ENVIRONMENTAL ZONE DESCRIPTION

SURRY POWER STATION - UNITS 1 AND 2

AUGUST 24, 1981

VIRGINIA ELECTRIC AND POWER COMPANY

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VEPCO
SURRY POWER STATION
UNITS 1 & 2

ENVIRONMENTAL ZONE DESCRIPTION

VOLUME 1

VIRGINIA ELECTRIC AND POWER COMPANY

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INTRODUCTION

The Environmental Zone Description (EZD) documents the specification of parameters for environmentally harsh areas of the Surry Power Station Units 1 & 2 which contain safety-related equipment (IE Bulletin 79-01B). These areas have been ascribed environmental zones which possess more or less uniform environments relating to temperature, pressure, relative humidity, chemical spray, radiation, and submergence. As applicable for each environmental zone, these environmental parameters are specified for normal operation as well as LOCA, MSLB, and HELB conditions.

In certain instances, it was desirable to determine for specific plant components and environmental parameters a specification for an area contained within an environmental zone (i.e., temperature stratification and radiation zones).

Each environmental zone is described on a zone sheet (EZD pages 3 through 23). Reference numbers appearing on the zone sheets are identified by the reference list (EZD pages 24 through 25). The reference list also identifies secondary references which support/supplement the primary references. A copy of each of both types of references is provided in the succeeding volumes of the EZD.

Primary references have numerical tabs which correspond to their respective reference numbers, whereas secondary references have alphabetical tabs. Immediately preceeding each primary reference is one or more pages of the user's guide; the user's guide identifies the specific pages of each primary reference where information from the zone sheet can be located.

INDEX TO ZONE SHEETS

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: AB-2B
DESCRIPTION: Auxiliary Building Penetration Area, Elev. 2'0"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Occupied spaces, 100F Normally unoccupied machinery spaces, 120F	14	NA	______	NA	______	120-205F, 0-30 secs 205F, 30-40 secs 205-190F, 40-1000 secs 190-145F, 1000-2000 secs 145-120F, 2000 secs-1 hr	4
PRESSURE (psia)	NA	______	NA	______	NA	______	15.2, 0-1 min 14.9, 1-60 min	4
RELATIVE HUMIDITY (%)	NC	______	NA	______	NA	______	100	4
CHEMICAL SPRAY	NA	______	NA	______	NA	______	NA	______
RADIATION (rads)	2.5×10^6	7	2.5×10^6	7	NA	______	NA	______
SUBMERGENCE (elev)	NA	______	NA	______	NA	______	Note	______

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

NOTE: Not applicable. No safety-related electrical equipment will be affected by the submergence level at the 2'0" elevation of the Auxiliary Building.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: AB-2C
DESCRIPTION: Auxiliary Building Charging Pump Cubicles, Elev. 2'0"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Normally unoccupied machinery spaces, 120F	14	NA	________	NA	________	120-140F, 0-30 secs 140F, 30-1000 secs 140-125F, 1000-2000 secs 125-120F, 2000 secs-1 hr	4
PRESSURE (psia)	NA	________	NA	________	NA	________	15.2, 0-1 min 14.9, 1-60 min	4
RELATIVE HUMIDITY (%)	NC	________	NA	________	NA	________	100	4
CHEMICAL SPRAY	NA	________	NA	________	NA	________	NA	________
RADIATION (rads)	2.8×10^6	7	8.0×10^6	7	NA	________	NA	________
SUBMERGENCE (elev)	NA	________	NA	________	NA	________	NOTE	________

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

NOTE: Not applicable. No safety related electrical equipment will be affected by the submergence level at the 2'0" elevation of the Auxiliary Building.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: AB-13A
DESCRIPTION: Auxiliary Building, General, Elev. 13'0"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Occupied spaces, 100F Normally unoccupied machinery spaces, 120F	14	NA	______	NA	______	120-205F, 0-30 secs 205F, 30-40 secs 205-190F, 40-1000 secs 190-145F, 1000-2000 secs 145-120F, 2000 secs-1hr	4
PRESSURE (psia)	NA	______	NA	______	NA	______	15.2, 0-1 min 14.9, 1-60 min	4
RELATIVE HUMIDITY (%)	NC	______	NA	______	NA	______	100	4
CHEMICAL SPRAY	NA	______	NA	______	NA	______	NA	______
RADIATION (rads)	NOTE	10	9.3×10^5	10	NA	______	NA	______
SUBMERGENCE (elev)	NA	______	NA	______	NA	______	NA	______

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

NOTE: The radiation dose of 2.66×10^7 for the 40-yr normal operation in zone AB-13A is caused by the primary drain tank and gas stripper located in radiation zone Q (Units 1 & 2). The radiation dose is calculated to be 4.87×10^3 in radiation zones O (Unit 1) and N (Unit 2) and 1.40×10^5 in radiation zones T (Unit 1) and S (Unit 2).

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: AB-13B
DESCRIPTION: Auxiliary Building Cable Vault, Elev. 13'0"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Normally unoccupied machinery spaces, 120F	14	NA	________	NA	________	NA	________
PRESSURE (psia)	NA	________	NA	________	NA	________	NA	________
RELATIVE HUMIDITY (%)	NC	________	NA	________	NA	________	NA	________
CHEMICAL SPRAY	NA	________	NA	________	NA	________	NA	________
RADIATION (rads)	1.96 x 10[illegible]	10	3.2 x 10[illegible]	10	NA	________	NA	________
SUBMERGENCE (elev)	NA	________	NA	________	NA	________	NA	________

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: AB-27
DESCRIPTION: Auxiliary Building, General Elev. 27'6" [excluding cont. vacuum pump cubicles]

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Occupied spaces, 100F Normally unoccupied machinery spaces, 120F	14	NA		NA		120-205F, 0- 30 secs 205F, 30-40 secs 205-190F, 40-1000 secs 190-145F, 1000-2000 secs 145-120F, 2000 secs-1 hr	4
PRESSURE (psia)	NA		NA		NA		15.2, 0-1 min 14.9, 1-60 min	4
RELATIVE HUMIDITY (%)	NC		NA		NA		100	4
CHEMICAL SPRAY	NA		NA		NA		NA	
RADIATION (rads)	1.3×10^{6}	10	6.8×10^{2}	10	NA		NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: AB-45
DESCRIPTION: Auxiliary Building, General, Elev. 45'10"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Occupied spaces, 100F Normally unoccupied machinery spaces, 120F	14	NA		NA		120-125F, 0-300 secs 125-122F, 300-2000 secs 122-120F, 2000 secs-1 hr	4
OPRESSURE (psia)	NA		NA		NA		15.2, 0-1 min 14.9, 1-60 min	4
RELATIVE HUMIDITY (%)	NC		NA		NA		100	4
CHEMICAL SPRAY	NA		NA		NA		NA	
RADIATION (rads)	1.1×10^5	10	2.7×10^5	10	NA		NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: CSPH-11
DESCRIPTION: Containment Spray Pump House, Elev. 11'6"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Occupied spaces, 100F Normally unoccupied machinery spaces, 120F	14	NA		NA		NA	
PRESSURE (psia)	NA		NA		NA		NA	
RELATIVE HUMIDITY (%)	NC		NA		NA		NA	
CHEMICAL SPRAY	NA		NA		NA		NA	
RADIATION (rads)	8.8×10^2	11	5.9×10^6	11	NA		NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: CSPH-27
DESCRIPTION: Containment Spray Pump House, Elev. 27'6"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Occupied spaces, 100F Normally unoccupied machinery spaces, 120F	14	NA		NA		NA	
PRESSURE (psia)	NA		NA		NA		NA	
RELATIVE HUMIDITY (%)	NC		NA		NA		NA	
CHEMICAL SPRAY	NA		NA		NA		NA	
RADIATION (rads)	8.8×10^2	11	5.3×10^2	11	NA		NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: MSVH-11
DESCRIPTION: Main Steam Valve House, General, Elev. 11'6"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Normally unoccupied machinery spaces, 120F	14	NA		NA		NA	
PRESSURE (psia)	NA		NA		NA		NA	
RELATIVE HUMIDITY (%)	NC		NA		NA		NA	
CHEMICAL SPRAY	NA		NA		NA		NA	
RADIATION (rads)	8.8×10^2	11	5.9×10^6	11	NA		NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: MSVH-27
DESCRIPTION: Main Steam Valve House, General, Elev. 27'6"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Normally unoccupied machinery spaces, 120F	14	NA		NA		Note	12
PRESSURE (psia)	NA		NA		NA		16.5, 0-10 sec 16.2, 10 sec-1 hr	12
RELATIVE HUMIDITY (%)	NC		NA		NA		100	12
CHEMICAL SPRAY	NA		NA		NA		NA	
RADIATION (rads)	8.8×10^2	11	1.7×10^4	11	NA		NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

NOTE: The HELB temperature of 300°F (0-1 hr) was calculated for environmental zone MSVH-27 which extends from elevation 27'6" to the roof. The HELB temperature for equipment located between elevations 27'6" and 38'0" is calculated to be 250°F (0-1 hr).

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: RC-3A
DESCRIPTION: Containment Inside Cranewall, Elev. (-)3'6"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Design, 105F Maximum, 125F	15 1	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	NA	
PRESSURE (psia)	9.0-11.1	1	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	NA	
RELATIVE HUMIDITY (%)	NC		100, 0-120 days	2	100, 0-120 days	2	NA	
CHEMICAL SPRAY	NA		Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	NA	
RADIATION (rads)	1.3×10^7	3	$\leq 2.4 \times 10^7$	3	$<2.4 \times 10^7$	3,5	NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: RC-3B
DESCRIPTION: Containment Outside Cranewall, Elev. (-)3'6"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Design, 105F Maximum, 125F	15 1	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	NA	
PRESSURE (psia)	9.0-11.1	1	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	NA	
RELATIVE HUMIDITY (%)	NC		100, 0-120 days	2	100, 0-120 days	2	NA	
CHEMICAL SPRAY	NA		Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	NA	
RADIATION (rads)	3.5×10^4	3	7.4×10^6	3	$<7.4 \times 10^6$	3,5	NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: RC-18B
DESCRIPTION: Containment Outside Cranewall, Elev. 18'4"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Design, 105F Maximum, 125F	15 1	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	NA	
PRESSURE (psia)	9.0-11.1	1	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	NA	
RELATIVE HUMIDITY (%)	NC		100, 0-120 days	2	100, 0-120 days	2	NA	
CHEMICAL SPRAY	NA		Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	NA	
RADIATION (rads)	3.5×10^4	3	7.4×10^6	3	$<7.4 \times 10^6$	3,5	NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: RC-27A
DESCRIPTION: Containment General, Elev. (-)27'7"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Design, 105F Maximum, 125F	15 1	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	NA	
PRESSURE (psia)	9.0-11.1	1	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	NA	
RELATIVE HUMIDITY (%)	NC		100, 0-120 days	2	100, 0-120 days	2	NA	
CHEMICAL SPRAY	NA		Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	NA	
RADIATION (rads)	3.5×10^4	3	3.5×10^7	3	$<3.5 \times 10^7$	3,5	NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: RC-27B*
DESCRIPTION: Containment, Elev. (-)27'7" Submerged (Below (-)21'11")

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Design, 105F Maximum, 125F	15 1	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	NA	
PRESSURE (psia)	9.0-11.1	1	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	NA	
RELATIVE HUMIDITY (%)	NC		100, 0-120 days	2	100, 0-120 days	2	NA	
CHEMICAL SPRAY	NA		Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	NA	
RADIATION (rads)	3.5×10^4	3	3.8×10^7	3	$<3.8 \times 10^7$	3,5	NA	
SUBMERGENCE (elev)	NA		(-)21'11"	6	(-)21'11"	6	NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

* No safety-related electrical equipment is contained in environmental zone RC-27B.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: RC-47A
DESCRIPTION: Containment Inside Cranewall, Elev. 47'4"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Design, 105F Maximum, 125F	15 1	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	NA	
PRESSURE (psia)	9.0-11.1	1	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	NA	
RELATIVE HUMIDITY (%)	NC		100, 0-120 days	2	100, 0-120 days	2	NA	
CHEMICAL SPRAY	NA		Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	NA	
RADIATION (rads)	<1.3 x 10^7	3	2.4 x 10^7	3	<2.4 x 10^7	3,5	NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: RC-47B
DESCRIPTION: Containment Outside Cranewall, Elev. 47'4"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Design, 105F Maximum, 125F	15 1	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	280F, 0-30 min 280-150F, 30-60 min 150-120F, 1-48 hr 120F, 2-120 days	2	NA	
PRESSURE (psia)	9.0-11.1	1	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	59.7, 0-30 min 59.7-14.7, 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	2	NA	
RELATIVE HUMIDITY (%)	NC		100, 0-120 days	2	100, 0-120 days	2	NA	
CHEMICAL SPRAY	NA		Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	2	NA	
RADIATION (rads)	3.5×10^4	3	7.4×10^6	3	$<7.4 \times 10^6$	3,5	NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: SB-9B
DESCRIPTION: Mechanical Equipment Room 3

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Occupied spaces, 100F Normally unoccupied machinery spaces, 120F	14	NA		NA		310F, 0-30 min 310-130F, 30-60 min	8
PRESSURE (psia)	NA		NA		NA		15.0	8
RELATIVE HUMIDITY (%)	NC		NA		NA		100	8
CHEMICAL SPRAY	NA		NA		NA		NA	
RADIATION (rads)	<2500	11	<2500	13	NA		NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: SFGD-1
DESCRIPTION: Safeguards Area

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Occupied spaces, 100F Normally unoccupied machinery spaces, 120F	14	NA		NA		NA	
PRESSURE (psia)	NA		NA		NA		NA	
RELATIVE HUMIDITY (%)	NC		NA		NA		NA	
CHEMICAL SPRAY	NA		NA		NA		NA	
RADIATION (rads)	8.8×10^2	7	8.0×10^6	9	NA		NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: TB-9
DESCRIPTION: Turbine Building, General, Elev. 9'6"

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Occupied spaces, 100F Normally unoccupied machinery spaces, 120F	14	NA		NA		310F, 0-30 min 310-130F, 30-60 min	8
PRESSURE (psia)	NA		NA		NA		15.0	8
RELATIVE HUMIDITY (%)	NC		NA		NA		100	8
CHEMICAL SPRAY	NA		NA		NA		NA	
RADIATION (rads)	<2500	11	<2500	13	NA		NA	
SUBMERGENCE (elev)	NA		NA		NA		NA	

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

ENVIRONMENTAL ZONE DESCRIPTION SHEET

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

ZONE: TB-35
DESCRIPTION: Turbine Building, Mezzanine Level

PARAMETER	NORMAL ENVIRONMENT	REFERENCE	LOCA ENVIRONMENT	REFERENCE	MSLB ENVIRONMENT	REFERENCE	HELB ENVIRONMENT	REFERENCE
TEMPERATURE (°F)	Occupied spaces, 100F Normally unoccupied machinery spaces, 120F	14	NA	________	NA	________	310F, 0-30 min 310-130F, 30-60 min	8
PRESSURE (psia)	NA	________	NA	________	NA	________	15.0	8
RELATIVE HUMIDITY (%)	NC	________	NA	________	NA	________	100	8
CHEMICAL SPRAY	NA	________	NA	________	NA	________	NA	________
RADIATION (rads)	<2500	11	<2500	13	NA	________	NA	________
SUBMERGENCE (elev)	NA	________	NA	________	NA	________	NA	________

NA = Not applicable. NC = Not calculated. Numbers appearing in Reference columns are identified at the end of this section.

REFERENCE LIST

1. Distribution Memorandum (from D.W. Speidell, Jr. of VEPCO dated August 21, 1978). Technical Specifications, Surry Power Station Units 1 & 2, Conditions of the License, August 14, 1978. Service Water Temperature Limit.

2. Stone & Webster Calculation No. 12846.44-US(B)-052-1.*

3. Stone & Webster Calculation No. 12846.54-RP-038-1.

4. Stone & Webster Calculation No. 12846.44-PE-050-0.*

5. IE Bulletin 79-01B, Surry Power Station Unit 1, Section 2.3.

6. Stone & Webster Calculation No. 12846.01-PE-036-0.*

7. Stone & Webster Calculation No. 12846.38-RP-024-1.

8. Stone & Webster Calculation No. 12846.44-PE-049-0.

9. Stone & Webster Calculation No. 12846.54-RP-037-0.

10. Stone & Webster Calculation No. 12846.44-UR(B)-043-0.*

11. Stone & Webster Calculation No. 12846.38-RP-031-0.*

12. Stone & Webster Calculation No. 12846.44-PE-044-0.

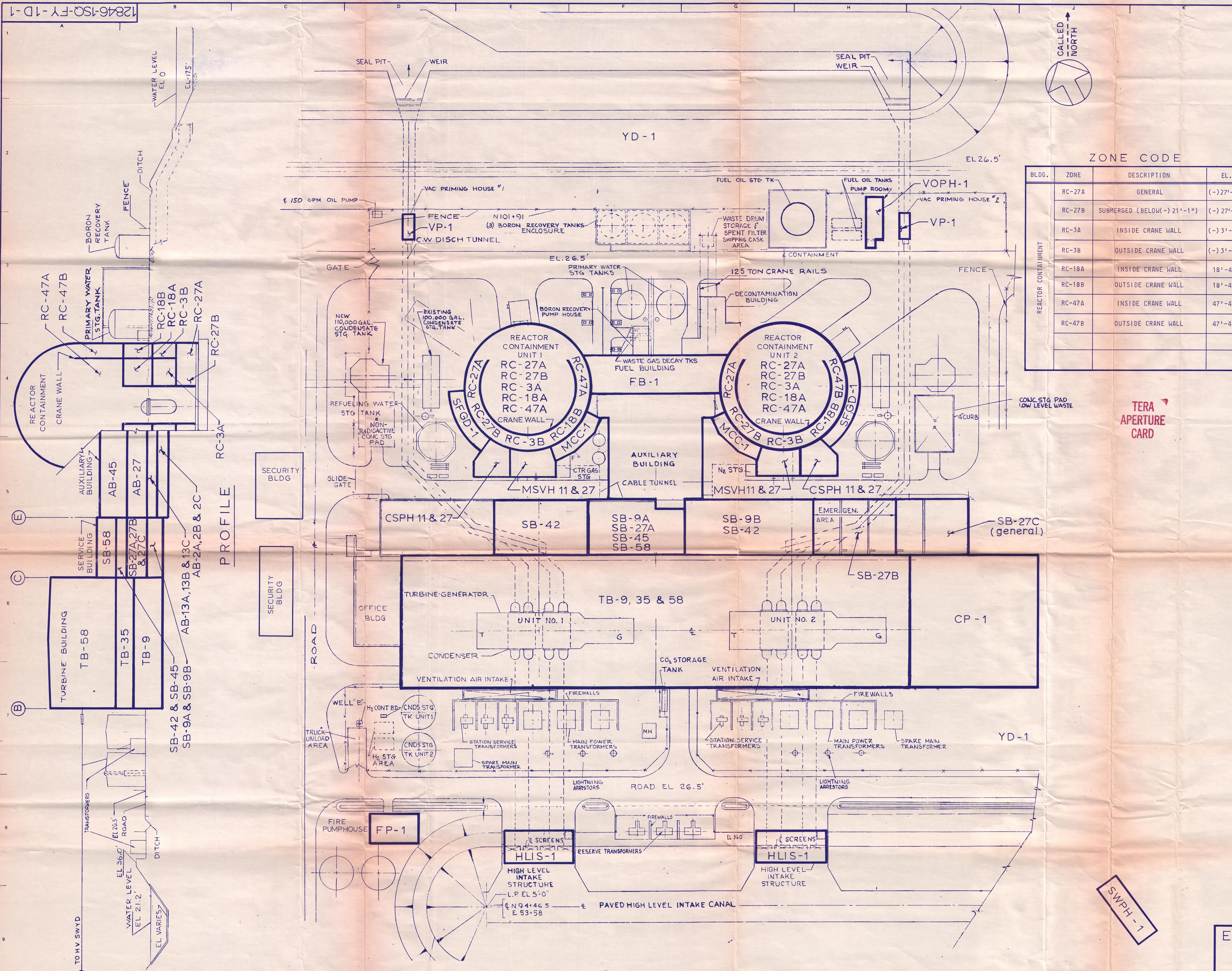
13. Stone & Webster Calculation No. 12846.54-RP-039-0.

14. FSAR Section 9.13.2 (Pg. 9.13.2-1); Surry Power Station Units 1 and 2, December 1, 1969.

15. FSAR Section 5.3 (pg. 5.3-1); Surry Power Station Units 1 and 2, December 1, 1969.

* The following calculations support the methodology approach provided in the above referenced calculations:

Stone & Webster Calculation No.	Input to Reference No.
12846.07-57	2
12846.01-PE-030-0	6
12846.19-PE-038-0	2
12846.44-PE-041-0	4
12846.44-PE-042-1	4
12846.19-PE-045-0	2
12846.44-PE-046-0	4
12846.38-RP-026-0	10
12846.54-RP-035-0	10
12050-RP-095-0	11



ZONE CODE

BLDG.	ZONE	DESCRIPTION	EL.
REACTOR CONTAINMENT	RC-27A	GENERAL	(-)27'-7"
	RC-27B	SUBMERGED (BELOW(-) 21'-1")	(-) 27'-7"
	RC-3A	INSIDE CRANE WALL	(-) 3'-6"
	RC-3B	OUTSIDE CRANE WALL	(-) 3'-6"
	RC-18A	INSIDE CRANE WALL	18'-4"
	RC-18B	OUTSIDE CRANE WALL	18'-4"
	RC-47A	INSIDE CRANE WALL	47'-4"
	RC-47B	OUTSIDE CRANE WALL	47'-4"

ZONE CODE

BLDG.	ZONE	DESCRIPTION	EL.
AUXILIARY BUILDING	AB-2A	GENERAL	2'-0"
	AB-2B	PENETRATION AREA	2'-0"
	AB-2C	CHARGING PUMP CUBICLES	2'-0"
	AB-13A	GENERAL	13'-0"
	AB-13B	CABLE VAULT	13'-0"
	AB-13C	CHARGING PUMP CUBICLES	13'-0"
	AB-27	GENERAL	27'-6"
	AB-45	GENERAL	45'-10"
SERVICE BUILDING	SB-9A	EMERGENCY SWITCHGEAR ROOM	9'-6"
	SB-9B	MECHANICAL EQUIPMENT ROOM #3	9'-6"
	SB-27A	CONTROL ROOM	27'-0"
	SB-27B	DIESEL GENERATOR ROOM	27'-0"
	SB-27C	GENERAL	27'-0"
	SB-42	MECHANICAL EQUIPMENT ROOMS 1 & 2	42'-0"
	SB-45	CABLE TRAYS	45'-3" & 47'-0"
	SB-58	SWITCHGEAR	58'-6"
MISCELLANEOUS AREAS	MSVH-11	MAIN STEAM VALVE HOUSE	11'-6"
	MSVH-27	MAIN STEAM VALVE HOUSE	27'-6"
	CSPH-11	CONTAINMENT SPRAY PUMP HOUSE	11'-6"
	CSPH-27	CONTAINMENT SPRAY PUMP HOUSE	27'-6"
	SFGD-1	SAFEGUARDS AREA	
	TB-9	TURBINE BLDG. GENERAL	9'-6"
	TB-35	TURBINE BLDG. MEZZANINE LEVEL	35'-6"
	TB-58	TURBINE BLDG. OPERATING LEVEL	58'-6"
	HLIS-1	HIGH LEVEL STRUCTURE	
	FP-1	FIRE PUMP HOUSE	
	FB-1	FUEL BUILDING	
	FOPH-1	FUEL OIL PUMP HOUSE	
	VP-1	VACUUM PRIMING HOUSE	
	CP-1	CONDENSATE POLISHING	
	YD-1	YARD	
	MCC-1	MOTOR CONTOR CENTER	
	SWPH - 1	SERVICE WATER PUMPHOUSE	

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ISSUE 1 — ORIGINAL ISSUE

ENVIRONMENTAL QUALIFICATION OF ELECTRICAL EQUIPMENT ZONE KEY PLAN

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FY-1D-1

DRAWN BY C. WIERZBICKI

RESP ENGR W. KNAPP
SUPV R.E. DAHLBORG

INDEX TO EQUIPMENT QUALIFICATION DIAGRAMS

12846-1SQ-FB-27B-1
12846-1SQ-FK-3A-1
12846-1SQ-FK-3B-1
12846-1SQ-FK-10A-1
12846-1SQ-FM-14A-1
12846-1SQ-FM-16A-1
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12846-1SQ-FM-100B-1
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12846-1SQ-FM-102A-1
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12846-1SQ-FM-106A-1
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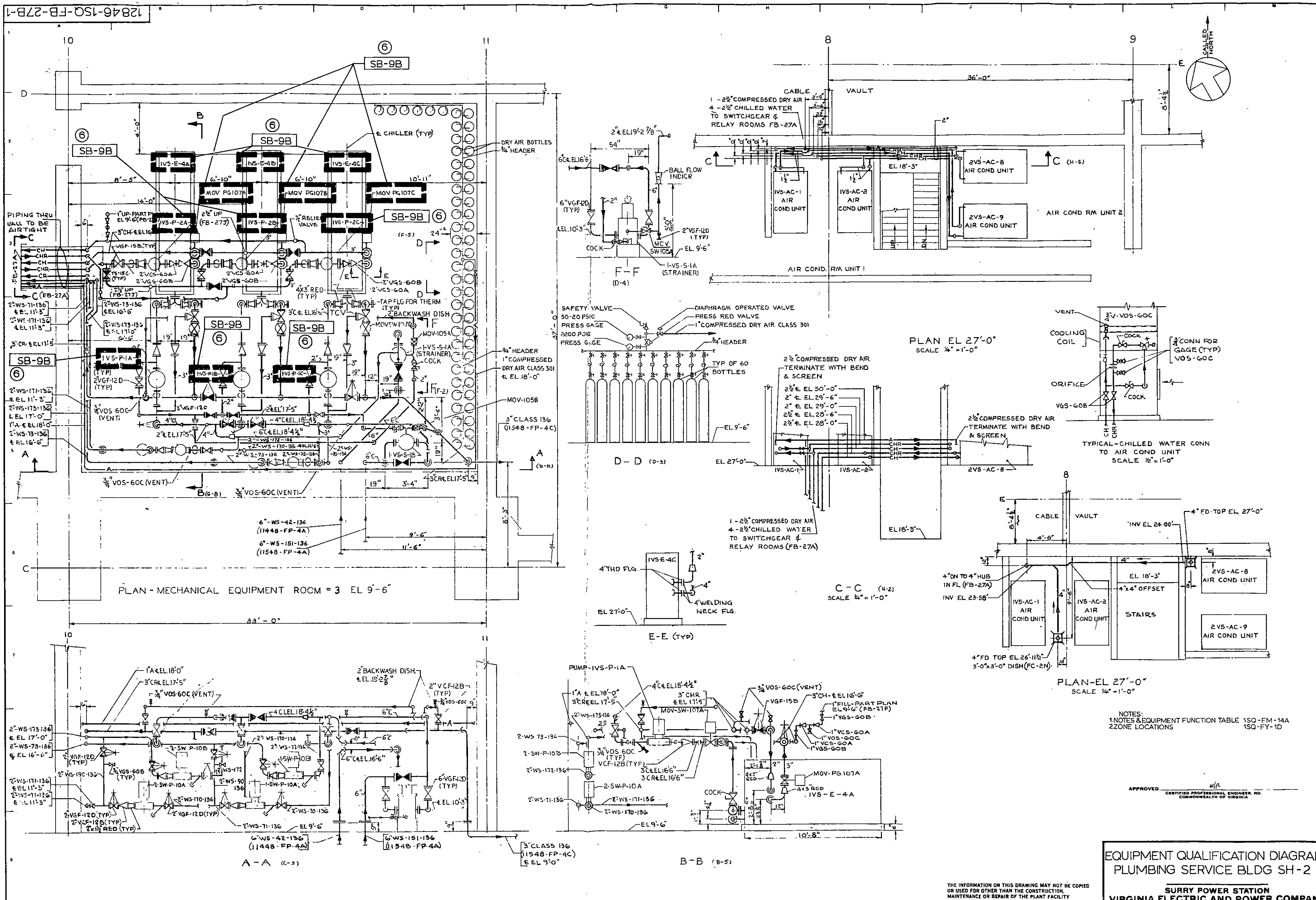
12846-1SQ-FM-122A-1
12846-1SQ-FM-126A-1



EQUIPMENT QUALIFICATION DIAGRAM
PLUMBING SERVICE BLDG SH-2

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

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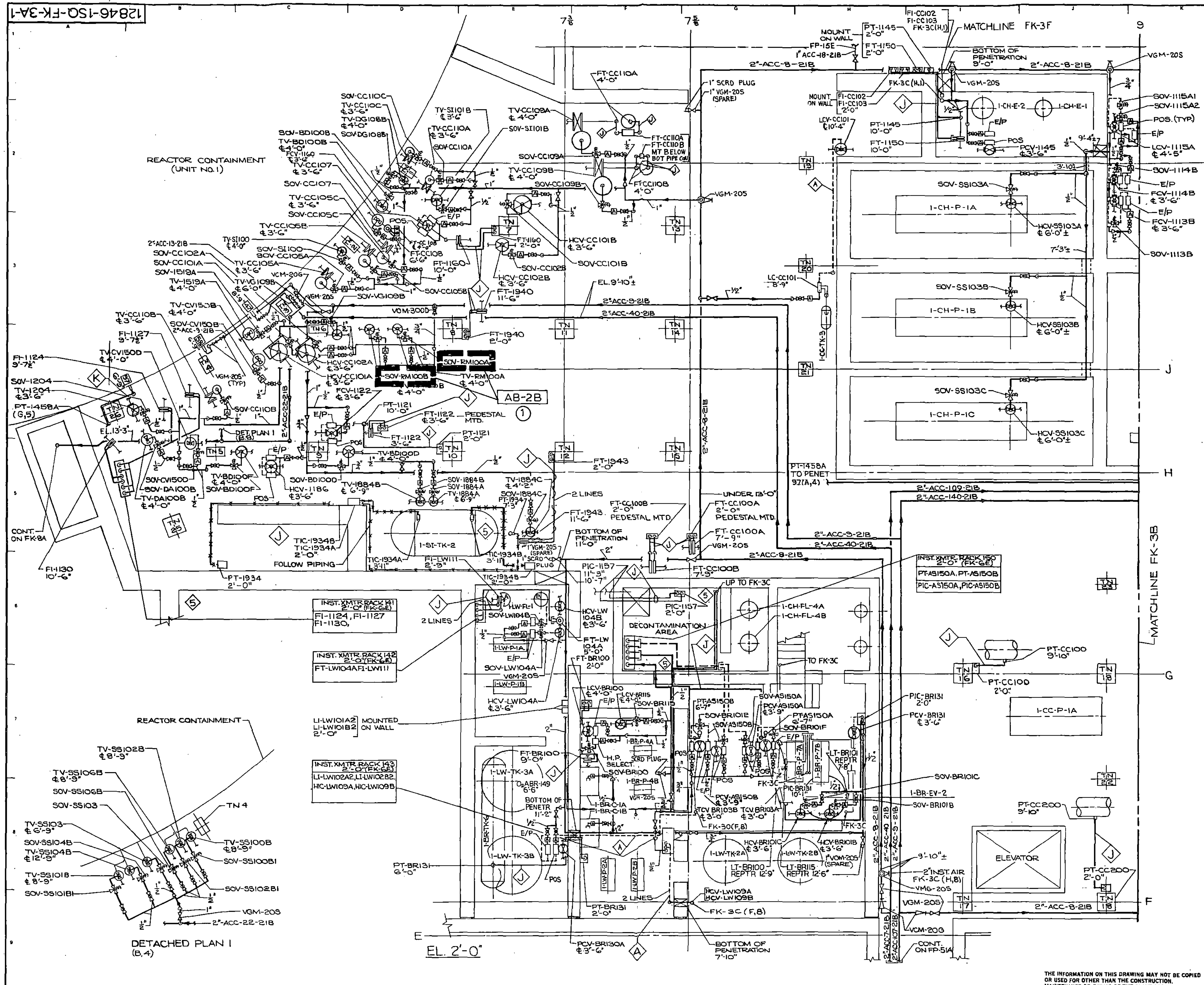

NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

APPROVED N/A
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EQUIPMENT QUALIFICATION DIAGRAM
INSTRUMENT PPG AUX BLDG SH-1

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VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

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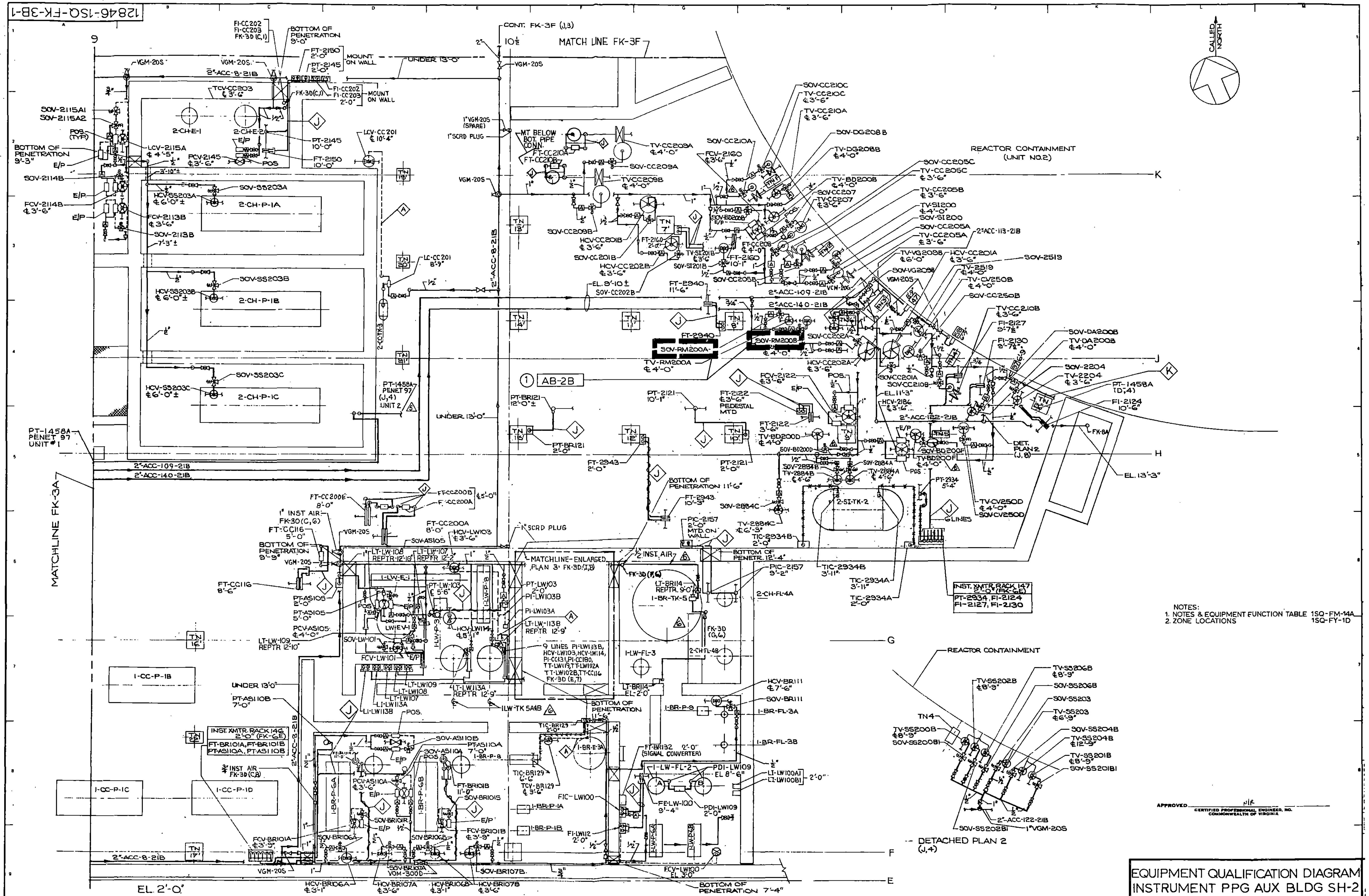

NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

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EQUIPMENT QUALIFICATION DIAGRAM
INSTRUMENT PPG AUX BLDG SH-2

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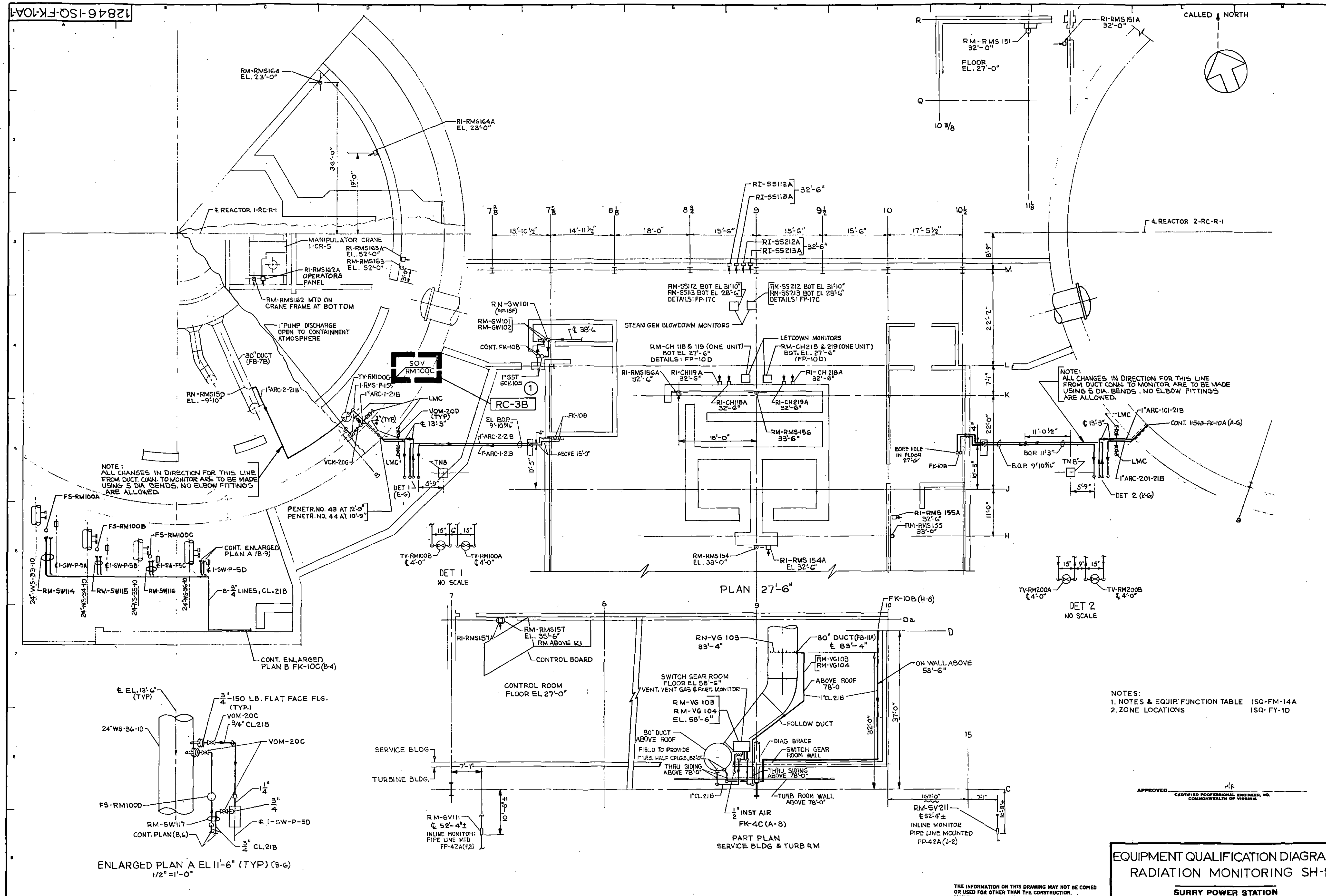

