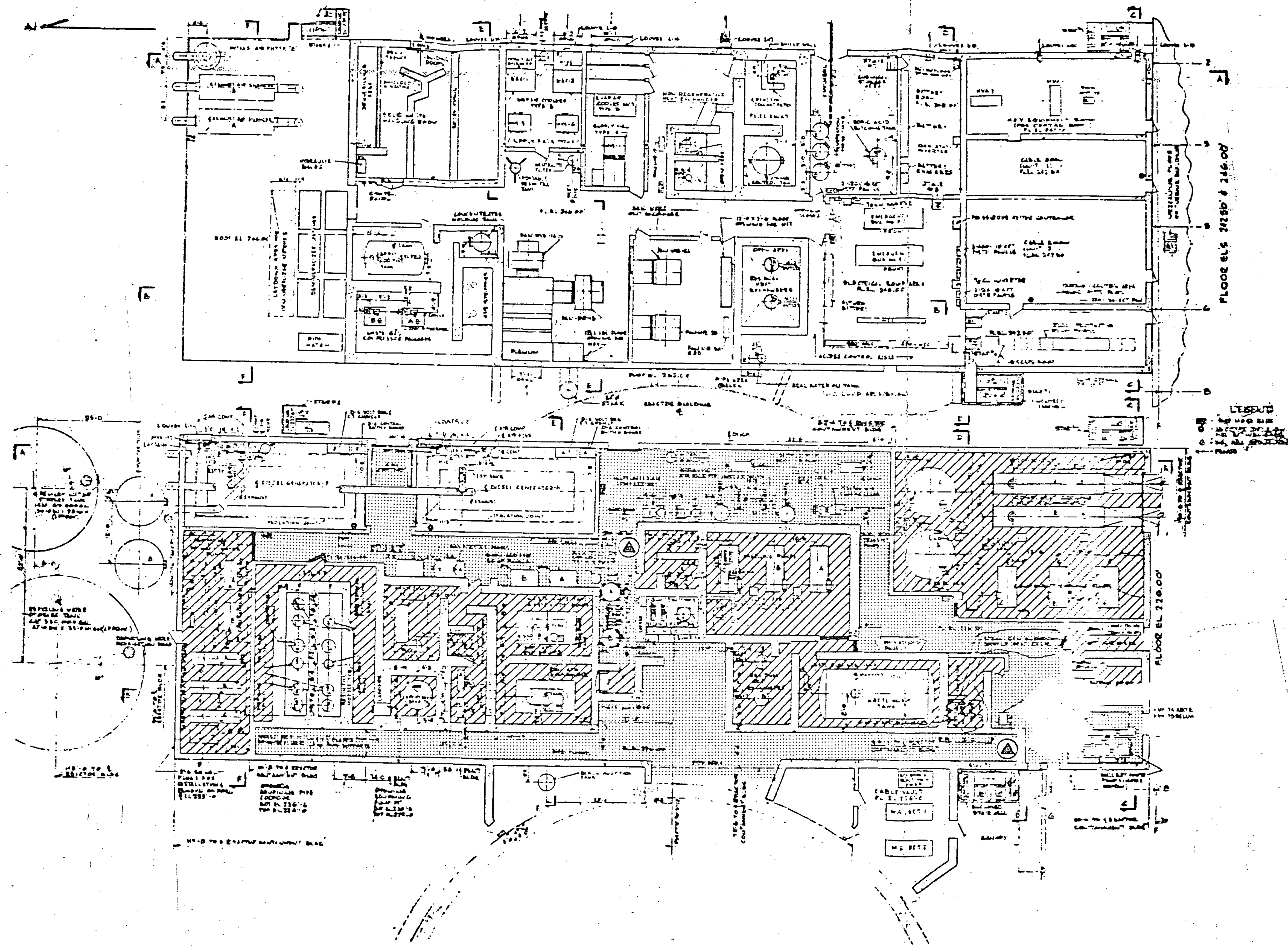



FIGURE E
AVERAGE WATER DEPTH IN ELEVATION 226
PRIMARY AND SECONDARY FLOOD AREAS VERSUS
DURATION OF 4" BREAK FLOW IN HALLWAY AT MCC 5