NOTES:
1. NOTES & EQUIP. FUNCTION TABLE ISQ-FM-14A
2. ZONE LOCATIONS ISQ-FY-1D

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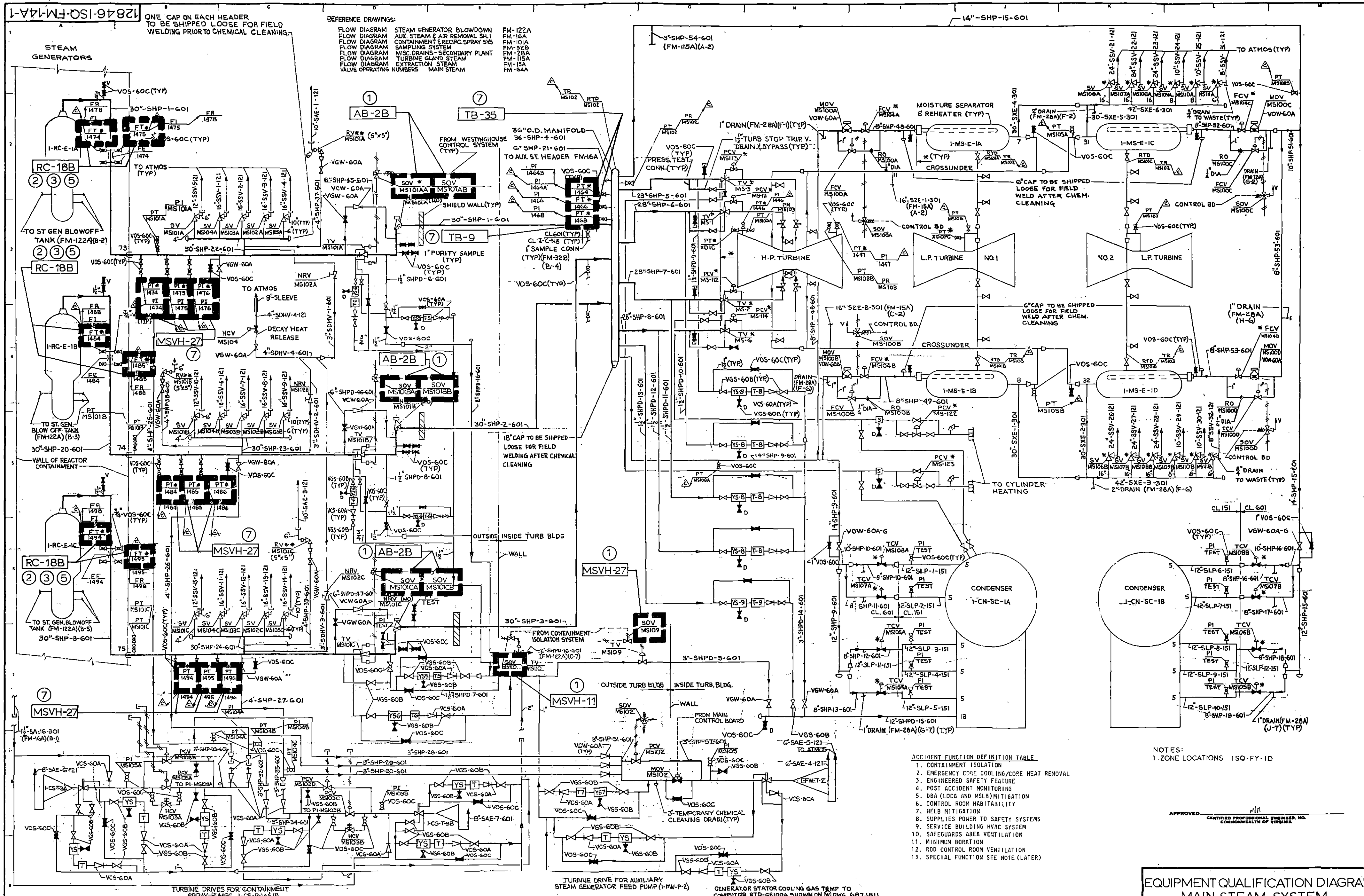
EQUIPMENT QUALIFICATION DIAGRAM
RADIATION MONITORING SH-1

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-ISQ-FK-10A-1



ACCIDENT FUNCTION DEFINITION TABLE

1. CONTAINMENT ISOLATION
2. EMERGENCY CORE COOLING/CORE HEAT REMOVAL
3. ENGINEERED SAFETY FEATURE
4. POST ACCIDENT MONITORING
5. DBA (LOCA AND MSLB) MITIGATION
6. CONTROL ROOM HABITABILITY
7. HELB MITIGATION
8. SUPPLIES POWER TO SAFETY SYSTEMS
9. SERVICE BUILDING HVAC SYSTEM
10. SAFEGUARDS AREA VENTILATION
11. MINIMUM BORATION
12. ROD CONTROL ROOM VENTILATION
13. SPECIAL FUNCTION SEE NOTE (LATER)

NOTES:
1. ZONE LOCATIONS 1SQ-FY-1D

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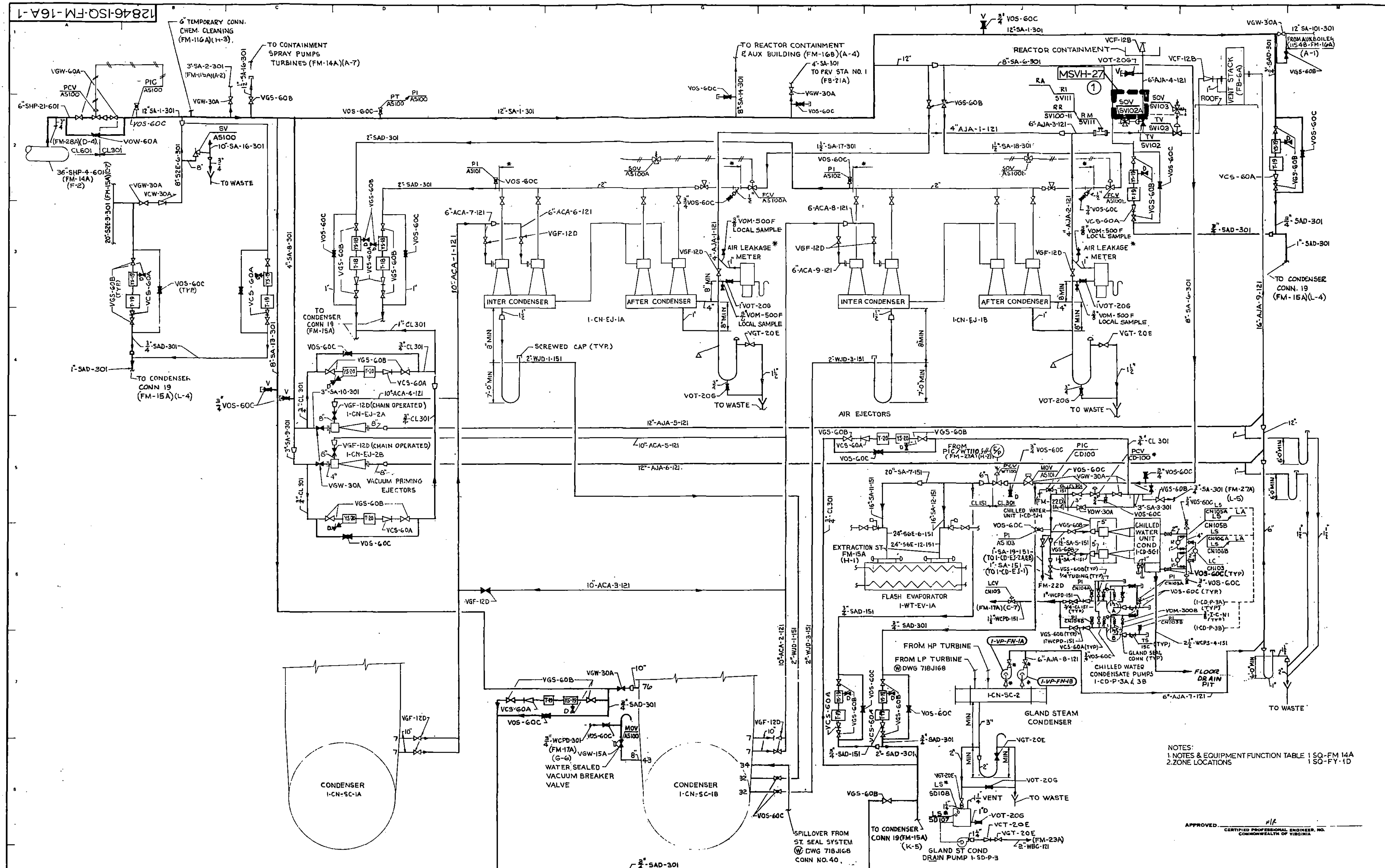
EQUIPMENT QUALIFICATION DIAGRAM MAIN STEAM SYSTEM

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-14A-1



APPROVED ______ CERTIFIED PROFESSIONAL ENGINEER, NO. ______ COMMONWEALTH OF VIRGINIA

EQUIPMENT QUALIFICATION DIAGRAM
AUX ST & AIR REMOVAL SH-1

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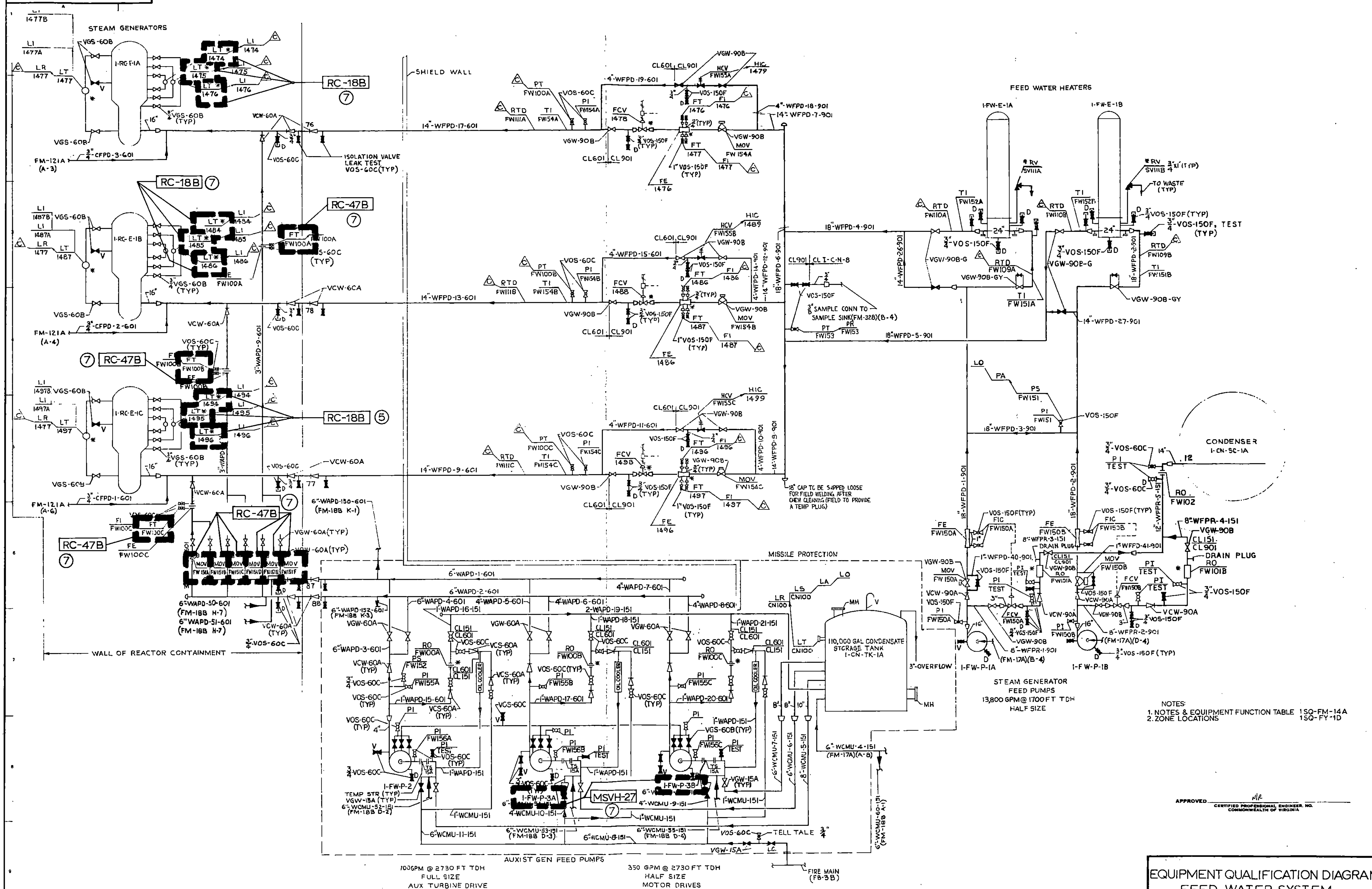
12846-1SQ-FM-18A-1



NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

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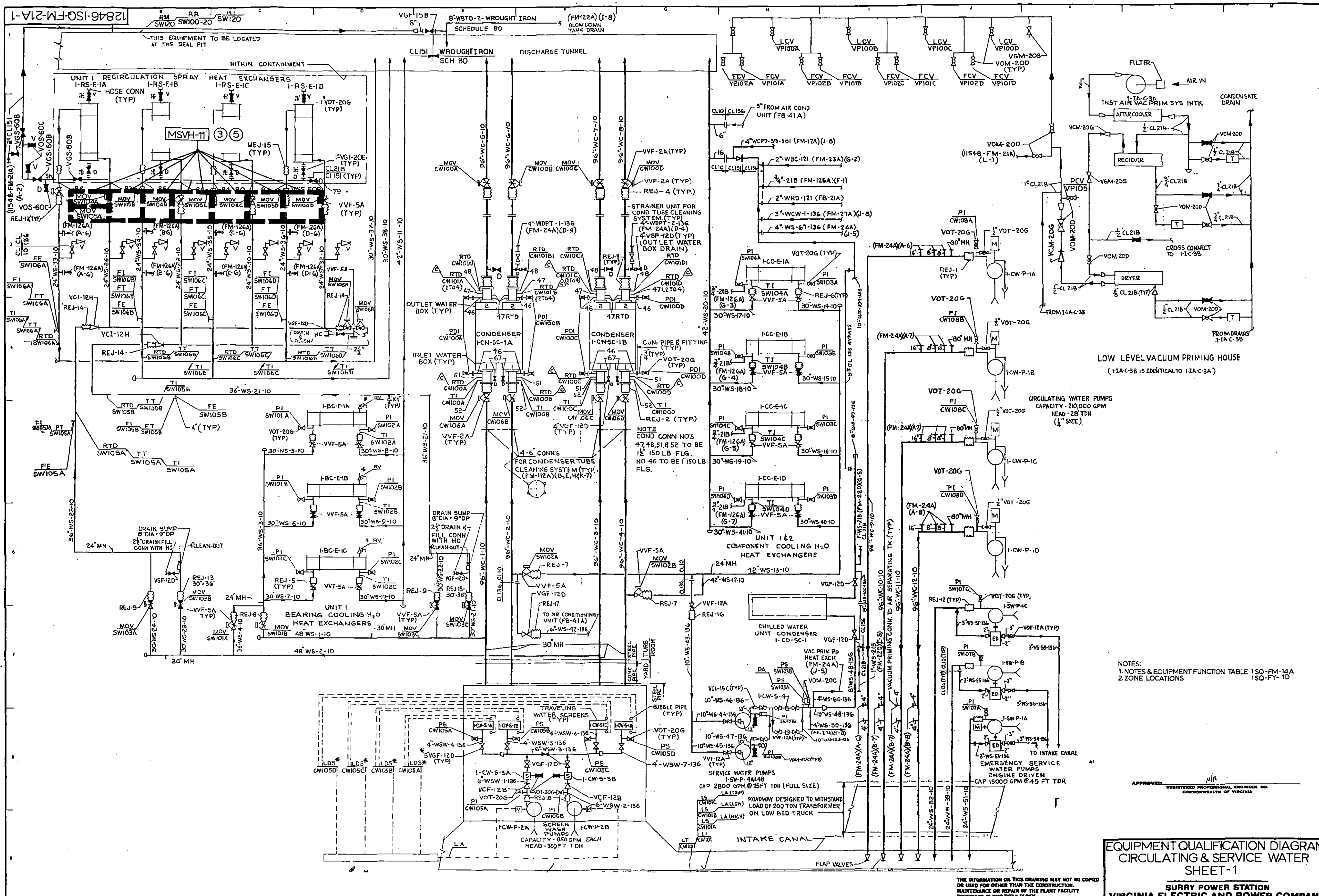
EQUIPMENT QUALIFICATION DIAGRAM
FEED WATER SYSTEM

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-18A-1



NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

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EQUIPMENT QUALIFICATION DIAGRAM CIRCULATING & SERVICE WATER SHEET-1

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-21A-1

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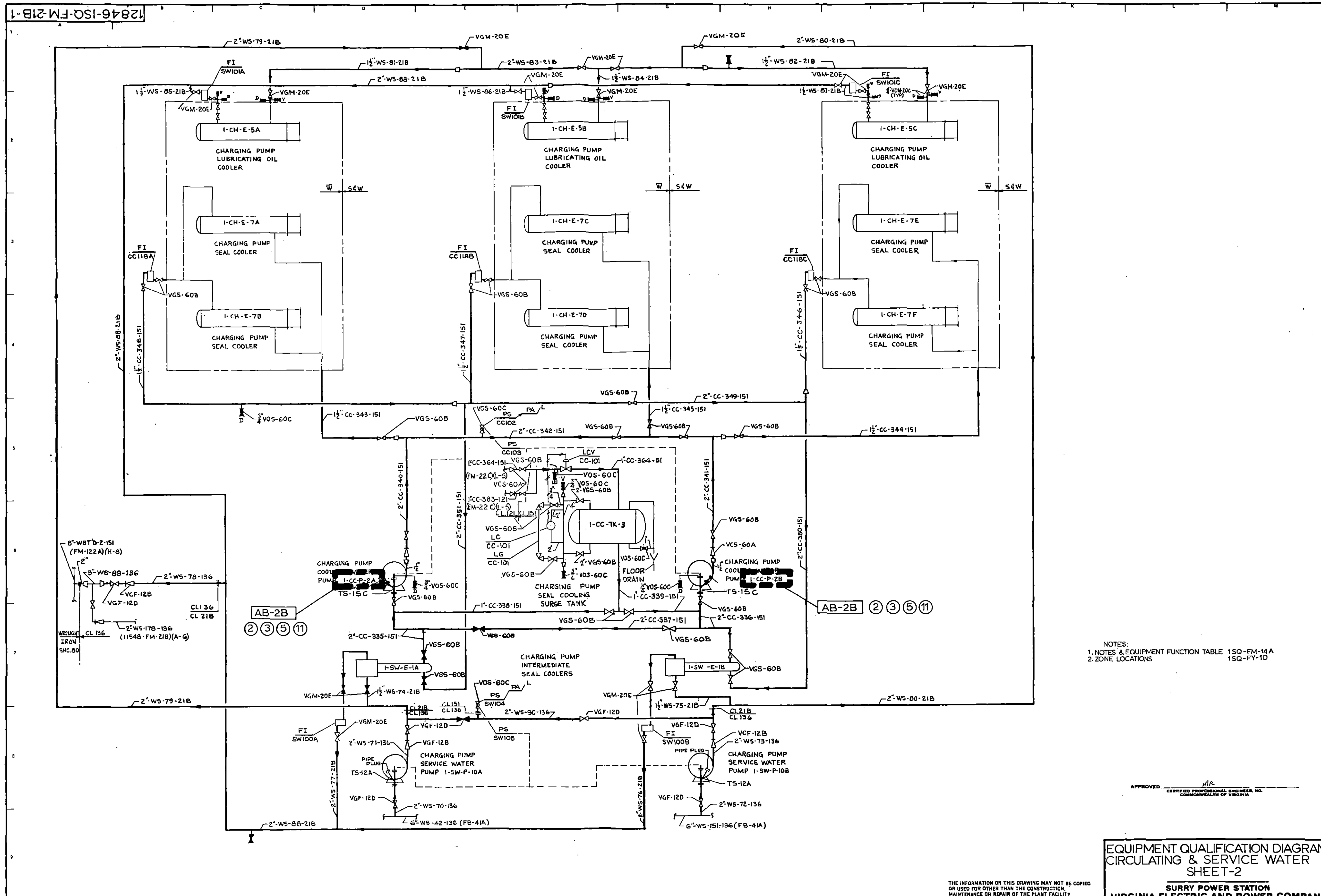

NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

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EQUIPMENT QUALIFICATION DIAGRAM CIRCULATING & SERVICE WATER SHEET-2

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION BOSTON, MASS.
DRAWING NUMBER 12846-1SQ-FM-21B-1

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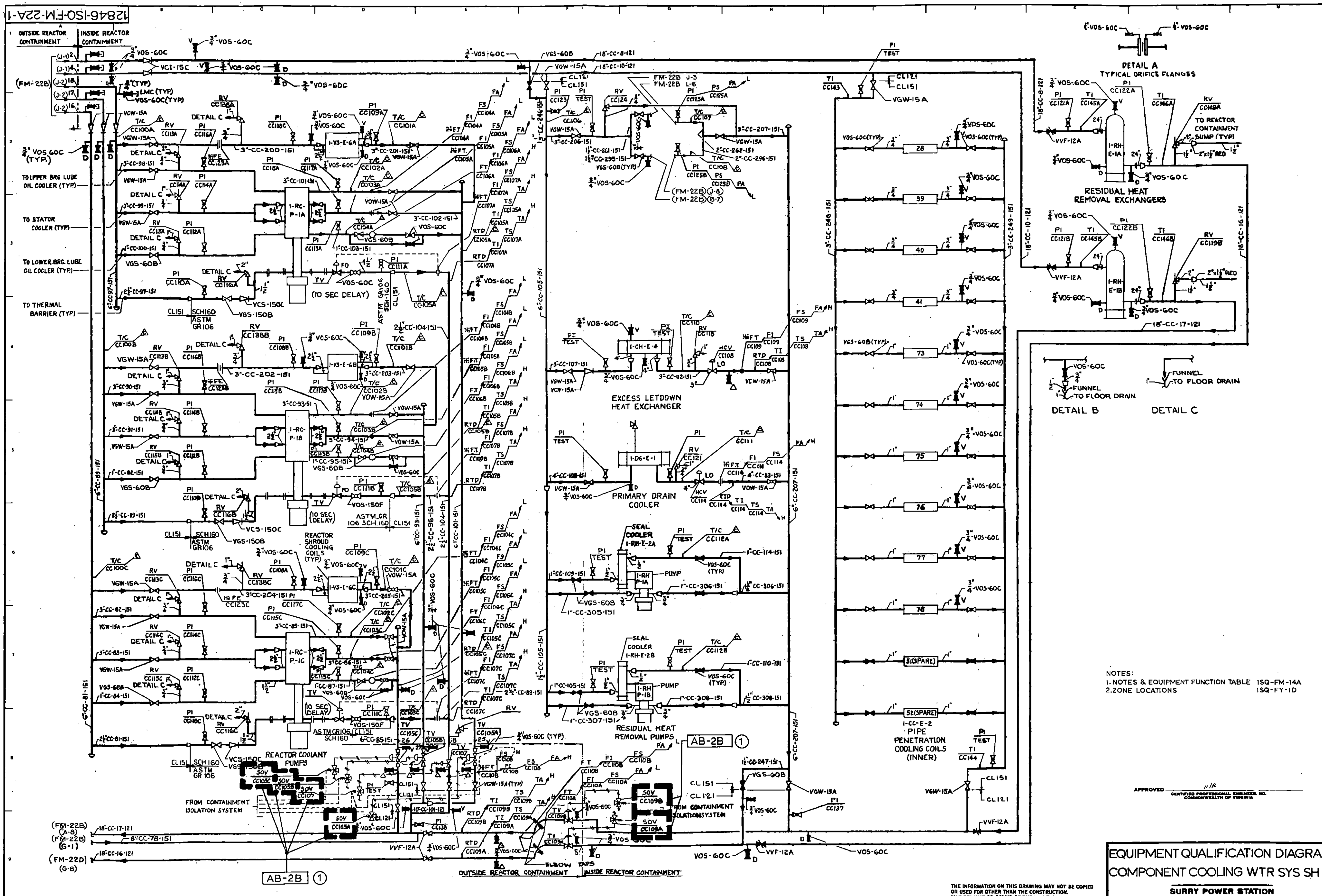

NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

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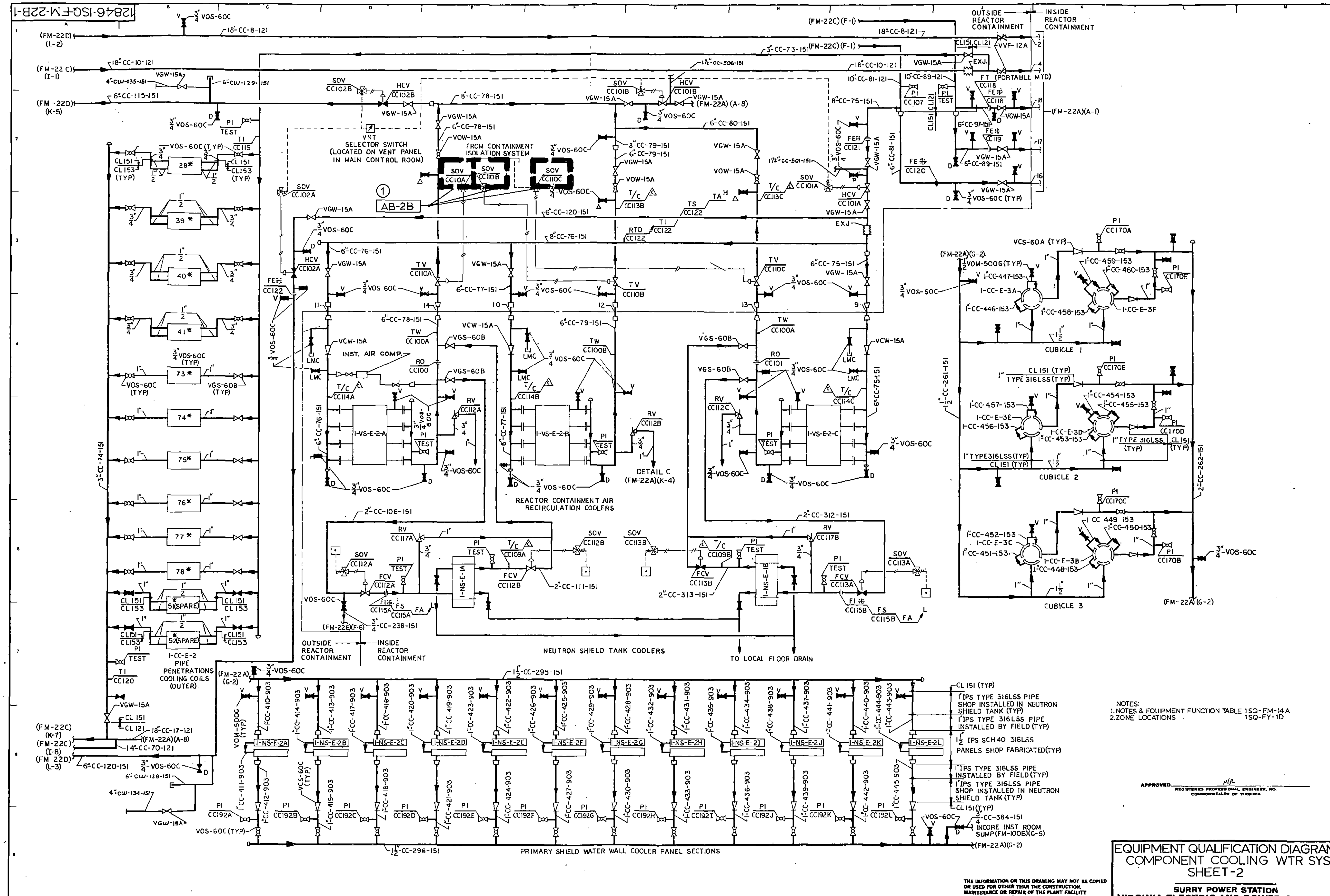
EQUIPMENT QUALIFICATION DIAGRAM
COMPONENT COOLING WTR SYS SH-1

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-ISQ-FM-22A-1



NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

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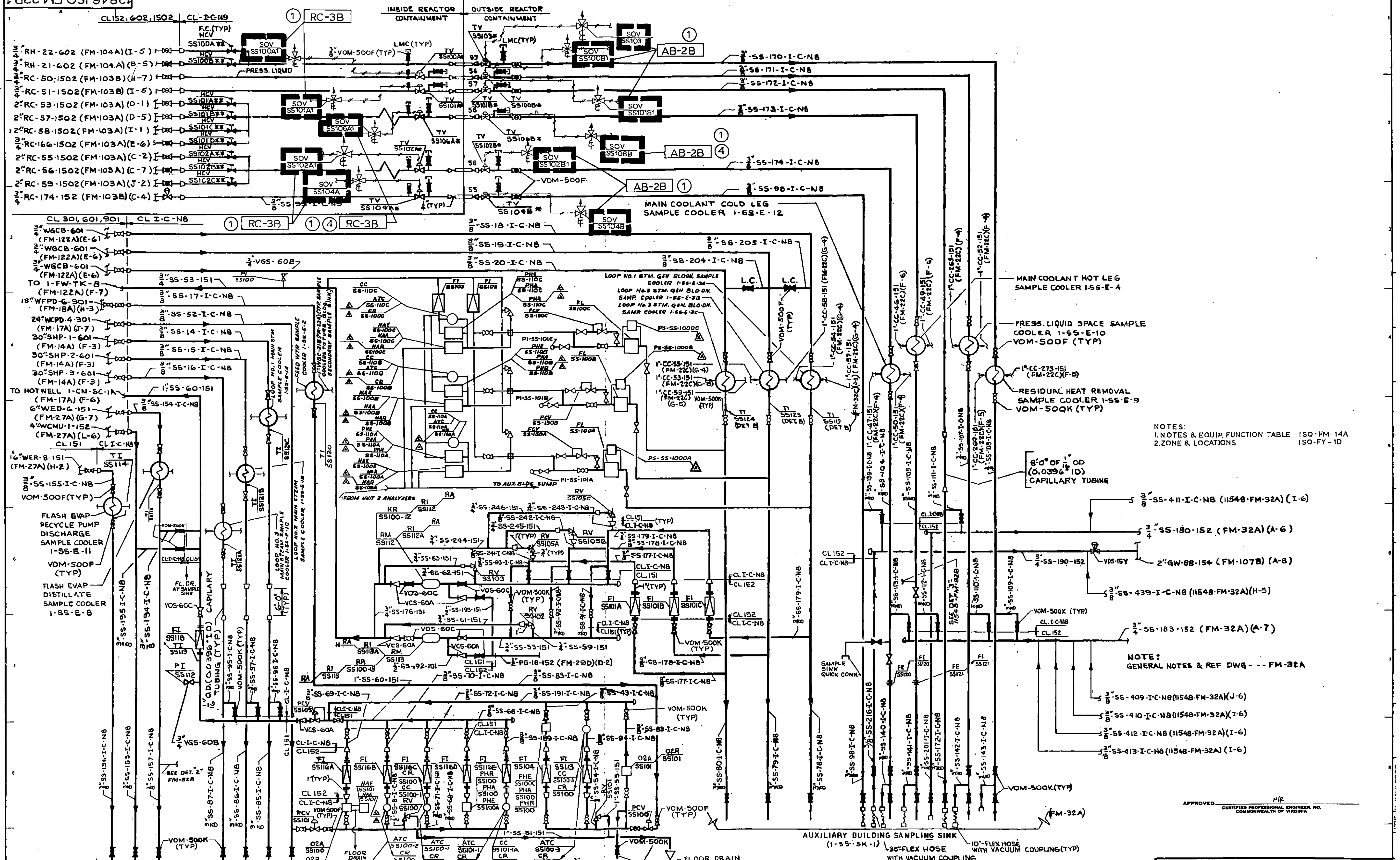
EQUIPMENT QUALIFICATION DIAGRAM COMPONENT COOLING WTR SYS SHEET-2

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-22B-1



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EQUIPMENT QUALIFICATION DIAGRAM SAMPLING SYSTEM SH-2

SURRY POWER STATION

VIRGINIA ELECTRIC AND POWER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION BOSTON, MASS.

DRAWING NUMBER 12846-ISQ-FM-32B-1

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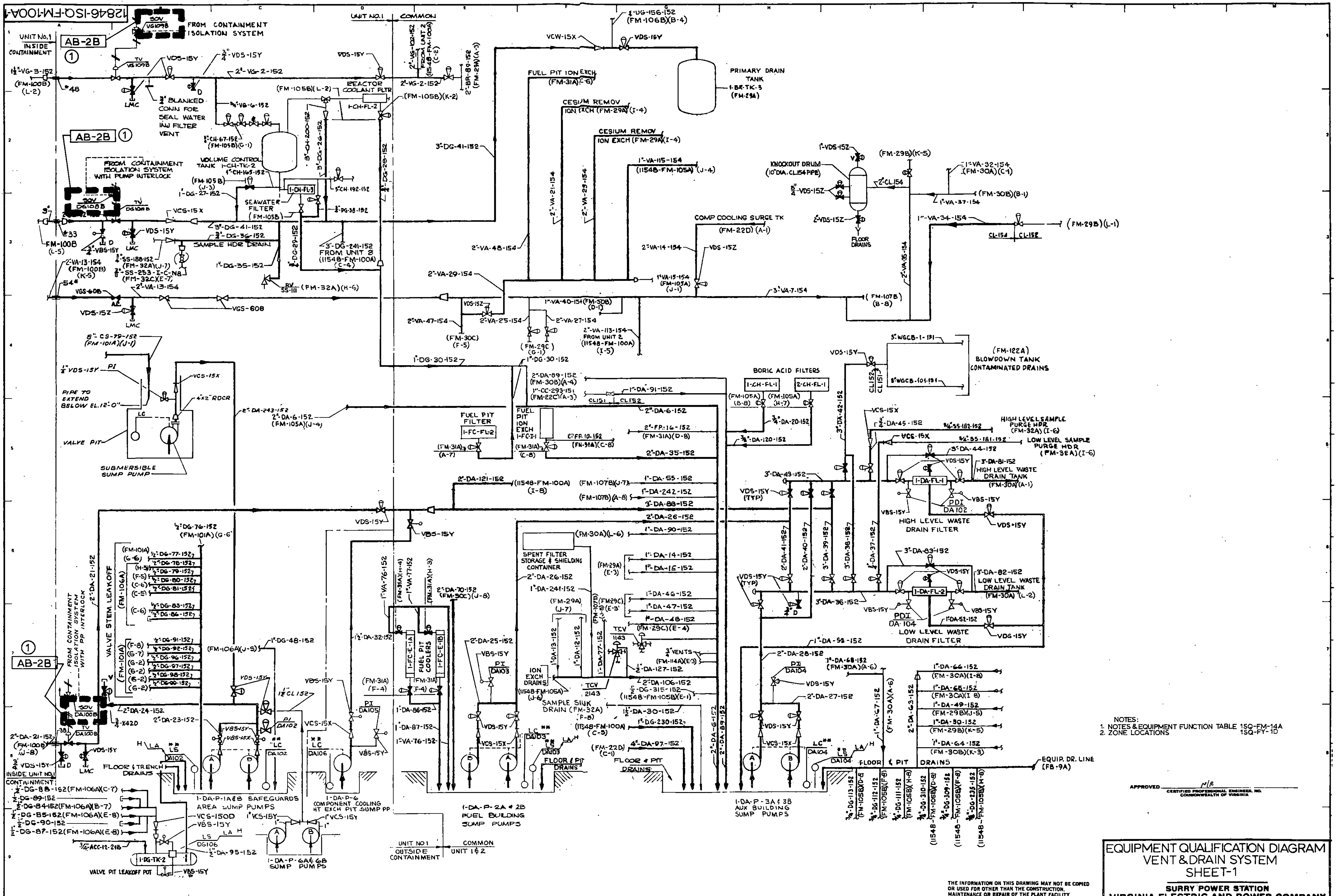

NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

APPROVED ________ CERTIFIED PROFESSIONAL ENGINEER, NO. COMMONWEALTH OF VIRGINIA

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ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
1	ORIGINAL ISSUE PER JO. NO 12846.44			DAP

EQUIPMENT QUALIFICATION DIAGRAM VENT & DRAIN SYSTEM SHEET-1

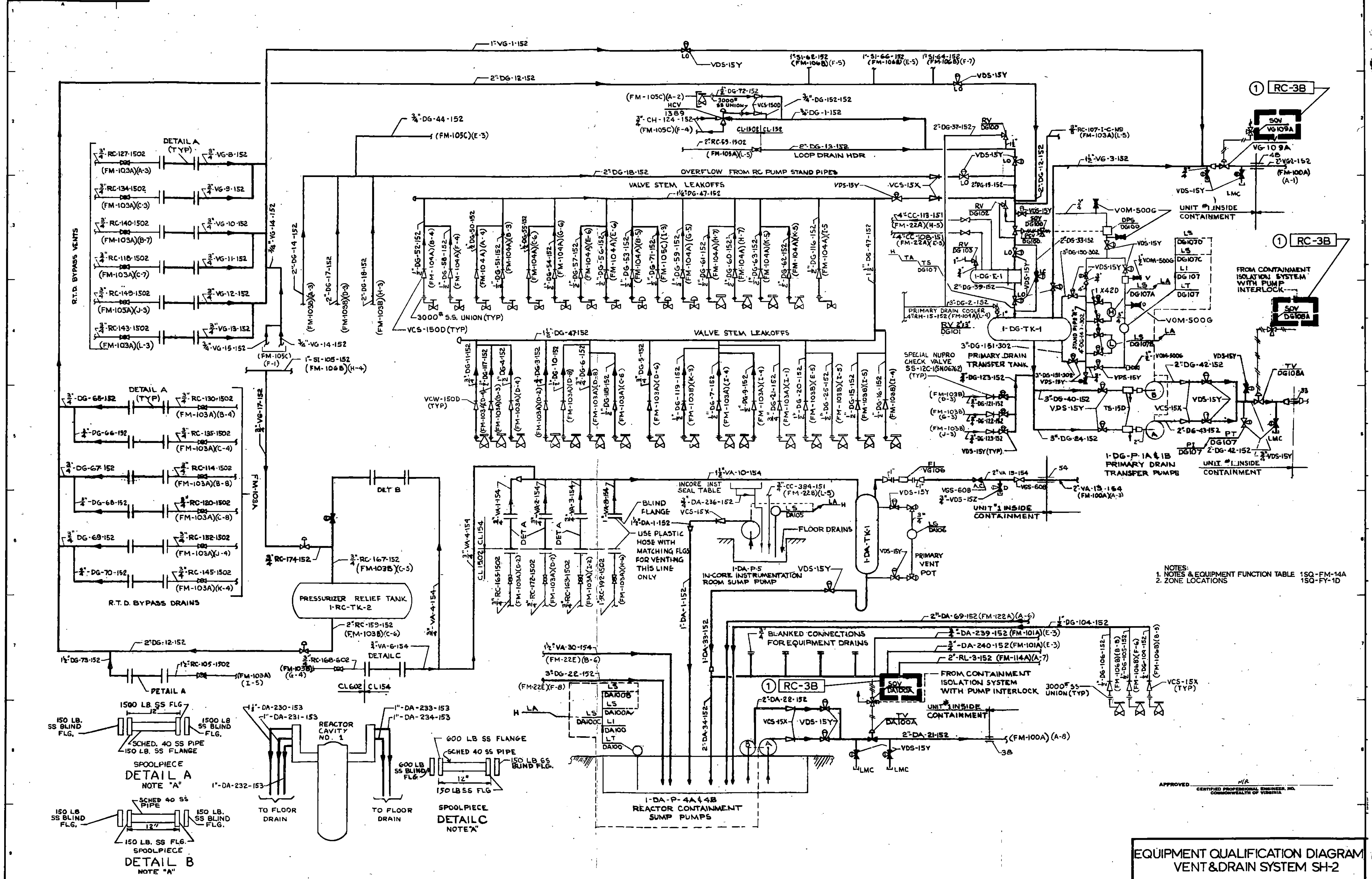
SURRY POWER STATION

VIRGINIA ELECTRIC AND POWER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-100A-1

12846-ISQ-FM-100B-1



NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

APPROVED

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EQUIPMENT QUALIFICATION DIAGRAM VENT & DRAIN SYSTEM SH-2

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-ISQ-FM-100B-1

ISSUE	DESCRIPTION	CHKD	CORRECT	APPD DATE
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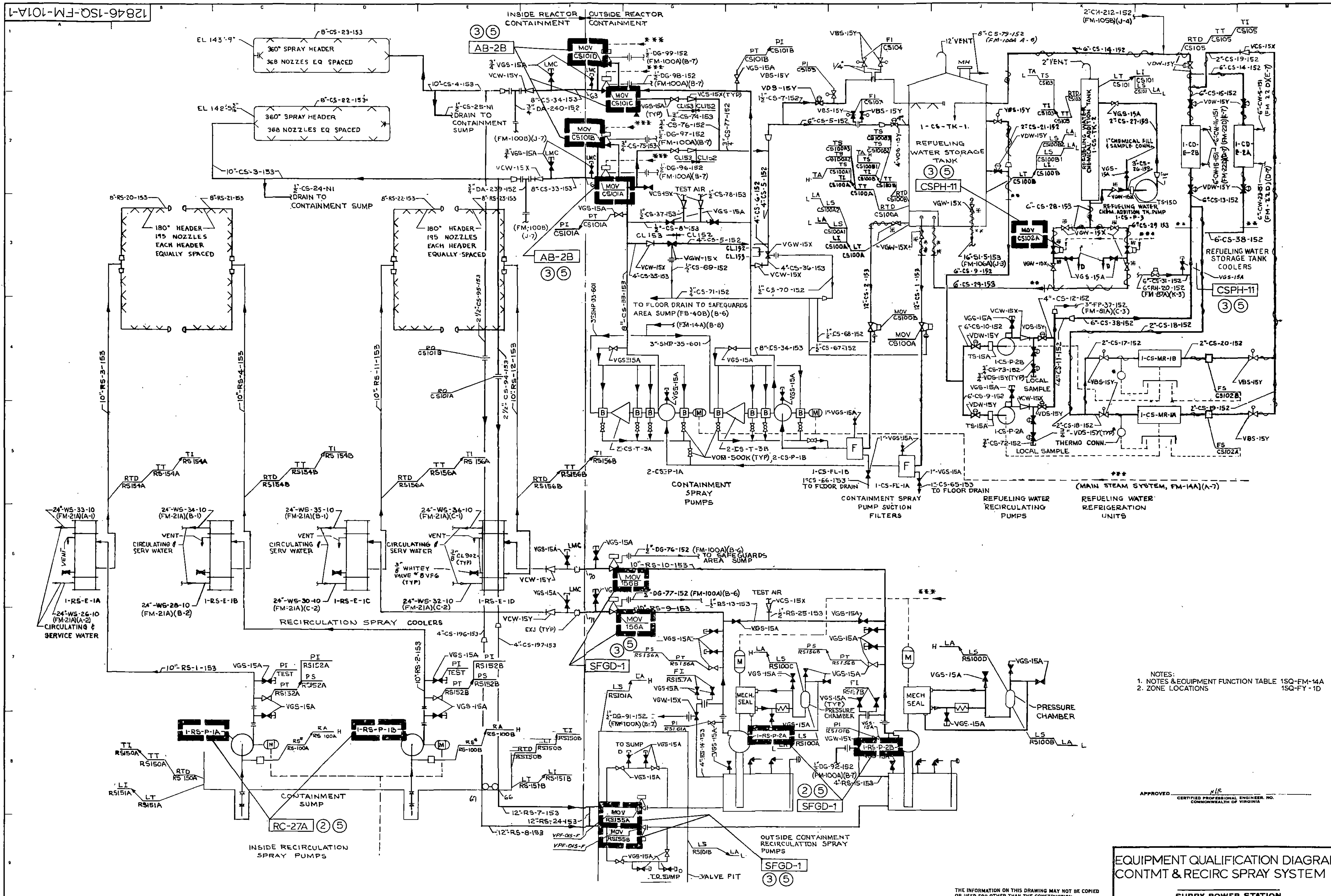
4				
3				
2				
1	ORIGINAL ISSUE PER J.O. NO 12846.44			



NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

APPROVED
CERTIFIED PROFESSIONAL ENGINEER, NO.
COMMONWEALTH OF VIRGINIA

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EQUIPMENT QUALIFICATION DIAGRAM CONTMT & RECIRC SPRAY SYSTEM

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-101A-1

ISSUE	DESCRIPTION	CHKD	CORRECT	APPD DATE
1	ORIGINAL ISSUE PER J.O. NO 12846.44			
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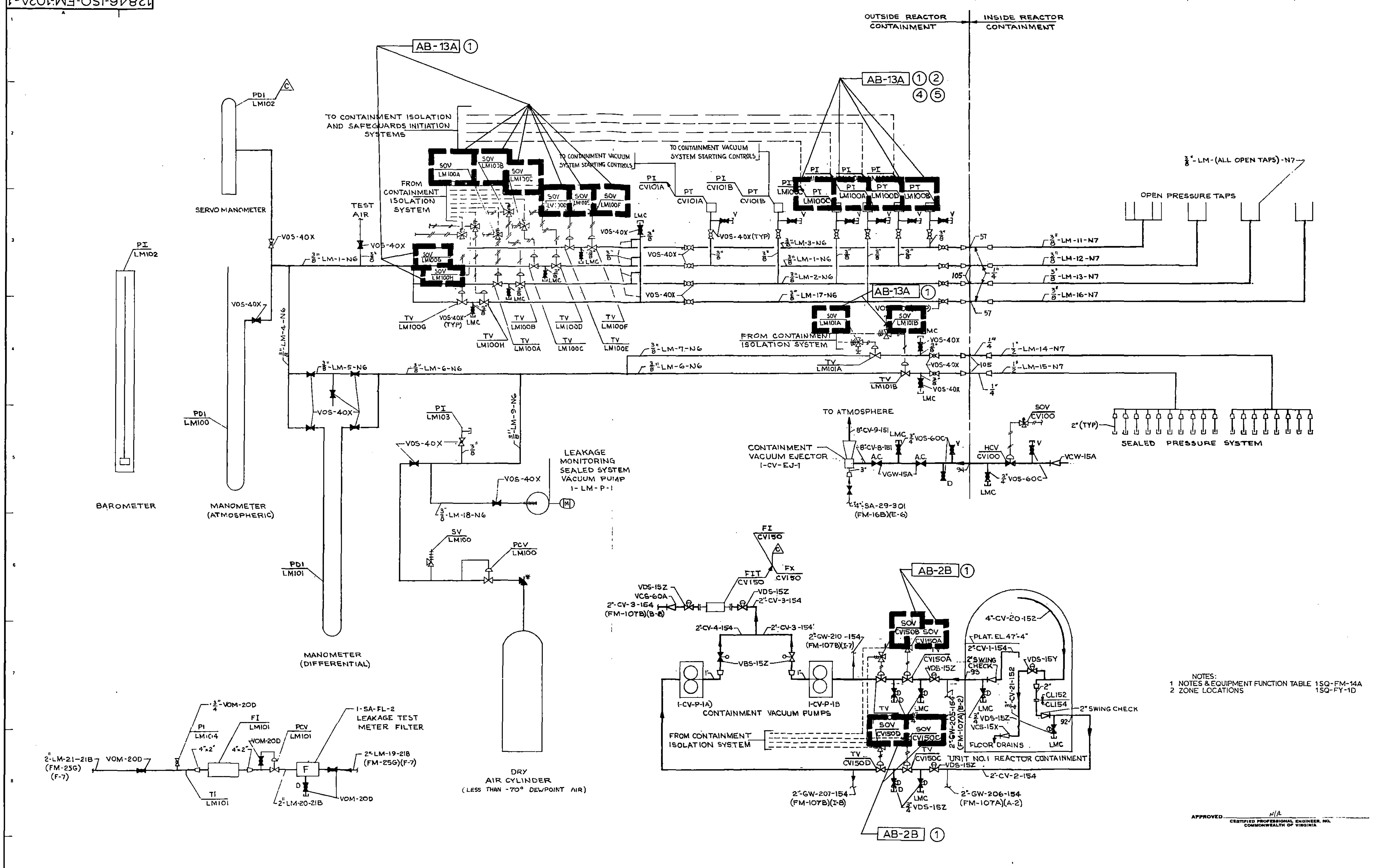

NOTES:
1 NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2 ZONE LOCATIONS 1SQ-FY-1D

APPROVED N/A
CERTIFIED PROFESSIONAL ENGINEER, NO. COMMONWEALTH OF VIRGINIA

THE INFORMATION ON THIS DRAWING MAY NOT BE COPIED OR USED FOR OTHER THAN THE CONSTRUCTION, MAINTENANCE OR REPAIR OF THE PLANT FACILITY, DESCRIBED IN THE TITLE BLOCK.

ISSUE	DESCRIPTION	CHKD	CORRECT	APPD DATE
5				
4				
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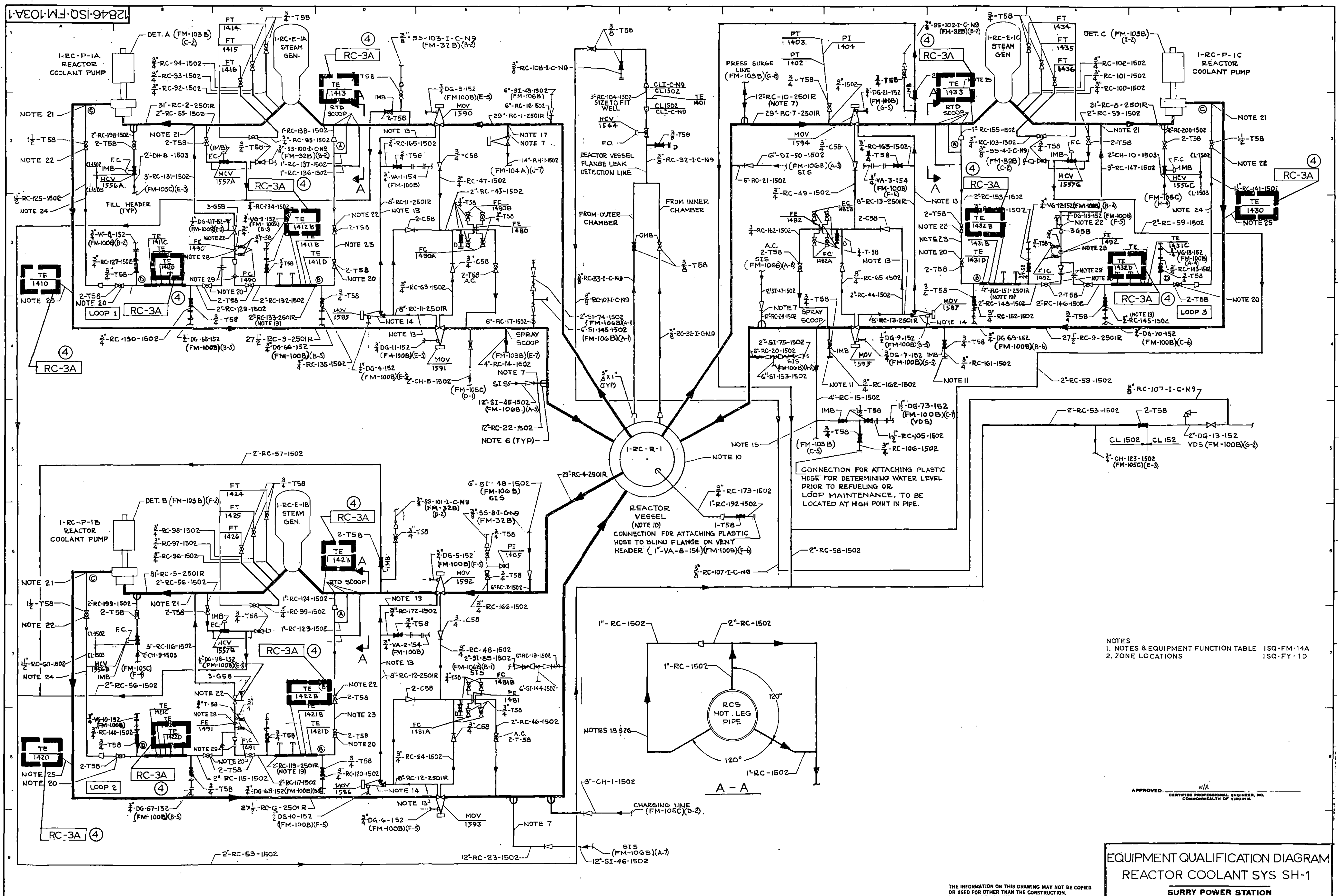
1	ORIGINAL ISSUE PER J.O. NO 12846.44			3/2/81

EQUIPMENT QUALIFICATION DIAGRAM CONTAINMENT VAC. & LEAKAGE MONITOR SYS.

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-102A-1



NOTES
1. NOTES & EQUIPMENT FUNCTION TABLE ISQ-FM-14A
2. ZONE LOCATIONS ISQ-FY-1D

APPROVED N/A
CERTIFIED PROFESSIONAL ENGINEER, NO. COMMONWEALTH OF VIRGINIA

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ISSUE	DESCRIPTION	CHKD	CORRECT	APPD DATE
5				
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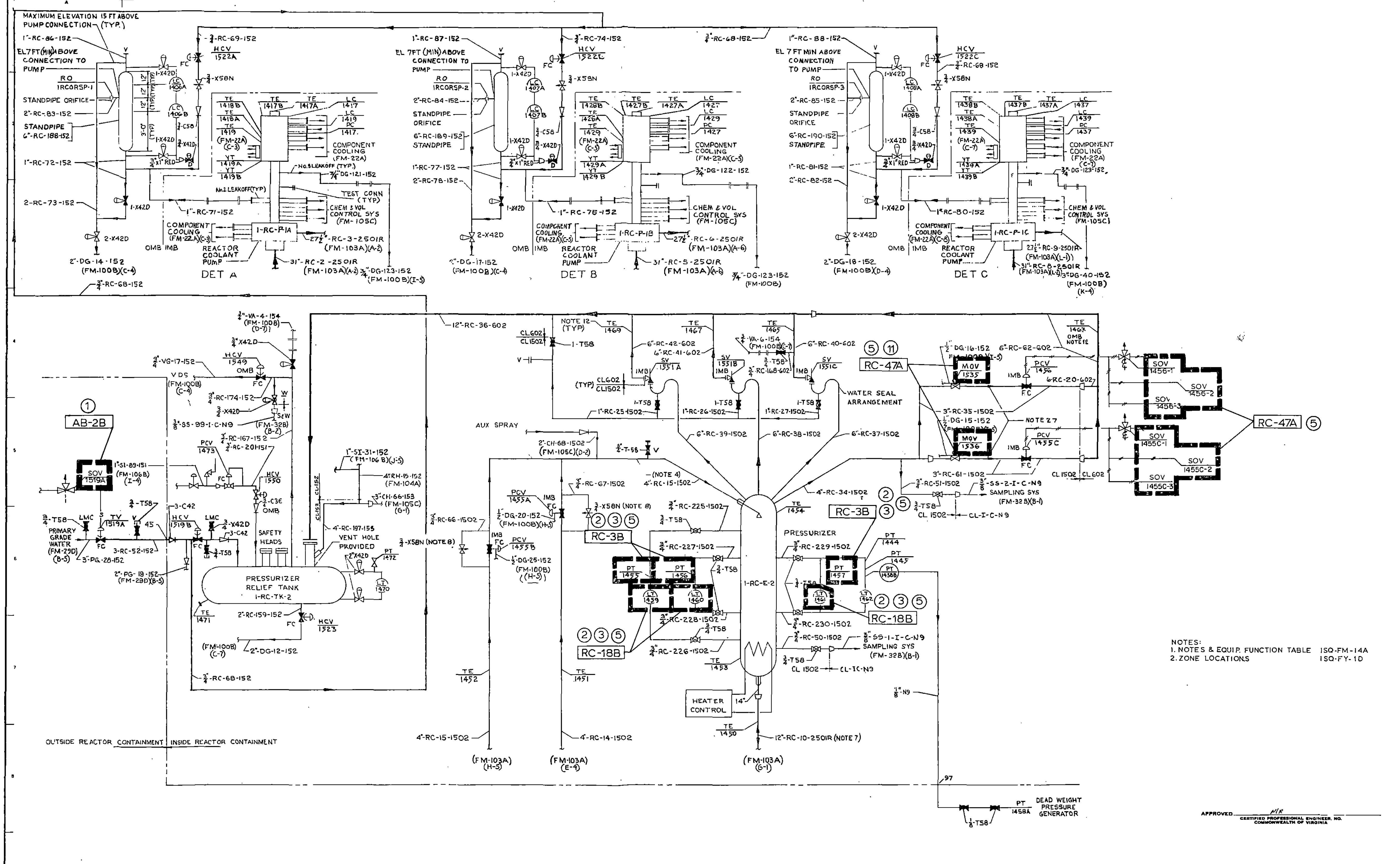
1	ORIGINAL ISSUE PER J.O. NO 12846.44			

EQUIPMENT QUALIFICATION DIAGRAM
REACTOR COOLANT SYS SH-1

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-103A-1

12846-1SQ-FM-103B-1



NOTES:
1. NOTES & EQUIP. FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

APPROVED
CERTIFIED PROFESSIONAL ENGINEER, NO.
COMMONWEALTH OF VIRGINIA

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ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
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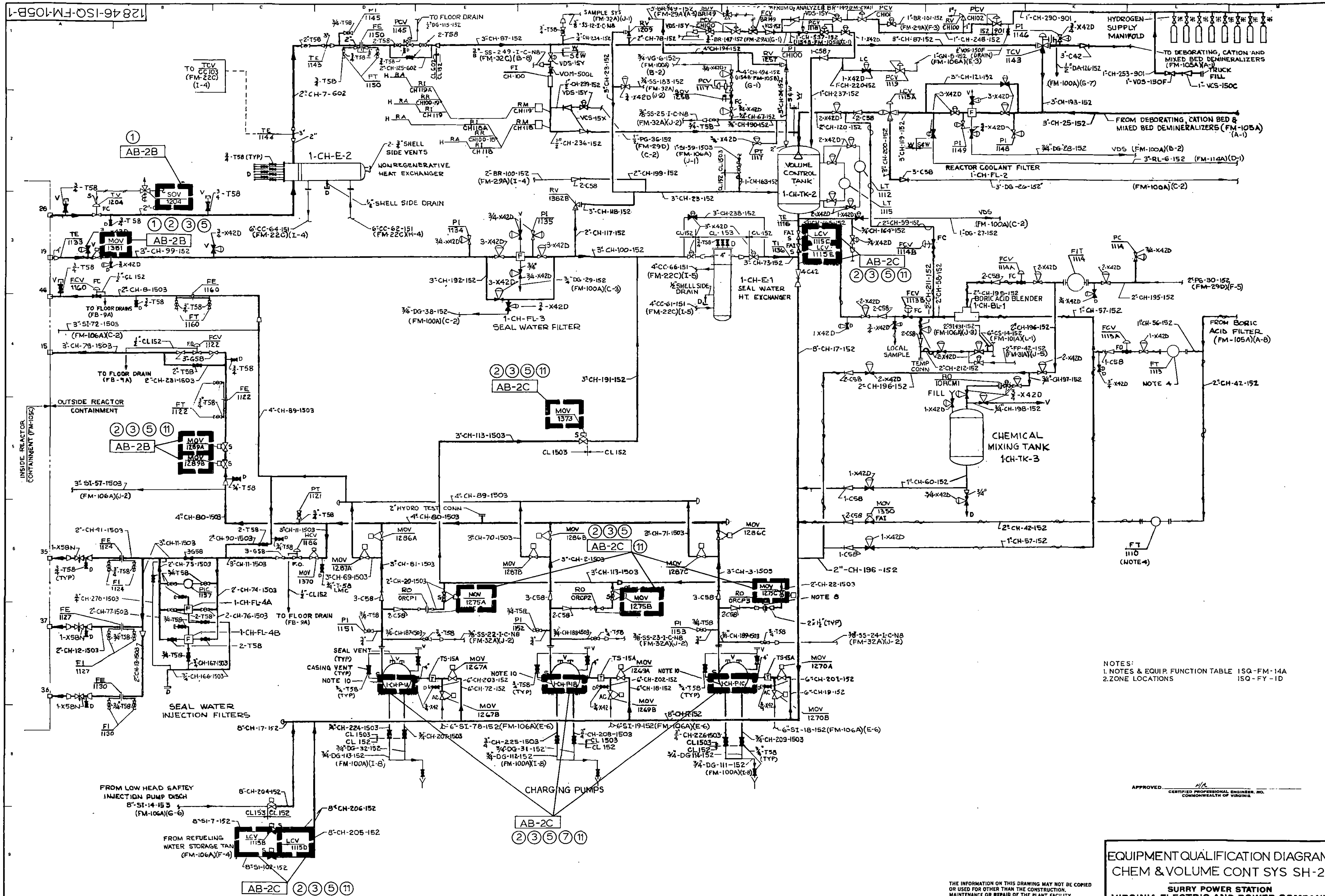
1	ORIGINAL ISSUE			

EQUIPMENT QUALIFICATION DIAGRAM REACTOR COOLANT SYS SH-2

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-103B-1



NOTES:
1. NOTES & EQUIP. FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

APPROVED

CERTIFIED PROFESSIONAL ENGINEER, NO. COMMONWEALTH OF VIRGINIA

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ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
5				
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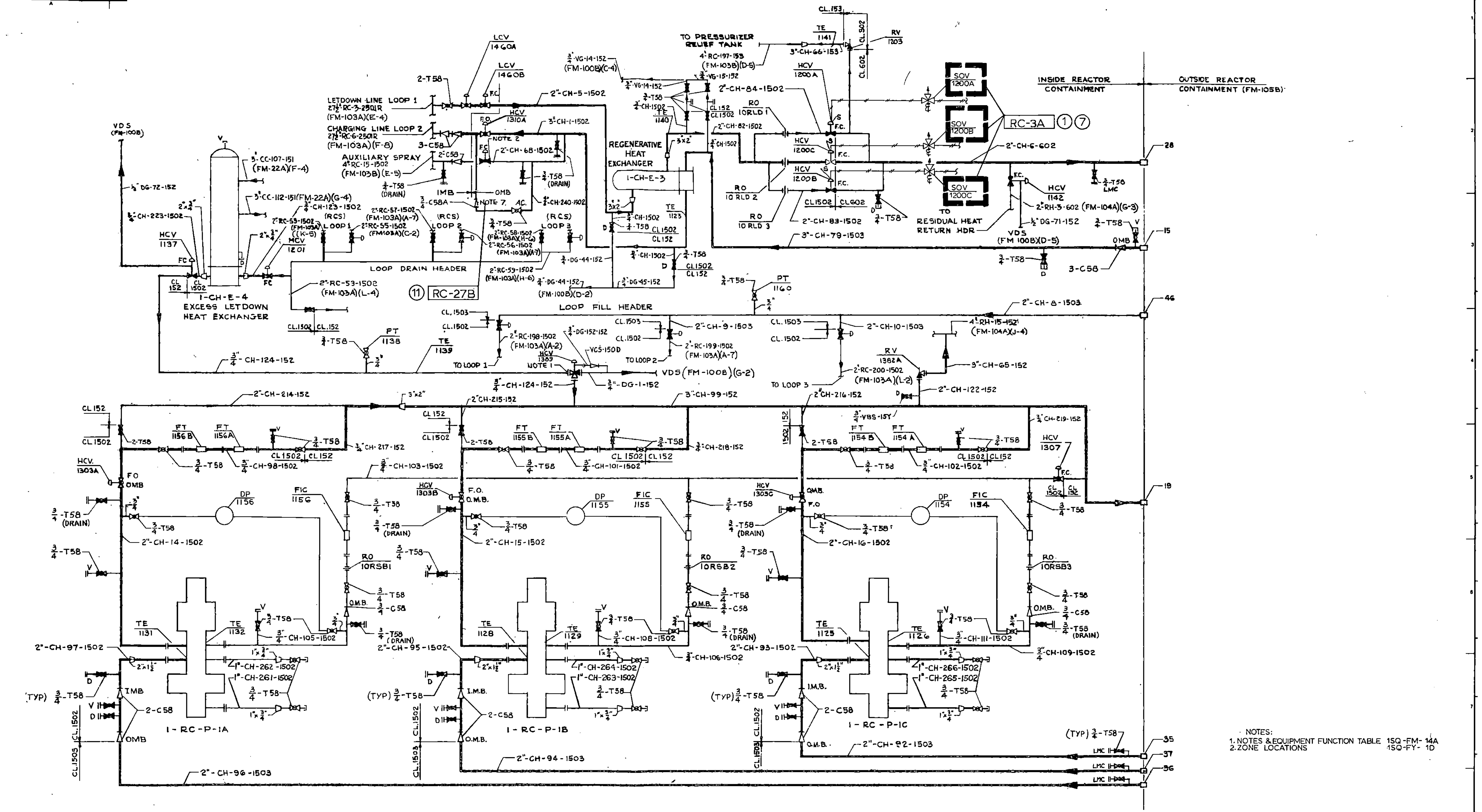
1	ORIGINAL ISSUE			

EQUIPMENT QUALIFICATION DIAGRAM
CHEM & VOLUME CONT SYS SH-2

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-105B-1



NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

APPROVED ___ N/R
CERTIFIED PROFESSIONAL ENGINEER, NO.
COMMONWEALTH OF VIRGINIA

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ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
5				
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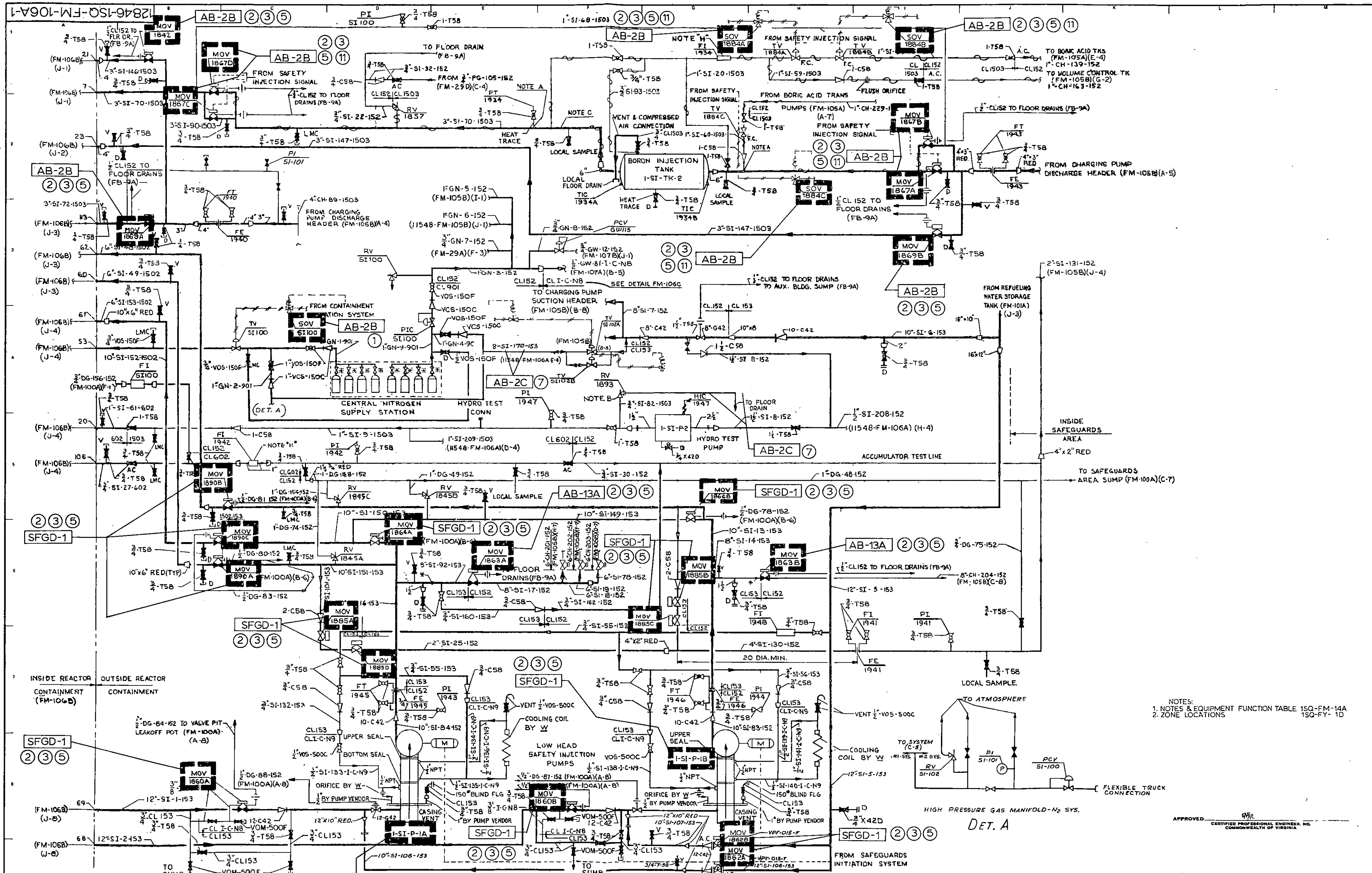
1	ORIGINAL ISSUE			

EQUIPMENT QUALIFICATION DIAGRAM CHEM & VOLUME CONTROL SYS SH-3

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-105C-1

12846-1SQ-FM-105C-1



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APPROVED ______ CERTIFIED PROFESSIONAL ENGINEER, NO. COMMONWEALTH OF VIRGINIA

EQUIPMENT QUALIFICATION DIAGRAM
SAFETY INJECTION SYS. SH-1

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-106A-1

ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
1	ORIGINAL ISSUE PER JO. NO 12846.44			
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3				
4				
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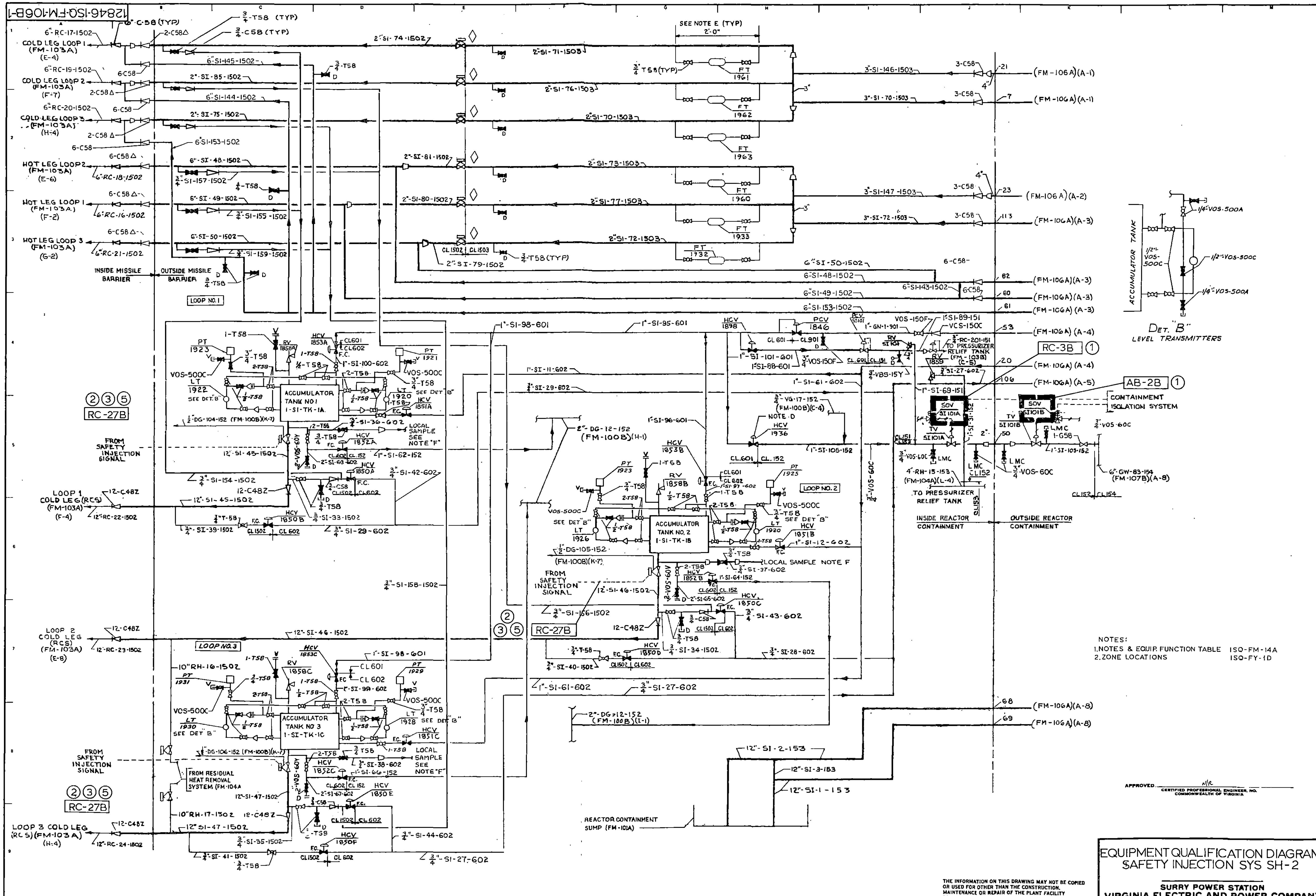

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ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
5				
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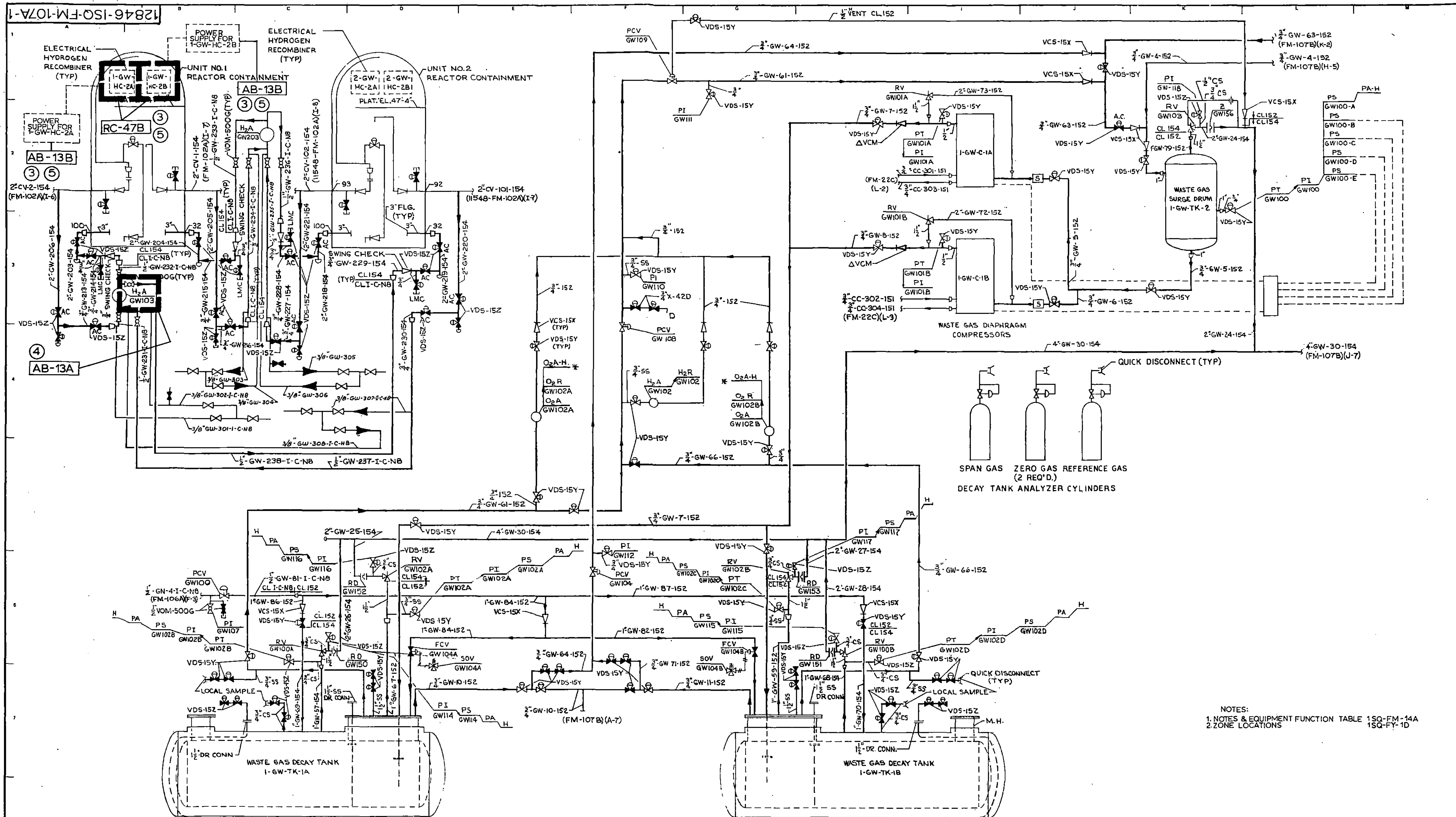
1	ORIGINAL ISSUE PER J.O. NO 12846.44			

EQUIPMENT QUALIFICATION DIAGRAM
SAFETY INJECTION SYS SH-2

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-ISQ-FM-106B-1



NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

APPROVED ____ REGISTERED PROFESSIONAL ENGINEER, NO. ____ COMMONWEALTH OF VIRGINIA

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EQUIPMENT QUALIFICATION DIAGRAM GASEOUS WASTE DISP. SYS SHEET-1

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION BOSTON, MASS.

DRAWING NUMBER 12846-ISQ-FM-107A-1

ISSUE	DESCRIPTION	CHKD	CORRECT	APPD DATE
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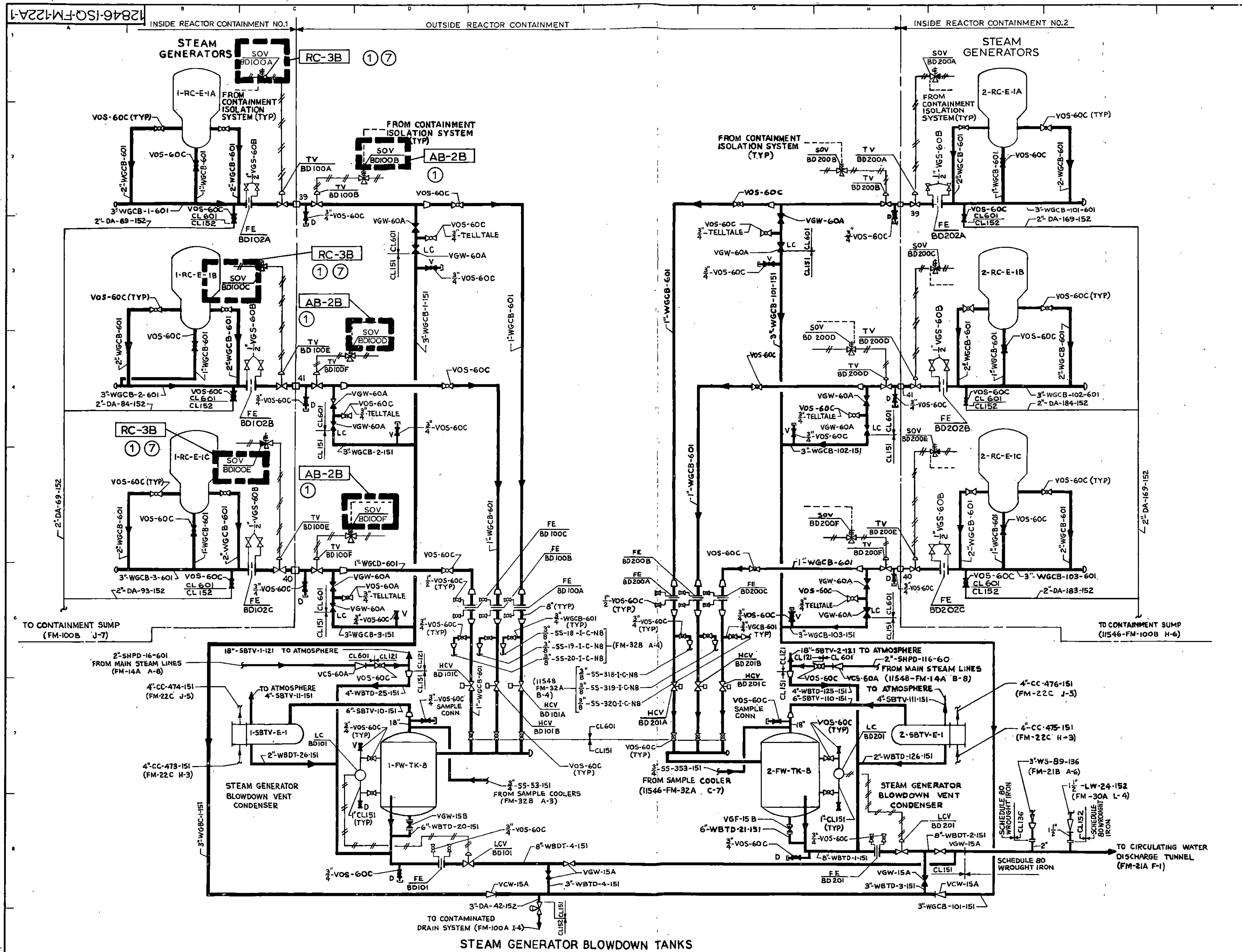
1	ORIGINAL ISSUE PER J.O. NO 1284644			



NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SO-FM-14A
2. ZONE LOCATIONS 1SO-FY-1D

APPROVED N/A REGISTERED PROFESSIONAL ENGINEER NO. COMMONWEALTH OF VIRGINIA

EQUIPMENT QUALIFICATION DIAGRAM STEAM GENERATOR BLOWDOWN

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION BOSTON, MASS.