BREAK LOCATIONS

PRIMARY FLOOD AREA

SECONDARY FLOOD AREA

FIGURE G

FLOOD AREAS FOR FIRE PIPE BREAKS ELEVATION 226

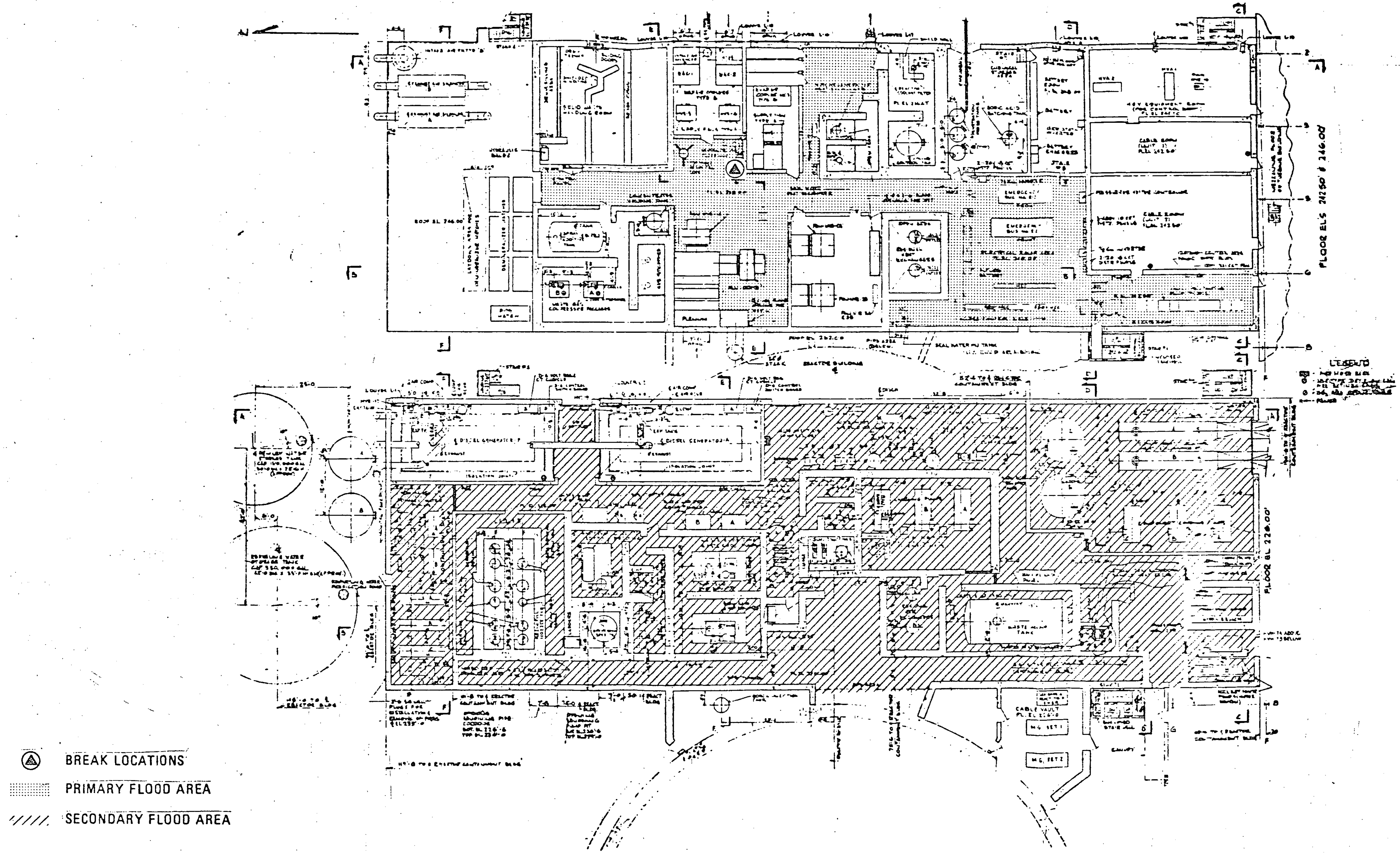



FIGURE F
FLOOD AREAS FOR BREAK ELEVATION 246