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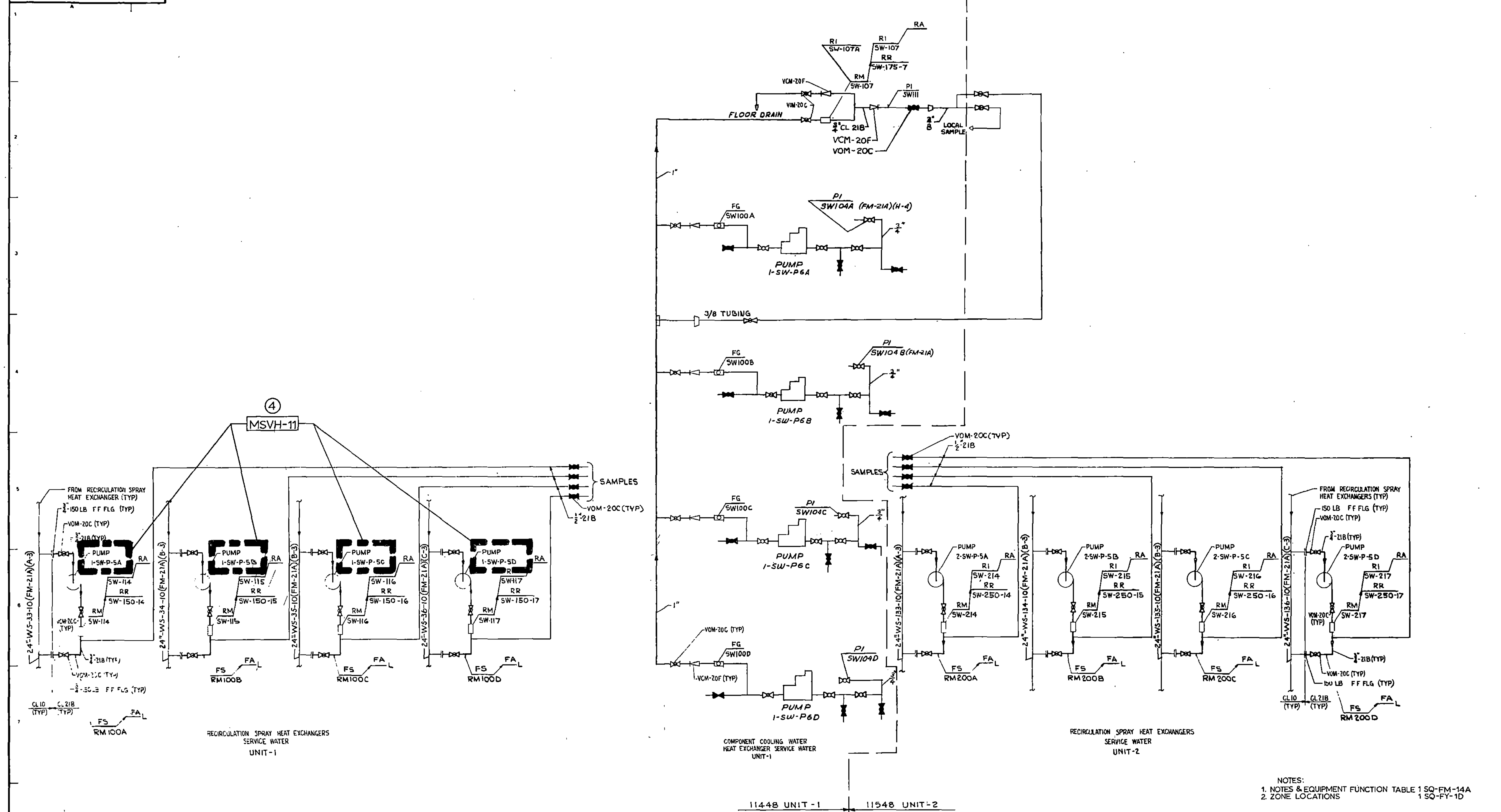
ISSUE	DESCRIPTION	CHKD	CORRECT	APPR DATE
1	ORIGINAL ISSUE PER JO NO 12846.44			5/31/81

DRAWING NUMBER 12846-1 SQ-FM-122A-1

12846-1SQ-FM-126A-1



NOTES:
1. NOTES & EQUIPMENT FUNCTION TABLE 1SQ-FM-14A
2. ZONE LOCATIONS 1SQ-FY-1D

APPROVED ___ CERTIFIED PROFESSIONAL ENGINEER, NO. COMMONWEALTH OF VIRGINIA

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ISSUE	DESCRIPTION	CHKD	CORRECT	APPD DATE
5				
4				
3				
2				
1	ORIGINAL ISSUE PER J.O. NO 12846.44			

EQUIPMENT QUALIFICATION DIAGRAM
RAD MONITORING SYSTEMS
CIRC. & SERVICE WTR.

SURRY POWER STATION
VIRGINIA ELECTRIC AND POWER COMPANY
STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 12846-1SQ-FM-126A-1

VEPCO

SURRY POWER STATION

UNITS 1 & 2

ENVIRONMENTAL ZONE DESCRIPTION

VOLUME 2

VIRGINIA ELECTRIC AND POWER COMPANY

INDEX TO REFERENCES

Tab	Description
1.	Distribution Memorandum Technical Specifications Surry Power Station Units 1 & 2, Conditions of the License, August 14, 1978. Service Water Temperature Limit (From D.W. Speidell, Jr. of VEPCO dated August 21, 1978).
2.	Stone & Webster Calculation No. 12846.44-US(B)-052-1.
3.	Stone & Webster Calculation No. 12846.54-RP-038-1.
4.	Stone & Webster Calculation No. 12846.44-PE-050-0.
5.	IE Bulletin 79-01B, Surry Power Station Unit 1, Section 2.3.
6.	Stone & Webster Calculation No. 12846.01-PE-036-0.
7.	Stone & Webster Calculation No. 12846.38-RP-024-1.
8.	Stone & Webster Calculation No. 12846.44-PE-049-0.
9.	Stone & Webster Calculation No. 12846.54-RP-037-0.
10.	Stone & Webster Calculation No. 12846.44-UR(B)-043-0.
11.	Stone & Webster Calculation No. 12846.38-RP-031-0.
12.	Stone & Webster Calculation No. 12846.44-PE-044-0.
13.	Stone & Webster Calculation No. 12846.54-RP-039-0.
14.	FSAR Section 9.13.2 (Pg. 9.13.2-1); Surry Power Station Units 1 and 2, December 1, 1969.
15.	FSAR Section 5.3 (pg. 5.3-1); Surry Power Station Units 1 and 2, December 1, 1969.

INDEX TO REFERENCES (Cont)

Tab	Description Stone & Webster Calculation No.	Input to Reference No.
A.	12846.07-5.7	2
B.	12846.01-PE-030-0	6
C.	12846.19-PE-038-0	2
D.	12846.44-PE-041-0	4
E.	12846.44-PE-042-1	4
F.	12846.44-PE-045-0	2
G.	12846.44-PE-046-0	4
H.	12846.38-RP-026-0	10
I.	12846.54-RP-035-0	10
J.	12050-RP-095-0	11

USER'S GUIDE TO E2D REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

E2D REFERENCE NO. 1
E2D REFERENCE DESCRIPTION: Distribution Memorandum (from D.W. Speidell, Jr. of VEPCO dated August 21, 1978). Technical Specifications, Surry Power Station Units 1 & 2, Conditions of the License, August 14, 1978. Service Water Temperature Limit.
ENVIRONMENTAL ZONE(S): RC-3A, RC-3B, RC-18B, RC-27A, RC-27B, RC-47A, RC-47B

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
TEMPERATURE (°F)	125 (maximum)	1						
PRESSURE (psia)	9.0-11.1	3						
RELATIVE HUMIDITY (%)								
CHEMICAL SPRAY								

DISTRIBUTION MEMORANDUM
TECHNICAL SPECIFICATIONS
SURRY POWER STATION
UNIT NOS. 1 AND 2

TO: Richmond, Virginia

Mrs. Marion E. Cliffe
Stone & Webster Eng. Corp.
Copy No. 148

FROM: David W. Speidell, Jr. August 21, 1978

CONDITIONS OF THE LICENSE
AUGUST 14, 1978
SERVICE WATER TEMPERATURE LIMIT

The Nuclear Regulatory Commission has recently issued Amendments No. 43 and 42 to the Operating License for the Surry Power Station Unit Nos. 1 and 2. This amendment which specifies license conditions results from our request to operate with a service water temperature above 87°F. These interim conditions will ensure adequate net positive suction head to the recirculation spray and low head safety injection pumps, as well as satisfactory containment depressurization performance, in the event of a loss of coolant accident. Of significance, the staff has imposed the following limitations:

"The facility shall be operated within the following limits:

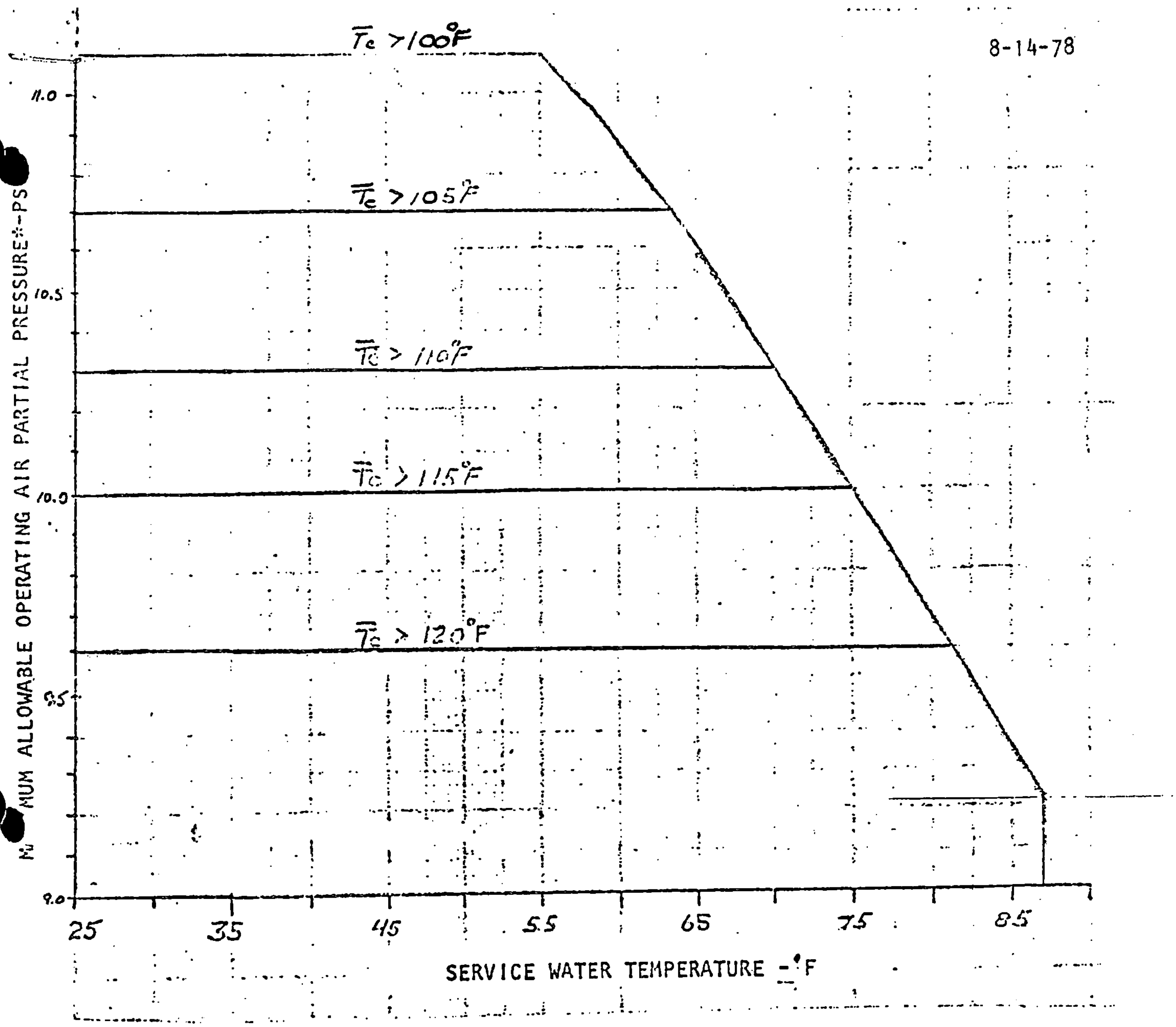
Maximum Service Water Temperature	90°F
Containment Temperature Allowable Range	100°F-125°F
Containment Air Partial Maximum Pressure	
1. For Service Water Temperature $\leq 87°$	Air partial pressure shall be maintained in accordance with Figure 3.F.2
2. For Service Water Temperature $>87°$	Air partial pressure shall be maintained in accordance with Figure 3.F.1.
Minimum Refueling Water Storage Tank Volume	385,200 gallons
Outside Recirculation Spray Pump Flow Rate	2250 gpm"

Since the order constitutes limiting conditions for operation, please place your copy of this memo in the front of your Technical Specifications and delete the previous distribution memo for the June 29, 1978 Order. Once you have inserted your copy, please sign and date the acknowledgement sheet and forward it to my office.

David W. Speidell, Jr.

Attachment

DWSjr:jal



NOTES

Maximum allowable operating air partial pressure in the containment as a function of service water temperature and refueling water storage tank temperature.

*Set point value in containment vacuum system instrumentation

$\bar{T}_c$ = Average containment temperature

Refueling Water Storage Tank Temperature ≤ 45°F

FIG 3.F.2

MAXIMUM ALLOWABLE OPERATING AIR PARTIAL PRESSURE SURRY POWER STATION

Unit 1 Amend No. 43

Unit 2 Amend No. 42

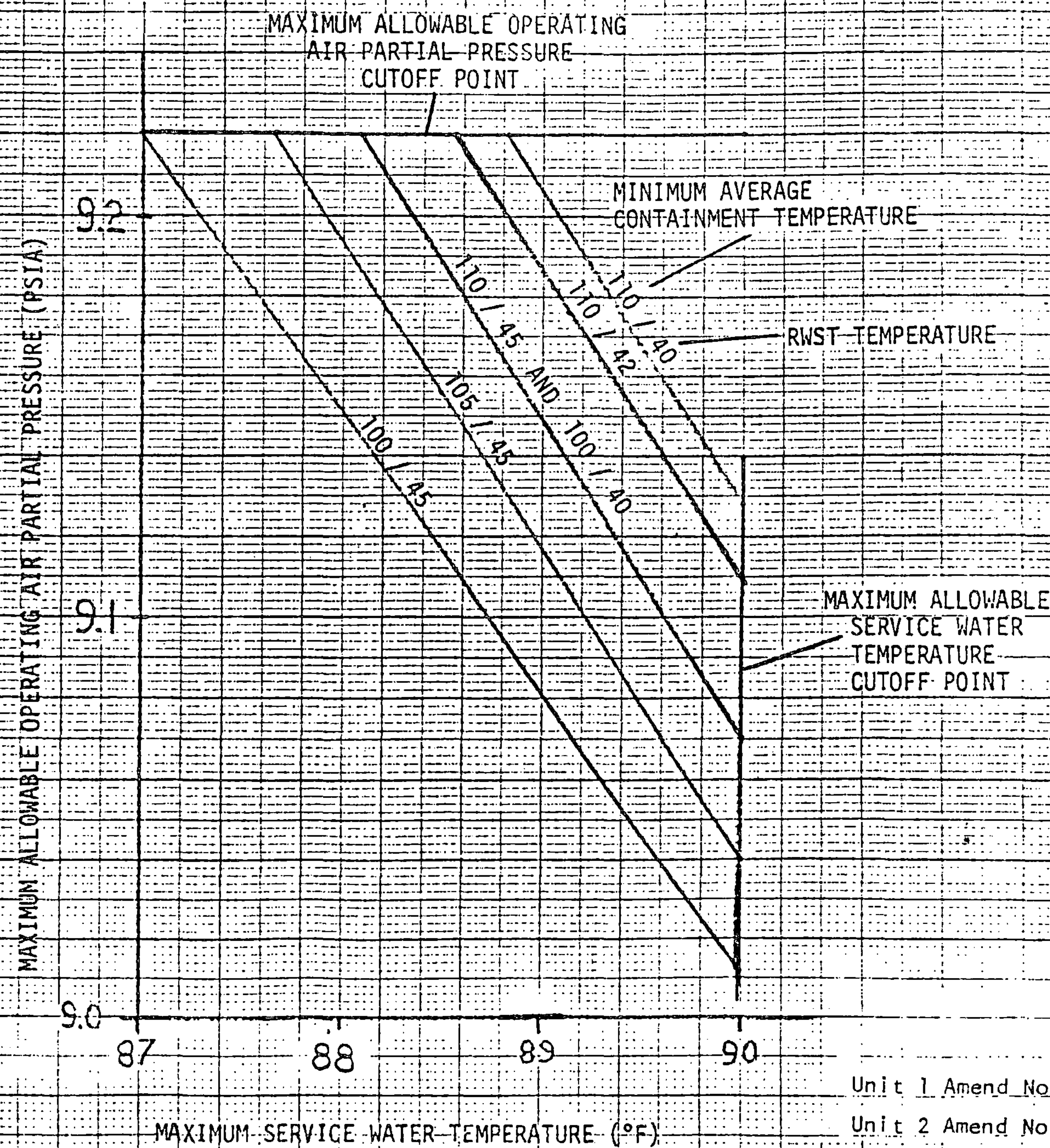
8-14-78

FIGURE 3.F.1

ALLOWABLE OPERATING PARAMETERS

FOR HIGH SERVICE WATER TEMPERATURES

SURRY POWER STATION UNITS 1 & 2



Unit 1 Amend No. 43

Unit 2 Amend No. 42

46 1320

K&E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN USA

USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 2
EZD REFERENCE DESCRIPTION: 12846.44-US(B)-052-1
ENVIRONMENTAL ZONE(S): RC-3A, RC-3B, RC-18B, RC-27A, RC-27B, RC-47A, RC-47B

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
TEMPERATURE (°F)			280 F, 0-30 min 280-150 F, 30-60 min 150-120 F, 1-48 hr 120 F, 2-120 days	7	280 F, 0-30 min 280-150 F 30-60 min 160-120 F, 1-48 hr 120 F, 2-120 days	7		
PRESSURE (psia)			59.7, 0-30 min 59.7-14.7 30-60 min 147.7-12.7, 1-48 hr 12.7, 2-120 days	6	59.7, 0-30 min 59.7-14.7 30-60 min 14.7-12.7, 1-48 hr 12.7, 2-120 days	6		
RELATIVE HUMIDITY (%)			100, 0-120 days	8	100, 0-120 days	8		
CHEMICAL SPRAY			Solution of 2000-2200 ppm H_3BO_3 buffered with NaOH to pH of 8.5-11, 0-4 hr. Same solution with pH of between 8.0 and 9.5, 4 hr-120 days	9	Solution of 2000-2200 ppm H_3BO_3 buffered with NaOh to pH of 8.5-11, 0-4 hr. Same solution with pH of between 8.0 and 9.5 4 hr-120 days	9		

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

▲5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF
VEPCO / Surry 1 & 2	21

CALCULATION TITLE (Indicative of the Objective):	QA CATEGORY (✓)
Containment Post-accident environmental conditions for equipment qualification.	☒ I – NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ____ OTHER

CALCULATION IDENTIFICATION NUMBER

J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12846.44	US	052	—	ETA 0004

*APPROVALS – SIGNATURE & DATE

PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)	REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (✓) YES	NO
Edwin Sum 6-4-81	D L Post 6-10-81	D L Post / I 6-10-81	0	—	✓ LOCTIC Rev. 22 L.01	
	NOTED JUN 11 1981 R.F.MILLER RFM					
Edwin Sum 7-7-81	D L Post 7-8-81	D L Post / I 7-8-81	1	0	"	
	NOTED JUL 9 1981 R.F.MILLER RFM					

DISTRIBUTION*

GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT. FILES (OR FIRE FILE IF NONE)	M. Cliffe 245/14	2			
	J. Barnhart 245/14	5			

1-C-1

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

12846.44 US(B)

Page No. 2

Preliminary

Item 052-1

Client VEPCO Location Surry 1/2 Est. No. J.O. No.

Subject Date By

Checked By

Based on Revised By

T.O.C.

[figures 1-4, 7-10 of Rev. 0 has been replaced by Rev. 1. There were inconsistancies in envelopes in Rev. 0. New envelopes are used in Rev. 1 which is less conservative. This page 2 is also revised to reflect the changes. All replaced pages are given in Appendix A.] Rev. 1

1-C-2

Client — Location 12846.44 — Est. No. US(B) — J.O. No. 052

Subject — Date — By

Checked — By

Based on — Revised — By

I. Title

Containment post-accident environmental conditions for equipment qualification.

II. Purpose

To document Surry 1+2 containment worst post-accident environmental conditions for equipment qualification (EQ) under the directive of IE Bulletin 79-01B & its supplements (ref. 1). Ref. 1 specifies that operating plants with automatic spray actuation are allowed to use LOCA temperature envelopes in lieu of Main Steam Line Break which is more severe. Pressure envelopes are more severe in LOCA than MSLB. This calc therefore addresses only post-LOCA conditions (MSLB has not been analysed for Surry). that are applicable to MSLB conditions.

III Reference

1. NRC I&E Bulletin 79-01B & Supplements
2. DC 77-9 Cont. Spray System Modification
3. DC 78-537 RS & LHSI modification
4. NU-100, LOCTIC manual.
5. ESSA calc 12846.19-PE-038-0 (Tech Spec)
6. Proj. " 12846.07-35-0 (pH)
7. ESSA " 12846.07-PE-035-0 (pH input)
8. " " 12846.19-PE-045-0 (long term P)
9. Proj. " 12846.07-57 (pH)
10. NRC SRP 6.5.2
11. ESSA calc. 12846.07-PE-037-0 (sump pH)
12. Proj. calc. 12846.07-26-0 (")
13. S&W dwg 11448-FP-5E-11 (RWST)
14. ESSA calc. 12846.07-PE-025-1 (QS flow)
15. " 12846.07-PE-009-1 (Spray cover.)
16. Proj. calc. 12846.19-9 (INS)
17. " 12846.19-24 (ONS)

12846.44 US(B) 052

Client | Location | Est. No. | J.O. No.
Subject | Date | By
Checked | By
Based on | Revised | By

IV Assumptions

1. PSDER is worst case for max pressure and temperature profiles in containment
2. Final NPSH fix (FF) configuration is in effect (for FF description, see ref. 2 & 3)
3. S&W (LOCTIC Rev. 22 Lev. 01, ref. 4) calculated blowdown & reflood release rates with old Westinghouse froth releases (generated for North Anna 1 & 2).

V Method

Temperature and pressure profiles for post-LOCA conditions are taken from Tech Spec calc (ref. 5 + 8) LOCTIC runs. PH values are taken from ref. 6 (which in turn utilized input from ref. 7). Relative humidity is simply max value of 100%. LOCTIC (ref. 4) Rev. 22 Lev. 01 is used in the above calc's to generate pressure-temperature profiles and is also used to generate input for pH calc.

V-a Pressure :-

Maximum post-LOCA pressure profile is generated by peak pressure (2nd peak) LOCTIC runs in ref. 5. Maximum long-term pressure is generated by subatmospheric peak pressure (3rd peak) LOCTIC runs in ref. 5 + 8. Peak pressure is 44.71 psig. As shown on p. 8 of Ref. 5, max 2nd peak is from run# 58. Figure 1 is the pressure profile for the transient. For comparison purpose, a 3rd peak profile for run# 56 is shown in fig. 2. Long term pressure is calculated in ref. 8 run# 88 + the profile is shown in fig. 3. Comparing fig. 1 + 2, pressure envelope

1-C-6

(fig. 1)
right after 2nd peak, should be taken from 3rd peak run (fig. 2 or 3). Pressure envelope is drawn in fig. 1-3 & redrawn on fig 4 by itself. Note that from 2 days to 120 days, maximum pressure is 0 psig (14.7 psia) since containment must be subatmospheric after 1 hr. The value of 12.7 is only an arbitrary estimate which was used previously. Max pressure of 45 psig is chosen since it is design pressure.

V - b. Temperature :-

Temperature is directly related to pressure. Thus maximum pressure runs in section V-a give maximum Temperature as well. Maximum post - LOCA Temp is generated by 2nd peak run (#58) from ref. 5 and is 277.1 °F @ 188 sec. The design value of 280 °F is chosen to be max temp. from 0 to ½ hr. Long term max temp envelope after reaching peak temp is based on 3rd peak runs (#56 in ref. 5 and #88 in ref. 8). The containment average temperature profile for run #58, 56, and 88 are plotted in fig. 5, 6, and 7 respectively. For comparison purpose, temp profile of two other runs are given on fig. 8 & 9.

Run #53 = fig. 8 = 3rd. peak run with different initial conditions as run #53

Run #67 = fig. 9 = 2nd. peak run with different initial conditions as run #58.

Fig 5 gives the max peak temp. Fig 6 and 7 are very close and give max long term Temp.

The maximum containment temperature envelope is drawn on fig. 5, 6 & 7 and redrawn separately on fig. 10. Note that the values of 150 °F (@ 1 hr) and 120 °F (@ 2 days) are arbitrarily chosen to cover the actual temp profile.

V - c. Relative Humidity:-

Maximum value of 100% is chosen for EQ since containment can be expected to be saturated most of the time after a LOCA.

V - d. Spray (quench spray [QS] and recirc spray [RS]) pH Values:-

Ref. 9 shows that quench spray pH is between 8.5 to 11.0 as allowed in SRP 6.5.2 (ref. 10). Maximum time before quench spray terminates from continuous operation is 4300 sec (from pH plots in ref. 9)

Ref. 11 shows that sump pH rises from 4.7 to 8 in

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less than 1 hr., then stablizes at pH 8.19. Thus the following pH envelopes are chosen for quench spray and combined (quench + recirc) spray:

quench spray { 0 to 4 hr. ⟶ pH 8.5 to 11.0

[for 1 train QS (≈ 2000 gpm, ref. 14), time to empty RWST w/o SI is about 366,000/2000 ≈ 3 hrs. (366,000 see any runs)]

combined spray { 0 to 1 hr. ⟶ pH 5.0 to 11.0
1 to 4 hrs. ⟶ pH 8.0 to 11.0
4 hrs. to 120 days ⟶ pH 8.0 to 9.5

The combined spray envelope should be used for EQ.

Note that in the first hour, we can assume a little mixing of quench + recirc spray such that the lowest spray pH is 5.0 instead of 4.7.

For completeness, RWST boron conc. is 2000 – 2200 ppm (ref. 12)

However, if equipment operation is not hindered by low pH, the quench spray pH can be used for EQ.

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V - a. Spray density (maximum) estimate :

Quench Spray : max RWST water ht is from overflow to bottom ≈ 48 ft. (ref. 13) ≡ L (≈36 psia)
min Containment pressure ≈ − 4 psia ≡ C
(typical subatmospheric containment value)

$(C - L)_{min} \approx -40$ psia

max. QS flow ≈ 5300 gpm (p. 15 of ref. 14)

Area of operating floor level covered
≈ π (63 ft)^2 (.92) (p. 2, ref. 15)
≈ 11470 ft^2

$(QS\ density)_{max} \approx \frac{5300}{11470}$
= 0.46 gpm/ft^2

Recir Spray : IRS flow = 3500 gpm × 2   ref. 16
= 7000 gpm
ORS flow = 3000 gpm × 2   ref. 17
= 6000 gpm
Total = 13000 gpm

$(RS\ density)_{max}$ = 13000/11470
assuming it sprays to annulus area
= 1.13 gpm/ft^2

QS + RS : Assume QS & RS sprays same area,

$(Total\ Spray\ density)_{max} \approx 1.13 + 0.46$
≈ 1.6 gpm/ft^2

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VI Result & Conclusion

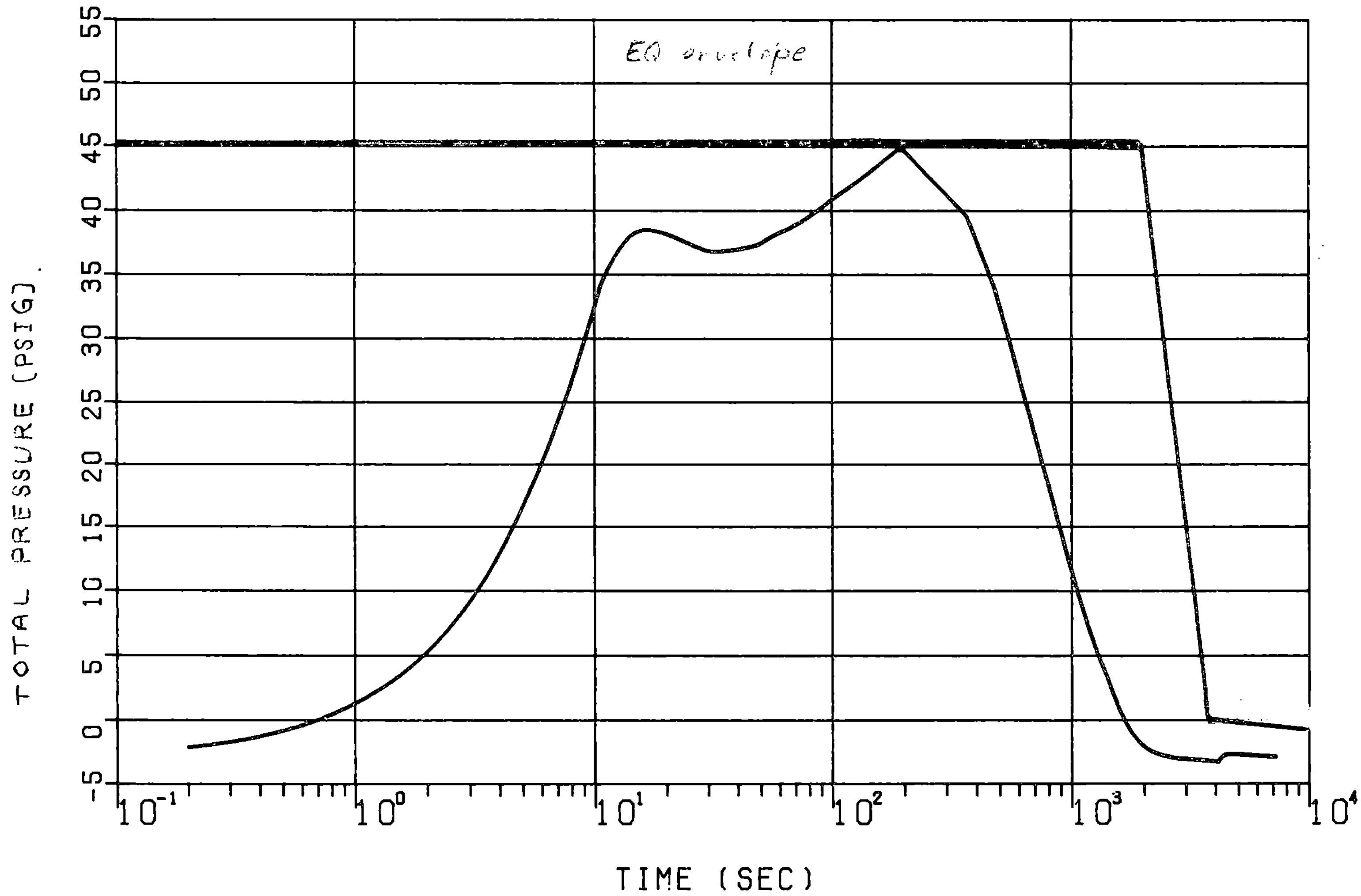
Containment post-accident environmental conditions for equipment qualification are derived from post-LOCA conditions. They are:

1. Pressure — fig. 6 (p.15)
2. Temperature — fig 10 (p.21)
3. Relative Humidity — 100% (p 7)
4. Spray pH :— (p.9)

time	pH
0 – 1 hr.	5.0 – 11.0
1 – 4 hrs.	8.0 – 11.0
4 hrs. – 120 days.	8.0 – 9.5

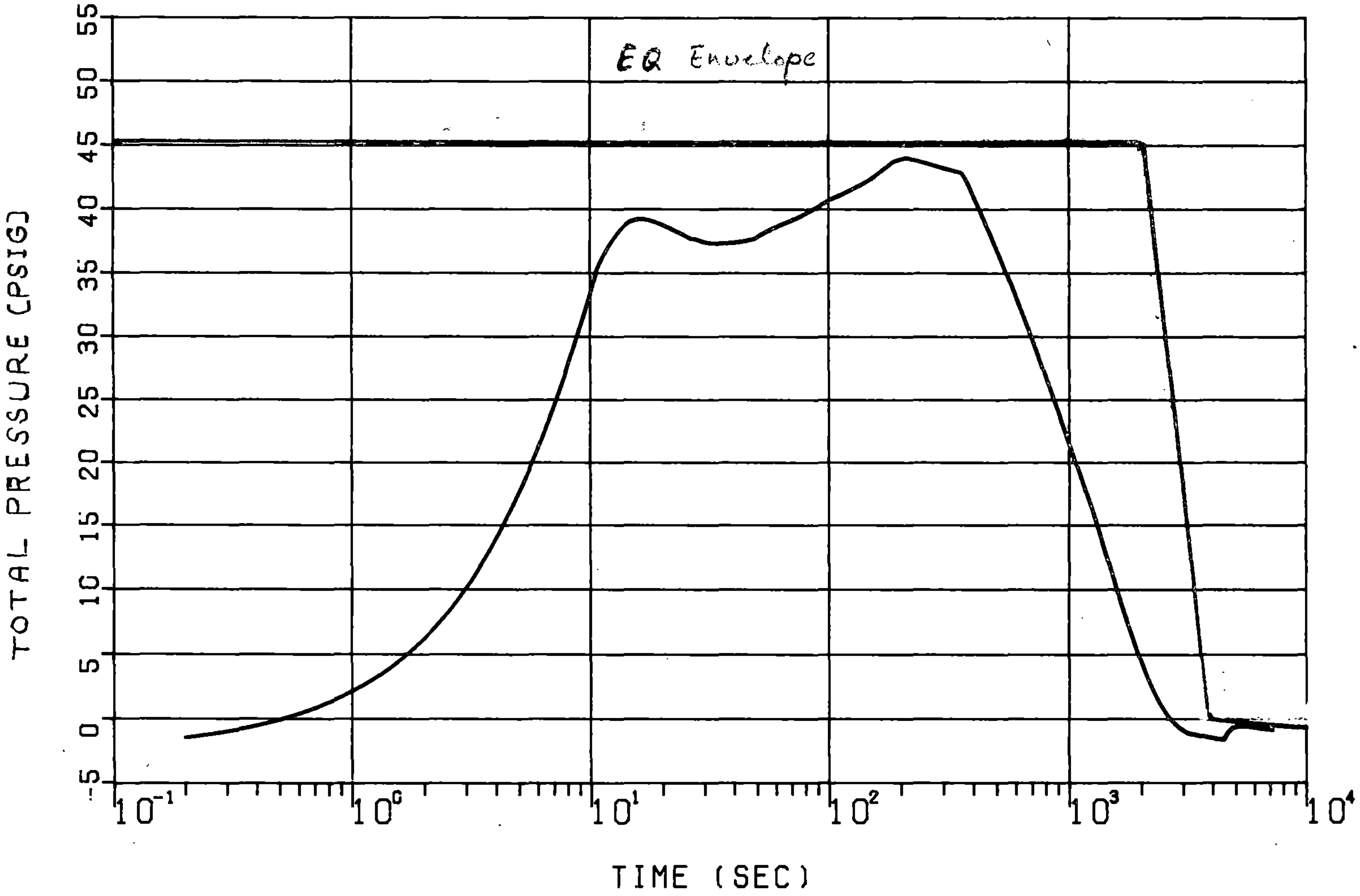
5. $(\text{Average spray density})_{max} \simeq 1.6$ gpm/ft² (p.10)

1-C-11



SURRY 1&2 TECH SPEC FINAL NPSH FIX
TOTAL PRESSURE VERSUS TIME
CONTAINMENT PRESSURE PROFILE
PLOT OF RUN # 2479058

1-C-13



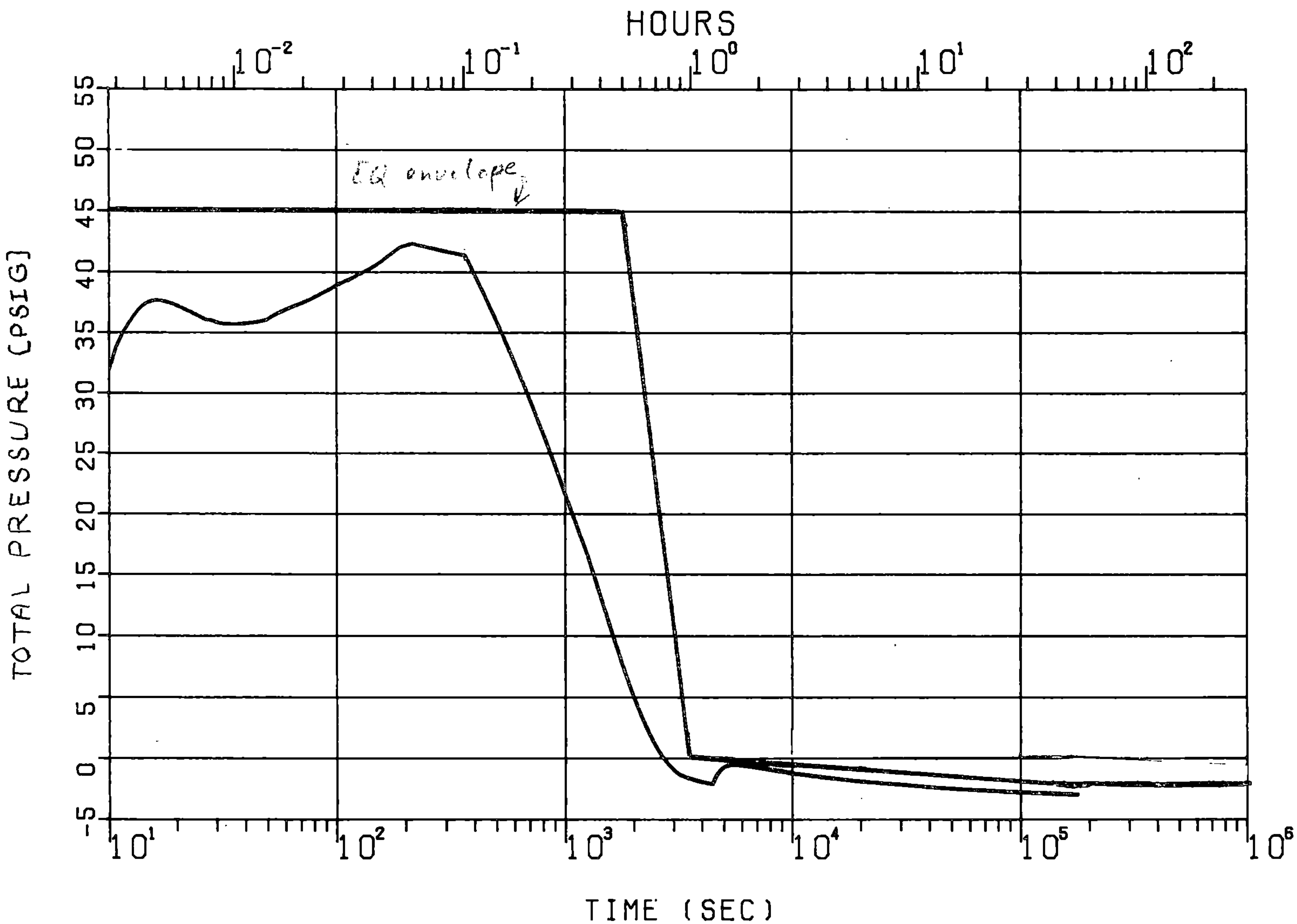
SURRY 1&2 TECH SPEC FINAL NPSH FIX
TOTAL PRESSURE VERSUS TIME
CONTAINMENT PRESSURE PROFILE
PLOT OF RUN # 2479056

Fig 2

12846.44 US(B) 052-1

p.13

I-C-14



SURRY 1&2 TECH SPEC FINAL NPSH FIX
TOTAL PRESSURE VERSUS TIME
CONTAINMENT PRESSURE PROFILE
PLOT OF RUN = 2479088

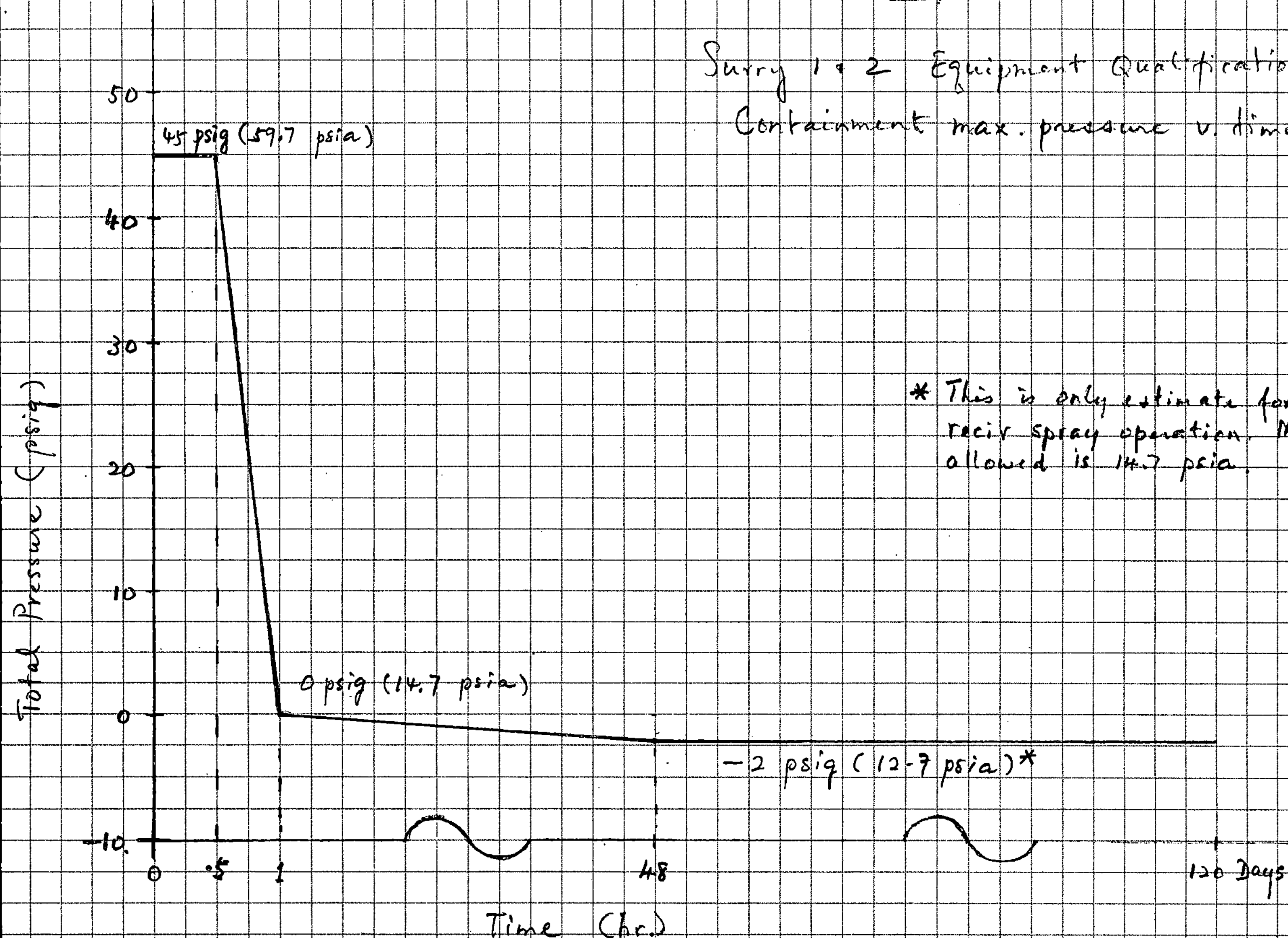
Fig. 3

12846.44 US(B) 052

I-14

Fig. 4

Surry 1 & 2 Equipment Qualification.
Containment max. pressure v. time



* This is only estimate for continuous recirc spray operation. Max pressure allowed is 14.7 psia.

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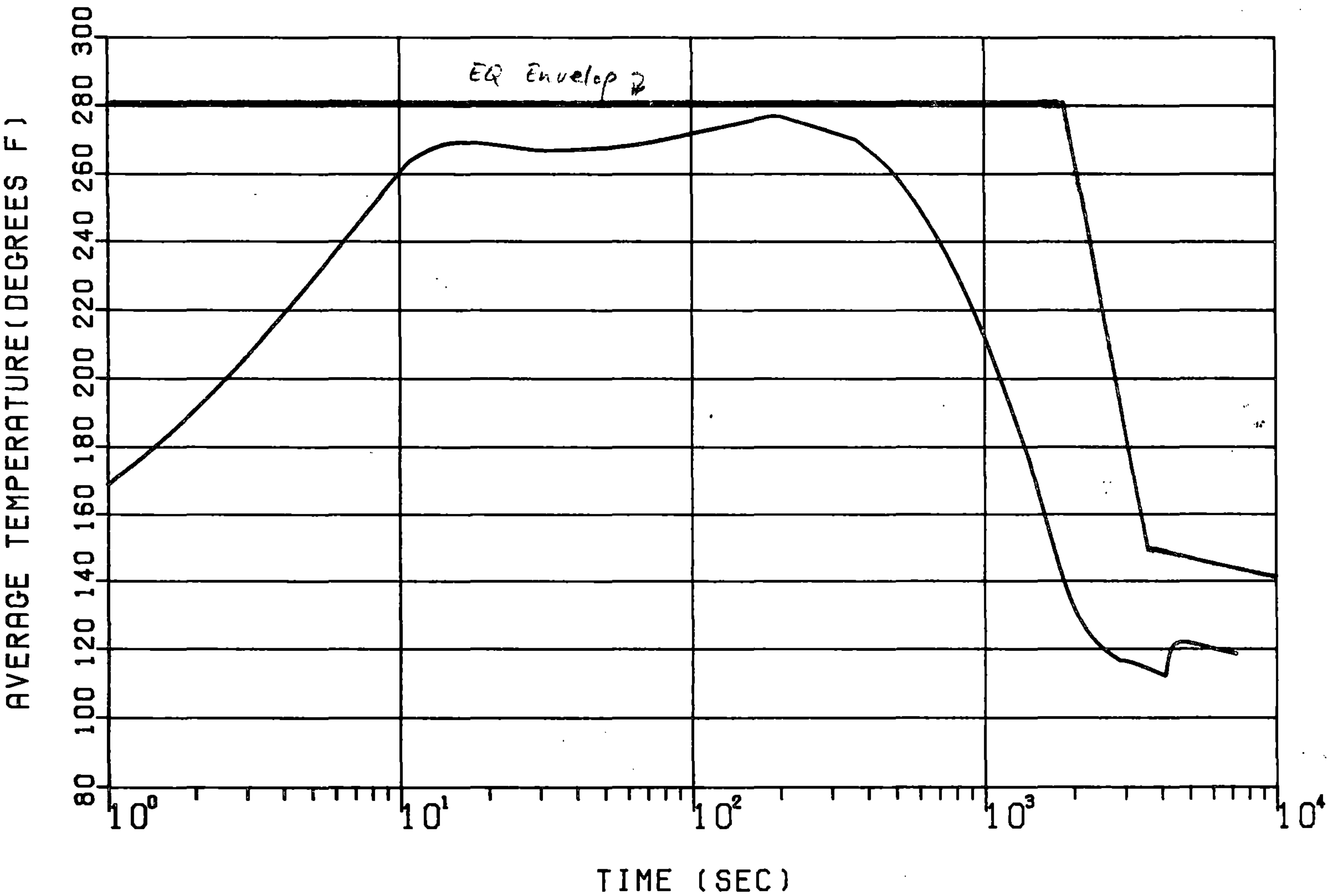

SURRY 1&2 TECH SPEC FINAL NPSH FIX
AVERAGE TEMPERATURE VERSUS TIME
CONTAINMENT TEMPERATURE PROFILES
PLOT OF RUN # 2479068

Fig-5

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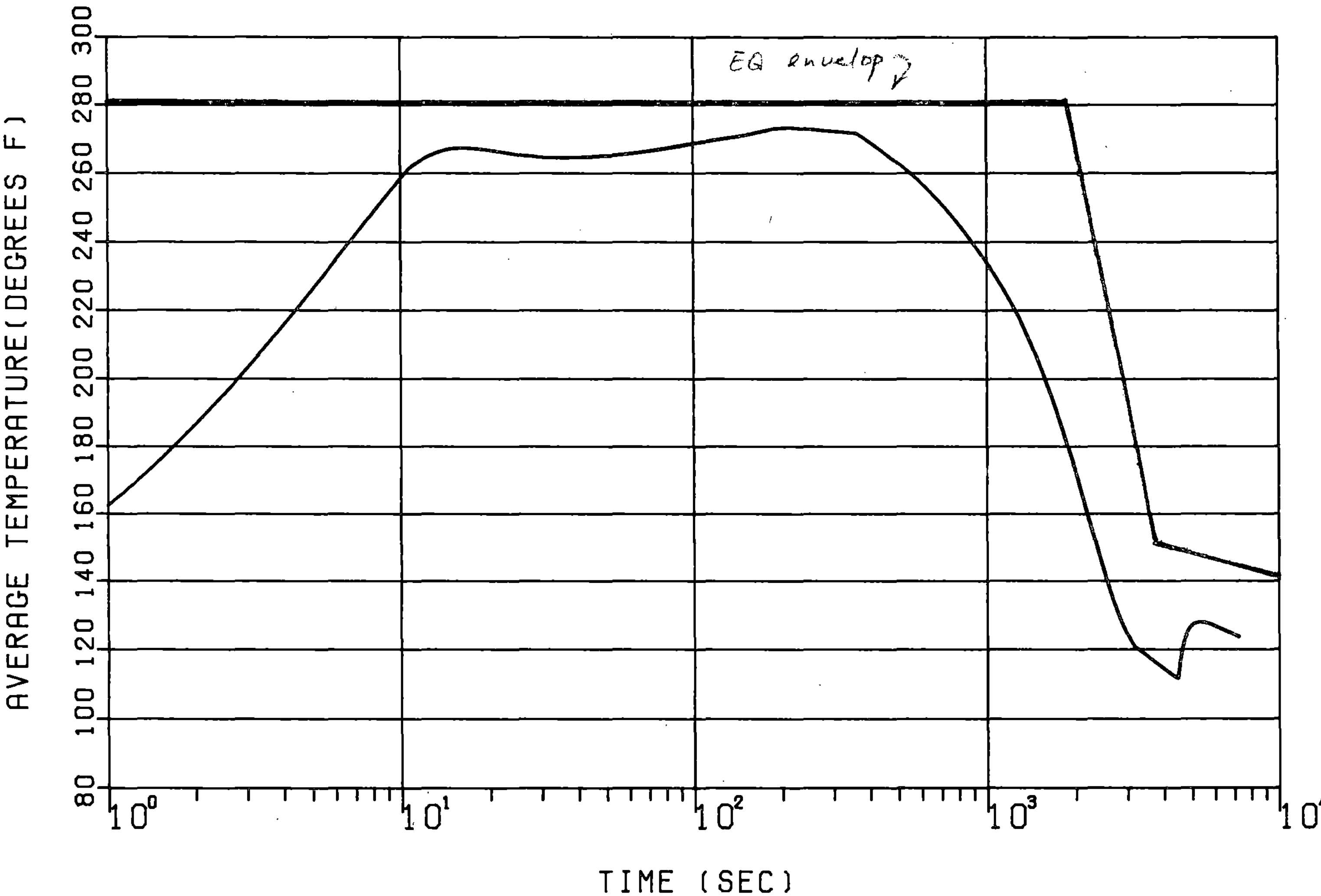
I-C-17



SURRY 1&2 TECH SPEC FINAL NPSH FIX
AVERAGE TEMPERATURE VERSUS TIME
CONTAINMENT TEMPERATURE PROFILES
PLOT OF RUN # 2479056

Fig-6

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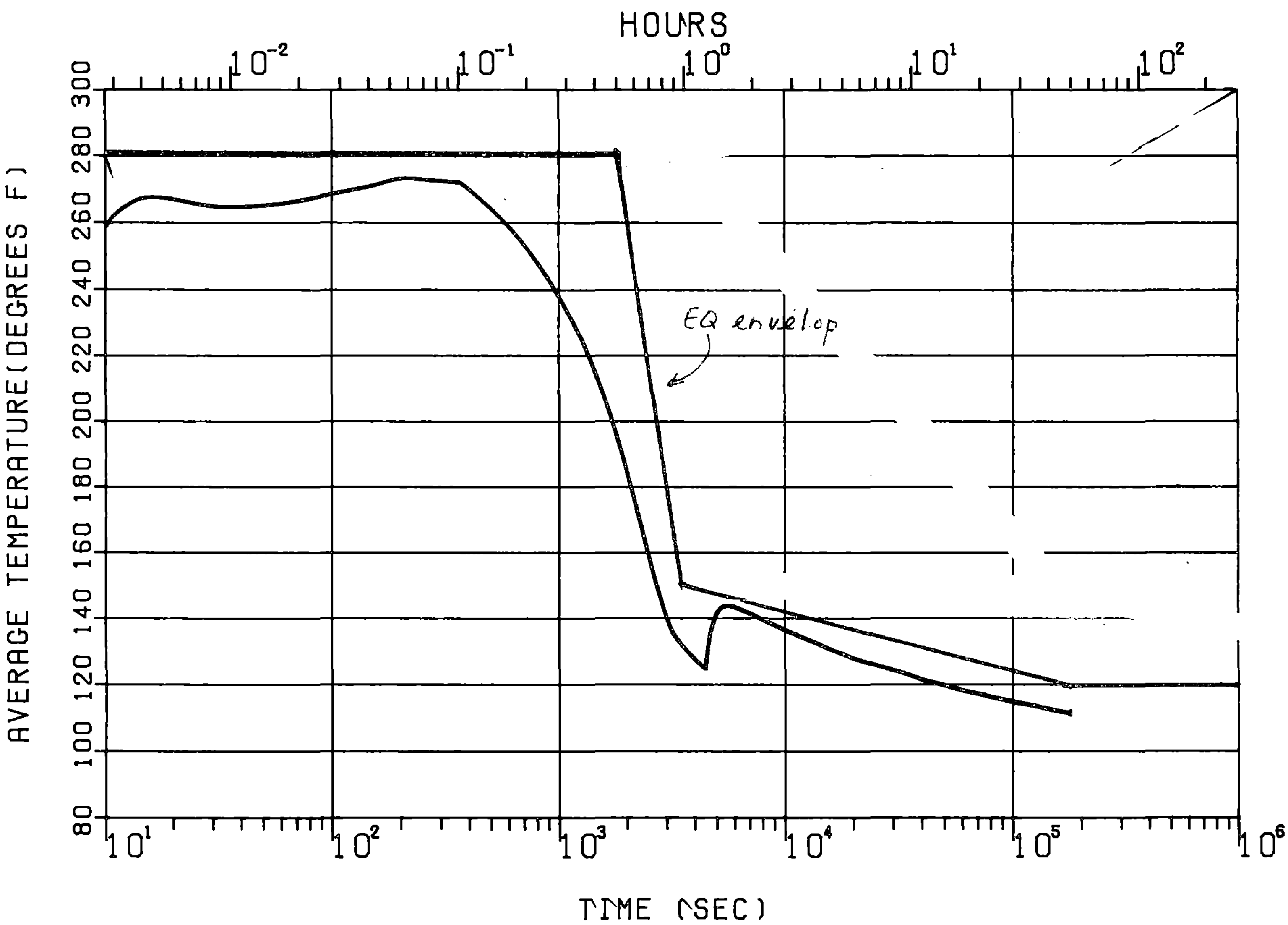
I-C-18



SURRY 1&2 TECH SPEC FINAL NPSH FIX
AVERAGE TEMPERATURE VERSUS TIME
CONTAINMENT TEMPERATURE PROFILES
PLOT OF RUN # 2479068

Fig 7

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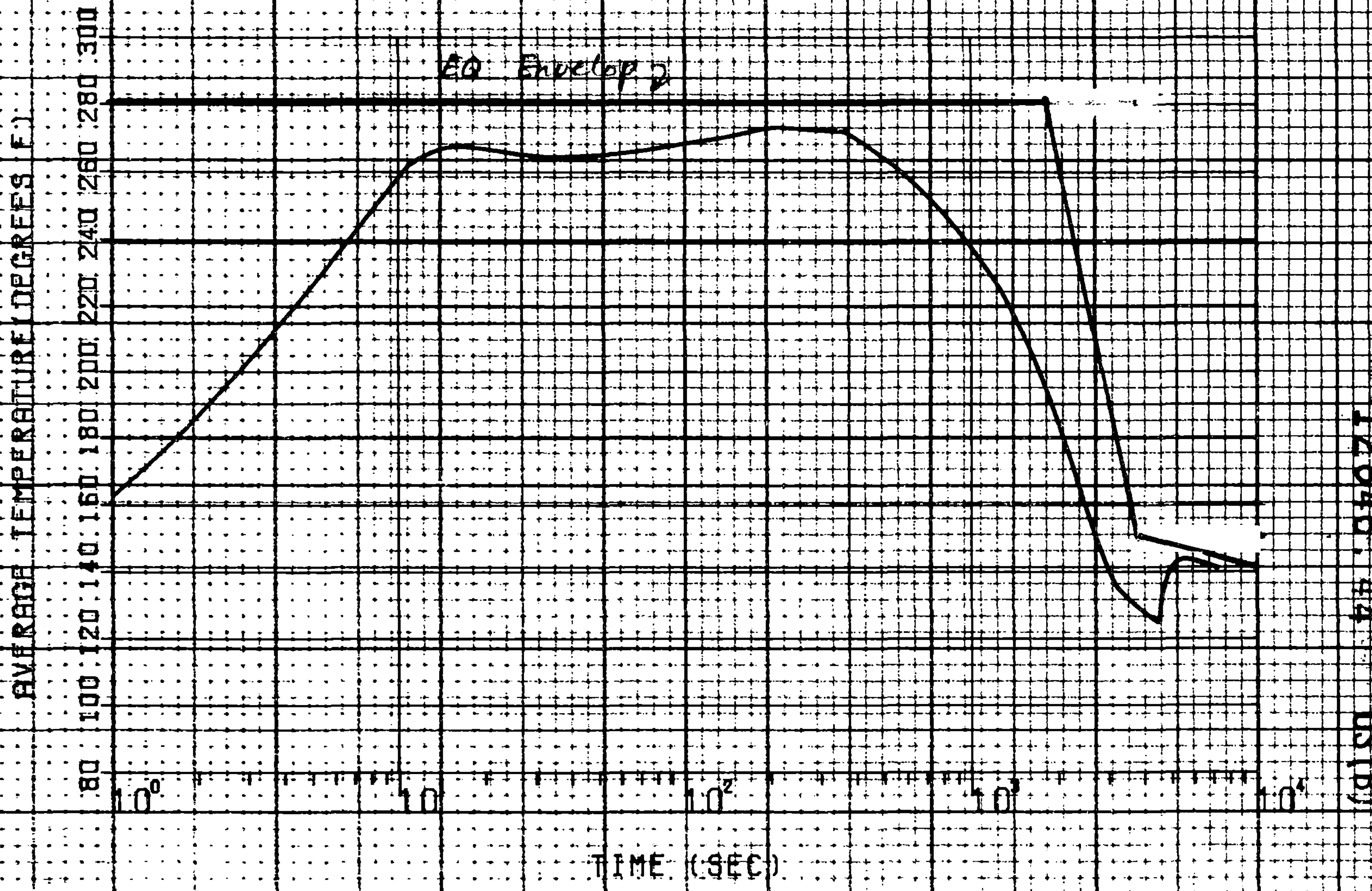

SURRY 1&2 TECH SPEC FINAL NPSH FIX
AVERAGE TEMPERATURE VERSUS TIME
CONTAINMENT TEMPERATURE PROFILES
PLOT OF RUN # 2479063

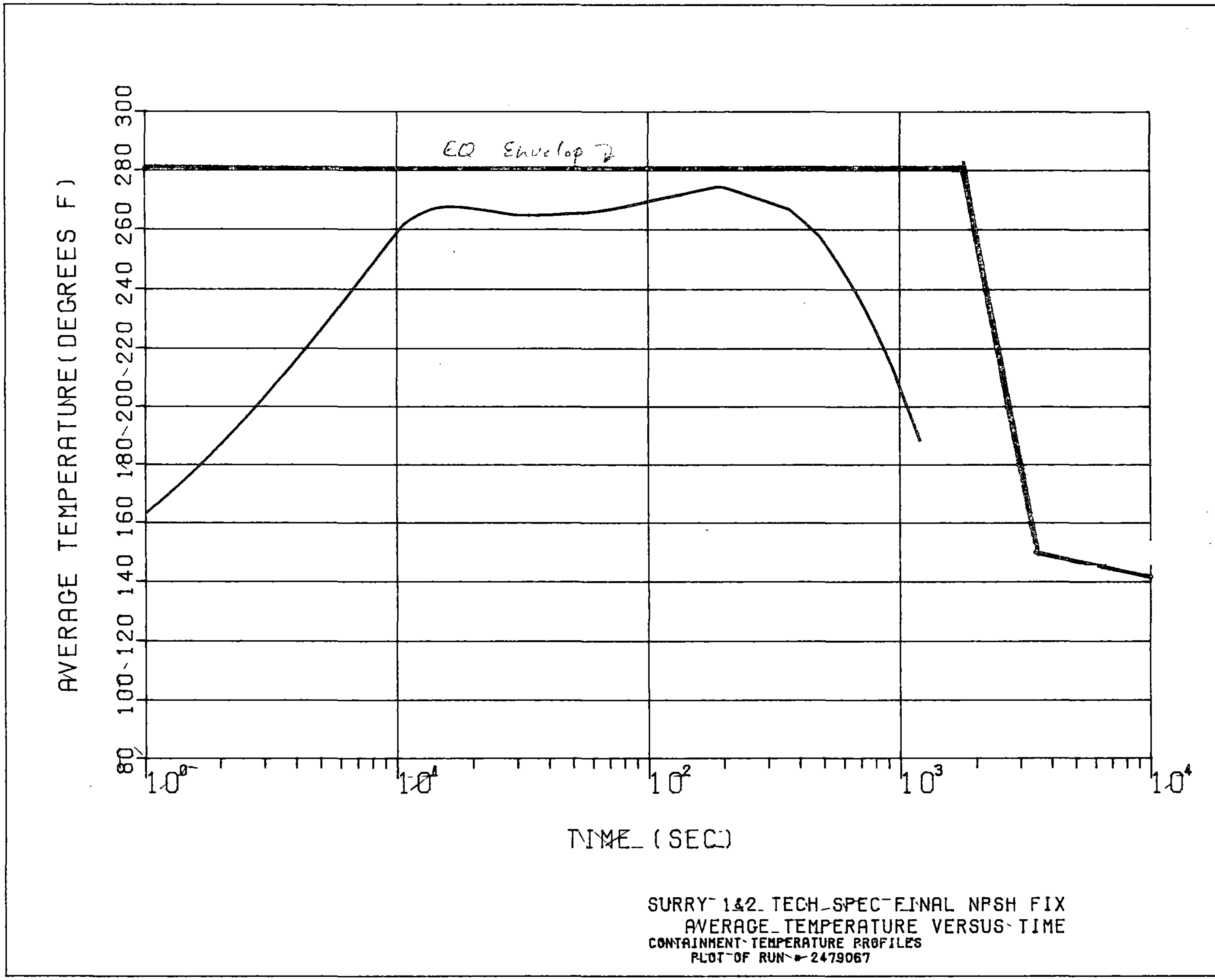

Fig. 9

12846.44

US(B)

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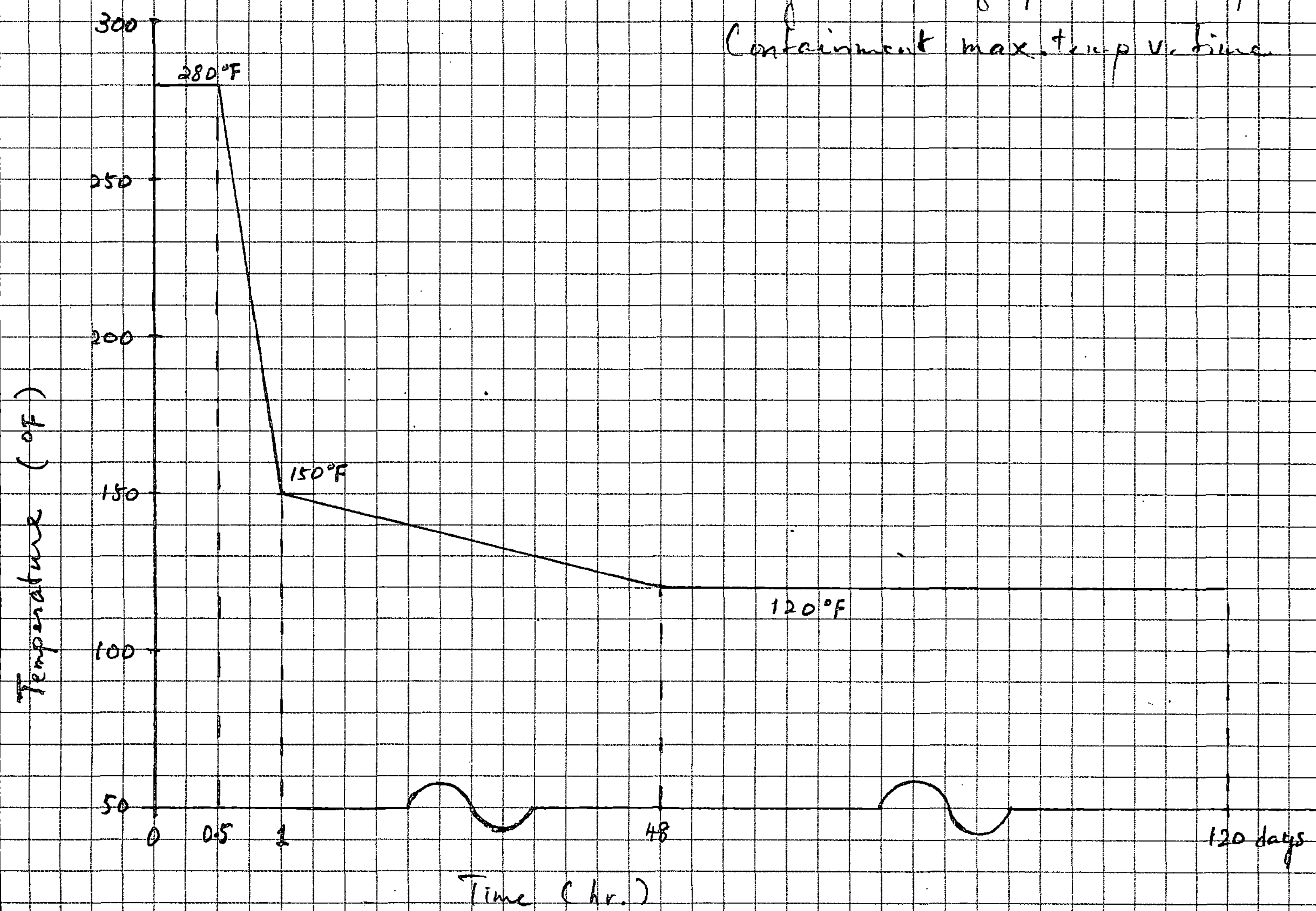
Fig. 10

Surry 1 & 2 Equipment Qualification

Containment max. temp v. time



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Appendix A - (see p. 2 for explanation)

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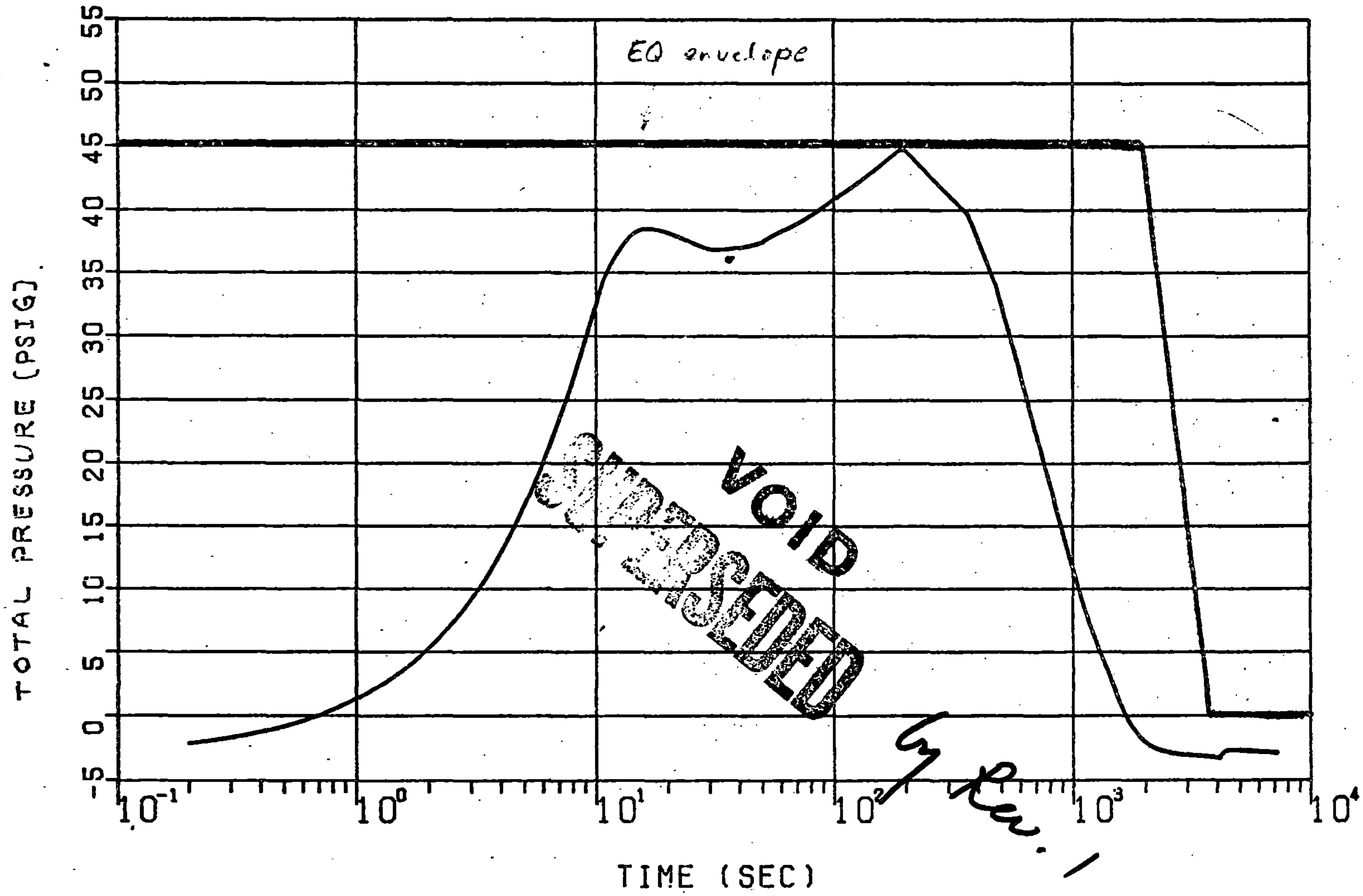
T.O.C.

1-C-22



SURRY 1&2 TECH SPEC FINAL NPSH FIX
TOTAL PRESSURE VERSUS TIME
CONTAINMENT PRESSURE PROFILE
PLOT OF RUN # 2479058

Appendix A

Fig. 1

II.8.6.44 US(B)

052

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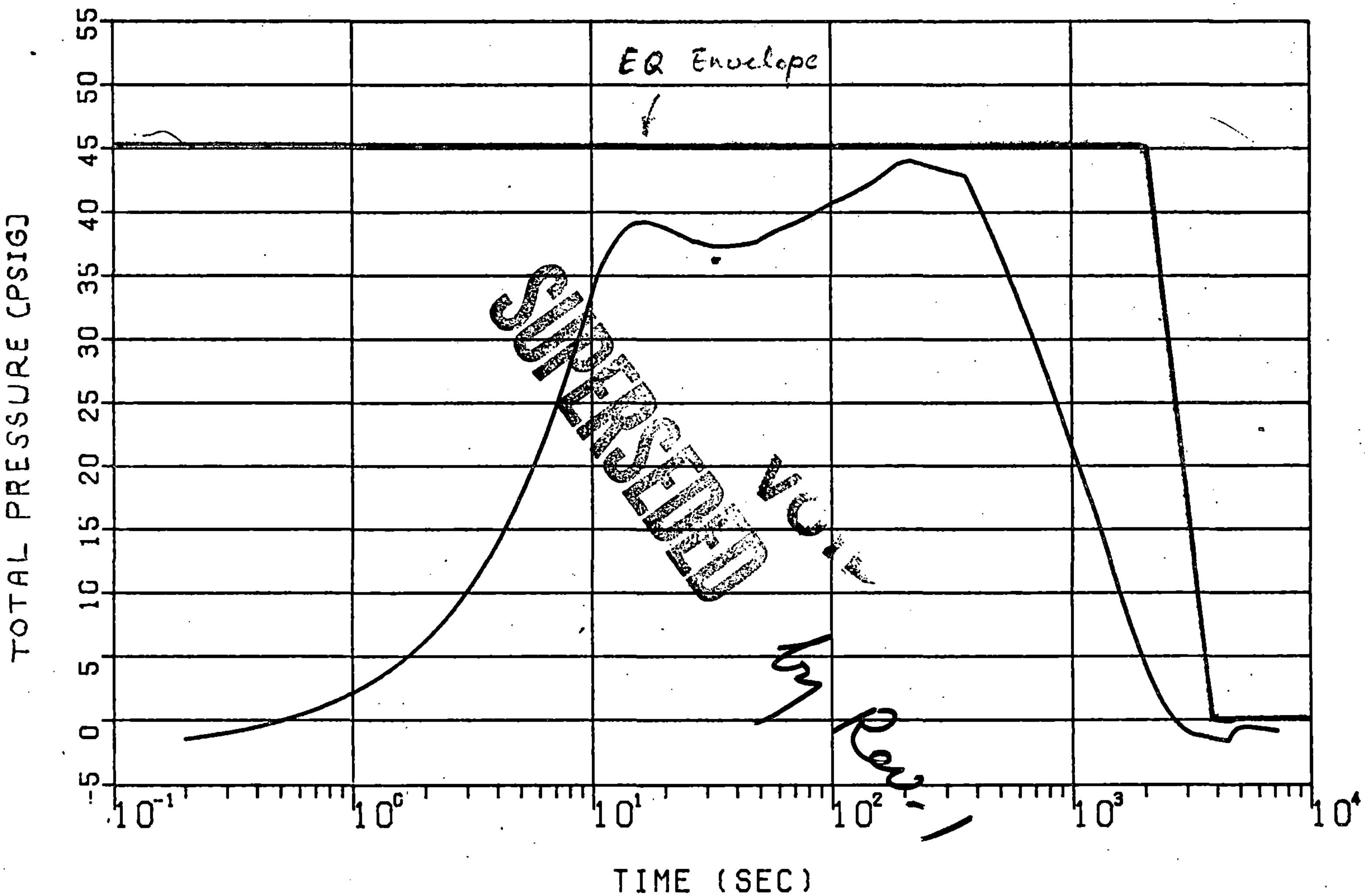

SURRY 1&2 TECH SPEC FINAL NPSH FIX
TOTAL PRESSURE VERSUS TIME
CONTAINMENT PRESSURE PROFILE
PLOT OF RUN # 2479056

Fig. 2

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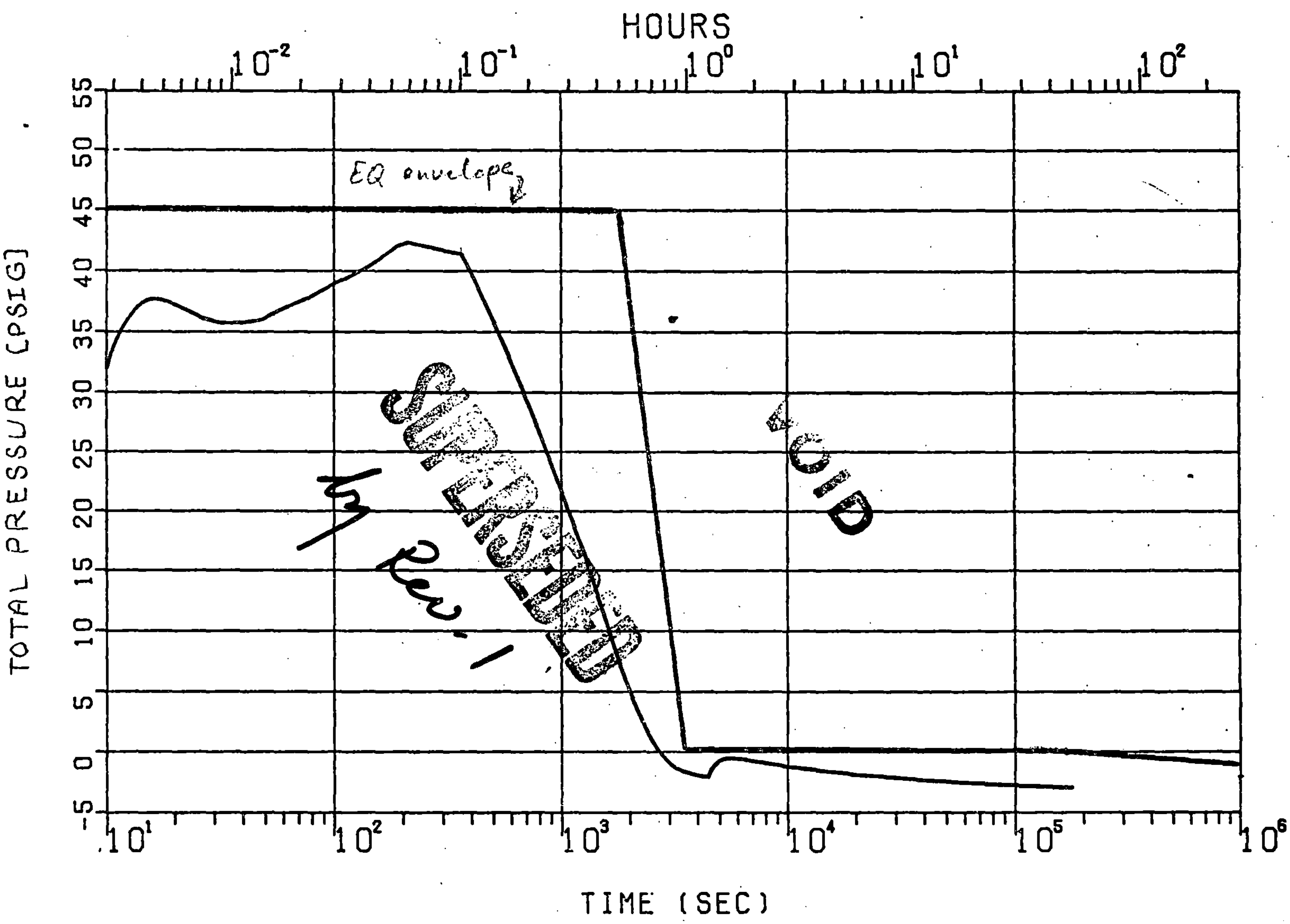

SURRY 1&2 TECH SPEC FINAL NPSH FIX
TOTAL PRESSURE VERSUS TIME
CONTAINMENT PRESSURE PROFILE
PLOT OF RUN # 2479088

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Fig. 3

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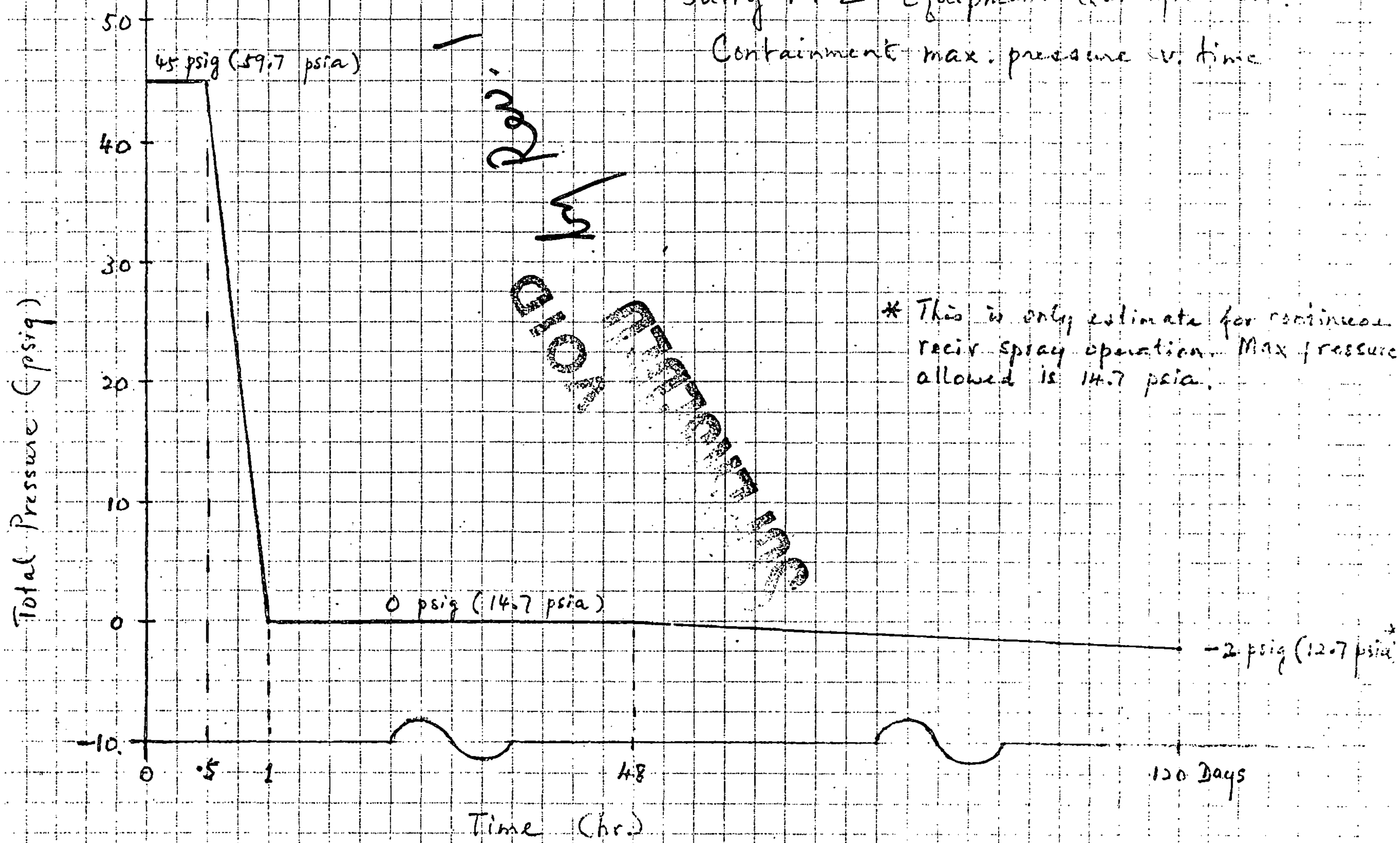
By | Date | Checked | By | Revised | By

▲ 5010.1D

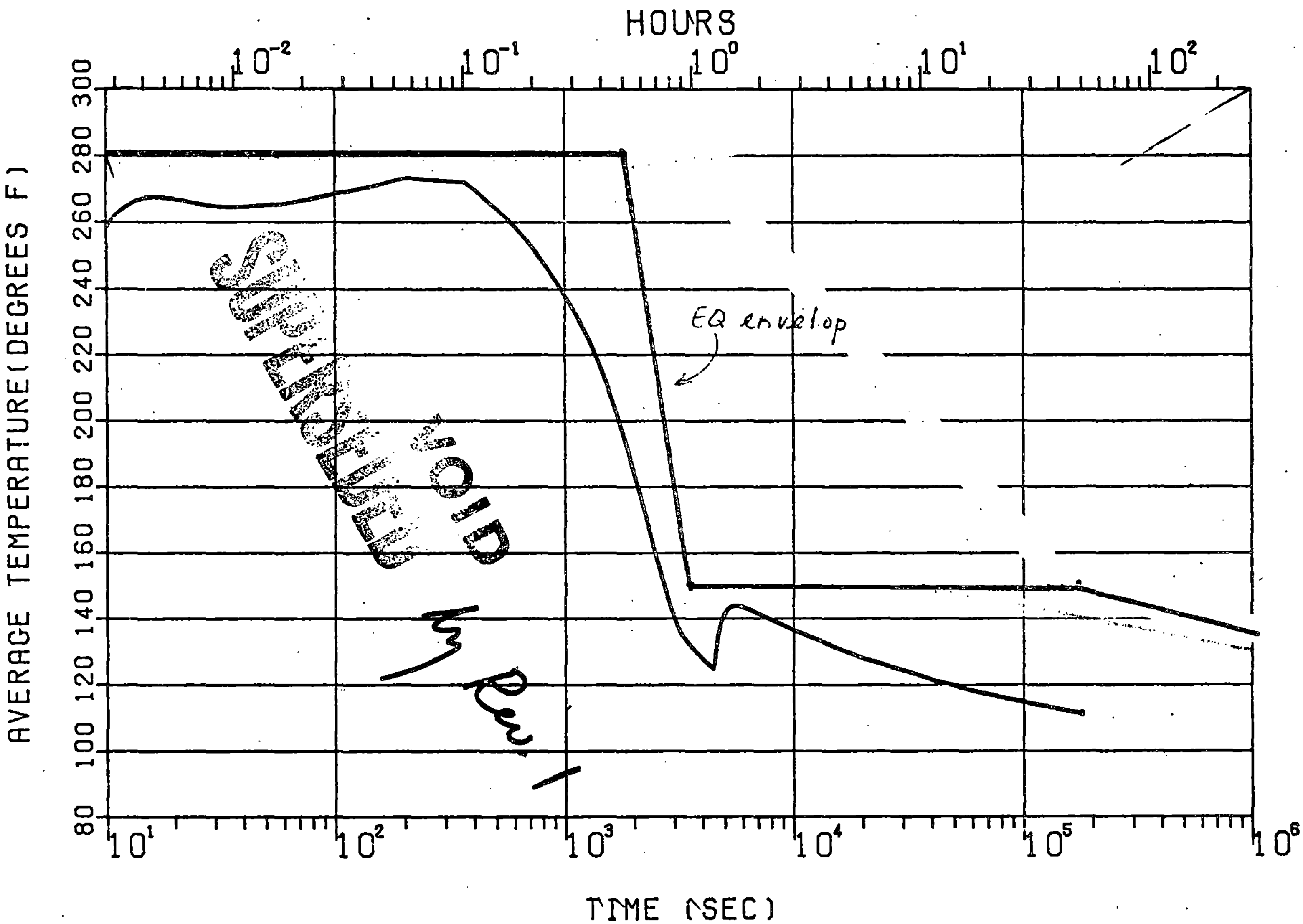
Fig. 4

Surry 1 & 2 Equipment Qualification.
Containment max. pressure v. time



1-C-26

1-C-27



SURRY 1&2 TECH SPEC FINAL NPSH FIX
AVERAGE TEMPERATURE VERSUS TIME
CONTAINMENT TEMPERATURE PROFILES
PLOT OF RUN # 2479068

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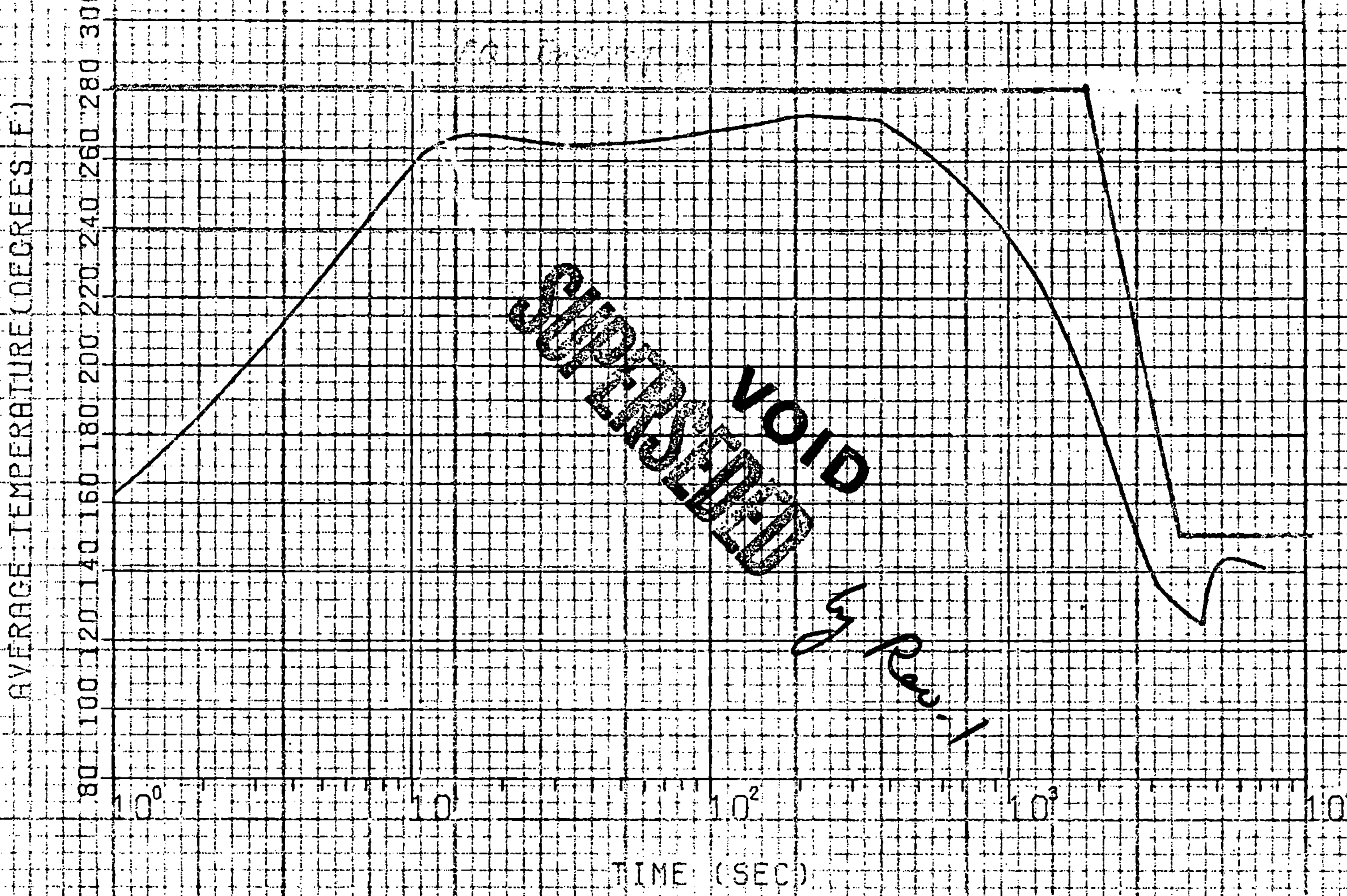
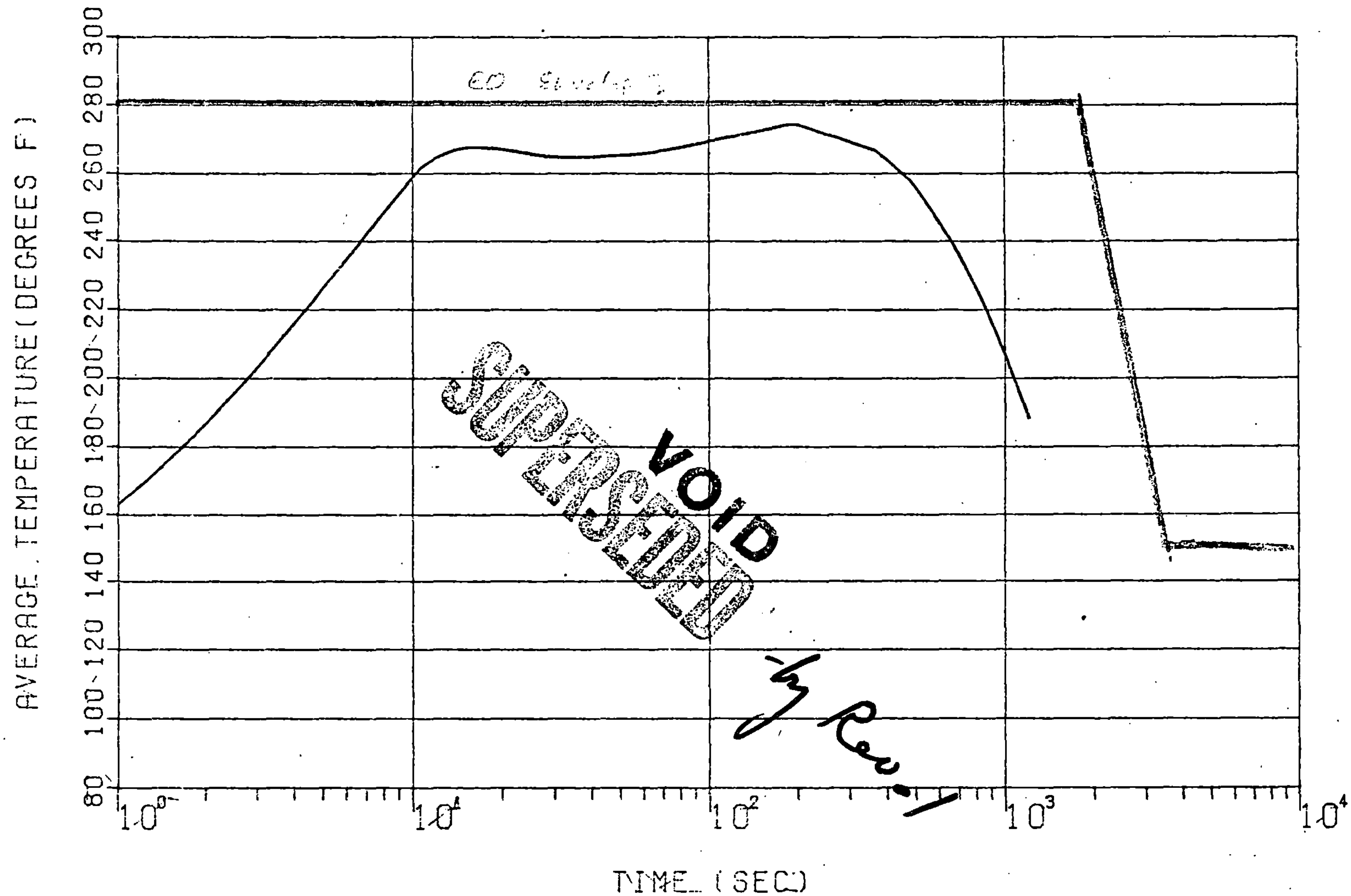


SURRY 1&2 TECH SPEC FINAL NPSH FIX
AVERAGE TEMPERATURE VERSUS TIME
CONTAINMENT TEMPERATURE PROFILES
PLOT OF RUN # 2479059



SURRY 1&2 TECH SPEC FINAL NPSH FIX
AVERAGE TEMPERATURE VERSUS TIME
CONTAINMENT TEMPERATURE PROFILES
PLOT OF RUN - 2479067

Fig. 9

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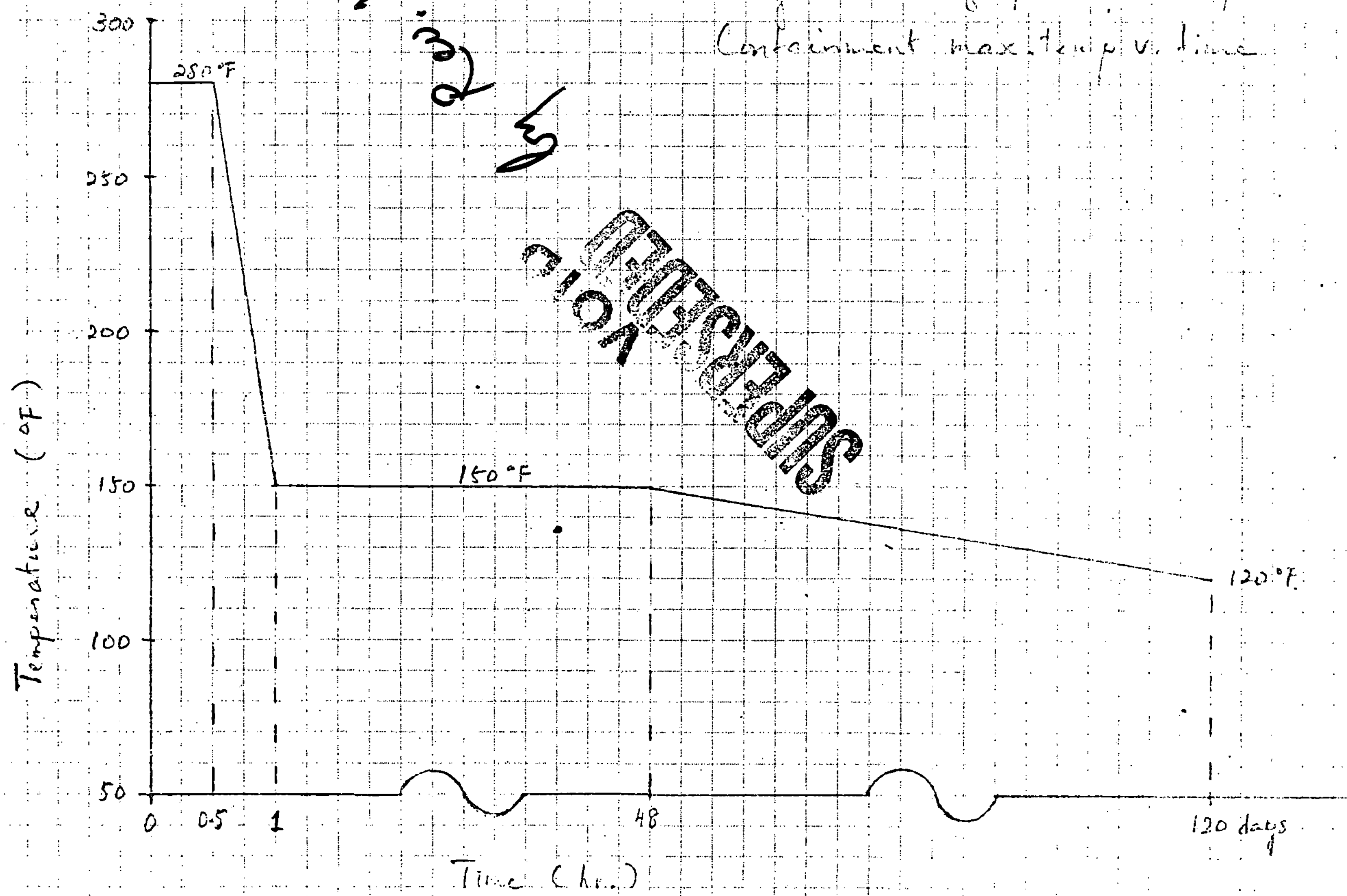
Fig. 10

Surry 1 & 2 Equipment Specification

Containment max. temp v. time



SUPERSEDED

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USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 3
EZD REFERENCE DESCRIPTION: 12846.54-RP-038-1
ENVIRONMENTAL ZONE(S): RC-3A

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	1.3×10^7	6	$\leq 2.4 \times 10^7$	6				

USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 3
EZD REFERENCE DESCRIPTION: 12846.54-RP-038-1
ENVIRONMENTAL ZONE(S): RC-3B, RC-18B, RC-47B

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	3.5×10^4	6	7.4×10^6	6				

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 3
EZD REFERENCE DESCRIPTION: 12846.54-RP-038-1
ENVIRONMENTAL ZONE(S): RC-27A

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	3.5×10^{4}	6	3.5×10^{7}	6				

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 3
EZD REFERENCE DESCRIPTION: 12846.54-RP-038-1
ENVIRONMENTAL ZONE(S): RC-27B

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	3.5×10^4	6	3.8×10^7	6				

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 3
EZD REFERENCE DESCRIPTION: 12846.54-RP-038-1
ENVIRONMENTAL ZONE(S): RC-47A

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	$<1.3 \times 10^7$	6	2.4×10^7	6				

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CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

▲5010.64 (FRONT)

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VEPCO Surry 1&2	16

CALCULATION TITLE (Indicative of the Objective): Dose Rates and Integrated Doses Inside Containment following a LOCA

QA CATEGORY (✓): ☑ I – NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ______ OTHER

CALCULATION IDENTIFICATION NUMBER

J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12846.54	power RP	RP-038-1		

*** APPROVALS – SIGNATURE & DATE**

PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)	REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (✓) YES	CONFIRMATION *REQUIRED (✓) NO
Wuhung peng 7/8/81	Shuwan Lin 7/8/81	Shuwan Lin 7/8/81		-RP-038-0	✓ ref. 'QADMOD' 'DRAGON' 'Activity' [illegible]	

DISTRIBUTION*

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RECORDS MGT. FILES (OR FIRE FILE IF NONE)					
Or. Serv.	J. BARNHART 14	✓			
Project	M. OMEARA 14	✓			

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12846.54	Power RP	RP-038-1		

Table of Contents

Note: This calc. supersedes calc. 12846.54-RP-638-0.

① Dose build-up in sump water has been taken into account.

② Dose above sump water is estimated.

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12846.54	Power NP	RP-038-1		

I. Purpose: The purpose of this calc. is to determine, following a LOCA,

(1). dose rate and integrated dose at the containment centerline,

(2). integrated dose behind crane wall,

(3). integrated dose outside personnel hatch at high range radiation monitor, and

(4). dose rate and integrated dose for an equipment totally submerged in the containment sump water;

also, to determine 40 year normal operating dose inside containment.

II. Approach

(1) In N.A. Calc. # 12050-RP-106-0, "LOCA Doses in the Containment for equipment qualification," (Ref. 1) dose rates and integrated doses at the containment centerline, behind the crane wall and outside personnel hatch have been calculated. In N.A. Calc. # 12050-RP-108-0, "Worst 6 Month γ LOCA Integrated dose Inside an infinite medium of containment sump water," ref.(2) dose rates and integrated dose inside the sump water were given.

(2) Due to the congruence of the reactor core and containment structure between North Anna and Surry plants, results mentioned in (1) will be used for Surry plant with a proper adjustment factor for the source strength. The difference in the door thickness of the personnel hatch was also adjusted.

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III References

(1). S & W North Anna Calc. # 12050-RP-106-0, "LOCA Doses in the Containment for Equipment Qualification," 9/19/80.

(2). S & W North Anna Calc. # 12050-RP-108-1 "Worst 6 month γ LOCA integrated dose inside an infinite medium of Containment Sump water," Calc. # 12050-RP-108-1.

(3) S & W Surry Calc. # 12846.38-RP-026-0, "NUREG-0578 Shielding Review - Aux. Bldg Radiation Zone maps following a LOCA."

(4) S & W Drawings - 11448-FM-1A, B, C, D, E, F, G.

(5) S & W Calc. 12846.38-RP-023-1, "Dose Rates to Containment High range Monitors, 0-8 hrs following release to containment of 100% Primary Coolant Inventory, 100% of Gap Inventory, 100%, 10% and 1% LOCA Activity." (12/21/79) (10/2/80)

(6 S&W DWG : 11448.3.13-20A (project).

(7) "Shielding Design Summary for Surry power station, VEPCO" by S&W, Radiation Protection Group, J.O. No. 11448, 12/70.

CALCULATION IDENTIFICATION NUMBER				
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IV DATA / Assumptions

- Source terms in containment atmosphere = 100% Noble gas
  50% halogens

  (no spray removal and plate out for halogens) (NUREG.0588)

  in Sump water : 50% of halogens
  1% of remaining fission products

- power level 2546 MW
  Containment free volume = 1.8×10^6 ft^3 (ref. 3)
  primary coolant = 9235 ft^3
  RWST dumped = 250000 gal.
  (Total sump water volume = 1.2×10^9 cm^3)

- The primary containment atmosphere volume contributed to centerline dose is the same as North Anna, i.e. 1.15×10^6 ft^3. This is the volume above the operating floor. (ref (1))

- Containment wall IR = 63 ft
  Crane wall IR = 51 ft (ref. (4))
  OR = 53 ft

- The distance from the high range monitor outside personnel hatch to the containment center line is 99 ft (ref 5)

- Personnel hatch door thickness is ½" (ref (6))

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 6
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V Results and Conclusions

(1). Dose rates and cummulative doses are shown in tables and figures on pages 7, 8, 9, 10, 12, 13, 14, 15.

(2) The 6 Month LOCA γ doses are

- Containment centerline (center of Containment space): 2.4×10^7 rads
  (On the operating floor : 1.6×10^7 rads)
- Outside crane wall = 7.4×10^6 rads
- Outside personnel hatch at existing HRRM = 3.8×10^4 rads
- Tatally submerged in the sump water * = ~~1.3×10^7 rads~~ 3.8×10^7 rads
  (~~1.2×10^7~~ 3.6×10^7 rads for 120 day LOCA dose)

W.P 3/6/81
Including dose build-up

(3) 40 year normal operating doses are

- Inside the crane wall (S.G. cubicles) = 1.3×10^7 rads
- Outside the crane wall = 3.5×10^4 rads

* For an equipment hung in the air above the sump water surface, the conservatively estimated 6 month LOCA γ dose is $\frac{1}{2}(3.8\times10^7) + 1.6\times10^7$
$= 3.5\times10^7$ rads
(dose build-up is included)

W. P. 7/2/81
S. L. 7/6/81

VI. Calculations

1. Dose Rate and Integrated Dose at Containment centerline

In ref. (1), dose rates and integrated doses were calculated for N.A. plant on the operating floor at containment center line. As pointed out in Attachment A of ref. (1), a more conservative dose point will be the center of the centerline, at which the dose rate is 1.51 times that on the operating floor. This dose rate will be further adjusted by the source strength factor f_1:

$$f_1 = \frac{(\text{Surry's power level}) \times (\text{N.A Containment free volume})}{(\text{N.A. power level}) \times (\text{Surry's Containment free volume})}$$

$$= \frac{(2546 \text{ MW}) \times (1.84 \times 10^6 ft^3)}{(2900 \text{ MW}) \; (1.8 \times 10^6 ft^3)} = 0.90$$

Therefore, the overall correction factor is $1.51 \times 0.90 = 1.36$.

The γ dose rates and cummulative γ doses at the center of containment space are listed in the following table

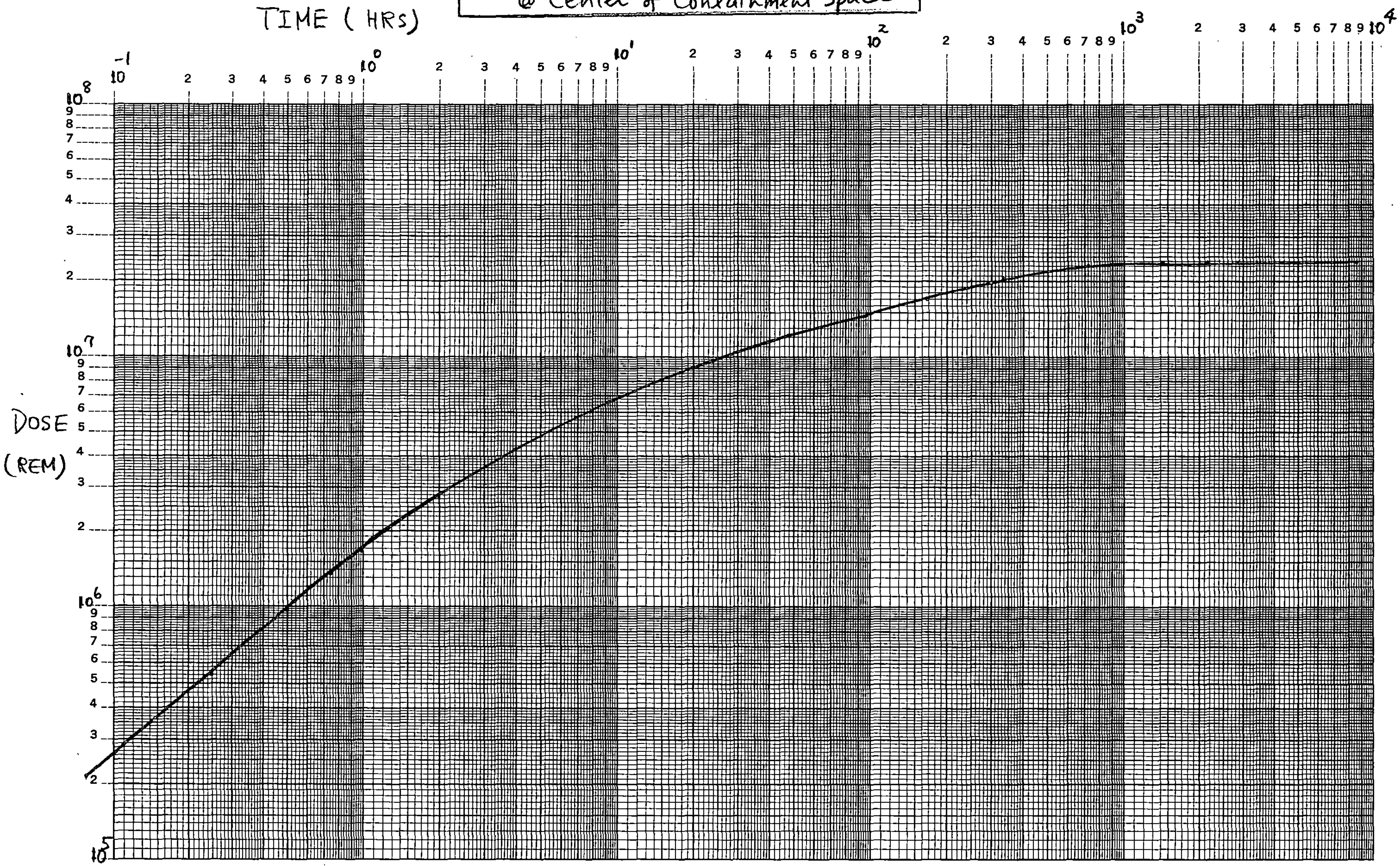
Time (hr)	γ Dose Rate (Rem/hr)	Cum. γ Dose (Rem)	Time (hr)	γ Dose Rate (Rem/hr)	Cum. γ Dose (Rem)
0	3.13+6	0.0	48	7.52+4	1.21+7
0.083	2.23+6	2.12+5	96	4.18+4	1.47+7
0.25	1.82+6	5.44+5	168	2.75+4	1.71+7
0.50	1.58+6	9.67+5	336	1.36+4	2.04+7
0.75	1.41+6	1.34+6	720	3.01+3	2.31+7
1.0	1.28+6	1.67+6	1440	2.09+2	2.38+7
2.0	9.37+5	2.76+6	2160	2.03+1	2.39+7
4.0	6.15+5	4.27+6	2880	6.23+0	2.39+7
8.0	3.66+5	6.15+6	4380	5.02+0	2.39+7
24.0	1.43+5	9.66+6	8760	4.86+0	2.39+7

⇒ 6 Month integrated dose at Center of Containment space = 2.4×10^7 rads

K+E LOGARITHMIC 3 x 5 CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 7520

Integrated Dose (REM) VS. Time (HRS)
@ Center of Containment Space



12846.54 RP-038-1

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8-D-1

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2. Dose rates and dose outside the crane wall

The dose rate at t=0 after LOCA outside the crane wall for North Anna plant has been calculated in ref. (1) to be 1.08×10^6 Rem/hr (see attachment A, pg A-3, ref (1)). This value will be adjusted by the source strength factor $f_1 = 0.90$. Consequently, the dose rate at t=0 for the Surry plant will be 9.72×10^5 Rem/hr. The dose rate at t=0 at containment centerline is 3.13×10^6 Rem/hr. The ratio is $9.72 \times 10^5 / 3.13 \times 10^6 = 0.3105$. Since in both cases the major dose contributions are from unscatterd γs' (the attenuation of build-up in the air is insignificant), dose rates at t >0 will have the same ratio. Dose rates and integrated dose outside the crane wall are listed in the following:

Time (hr)	γ Dose Rate (rem/hr)	Cum. γ Dose (rem)	Time (hr)	γ Dose Rate (rem/hr)	Cum. γ Dose (rem)
0	9.72+5	0	48	2.33+4	3.76+6
0.083	6.92+5	6.58+4	96	1.30+4	4.56+6
0.25	5.65+5	1.69+5	168	8.54+3	5.31+6
0.50	4.91+5	3.00+5	336	4.22+3	6.33+6
0.75	4.38+5	4.16+5	720	9.35+2	7.17+6
1.0	3.97+5	5.19+5	1440	6.49+1	7.39+6
2.0	2.91+5	8.57+5	2160	6.30+0	7.42+6
4.0	1.91+5	1.33+6	2880	1.93+0	7.42+6
8.0	1.14+5	1.91+6	4380	1.56+0	7.42+6
24.0	4.44+4	3.00+6	8760	1.51+0	7.42+6

⇒ 6-month integrated dose outside the crane wall = 7.4×10^6 rads

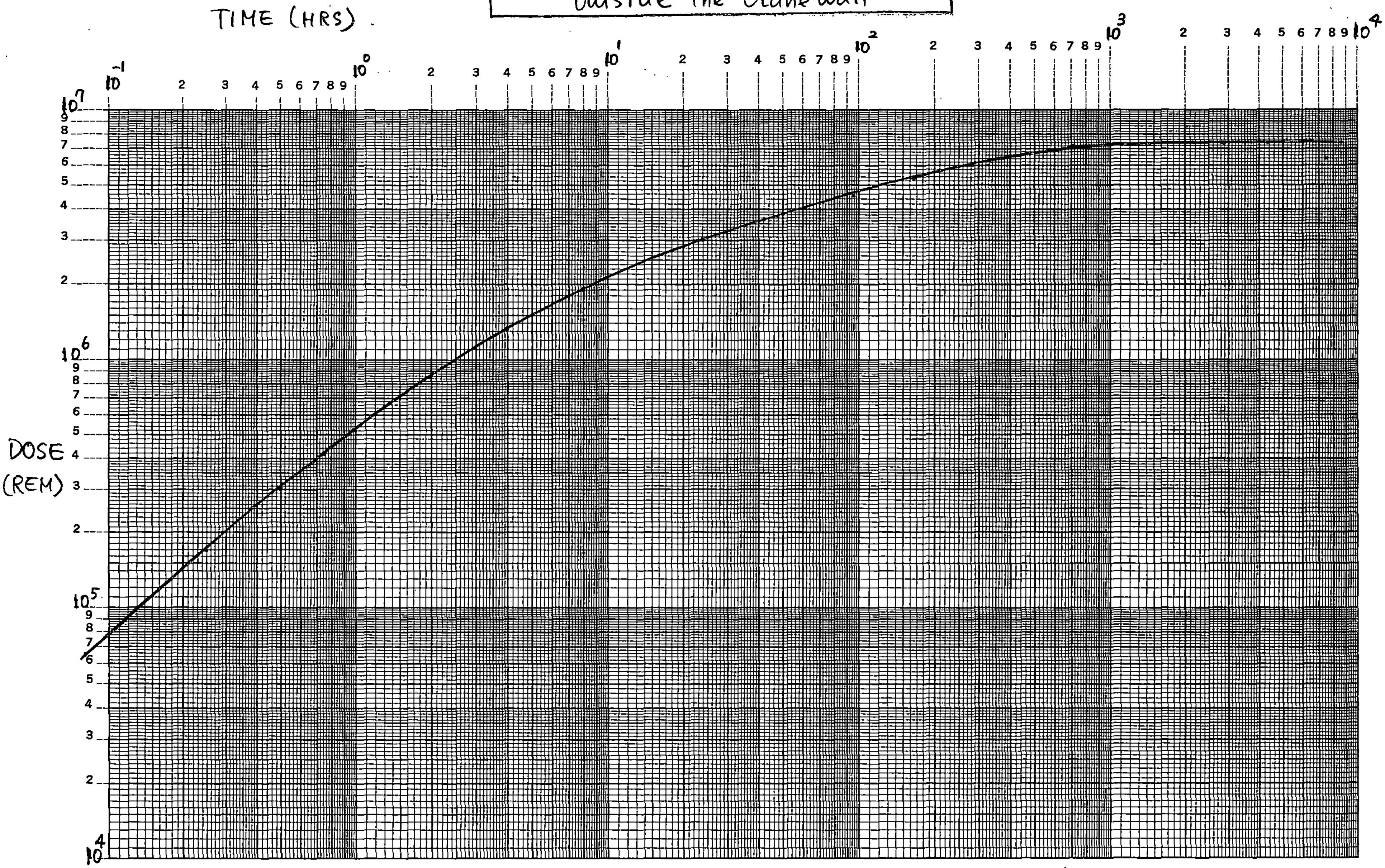
1-D-9

1-D-10

K+E LOGARITHMIC 3 x 5 CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 7520

Integrated Dose (REM) vs. Time (HRS)
Outside the Crane Wall



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3. Dose Rates and Dose Outside the personnel hatch at the existing high range radiation monitor

The dose rate at t=0 for North Anna has been calculated to be 4.76×10^6 mR/hr (p. 30 of ref. (1)). The door thickness for North Anna is 3/4" and that of Surry is 1/2" (ref. (5) and ref. (6)). There is a difference of 1/2" of steel shielding because of two doors. Dose rate increase due to reduction of 1/2" steel shield can be calculated as follows: (All parameters are from QADMOD user's manual)

Take an "average" energy of 1.3 MeV for the source photons.

$\frac{\mu}{\rho} = 0.0521 \ cm^2/g$; $b = \mu t = 0.0521 \times 7.8 \times \frac{1}{2} \times 2.54 = 0.516$

$B(\mu t) = 1 + 0.8691 \cdot b + 0.02534 \cdot b^2 + 0.001239 \cdot b^3 = 1.455$

The shielding adjustment factor is $\frac{1}{B} e^{\mu t} = 1.15$.

The source strength adjustment factor is $f_1 = 0.90$. Therefore, Surry dose rate at t=0 is 4.93×10^6 mR/hr. The ratio of dose rate outside personnel hatch to that at containment centerline is $(4.93 \times 10^6 \text{ mR/hr}) / (3.13 \times 10^9 \text{ mR/hr}) = 1.58 \times 10^{-3}$. We use this ratio to determine dose rates outside personnel hatch for $t > 0$. This approach is conservative because source spectrum is softer for $t > 0$. The dose rates and integrated doses are listed in the following page.

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Dose Rates & Integrated Doses Outside Personnel Hatch

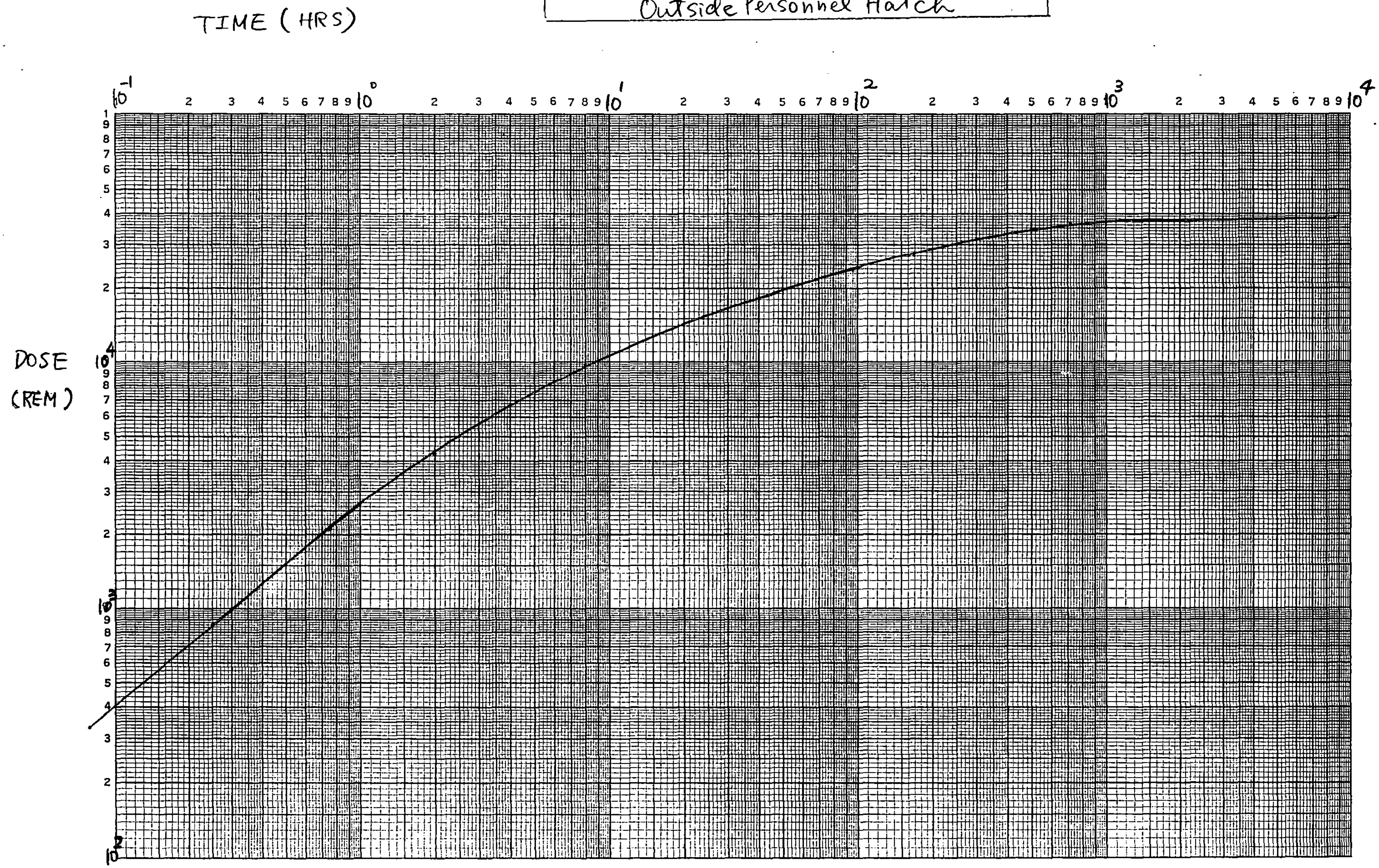
Time (hr)	γ Dose Rate (mrem/hr)	Cum. γ Dose (mrem)
0	4.95+6	0.0
0.083	3.52+6	3.35+5
0.25	2.88+6	8.60+5
0.50	2.50+6	1.53+6
0.75	2.23+6	2.12+6
1	2.02+6	2.64+6
2	1.48+6	4.36+6
4	9.72+5	6.75+6
8	5.78+5	9.72+6
24	2.26+5	1.53+7
48	1.19+5	1.91+7
96	6.60+4	2.32+7
168	4.35+4	2.70+7
336	2.15+4	3.22+7
720	4.76+3	3.65+7
1440	3.30+2	3.76+7
2160	3.21+1	3.78+7
2880	9.84+0	3.78+7
4380	7.93+0	3.78+7
8760	7.68+0	3.78+7

⇛ 6 Month LOCA integrated Dose outside personnel hatch is 3.8×10^4 rads.

I-D-13

K+E LOGARITHMIC 3 X 5 CYCLES 46 7520 MADE IN U.S.A.
KEUFFEL & ESSER CO.

Integrated Dose (REM) vs. Time (hrs)
Outside Personnel Hatch



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4. Dose rate and integrated dose in an infinite medium of sump water.

In ref. (2), the dose rate and integrated dose in an infinite medium of sump water were given for North Anna plant. The source strength adjustment factor f_2 is

$$f_2 = \frac{\text{Surry Power Level}}{\text{N.A. Power Level}} \times \frac{\text{N.A. Total Sump Water}}{\text{Surry Total Sump Water}}$$

$$= \frac{2546 \text{ MW}}{2900 \text{ MW}} \times \frac{1.5 \times 10^9 \text{ cm}^3}{1.2 \times 10^9 \text{ cm}^3} = 1.1 \qquad \text{ref. (3)}$$

The dose rates and integrated doses as a function of time after LOCA are given in the following:

Time (hr)	Without dose build-up: γ Dose Rate* (rem/hr)	Without dose build-up: Cum. γ Dose* (rem)	With dose build-up factors**: γ Dose rate (Rem/hr)	With dose build-up factors**: Cum. γ Dose (Rem)
0	6.41+5	0	1.55+6	0
1	3.70+5	5.05+5	9.26+5	1.24+6
2	2.56+5	8.18+5	6.49+5	2.03+6
8	1.03+5	1.89+6	2.70+5	4.78+6
24	4.06+4	3.04+6	1.17+5	7.88+6
96	1.34+4	4.98+6	4.24+4	1.36+7
192	9.08+3	6.06+6	2.85+4	1.70+7
360	5.85+3	7.32+6	1.80+4	2.09+7
720	2.88+3	8.89+6	8.61+3	2.57+7
2160	9.59+2	1.17+7	2.83+3	3.39+7
2880	7.79+2	1.23+7	2.30+3	3.58+7
4320	4.17+2	1.32+7	1.23+3	3.83+7

⇒ The 6 Month integrated dose for an equipment totally submerged in the sump water is 3.8×10^7 rads
(1.3×10^7 rads without including dose build-up)

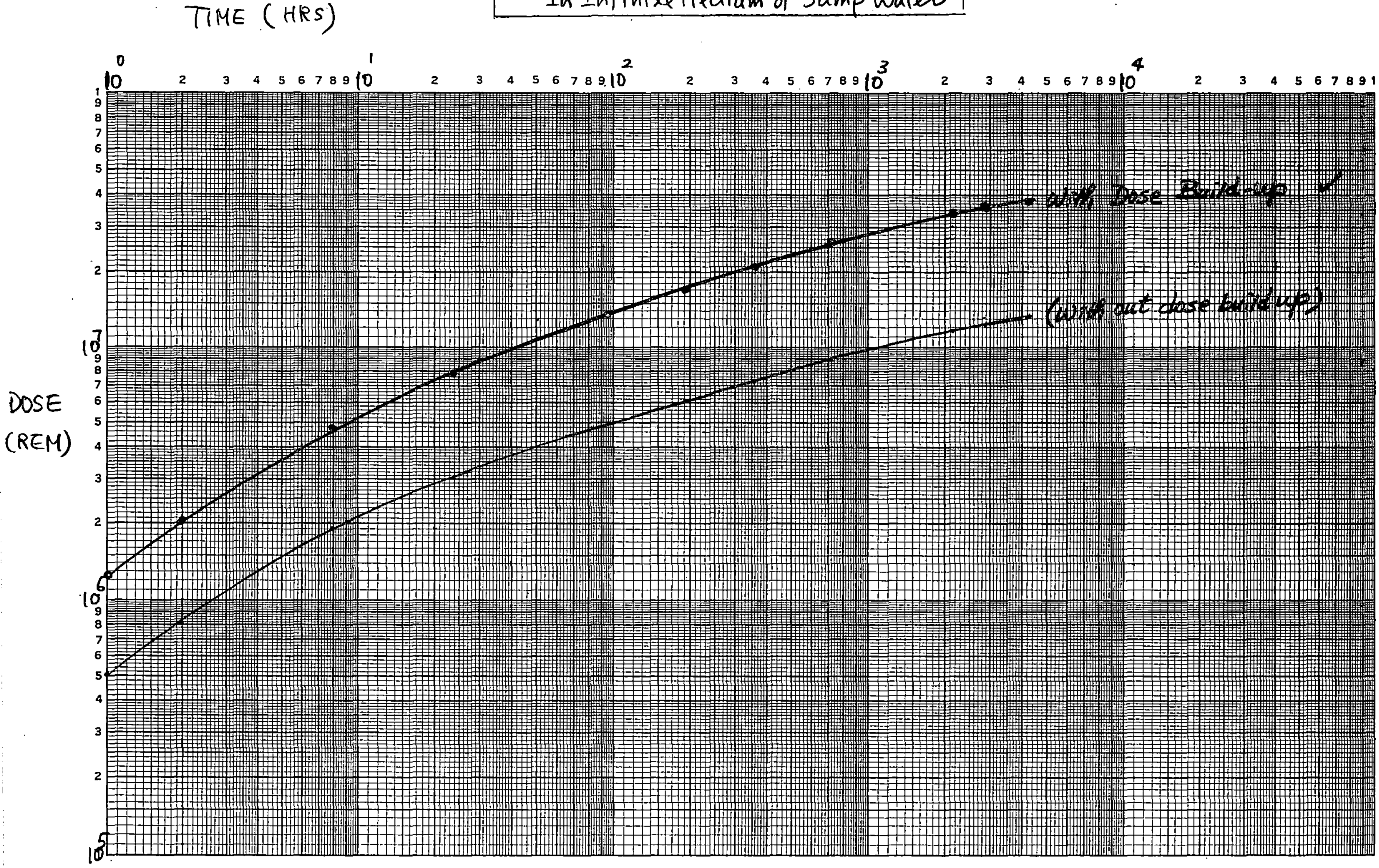
* Those numbers are dose rates without taking into account the build up factors

** Taken from revision 1 of ref (2) with build-up considered. 3/6/81

1-D-15

K+E LOGARITHMIC 3 X 5 CYCLES 46 7520 MADE IN U.S.A. KEUFFEL & ESSER CO.

Integrated Dose (REM) vs. Time (HRS) In Infinite Medium of Sump Water



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5. 40 year normal operating dose

(1). Inside the crane wall

According to ref. (7), "Shielding design summary for Surry power station, VEPCO", the maximum dose rate inside the containment during normal operation is 37 rads/hr, which occurs inside the steam generator cubicles.

The maximum 40 year dose is

$$37 \frac{rads}{hr} \times 24 \times 365 \times 40 \; hrs = 1.3 \times 10^7 \; rads$$

(2). Outside the crane wall

The design basis maximum dose rate outside the crane wall is 100 mR/hr and the 40 year dose will be

$$0.1 \; rads/hr \times 24 \times 365 \times 40 \; hrs = 3.5 \times 10^4 \; rads.$$

1-D-16

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 4
EZD REFERENCE DESCRIPTION: 12846.44-PE-050-0
ENVIRONMENTAL ZONE(S): AB-2B, AB-13A, AB-27

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
TEMPERATURE (°F)							120-205, 0-30 sec 205, 30-40 secs 205-190, 40-1000 secs 190-145, 1000-2000 secs 145-120, 2000 secs-1 hr	24
PRESSURE (psia)							15.2, 0-1 min 14.9, 1-60 min	24
RELATIVE HUMIDITY (%)							100	24
CHEMICAL SPRAY								

USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 4
EZD REFERENCE DESCRIPTION: 12846.44-PE-050-0
ENVIRONMENTAL ZONE(S): AB-2C

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
TEMPERATURE (°F)							120-140, 0-30 sec 140, 30-1000 secs 140-125, 1000-2000 secs 125-120, 2000 secs-1 hr	24
PRESSURE (psia)							15.2, 0-1 min 14.9, 1-60 min	24
RELATIVE HUMIDITY (%)							100	24
CHEMICAL SPRAY								

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 4
EZD REFERENCE DESCRIPTION: 12846.44-PE-050-0
ENVIRONMENTAL ZONE(S): AB-45

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
TEMPERATURE (°F)							120-125, 0-300 secs 125-122, 300-2000 secs 122-120, 2000 secs-1 hr	24
PRESSURE (psia)							15.2, 0-1 min 14.9, 1-60 min	24
RELATIVE HUMIDITY (%)							100	24
CHEMICAL SPRAY								

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CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

▲5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF 94
VEPCO, SURRY UNIT 1 & 2 AUX. BLDG. ENVIRONMENTAL QUALIFICATION	

CALCULATION TITLE (Indicative of the Objective):	QA CATEGORY (✓)
AUX. BUILDING HELB TEMPERATURE ANALYSIS WITH PROPOSED MODIFICATIONS	☒ I – NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ______ OTHER

CALCULATION IDENTIFICATION NUMBER				
J. O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12846.44	NTD-ESSAG	PE-050	00004	

* APPROVALS – SIGNATURE & DATE						
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)	REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (✓) YES	NO
[signature] 12/1/80	[signature] 1/13/81	[signature] 1/13/81	0		✓ (See p. 2)	

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Project	HWDurkin 245/14 CHWilbur 245/14 WE Schulz 245/14 WT Knapp 245/14 MEO'Meara 245/14	Results only by 2/4/81 IOM			

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NOTE: CONFIRMATION OF THE CONTINUED OPERABILITY OF THE CENTRAL EXHAUST SYSTEM UNDER THE INCREASED ATMOSPHERIC DENSITY RESULTING FROM THE HIGH ENERGY LINE FAILURES ANALYZED IS REQUIRED.

Verification of the information provided in Attach. I [illegible]

1-E-2

OBJECTIVE: TO EVALUATE THE TEMPERATURE EFFECTS OF HIGH ENERGY LINE BREAKS IN THE SURRY UNIT 1 AND 2 AUXILIARY BUILDING AS A RESULT OF THE INSTALLATION OF PROPOSED MODIFICATIONS, BASED ON THE RESULTS OF THE REF. 2 CALCULATION PERFORMED IN RESPONSE TO THE I.E. BULLETIN 79-01B FOR THIS STRUCTURE.

METHOD: UTILIZING THE DATA OBTAINED IN THE REF. 2 CALCULATION WITH REGARDS TO TEMPERATURE PROFILE, MODIFICATIONS ARE POSTULATED AND ANALYZED FOR EFFECTIVENESS IN REDUCING THE SEVERETY OF THE TRANSIENTS WHICH RESULTED IN THAT CALCULATION. ADDITIONALLY THE MODEL DEVELOPED IN THE REF. 1 CALCULATION FOR THIS STRUCTURE IS REVISED TO INCLUDE THE USE OF ADDITIONAL PASSIVE HEAT SINKS AND AN ACTIVE EXHAUST VENTILATION SYSTEM FOR PURPOSES OF PROVIDING A REFINED EVALUATION OF THE POTENTIAL TEMPERATURE EFFECTS OF HIGH ENERGY LINE BREAKS WITH RESPECT TO THE AREAS OF THE AUXILIARY BUILDING WHICH CONTAIN IDENTIFIED CLASS 1E ELECTRICAL COMPONENTS. INPUT DATA OF THE NODAL MODEL AND MASS-ENERGY RELEASE RATES FROM EACH IDENTIFIED FAILURE ARE USED IN THE S&W ENG. CORP. NU-92 THREED SUBCOMPARTMENT ANALYSIS COMPUTOR PROGRAM, VERSION 12, LEVEL 1 TO EVALUATE THE RESULTANT AVERAGE TEMPERATURE PROFILE FOR EACH NODE. AN 'ENVELOPE' CURVE FROM THIS DATA IS DEVELOPED THAT DESCRIBES THE DURATION AND PEAK VALUES OF TEMPERATURE FOR EACH AREA OF CONCERN AS CONSERVATIVE WORSE CASE ENVIRONMENTS RESULTING FROM ALL ANALYZED FAILURES. PIPE BREAK SIZE AND LOCATION ARE SELECTED ON THE BASIS OF THE INFORMATION CONTAINED IN REF 10, SECT. P.2.2-1 AND PROXIMITY TO THE AREAS OF CONCERN. THE METHODS OF DEVELOPING NODAL AND JUNCTION DATA CARDS ARE SIMILAR TO THOSE UTILIZED IN THE REF. 1 CALCULATION AND IN THE GUIDELINES OF REF. 14

ASSUMPTIONS: THE FOLLOWING GENERAL ASSUMPTIONS ARE MADE FOR THIS ANALYSIS

1.) CIRCUMFERENTIAL PIPE BREAK OF THE STEAMGENERATOR BLOWDOWN LINE WILL AUTOMATICALLY ISOLATE SUCH THAT THE RELEASE OF ENERGY TO THE NODE IS EFFECTIVELY 0.0 AT 30 SECS AFTER THE FAILURE OCCURS. THIS ASSUMES THAT HARDWARE MODIFICATIONS ARE MADE TO PROVIDE ADEQUATE DUAL PROTECTION CAPABILITIES SUCH THAT A SINGLE ACTIVE FAILURE WILL NOT PRECLUDE AUTOMATIC ISOLATION OF THIS LINE UPON ACTUATION OF HIGH FLOW SIGNAL.

2) PROVISIONS ARE ESTABLISHED TO ENSURE THAT THE LOUVRED OPENINGS IN THE SIDE WALLS OF THE VENTILATION EQUIPMENT ROOM, ELEV 45'10" ARE AT ALL TIMES OPEN AND FREE OF OBSTRUCTIONS.

3) IT IS ASSUMED THAT THE CENTRAL EXHAUST SYSTEM (1-EH-14) IS IN OPERATION AT THE TIME OF THE FAILURES OCCURENCE AND WILL REMAIN IN OPERATION THROUGHOUT THE DURATION OF THE ACCIDENT. PASSIVE HEAT SINKS WERE ALSO UTILIZED IN THIS CALCULATION

4) THE PIPE WALL PENETRATIONS BETWEEN CHARGING PUMP CUBICLE 1CH-P-1A AND THE UNIT 1 PIPE TUNNEL AND THE CORRESPONDING PENETRATIONS FOR THE UNIT 2 PIPE TUNNEL AND CHARGING PUMP CUBICLE FOR EVALUATION PURPOSES ARE ASSUMED TO BE CAPABLE OF BEING EFFECTIVELY SEALED IN A MANNER THAT WOULD ELIMINATE AIR FLOW BETWEEN THE ADJACENT AREAS AND WOULD WITHSTAND ANY CONCIEVABLE PRESSURE DIFFERENTIAL THAT MAY DEVELOPE AS A RESULT THROUGHOUT THE COURSE OF A FAILURE ANALYSIS.

5) AMBIENT AIR TEMPERATURE MONITORS ARE INSTALLED IN STRATEGIC LOCATIONS THROUGHOUT THE AUXILIARY BUILDING WITH REMOTE ALARM AND MONITORING CAPABILITIES IN THE MAIN CONTROL ROOM ALONG WITH IMPLEMENTATION OF EMERGENCY PROCEDURES THAT WOULD RESULT IN THE IMMEDIATE ISOLATION OF ALL NON-ESSENTIAL HIGH ENERGY LINES UPON INDICATION OF A RISE IN AMBIENT AIR TEMPERATURE GREATER THAN 120OF TO PROVIDE THE BASIS FOR AN ASSUMPTION THAT A FAILURE TERMINATED BY OPERATOR ACTION COULD BE ACCOMPLISHED WITHIN 900 SECS OF THE FAILURES OCCURRENCE.

6) ADDITIONAL ASSUMPTIONS ARE NOTED AS APPROPRIATE THROUGHOUT THE CALCULATION.

<u>CALCULATION</u>: THE RESULTS OF THE REF. 2 CALCULATION LED TO THE DETERMINATION THAT THE COMPONENTS MOST SENSITIVE TO THE TEMPERATURE PROFILES OBTAINED ARE THOSE LOCATED IN THE 2'0" ELEVATION OF THE CHARGING PUMP CUBICLES. (NODES 2 AND 3 OF REF 1). IT IS POSTULATED THAT MODIFICATIONS WHICH WOULD REDUCE THE DURATION OF THE FAILURES ANALYZED THAT REQUIRE OPERATOR ACTION FOR TERMINATION MAY RESULT IN SIGNIFICANTLY LESS SEVERE TEMPERATURES THAN THOSE OBTAINED IN THE REF 2 CALCULATION. FURTHERMORE, IT IS POSTULATED THAT ELIMINATING THE DIRECT FLOWPATH FROM THE CH-P-1A CHARGING PUMP CUBICLE AND ITS RESPECTIVE PIPE TUNNEL (FOR UNIT 1 OR UNIT 2) AS REPRESENTED BY JUNCTION #3 OF REFERENCE 1 BY SEALING OFF THIS PIPE WALL PENETRATION MAY PROVIDE SOME ADDITIONAL TEMPERATURE PROTECTION FROM HIGH ENERGY LINE FAILURES. A COMPARITIVE CALCULATION IS MADE TO EVALUATE THE EFFECTIVENESS, IF ANY, OF THIS MODIFICATION.

TO ACCOMPLISH REDUCTION OF THE BLOWDOWN DURATION, THE MODIFICATION PROPOSED IN ASSUMPTION 5 GIVEN ON THIS PAGE IS UTILIZED. THE USE OF 900 SECS FOR TERMINATING THE FAILURE IS ARBITRARY IN NATURE, HOWEVER IT IS CONSIDERED TO BE CONSERVATIVE. TO PROVIDE A MORE REFINED EVALUATION OF THE FAILURES ANALYZED CERTAIN CHANGES TO THE MODEL DEVELOPED IN THE REF 1 CALCULATION IS MADE IN ADDITION TO THOSE BROUGHT ABOUT BY THE PROPOSED MODIFICATIONS, THESE CHANGES LISTED BELOW. AS A RESULT, THE POTENTIALLY LIMITING FAILURES FOR THIS REVISED MODEL ARE SLIGHTLY DIFFERENT THAN THOSE ANALYZED IN THE REF. 2 CALCULATION, THESE IDENTIFIED IN THE SUMMARY SECTION, PAGES 20-22 OF THIS CALCULATION. TO PROVIDE SOME INDICATION OF THE BENEFIT OBTAINED FROM SEALING THE WALL PIPING PENETRATIONS TO THE CHARGING PUMP CUBICLE, AS PREVIOUSLY NOTED, A COMPARITIVE ANALYSIS OF THE CIRCUMFERENTIAL STEAM GENERATOR BLOWDOWN LINE BREAK IN NODE 4 IS MADE KEEPING ALL FACTORS EQUAL IN BOTH EXCEPT IN ONE, THIS PENETRATION IS SEALED.

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IN GENERAL, THE FOLLOWING CHANGES TO THE MODEL DEVELOPED IN REF 1, SHOWN BY THE DIAGRAM ON PAGE 8 OF THAT CALCULATION, ARE MADE FOR THE REASONS LISTED.

1. NODE 30 AND THE ASSOCIATED JUNCTION #46 IS DELETED. THIS NODE IS "DEAD ENDED", OF RELATIVELY SMALL VOLUME AND CONTAINS NO ELECTRICAL COMPONENTS OF CONCERN, CONSEQUENTLY IS OF INSIGNIFICANT CONTRIBUTION TO THE CALCULATION.
2. NODES 26, 27, 28 AND 29 ARE COMBINED INTO THE SINGLE NODE #26 TO ELIMINATE THE COMPUTATIONAL INSTABILITIES THAT RESULTED FROM THE ARTIFICIALLY HIGH FLOW RESISTANCES BETWEEN THESE NODES EVIDENCED IN THE REF. 2 CALCULATIONS UTILIZING THE ORIGINAL DATA.
3. AN "ATMOSPHERIC" NODE WITH TWO ASSOCIATED JUNCTIONS FROM NODE 26 OF THIS MODEL IS ADDED TO INCLUDE THE EFFECTS OF THE LOUVERED INTAKES ON THE 45'10" ELEVATION AS DESCRIBED ON PAGES 6-9 OF REF 2.
4. THE REMAINING CHARGING PUMP CUBICLES 1-CH-P-1A, 2CH-P-1A, 1B AND 1C ARE ADDED TO THE MODEL TO EVALUATE THE INDIVIDUAL TEMPERATURE PROFILES THAT EACH CUBICLE OBTAINS.
5. JUNCTION #3, THE OPENING BETWEEN NODES 5 AND 3 IS REMOVED FROM THE MODEL TO EVALUATE THE EFFECTS ON THE TEMPERATURE PROFILE OF THE CHARGING PUMP CUBICLE OBTAINED BY SEALING OFF THIS WALL PENETRATION.
6. 7 ADDITIONAL HEAT SINKS ARE INCLUDED ON THE 2'0" AND 13'0" ELEVATIONS TO THE MODEL TO PROVIDE INCREASED HEAT REMOVAL CAPACITY FROM THE MODEL.
7. A SIMULATED MODEL OF THE CENTRAL EXHAUST SYSTEM IS, IN PART, INCLUDED TO APPROXIMATE THE EFFECTS OF THIS SYSTEM ON THE TEMPERATURE PROFILE OF THE CHARGING PUMP CUBICLES.

A CROSS-REFERENCE GUIDE TO LOCATING THE SOURCE OF DATA FOR THE MODEL USED IN THIS CALCULATION IS PROVIDED ON PAGES 15-15B WITH A FLOW DIAGRAM BY DESIGNATION NUMBER PROVIDED ON PAGE 16 OF THIS CALCULATION. DATA UTILIZED IN THIS CALCULATION WHICH IS RETAINED UNCHANGED FROM THE DATA GIVEN ON PAGES 153 to 156 OF REF 1 IS NOT REPEATED HERE, AND IS SO INDICATED ON THE CROSS-REFERENCE SUMMARY. BELOW IS GIVEN THE NODAL AND JUNCTION DATA OBTAINED FOR THE MODEL USED IN THIS CALCULATION WHICH ARE DIFFERENT FROM THAT GIVEN BY THE MODEL DEVELOPED IN REF 1

NODAL DATA CARDS

NODE 26 : NET VOLUME WILL EQUAL SUM OF VOLUMES OF NODE 26, 27, 28 AND 29 AS GIVEN ON PAGE 153 OF REF 1

$35998.5\ ft^3 + 25881.7\ ft^3 + 68204.7\ ft^3 + 19206.2\ ft^3 = 149291.1\ ft^3$

AT ELEVATION 45.83 ft WITH A HEIGHT OF 18.5 ft

NODE 30 : ATMOSPHERIC NODE WITH AN ASSUMED VOLUME OF $1.0 \times 10^{20}\ ft^3$. AN ELEVATION OF 27.5' WITH A HEIGHT OF 50.0' IS ARBITRARILY USED

NODE 39 : THIS NODE IS USED TO SIMULATE THE EFFECTS OF COMBINING ALL VENTILATION INTAKES INTO A COMMON VOLUME WHICH IS SUBSEQUENTLY EVACUATED BY A SINGLE EXHAUST FAN. THE VOLUME IS ARBITRARILY SET

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CALCULATION SHEET

▲5010.65

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TO EQUAL 2,000 ft^3 AS ADEQUATELY LARGE ENOUGH TO HANDLE THE EXPECTED MASS FLOW INTO THE NODE YET NOT SO LARGE AS TO BE RELATIVELY INSENSITIVE TO THE OPERATION OF THE FAN. ELEV. 2.0' AND HEIGHT OF 70' IS USED.

NODE 40 : THIS NODE PROVIDES THE VOLUME TO WHICH THE FAN EXHAUST IS DIRECTED, THE 'ATMOSPHERE' WITH AN ASSUMED VOLUME OF 1.0×10^{20} FT^3. THE PRESSURE OF 15.0 PSIA IS UTILIZED HERE TO ENSURE THAT ANY EXPECTED PRESSURE THAT MAY DEVELOPE IN NODE 39, THE VOLUME FROM WHICH THE FAN TAKES SUCTION, WILL NOT EXCEED THE PRESSURE OF THIS NODE WHERE THE FAN EXHAUSTS, A CONDITION WHICH WOULD ABORT THE COMPUTOR ANALYSIS.

FOR PURPOSES OF CLARIFICATION, THE NODAL DATA CARDS ADDED FOR THE INCLUSION OF ALL CHARGING PUMPS ORIGINATES FROM THE CALCULATION OF THE VOLUMES ASSOCIATED WITH 1CH-P-1C AND 1-CH-P1B PERFORMED IN REFERENCE 1 CALCULATION AS FOLLOWS. (REFER TO ATTACH. 1 AND 2 OF REF 1 CALCULATION)

1CH-P-1C AT 2'0" ELEV IS NODE 3 IN THE REF 1 CALCULATION

1CH-P-1C AT 13'0" ELEV IS NODE 15 IN THE REF 1 CALCULATION

IT IS ASSUMED THAT THE VOLUMES AND DIMENSIONS OF THE ADDED CUBICLE: 2CH-P-1C IS THE SAME AS THOSE DEVELOPED FOR 1CH-P-1C SUCH THAT NODE 34 IS THE SAME AS NODE 2 AND NODE 37 IS THE SAME AS NODE 15. SIMILARLY FOR THE REMAINING CUBICLES, IT IS ASSUMED THAT FOR THE NODES AT THE 2'0" ELEVATION FOR EACH CUBICLE IS THE SAME AS NODE 2 OF THE REFERENCE 1 CALCULATION, WHICH IS THE 2'0" ELEVATION OF CUBICLE 1-CH-P-1B AND THE 13'0" ELEVATION OF EACH CUBICLE IS THE SAME AS NODE 14 OF THE REFERENCE 1 CALCULATION, WHICH IS THE 13'0" ELEVATION OF CUBICLE 1-CH-P-1B. THUS, THE ADDED CUBICLE 1-CH-P1A, 2-CH-P-1B AND 2-CH-P-1A AT THE 2'0" ELEVATION, WHICH ARE NODES 31, 33 AND 35 RESPECTIVELY ARE THE SAME AS NODE 2 OF REF 1 GIVEN ON PAGE 153 AND THE 13'0" ELEVATION OF THOSE CUBICLES, NODES 32, 36 AND 38 RESPECTIVELY ARE THE SAME AS NODE 14 OF THAT CALCULATION, DATA GIVEN ON THE SAME PAGE. IT IS ASSUMED THAT ANY DIFFERENCE BETWEEN THE VOLUMES OF THESE NODES OBTAINED IN THIS MANNER AND THE ACTUAL VOLUME IS INSIGNIFICANT.

JUNCTION DATA CARDS: THE FOLLOWING IS THE CALCULATION OF DATA FOR THE JUNCTIONS WHICH ARE, WITH THE EXCEPTION OF THE DESIGNATION NUMBER, NOT IDENTICAL TO THAT GIVEN ON PAGES 154 AND 155 OF REF. 1.

THE SYMBOLS USED TO IDENTIFY THE PARAMETERS ANALYZED, FOR CLARIFICATION PURPOSES, ARE AS FOLLOWS.

$\vec{K}$ IS THE FORWARD LOSS COEFFICIENT, NET. (FORWARD FLOW DIRECTION IS DEFINED IN THE JUNCTION DESCRIPTION BY THE STATEMENT "NODE (a) TO NODE (b) WHICH IMPLIES FORWARD FLOW FROM NODE (a) TO NODE (b) THROUGH THE JUNCTION. $\overleftarrow{K}$ IS THE SAME COEFFICIENT IN THE REVERSE DIRECTION.

I IS THE INERTA

$\vec{K}_m$ IS THE MOMENTUM FLUX TERM IN THE FORWARD DIRECTION, $\overleftarrow{K}_m$ IS THE SAME TERM IN THE REVERSE DIRECTION.

F IS THE CROSS-SECTIONAL FLOW AREA, SUBSCRIPT (j) REFERS TO THE JUNCTION FLOW AREA, NUMERICAL SUBSCRIPT IS THE FLOW AREA OF THE NODE OF THAT NUMBER.

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L IS THE FLOW LENGTH, BASED ON THE DISTANCE FROM THE CENTROID OF THE NODE TO THE JUNCTION WHEN USED IN ASSOCIATION WITH A NODE AND THE LENGTH OF THE RESTRICTION WHEN USED IN ASSOCIATION WITH A JUNCTION, SUBSCRIPTS UTILIZED IN THE SAME MANNER AS EMPLOYED IN IDENTIFYING F TO DENOTE WHICH NODE IS DISCUSSED OR IF THE VALUE RELATES TO THE JUNCTION IN QUESTION.

THE REMAINING SYMBOLS USED WILL BE THE SAME AS THE SYMBOLS EMPLOYED IN THE RESPECTIVE SOURCE FROM WHICH THE RELATIONSHIP OR FORMULA IS OBTAINED, THAT SOURCE REFERENCED AS APPROPRIATE.

JUNCTION #36, NODE 23 to NODE 26

NOTE: THE JUNCTIONS CONNECTING NODES WHICH WERE UNCHANGED FROM THE REF. 1 CALCULATION TO THE REVISED NODE 26 OF THIS CALCULATION ARE RE-ANALYZED TO EVALUATE THE EFFECTS ON THE VALUES OF LOSS COEFFICIENTS AND INERTIA WHICH MAY OCCUR FROM THIS CHANGE. THE PHYSICAL QUANTITIES OF JUNCTION AREA, ELEVATION ETC ARE LEFT THE SAME AS THAT GIVEN BY THE REF. 1 CALCULATION.

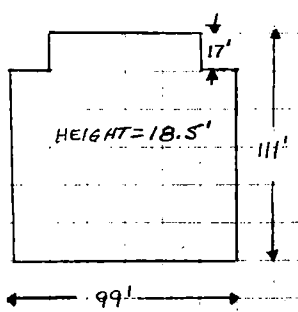
1) AS SHOWN BY THE COMPARITIVE CALCULATION PERFORMED FOR JUNCTION #38 GIVEN BELOW, THE VALUES OF $\vec{K}$, $\overleftarrow{K}$ ARE NOT SIGNIFICANTLY AFFECTED AS A RESULT OF REVISING THE SIZE OF NODE 26, THEREFORE IT IS ASSUMED THAT RETAINING THESE VALUES UNCHANGED WILL HAVE NEGLIGIBLE EFFECT ON RESULTS.

∴ from REF. 4, p142, JUNCTION #37 $F_j = 60.0\ ft^2$

$\vec{K} = 2.553$

$\overleftarrow{K} = 2.6071$ AT ELEV. 44.25' (p154 of REF 1)

NODE 26 IS DIMENSIONED IN THE FOLLOWING MANNER



THE OVERALL DIMENSIONS ARE TAKEN FROM THOSE CALCULATED FOR NODES 26 thru 29 of REF 1 ON PAGES 86, 88 AND 90 of THAT CALCULATION, HERE COMBINED TO PROVIDE THE TOTAL LENGTH AND WIDTH. FLOW THROUGH THIS JUNCTION IS CONSIDERED TO BE VERTICAL RELATIVE TO THE DIMENSIONS GIVEN AT THE LEFT, THUS, THE FLOW LENGTH, L_{26} IS APPROXIMATELY 1/2 THE HEIGHT OF THE NODE, AND THE FLOW AREA, F_{26} WILL BE TAKEN AS THE PRODUCT OF THE OVERALL LENGTH 111 ft AND GREATEST WIDTH, 99 ft. WHILE THIS IS NOT STRICTLY CORRECT THE VALUE OBTAINED IN THIS MANNER WILL NOT SIGNIFICANTLY DEVIATE FROM ACTUAL VALUES AND ITS EFFECTS ON RESULTS ARE NEGLIGIBLE.

THE CONTRIBUTION OF NODE 26 TO THE TOTAL INERTIA TERM AS CALCULATED AND SUMMED WITH THE VALUES OBTAINED FOR THE JUNCTION AND NODE 23 INERTIA TERMS, WHICH ARE UNCHANGED, FOUND ON PAGES 78 AND 79 of REF. 1 FOR JUNCT. #37

thus. $L_{N26} = 1/2(18.5') = 9.25\ ft$

$F_{26} = (111')(99') = 10989\ ft^2$

$$I = \frac{9.25\ ft}{10989\ ft^2} + .03571\ ft^{-1} + .00301\ ft^{-1} = 0.0396\ ft^{-1} = .040\ ft^{-1}$$

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JUNCTION #38 NODE 24 to NODE 26 (STAIRWELL)

THE DATA FOR THIS JUNCTION IS OBTAINED AS follows

1) $L_{24} = \frac{1}{2}(17')$; THE LENGTH AND WIDTH of NODE 24 ≈ 34'x79' : PAGE 31 of REF 1

2) $L_{26} = 9.25'$; $F_{26} = 10989\ ft^2$: from JUNCTION #36 of THIS CALCULATION

3) $L_j = 1.5'$; $F_j = 63 ft^2$; $D_H = 6'$; $L_j/D_h = 0.25$ (or l/D_h) ; $\tau = 1.20$; $F_{24} = 2053.1 ft^2$ from PAGE 143 of REF 1 for JUNCTION #39

TO EVALUATE THE FRICTION LOSS of THE JUNCTION AS A THICK EDGED ORIFACE THE following CALCULATION IS MADE IN THE MANNER GIVEN ON PAGE 137 of REF. 3.

$\lambda\left(\frac{L_j}{D_h}\right)$ where $\lambda = \frac{1}{\left(2\log\frac{3.7}{\bar{\Delta}}\right)^2}$ where $\bar{\Delta} = \frac{\Delta}{D_h}$ in mm.

from TABLE 2-1, PAGE 65 of REF. 3 for AVERAGE CONDITION CONCRETE

$\Delta = 2.5$ mm.

∴

$$\lambda\left(\frac{L_j}{D_h}\right) = \left[\left(2\log\frac{3.7}{\frac{(2.5mm)(.03937 mm/in)}{(6ft)(12 in/ft)}}\right)^2\right]^{-1}(0.25) = 0.0053$$

from PAGE 137 of REF. 3, THE RESISTANCE TO FLOW (IN THE FORWARD DIRECTION) of THE JUNCTION AS A THICK-EDGED ORIFACE IS:

$$\zeta = 0.5\left(1-\frac{F_j}{F_{24}}\right) + \left(1-\frac{F_j}{F_{26}}\right)^2 + \tau\sqrt{\left(1-\frac{F_j}{F_{24}}\right)}\left(1-\frac{F_j}{F_{26}}\right) + \lambda\left(\frac{L_j}{D_h}\right)$$

$$= 0.5\left(1-\frac{63ft^2}{2053.1ft^2}\right) + \left(1-\frac{63ft^2}{10989ft^2}\right)^2 + 1.2\sqrt{\left(1-\frac{63ft^2}{2053.1ft^2}\right)}\left(1-\frac{63ft^2}{10989ft^2}\right) + 0.0053 = 2.65$$

$$\vec{K}_m = \left(\frac{63ft^2}{10989ft^2}\right)^2 - \left(\frac{63ft^2}{2053.1ft^2}\right)^2 = -0.0006173$$ WHICH IS NEGLIGIBLE

THE DIFFERENCE BETWEEN $\zeta = 2.65$ OBTAINED HERE AND 2.63 OBTAINED for K_{TED} ON PAGE 143 of REF 1 for JUNCTION #39 IS INSIGNIFICANT, THUS THE LOSS COEFFICIENT of $\vec{K} = 2.6733$ AND $\overleftarrow{K} = 2.6718$ ARE RETAINED AS CALCULATED IN REF 1. THE INERTIA TERM IS EVALUATED AS follows, where the CONTRIBUTIONS TO THE TOTAL from THE JUNCTION AND NODE 24 IS OBTAINED from PAGES 83 AND 84 of REF. 1

$$I = \frac{9.25 ft}{10989 ft^2} + 0.0312 ft^{-1} + 0.0414 ft^{-1} = 0.035\ ft^{-1}$$

AT ELEV 49.25' (p154, REF 1)

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JUNCTION # 39, NODE 24 TO NODE 26 (GRATING)

THE VALUES OF F_j, $\vec{K}$, $\overleftarrow{K}$ ARE RETAINED UNCHANGED AS GIVEN ON PAGE 154 OF REF. 1, THE EFFECTS ON THE LOSS COEFFICIENT FROM REVISING NODE 26 ARE CONSIDERED NEGLIGIBLE AS SHOWN IN THE JUNCTION #38 PORTION OF THIS CALCULATION. THE INERTIA IS EVALUATED AS FOLLOWS, THE DATA OBTAINED FROM THE VALUES GIVEN IN JUNCTION #38 OF THIS CALCULATION, AND $L_j = 1.5'$, $F_j = 83.2\,ft^2$ FROM PAGE 143 OF REF 1, JUNCTION # 40.

$$I = \frac{L_{24}}{F_{24}} + \frac{L_{26}}{F_{26}} + \frac{L_j}{F_j} = \frac{8.5'}{2053.1\,ft^2} + \frac{9.25'}{10989\,ft^2} + \frac{1.5'}{83.2\,ft^2} = .022\,ft^{-1}$$

JUNCTION # 44, NODE 26 TO 30 AND JUNCTION # 45, NODE 26 TO 30

VALUES OF F_j, $\vec{K}$, $\overleftarrow{K}$ AND I WERE CALCULATED ON PAGES 11 & 12 OF REF. 2 AND ARE RETAINED HERE UNCHANGED.

JUNCTION # 46, NODE 2 TO NODE 31

FROM REF 4 AND 5, THE DIMENSIONS OF THIS JUNCTION ARE

$$L_j = 18''$$

$$\text{PERIMETER } (\Pi) = 2'3'' \times 14'' = 6.833'$$

THE DIMENSIONS OF NODE 31 IS IDENTICAL TO THAT OF NODE 2, GIVEN ON PAGE 126 OF REF 1, SUCH THAT

$$L_2 = L_{31} = 4.75'$$

$$F_2 = F_{31} = 248.7'$$

PAGE 101 OF REF 1 ASSUMES A 50% REDUCTION IN JUNCTION AREA FROM PIPING FOR JUNCTION #2 OF THAT CALCULATION, THIS ASSUMPTION WILL BE USED FOR THIS JUNCTION AS WELL, WHERE

$$F_j = (2'3'')(14'')(0.5) = 1.31\,ft^2$$

EVALUATED AS A THICK EDGED ORIFICE IN A MANNER SIMILAR TO THAT USED FOR JUNCTION #2 OF REF. 1, P126, UTILIZING THE RELATIONSHIPS ESTABLISHED ON P137 OF REF 3, THE LOSS COEFFICIENT (K) IS EVALUATED AS FOLLOWS

$$\frac{L_j}{D_h} = \frac{1.5'}{\left(\frac{4(1.31\,ft^2)}{6.833'}\right)} = 1.956 \quad \text{where } D_h = \frac{4(F_j)}{\Pi}$$

L_j/D_h PROVIDES THE VALUE $\tau = 0.0799$ BY INTERPOLATION FROM DIAG. 4-11, P137 OF REF 3

$$\lambda\left(\frac{L_j}{D_h}\right) = \frac{1}{\left(2\log\frac{3.7}{\bar{\Delta}}\right)^2} \quad \text{where } \bar{\Delta} = \frac{\Delta}{D_h} \text{ in mm. } \Delta = 2.5\,mm \text{ for average}$$

CONDITION CONCRETE, FROM P. 65 OF REF 3,

$$\therefore \lambda\left(\frac{L_j}{D_h}\right) = \left[\left(2\log\frac{\quad}{\frac{(2.5\,mm)(.03937\,in/mm)}{\left(\frac{4(1.31\,ft^2)}{6.833'}\right)(12\,in/ft)}}\right)^2\right]^{-1}(1.956) = 0.0763$$

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$$\zeta = 0.5\left(1-\frac{F_j}{F_2}\right)+\left(1-\frac{F_j}{F_{31}}\right)^2+\tau\sqrt{\left(1-\frac{F_j}{F_2}\right)\left(1-\frac{F_j}{F_{31}}\right)}+\lambda\left(\frac{L_j}{D_h}\right)$$

$$= 0.5\left(1-\frac{1.31ft^2}{245.7ft^2}\right)+\left(1-\frac{1.31ft^2}{245.7ft^2}\right)^2+0.0799\sqrt{\left(1-\frac{1.31ft^2}{245.7ft^2}\right)\left(1-\frac{1.31ft^2}{245.7ft^2}\right)}+0.0763 = 1.64$$

ζ IS THE SAME VALUE IN EITHER DIRECTION SINCE $F_2 = F_{31}$

$\overrightarrow{K}_m$ AND $\overleftarrow{K}_m$ ARE CONSIDERED NEGLIGIBLE AND THUS ARE NOT INCLUDED

THE RESISTANCE TO FLOW FROM NODAL FRICTION (ζ_{fr}) = 0.0236, GIVEN ON PAGE 115 OF REF 1

$$\overrightarrow{K} = \zeta + \zeta_{fr} = 1.64 + 0.0236 = 1.66$$
$$\overleftarrow{K} = \zeta + \zeta_{fr} = 1.64 + 0.0236 = 1.66$$

INERTIA (I) IS EVALUATED AS $I = \frac{L_2}{F_2} + \frac{L_{31}}{F_{31}} + \frac{L_j}{F_j}$

$$I = \frac{1.5'}{1.31ft^2} + \frac{4.75'}{245.7ft^2} + \frac{4.75'}{245.7ft^2} = 1.182$$

UTILIZE SAME ELEV AS JUNCT 2 ELEVATION = 9.2', p 154 of REF 1

JUNCTION 57 TO 65 MAKE UP THE PORTION OF THIS MODEL INTENDED TO APPROXIMATE THE EFFECTS OF THE CENTRAL EXHAUST SYSTEM. FROM THE DRAWINGS OF REF 6, 7, 8 THE PORTIONS OF THIS SYSTEM, DESIGNATED 1-EH-14, THAT WERE USED INCLUDE THE INTAKE POINTS OF EACH CHARGING PUMP CUBICLE, ONE FROM THE NARROW CORRIDOR BETWEEN THE UNIT 1 & 2 CHARGING PUMP CUBICLES ON THE 2'0" ELEVATION, WHICH, FOR ORIENTATION PURPOSES, CORRESPONDS TO NODE 1 OF THE MODEL AND A SINGLE INTAKE ON THE 13'0" ELEVATION BETWEEN THE UNIT 1 AND UNIT 2 CHARGING PUMP CUBICLES CALLED THE PURIFICATION AREA. THIS LAST AREA INTAKE IS DESIGNATED TO BE LOCATED IN NODE 21 OF THE MODEL. THE INTENT OF THIS MODEL IS DIRECTED PRIMARILY TO ANALYZE THE EFFECTS ON THE TEMPERATURE PROFILE OF THE CHARGING PUMP CUBICLE, THUS MODELING ONLY THE PORTION OF THE SYSTEM AS INDICATED ABOVE IS CONSIDERED ADEQUATE. THE REFERENCED DRAWINGS INDICATE THE DESIGN FLOWRATE OF EACH INTAKE IN CFM, HOWEVER, AS INDICATED BY ATTACHMENT 1 OF THIS CALCULATION THOSE INTAKES PROVIDED IN THE CHARGING PUMP CUBICLES ARE CURRENTLY UNDERGOING DESIGN CHANGES WHICH WOULD ESTABLISH A FLOW RATE OF 6500 cfm FOR EACH INTAKE VICE THE 8000 cfm THAT IT IS CURRENTLY RATED AT. THE DESIGN CHANGE WILL NOT AFFECT THE RATED FLOW OF THE OTHER INTAKES UTILIZED. EACH INTAKE WILL BE INPUTED AS A SINGLE JUNCTION CONNECTING THE NODE FROM WHICH IT DRAWS AIR TO THE SIMULATED "VENT" NODE, #39. TO APPROXIMATE THE DESIRED FLOW RATE THROUGH EACH OF THESE JUNCTIONS, A RATIO IS ESTABLISHED SUCH THAT, KEEPING ALL OTHER FACTORS EQUAL, THE NET FLOW OUT THE VENT NODE, BY WAY OF A CONSTANT FLOW FAN CURVE, WILL ESTABLISH APPROXIMATELY THE NET FLOW INTO THE

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VENT NODE, THE COMPONENTS OF WHICH ARE DIVIDED AMONG EACH JUNCTION PRIMARILY DEPENDENT ON THE RELATIVE SIZE OF EACH. THIS THEN IS ACCOMPLISHED BY SUMMING THE RATED FLOWS OF ALL INTAKE JUNCTIONS AND UTILIZING THAT TOTAL FOR THE FAN TABLE DATA CARDS, ALONG WITH SELECTING A CORRESPONDING HEAD SUCH THAT ANY DIFFERENTIAL PRESSURE DEVELOPED ACROSS THIS FAN JUNCTION WOULD NOT RESULT IN A CALCULATED HEAD THAT EXCEEDS THE VALUE USED IN THE FAN TABLE CARD. EACH JUNCTION REPRESENTING AN INTAKE IS THEN ASSIGNED A RATIOD FLOW AREA TO BALANCE INTAKE FLOWS ACCORDINGLY, RELATIVE TO THE DESIRED FLOW RATE OF EACH. BY USING THE LOWEST FLOW RATE INTAKE AS ARBITRARILY EQUAL TO $1.0\ ft^2$, THIS RATIO IS ESTABLISHED. ALL OTHER COMPONENTS OF JUNCTION LOSS COEFFICIENT AND INERTIA ARE INITIALLY SET EQUAL FOR ALL JUNCTIONS AT ARBITRARY VALUES WHOSE SELECTION WILL HAVE THE PRIMARY EFFECT OF DETERMINING THE RESPONSIVENESS OF THIS SIMULATED EXHAUST VENTILATION SYSTEM TO CHANGES IN DIFFERENTIAL PRESSURE. THE VALUES CHOSEN WERE ORIGINALLY $I = 0.1$, $\vec{K} = 1.0$ AND $\overleftarrow{K} = 30.0$ (A HIGH RESISTANCE TO REVERSE FLOW THROUGH THESE JUNCTIONS IS CHOSEN TO PRECLUDE THIS EFFECT FROM OCCURING). BASED ON THE FLOW TO AREA RATIO, THE JUNCTION AREAS UTILIZED WOULD BE AS FOLLOWS. FOR THE INTAKE FROM NODE 1, AT 400 cfm = $1.0\ ft^2$ (THE SMALLEST FLOWRATE, ESTABLISHING THE RATIO)

FROM THE CHARGING PUMP CUBICLES, AT 6500 cfm = $16.25\ ft^2$

FROM NODE 21, AT 900 cfm = $2.25\ ft^2$

JUNCTION #39, WHICH REPRESENTS THE FAN, UTILIZES THE FAN TABLE TO DETERMINE FLOW THROUGH THE JUNCTION, TOTAL cfm OF ALL INTAKE JUNCTIONS = 40,300 cfm, THE VALUES OF JUNCTION AREA, INERTIA AND LOSS COEFFICIENTS MUST STILL BE INPUTED ON THE JUNCTION DATA CARD, HOWEVER THEY ARE NOT UTILIZED IN CALCULATING FLOW THROUGH THE JUNCTION THEREFORE THE VALUES INPUTED HERE ARE IRRELEVANT. USING THESE VALUES, A TEST RUN WAS MADE TO DETERMINE THE ACCURACY OF THE SIMULATED MODEL IN OBTAINING THE DESIRED FLOWRATES. FROM THE RESULTS OF THIS TEST, IT WAS NECESSARY TO ADJUST THE VALUES TO BALANCE THE FLOW THROUGH INDIVIDUAL JUNCTIONS TO OBTAIN ACCEPTABLE APPROXIMATIONS OF VOLUMETRIC FLOW RATE ATTRIBUTABLE TO EACH, PRIMARILY DUE TO THE LARGE DIFFERENCE IN JUNCTION AREA BETWEEN THAT OF THE CHARGING PUMP CUBICLES AND THOSE OF THE JUNCTIONS FROM NODE 1 AND NODE 21. 0.2 SECS OF ANALYSIS TO ESTABLISH FLOW PATTERNS DEVELOPED BY DIFFERENCES IN NODAL ELEVATION WAS PERFORMED PRIOR TO INITIATING FLOW ESTABLISHED BY THE FAN OPERATION AND 1.8 SECS OF THIS ANALYSIS WAS REQUIRED TO ATTAIN RELATIVELY STABLE FLOW RATES THROUGH EACH JUNCTION THEREAFTER. CONSEQUENTLY, ALL FAILURE ANALYSIS WILL UTILIZE A 2.0 SEC DELAY PRIOR TO INITIATING A FAILURE FROM THE START OF THE ANALYSIS TO ALLOW FOR A STABILIZATION OF THE BUILDING FLOW PATTERNS ATTRIBUTABLE TO THE EXHAUST FAN SYSTEM OPERATION.

BELOW IS A SUMMARY OF THE RESULTANT JUNCTION INPUT DATA WHICH RESULTED IN ACCEPTABLE APPROXIMATIONS OF VOLUMETRIC FLOW RATE THROUGH EACH JUNCTION. NOTE THAT THE JUNCTIONS FROM NODE 1 AND 21 RESULT IN SLIGHTLY HIGHER THAN DESIGN FLOW RATES, HOWEVER THE FLOWS OBTAINED ARE ADEQUATE AS AN APPROXIMATION AND WILL NOT ADVERSLY AFFECT THE OVERALL CONSERVATISM OF THIS CALCULATION.

#57 NODE 1 to NODE 39 ; F_J = 1.0 ; I = 10.0 ; $\vec{K}$ = 1.0 ; $\overleftarrow{K}$ = 30.0 ; ELEV = 9.0
#58 " 2 " " " ; F_J = 16.25 ; I = 1.0 ; " ; " ; ELEV = 9.0
#59 " 3 " " " ; F_J = 16.25 ; I = 1.0 ; " ; " ; ELEV = 9.0
#60 " 31 " " " ; F_J = 16.25 ; I = 1.0 ; " ; " ; ELEV = 9.0
#61 " 21 " " " ; F_J = 3.25 ; I = 10.0 ; " ; " ; ELEV = 15.0
#62 " 33 " " " ; F_J = 16.25 ; I = 1.0 ; " ; " ; ELEV = 9.0
#63 " 34 " " " ; F_J = 16.25 ; I = 1.0 ; " ; " ; ELEV = 9.0
#64 " 35 " " " ; F_J = 16.25 ; I = 1.0 ; " ; " ; ELEV = 9.0

NOTE THAT F_J OF JUNCTION #61 WAS INCREASED TO 3.25 ft² FROM THE CALCULATED RATIO OF 2.25 ft² FOR 900 cfm AS THE FLOW OBTAINED FROM THE STRICT RATIO WAS MUCH LESS THAN THE DESIRED FLOW.

JUNCTION #65 ; NODE 39 to NODE 40, AS PREVIOUSLY NOTED, UTILIZES THE FAN TABLE TO CALCULATE FLOW, THEREFORE VALUES INPUTED IN THE JUNCTION DATA ARE IRRELEVANT. THE FAN TABLE UTILIZED IS A CONSTANT FLOW 40300 cfm to A HEAD OF 3,000 ft, CHOSEN AS ADEQUATELY HIGH ENOUGH SUCH THAT ANY CALCULATED HEAD WOULD NOT EXCEED THIS VALUE.

IN THE COMPARITIVE ANALYSIS PERFORMED TO EVALUATE THE EFFECTIVENESS OF REDUCING THE TEMPERATURE TRANSIENT IN THE CHARGING PUMP CUBICLES BY SEALING THE PIPE WALL PENETRATIONS, THE JUNCTION BETWEEN NODE 5 AND NODE 3 OF REF. 1 IS RE-INCLUDED IN THIS CALCULATION BETWEEN NODE 5 AND 3 AND NODE 7 & 34 (WITH THE ASSUMPTION THAT BOTH OPENINGS ARE IDENTICAL). IN THE COMPARITIVE ANALYSIS ONLY JUNCT. #66, NODE 5 to 3 AND JUNCT. #67, NODE 7 to 34 ARE USED, THE DATA THE SAME AS FOR JUNCTION #3 OF REF. 1, p154

SUMMARY OF HEAT SINK DATA (ALL MATERIAL UTILIZED IS CONCRETE)

MATERIAL DATA CARD VALUES OF THERMAL CONDUCTIVITY AND VOLUMETRIC HEAT CAPACITY ARE DETERMINED AS FOLLOWS, FROM REF 18 FOR CONCRETE, CINDER (STONE 1-2-4-MIX)

k, w/m°C = 1.37, CONVERSION FACTOR 1 w/m°C = .5778 BTU/hr-ft-°F

1.37(0.5778) = 0.79 BTU/hr-°F-ft

C_p, ρ = 1900–2300 kg/m³, C_1 = .88; kJ/kg°C, CONV. FACTOR 1 kJ/kg°C = 0.23884 BTU/lbm-°F

(1900 kg/m³)(.06243 lbm/ft³)(.23884 BTU/lbm-°F)(.88 kJ/kg-°C) = 24.93 BTU/ft³-°F

1) MESH POINT CO-ORDINATES WERE SELECTED AT APPROXIMATELY 1" INTERVALS
2) ALL HEAT SINKS WERE CONSIDERED TO BE INDEPENDENT AND AFFECT ONLY ONE NODE, VOLUME EXPOSURE RIGHT INPUTED AS ZERO
3) APPROXIMATE SURFACE AREAS OF THE CONCRETE WALLS, FLOOR AND CIELING ONLY WERE USED FOR EACH NODE AS A SINK
4) AN ASSUMED 8% REVAPORIZATION IS USED FOR ALL HEAT SINKS
5) MATERIAL THICKNESS IS TAKEN TO BE CONSERVATIVELY AS ½ OF THE SMALLEST WALL THICKNESS OF THE INDIVIDUAL NODE
6) LOCATIONS OF HEAT SINKS #1 THRU 10 WERE DETERMINED IN REF 1, p156, SINKS 11 THRU 17 WERE PLACED FOR MAXIMUM EFFECTIVENESS ON POTENTIAL TEMPERATURE REDUCTIONS FOR THE AIR FLOW TO THE CHARGING PUMP CUBICLES.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 13
12844.44		PE-050		

SINK #1, NODE 4; DATA SAME AS GIVEN ON PAGE 156, REF 1
SINK #2, NODE 5; " " " " " " " "
SINK #3, NODE 6; " " " " " " " "
SINK #4, NODE 7; " " " " " " " "
SINK #5, NODE 8; " " " " " " " "
SINK #6, NODE 9; " " " " " " " "
SINK #7, NODE 10; " " " " " " " "
SINK #8, NODE 11; " " " " " " " "
SINK #9, NODE 21; " " " " " " " "
SINK #10, NODE 22; " " " " " " " "
SINK #11, NODE 12; (2) SIDE WALLS, 20'X9', 18" THICK, PAGE 12, REF 1
(1) FLOOR 7½'X20', 4' THICK, " " "
(1) END WALL ≈ 7½'X7', 18" THICK, ESTIMATED FROM REF 4
<u>TOTAL AREA</u> 562.5 FT², 9" THICKNESS USED
SINK #12, NODE 13; (2) SIDEWALLS, (22'X3½')+(13.75'X9'), 18" THICK, PAGE 25, REF 1
(1) CIELING, 22'X7.5', 18" THICK, " " "
(1) ENDWALL ≈ 22½'X7.5', 18" THICK " " "
<u>TOTAL AREA</u> = 660.25 FT², 9" THICKNESS USED
SINK #13, NODE 16; (1) SIDE WALL 34'X13½' 18" THICK, PAGE 24, REF 1
(1) CIELING 12'X34', 12" THICK, " "
(1) FLOOR 12'X34', 18" THICK, " "
<u>TOTAL AREA</u> 1075.0 FT², 6" THICKNESS USED
SINK #14, NODE 17; (1) SIDE WALL, 12'X13½', 2' THICK, PAGE 24, REF 1
(1) SIDE WALL, 7'X12½', 18" THICK, " " "
(1) END WALL, 12¾'X13½', 18" THICK, " " "
(1) END WALL, (28½'X13½', 3' THICK, " " "
(1) CIELING ≈ (28½'X12')+(7'X15¾'), 12" THICK, P 24, REF 1
(1) FLOOR ≈ (28½'X12')+(7'X15¾'), 18" THICK, " "
<u>TOTAL AREA</u> = 1717.875', 6" THICKNESS USED
SINK #15, NODE 18; (2) END WALLS ≈ 64'X13½', 3' AND 18" THICK, P 24, REF 1
(1) CIELING ≈ 64'X10', 12" THICK " "
(1) FLOOR ≈ 64'X10', 2' THICK " "
<u>TOTAL AREA</u> = 3008 FT², 12" THICKNESS IS USED, THE CIELING THOUGH 12" THICK, IS NOT USED BY ANOTHER NODE AS A HEAT SINK, THEREFORE THE FULL THICKNESS IS AVAILABLE FOR USE IN THIS NODE WITHOUT COMPROMISING THE CONSERVATISM OF THIS TECHNIQUE FOR DEVELOPING HEAT SINKS
SINK #16, NODE 19; SAME AS SINK #14
SINK #17, NODE 20, SAME AS SINK #13

E.11 TABLE DATA CARDS.

1. CIRCUMFERENTIAL STEAM GENERATOR BLOWDOWN LINE BREAK DATA IS TAKEN FROM REF. 9, PAGE 7, CASE 1

2. STEAM GENERATOR BLOWDOWN LINE CRACK DATA UTILIZED PRELIMINARY VALUES WHICH DIFFER SLIGHTLY FROM THE FINAL VALUES GIVEN BY REF 9, PAGE 7, CASE 2(B). THE DIFFERENCE IN THESE VALUES WILL NOT SIGNIFICANTLY AFFECT THE RESULTS OF THE CALCULATION

3. LETDOWN LINE CIRCUMFERENTIAL BREAK DATA WAS TAKEN FROM PRELIMINARY VALUES WHICH AFTER 2.16 SECS IS SLIGHTLY HIGHER THAN THE FINAL VALUES GIVEN BY REF 9, PAGES 10 AND 11, CASE 2. THUS, THE ANALYSIS PERFORMED UTILIZING THE PRELIMINARY DATA IS MORE CONSERVATIVE THAN THAT OF AN ANALYSIS USING THE FINAL DATA, FURTHERMORE THIS FAILURE DID NOT PROVE TO BE LIMITING FOR COMPONENTS OF CONCERN, THUS RE-ANALYSIS UTILIZING THE FINAL VALUES FOR MASS-ENERGY RELEASE RATES IS NOT NECESSARY.

4. 6" AUXILIARY STEAM LINE CRACKS.

THE MASS FLOW RATE ($\dot{m}$) FROM A CRACK FAILURE IS EVALUATED AS FOLLOWS

$\dot{m} = GA$ WHERE G IS THE MOODY CRITICAL FLOW RATE INTERPOLATED FROM TABLE 6B-2 OF REF 12 AT AN ASSUMED $fL/D = 0.0$, QUALITY FACTOR $= 1.0$ IN 10^3 lbm/sec-ft²

WHERE A IS THE CRACK SIZE, DETERMINED FROM THE INFORMATION CONTAINED IN REF 7, PAGE 2.2.1 AS $A = (d/2)(t/2)$ IN ft²

d = PIPE DIAMETER IN INCHES, TAKEN TO BE, CONSERVATIVELY, AS THE OUTSIDE DIAMETER FOR 6" NOMINAL PIPE SIZE AS GIVEN BY APPENDIX B OF REF. 11 WHICH = 6.625"

t = WALL THICKNESS IN INCHES AS GIVEN FOR NOMINAL 6" DIA, 40S PIPE OF THE SAME REF. WHICH = 0.280"

IF A SINGLE ACTIVE FAILURE OF THE AUXILIARY STEAM SYSTEM PRESSURE REGULATING VALVE IS POSTULATED SUCH THAT STEAM PRESSURE IS MAXIMIZED, THE RESULTANT SYSTEM PRESSURE IS ASSUMED TO BE A CONSTANT 214.7 psia, LIMITED BY THE ACTUATION OF THE SYSTEM PRESSURE RELIEF VALVE AS GIVEN BY REF. 13. THEN MASS FLOW RATE FOR THIS FAILURE, THEN, IS AS FOLLOWS

$$\dot{m} = \left[0.47\times10^3 \frac{lbm}{sec\text{-}ft^2} + \left(0.68\times10^3\frac{lbm}{sec\text{-}ft^2} - 0.47\times10^3\frac{lbm}{sec\text{-}ft^2}\right)\left(\frac{214.7\,psia - 200\,psia}{300\,psia - 200\,psia}\right)\right]\left(\frac{6.625''}{2}\right)\left(\frac{0.28''}{2}\right)\left(\frac{1\,ft^2}{144\,in^2}\right) = 1.613\,\frac{lbm}{sec}$$

THE ENERGY RELEASE RATE ($\dot{Q}$) IS EVALUATED AS $\dot{m}h$ WHERE h IS THE ENTHALPY OF THE SYSTEM, ≈ 1197 BTU/lbm FROM THE STEAM TABLES, THUS

$$\dot{Q} = 1.613\,lbm/sec\,(1197\,BTU/lbm) = 1930.52\,BTU/sec$$

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

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CALCULATION IDENTIFICATION NUMBER				
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12841.44		PE-050		

NODAL DATA CALCS : THE INPUT VALUES of PRESSURE = 14.7 psia, TEMPERATURE = 120.0°F RELATIVE HUMIDITY = 1.0 ARE THE SAME for All NODES.

NODE DESIG.	VOLUME (FT^3)	ELEV. (FT)	HEIGHT (FT)	DATA SOURCE
1	1137.7	2.0	9.50	NODE 1, P153 of REF 1
2	2011.2	2.0	16.0	NODE 2 " " "
3	2011.2	2.0	10.0	NODE 3, " " "
4	26611.5	2.0	12.0	NODE 4, " " "
5	5150.7	2.0	9.5	NODE 5 " " "
6	18697.8	2.0	10.10	NODE 6 " " "
7	5150.7	2.0	9.5	NODE 7 " " "
8	26611.5	2.0	12.0	NODE 8 " " "
9	4050.0	2.0	9.0	NODE 9 " " "
10	5820.0	2.0	9.0	NODE 10 " " "
11	4050.0	2.0	9.0	NODE 11 " " "
12	1255.5	2.0	9.0	NODE 12 " " "
13	1400.2	13.0	12.5	NODE 13 " " "
14	2799.8	13.0	12.5	NODE 14 " " "
15	2696.6	13.0	12.5	NODE 15 " " "
16	5122.4	13.0	13.5	NODE 16 " " "
17	5678.0	13.0	13.5	NODE 17 " " "
18	8035.2	13.0	13.5	NODE 18 " " "
19	5678.0	13.0	13.5	NODE 19 " " "
20	5122.4	13.0	13.5	NODE 20 " " "
21	17220.2	13.0	12.5	NODE 21 " " "
22	17533.5	13.0	12.5	NODE 22 " " "
23	47234.0	27.5	17.0	NODE 23 " " "
24	31900.5	27.5	17.0	NODE 24 " " "
25	29622.1	27.5	17.0	NODE 25, " " "
26	1492911.1	45.83	18.5	P. 5 OF THIS CALC.
27	8930250	9.0	49.0	NODE 31, P153, REF 1
28	13235.0	11.5	15.15	NODE 32, " "
29	13235.0	11.5	15.15	NODE 33, " "
30	1.0×10^{20}	27.5	50.0	P. 5 of THIS CALC
31	2011.2	2.0	10.0	NODE 2, P153, REF 1
32	2799.8	13.0	12.5	NODE 14, " "
33	2011.2	2.0	10.0	NODE 2, P153, REF 1
34	2011.2	2.0	10.0	NODE 3, P153, REF 1
35	2011.2	2.0	10.0	NODE 2, " "
36	2799.8	13.0	12.5	NODE 14, " "
37	2696.6	13.0	12.5	NODE 15, " "
38	2799.6	13.0	12.5	NODE 14, " "
39	2000	2.0	70.0	PAGE 5 of THIS CALC
40	1.0×10^{20}	27.5	50.0	PAGE 6 of THIS CALC

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CALCULATION IDENTIFICATION NUMBER				
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12846.44		PE-050		

JUNCTION DATA CARDS:

#	VOL.# AT INLET	VOL.# AT EXIT	FLOW AREA (ft^2)	INERTIA (ft^{-1})	FWD flow coef.	REV flow coef.	ELEV. (ft)	DATA SOURCE
1	1	6	32.5	0.2888	2.219	1.476	7.58	JUNCT. 1, p 154, REF 1
2	2	3	1.75	0.894	1.61	1.61	9.2	JUNCT. 2, " "
3	4	5	246.7	.062	1.062	.216	6.5	JUNCT. 4, " "
4	5	6	78.6	.127	1.844	1.672	6.63	JUNCT. 5, " "
5	7	6	78.6	.127	1.844	1.672	6.63	JUNCT. 6, " "
6	8	7	246.7	.062	1.062	0.216	6.5	JUNCT. 7, " "
7	1	12	3.75	0.473	1.61	1.61	9.75	JUNCT. 8, " "
8	1	12	1.13	0.940	1.549	1.549	2.75	JUNCT. 9, " "
9	7	11	20.25	0.401	1.716	1.272	4.75	JUNCT. 10, " "
10	8	11	56.7	0.062	1.047	1.094	6.5	JUNCT. 11, " "
11	4	9	56.7	.062	1.047	1.094	6.5	JUNCT. 12, " "
12	5	9	20.25	.401	1.716	1.272	4.75	JUNCT. 13, " "
13	10	12	60.75	.149	1.491	-0.123	4.75	JUNCT. 14, " "
14	9	10	90.0	0.434	1.004	-0.45	4.5	JUNCT. 15, " "
15	11	10	90.0	0.434	1.004	-0.45	4.5	JUNCT 16, " "
16	9	17	24.5	0.337	2.088	2.048	4.5	JUNCT 17, " "
17	12	13	84.0	0.102	0.558	0.012	11.0	JUNCT 18, " "
18	11	19	24.5	0.337	2.088	2.048	11.0	JUNCT 19, " "
19	3	15	311.1	0.077	0.264	0.264	12.50	JUNCT 20, " "
20	2	14	208.7	.060	0.264	0.264	12.50	JUNCT 21, " "
21	17	18	135.0	0.288	1.007	-0.451	19.75	JUNCT 22, " "
22	18	19	135.0	.288	-0.451	1.007	19.75	JUNCT 23, " "
23	19	20	162.0	0.142	0.696	-.369	19.75	JUNCT 24, " "
24	14	16	47.5	.164	1.027	1.718	19.25	JUNCT 25, " "
25	15	16	47.5	.164	1.027	1.718	19.25	JUNCT 26, " "
26	16	21	162.0	.111	-0.197	1.456	19.75	JUNCT 27, " "
27	17	23	21.0	.328	1.893	1.886	18.43	JUNCT 28, " "
28	19	23	21.0	.328	1.893	1.886	18.43	JUNCT 29, " "
29	20	21	162.0	.111	-.197	1.456	19.75	JUNCT 30, " "
30	18	13	21.0	.329	2.1250	2.1497	19.25	JUNCT 31, " "
31	16	17	162.0	.142	-.369	.696	19.75	JUNCT 32, "
32	21	22	496.5	.029	.831	-.418	19.25	JUNCT 33, " "
33	22	24	66.5	.032	2.552	2.552	26.5	JUNCT 34, " "
34	25	23	195.0	.112	1.197	1.180	35.0	JUNCT 35, " "
35	25	23	155.0	.17	1.225	1.189	35.0	JUNCT 36, " "
36	23	26	60.0	.040	2.553	2.607	44.25	p. 7 of THIS CALC
37	24	25	983.6	.030	1.284	-.181	35.0	JUNCT 38, p 154, REF 1
38	24	26	63.0	.035	2.673	2.672	44.25	p. 8 of THIS CALC
39	24	26	83.2	.022	1.636	1.634	44.25	p. 8 " " "
40	6	22	792.0	.101	1.253	1.180	12.0	JUNCT. 47, p 155, REF 1
41	6	27	27.1	2.83	3.05	3.05	5.0	JUNCT. 48 " "
42	4	28	5.69	1.723	2.809	2.822	19.08	JUNCT. 49, " "
43	8	29	5.69	1.723	2.809	2.822	19.08	JUNCT. 50, " "
44	26	30	42.24	.072	2.653	2.104	50.0	p. 9 of THIS CALC

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12846.44		PE-050		

JUNCTION DATA CARDS (CONT'D)

#	VOL # AT INLET	VOL # AT EXIT	FLOW AREA (ft^2)	INERTA (ft^{-1})	FWD flow COEF.	REV. flow COEF.	ELEV (FT)	DATA SOURCE
45	26	30	42.29	.072	2.653	2.104	50.0	P. 9 OF THIS CALC
46	2	31	1.31	1.182	1.66	1.66	9.2	P. 9. of THIS CALC
47	31	32	208.7	.06	.264	.264	12.5	JUNCT. 21, P 154, REF. 1
48	32	16	47.5	.164	1.027	1.718	19.25	JUNCT. 25, " "
49	33	34	1.75	.894	.161	.161	9.2	JUNCT. 2, " "
50	34	37	211.1	.077	.264	.264	12.5	JUNCT. 20, " "
51	33	36	208.7	.060	.264	.264	12.5	JUNCT. 21 " "
52	36	20	47.5	.164	1.027	1.718	19.25	JUNCT. 25 " "
53	37	20	47.5	.164	1.027	1.718	19.25	JUNCT. 26 " "
54	33	35	1.31	1.182	1.66	1.66	9.2	SAME AS JUNCT 46 OF THIS CALC
55	35	38	208.7	.06	.264	.264	12.5	JUNCT. 21, P154, REF 1
56	38	20	47.5	.164	1.027	1.718	19.25	JUNCT. 25, " "
57	1	39	1.0	10.0	1.0	30.0	9.0	PAGES 10-12 OF THIS CALC
58	2	39	16.25	1.0	1.0	30.0	9.0	" " " "
59	3	39	16.25	1.0	1.0	30.0	9.0	" " " "
60	31	39	16.25	1.0	1.0	30.0	9.0	" " " "
61	21	39	3.25	10.0	1.0	30.0	15.0	" " " "
62	33	39	16.25	1.0	1.0	30.0	9.0	" " " "
63	34	39	16.25	1.0	1.0	30.0	9.0	" " " "
64	35	39	16.25	1.0	1.0	30.0	9.0	" " " "
65	39	40	1.0	0.1	1.0	30.0	50.0	" " " "

ALL REGULAR JUNCTIONS UTILIZE HOMOGENEOUS EQUILIBRIUM CHOKING INDEX AND A CHOKED flow MODEL MULTIPLIER of 1.0. JUNCTION 65 UTILIZES THE FAN THIS

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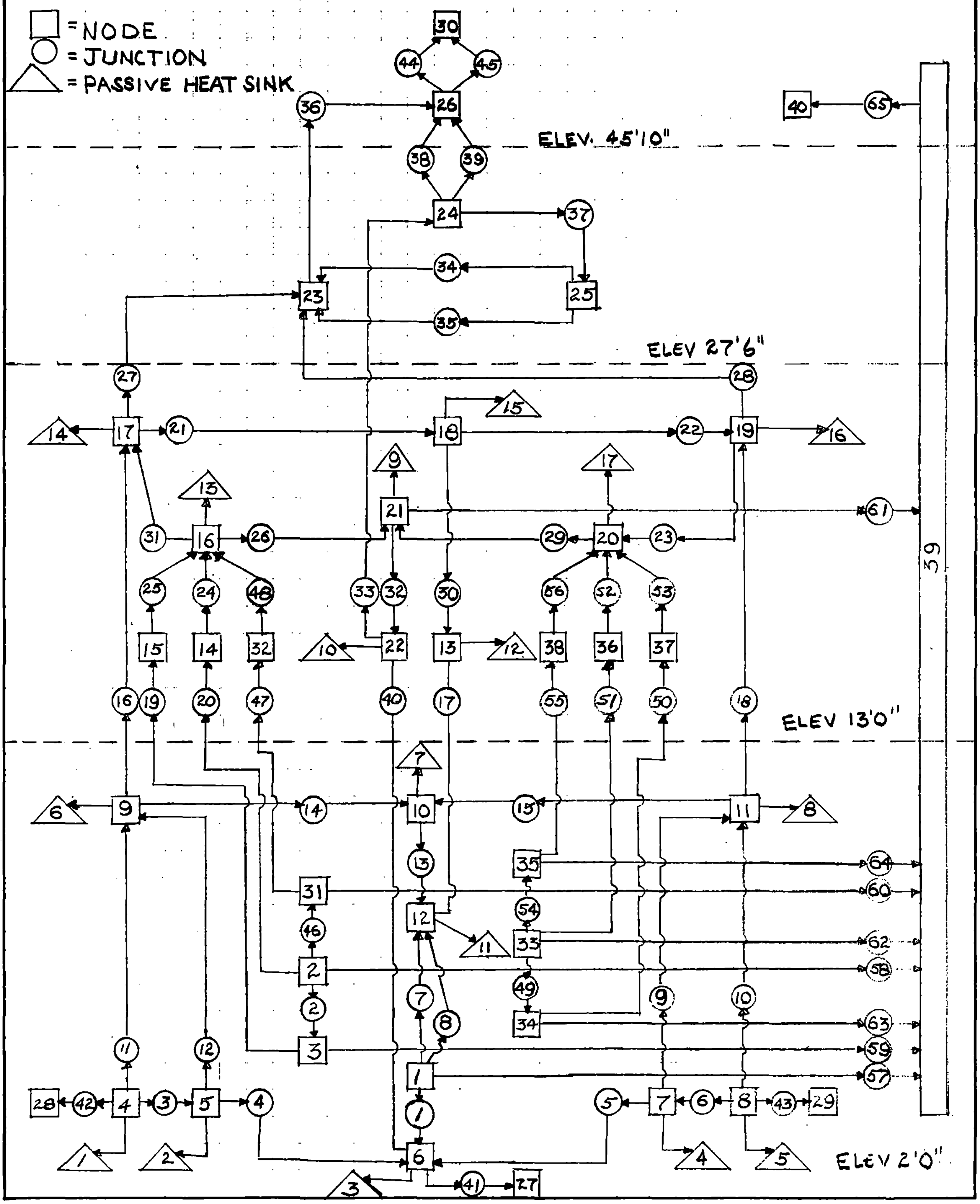
12846.44		PE-250		

FLOW DIAGRAM



1-E-18

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CALCULATION SHEET

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CALCULATION IDENTIFICATION NUMBER				
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THE FOLLOWING TWO PAGES CONTAIN A PLAN VIEW DIAGRAM OF THE NODAL ARRANGEMENT IN THE AUXILIARY BUILDING FOR PURPOSES OF RELATING THE AREAS OF CONCERN TO THE CORRESPONDING NODES OF THE MODEL AS IDENTIFIED IN ATTACHMENT 2 OF REF. 2. ONLY THOSE AREAS SO IDENTIFIED ARE LABELED, AS OPPOSED TO THE LABELING OF ALL AREAS AS WAS PERFORMED IN THE REFERENCED ATTACHMENT. NOTE THAT THE AREAS LABELED AS (C), (AA) AND (Z) ON PAGES 2 AND 4 OF THE ATTACHMENT ARE NOTED AS AREAS OF INTEREST, HOWEVER P 14 OF REF. 2 INDICATES THAT THESE AREAS ARE NOT OF INTEREST AT THE PRESENT TIME, THUS FAILURE ANALYSIS FOR TEMPERATURE PROFILES IN THOSE AREAS IS NOT PERFORMED.

THE LETTER DESIGNATIONS IN THE ○ ARE THE AREAS OF CONCERN IDENTIFIED BY THE REFERENCED ATTACHMENT.

THE NUMERIC DESIGNATIONS ARE THE NODE NUMBERS USED IN THIS CALCULATION

THE //// INDICATE AREAS OF THE AUXILIARY BUILDING NOT INCLUDED IN THE NODAL MODEL

THE ENVELOPE CURVES, FOR SUMMARY PURPOSES, ARE DEVELOPED FROM GRAPHS OF THE NODES THAT CORRESPOND TO THE IDENTIFIED AREAS OF CONCERN, THAT RELATIONSHIP SUMMARIZED ON PAGE 20 OF THIS CALCULATION, NOTE THAT CURVE "D" REPRESENTING AREAS (O) AND (N) IS DEVELOPED FROM THE PROFILES OF 3 NODES, #16, 20, 21 AS THOSE AREAS ALSO INCLUDE A PORTION OF NODE 21.

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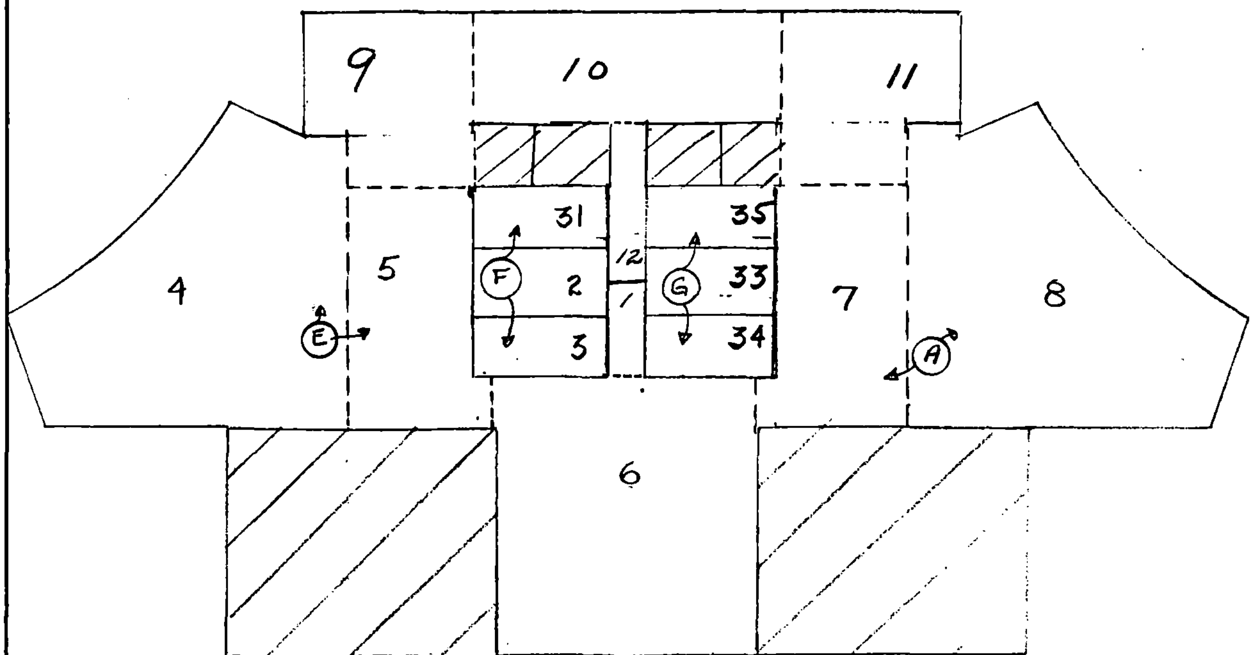
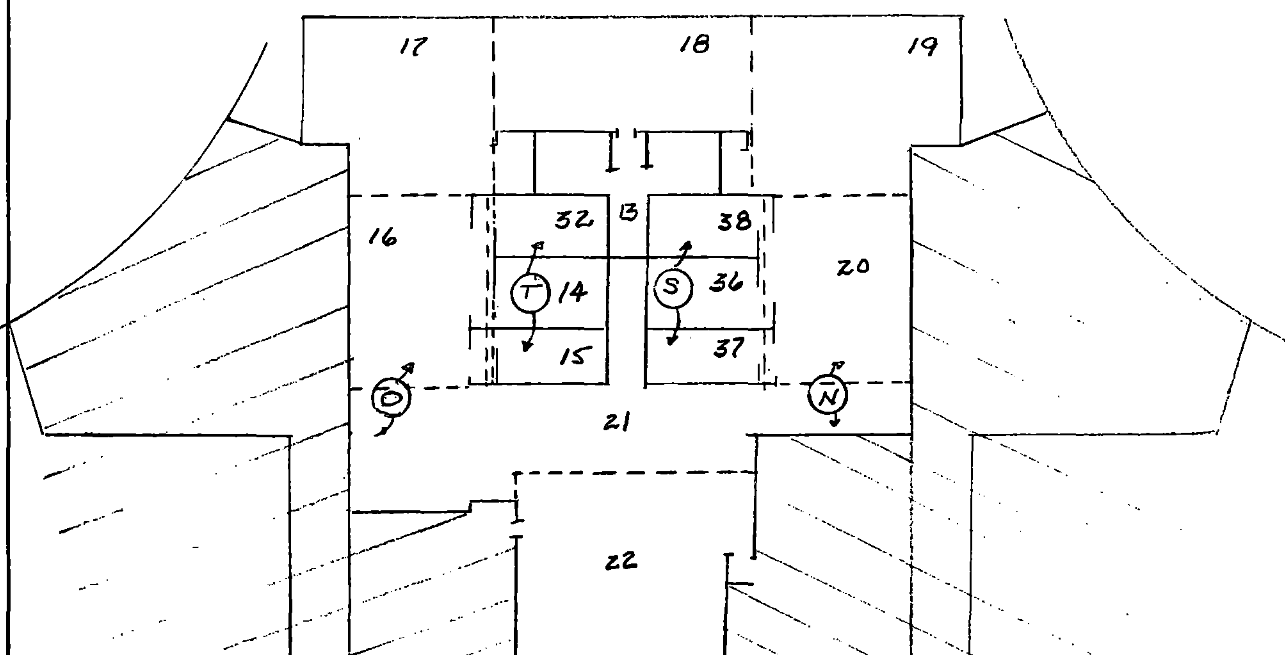


ELEV. 2'0"



ELEV 13'0"

1-E-20

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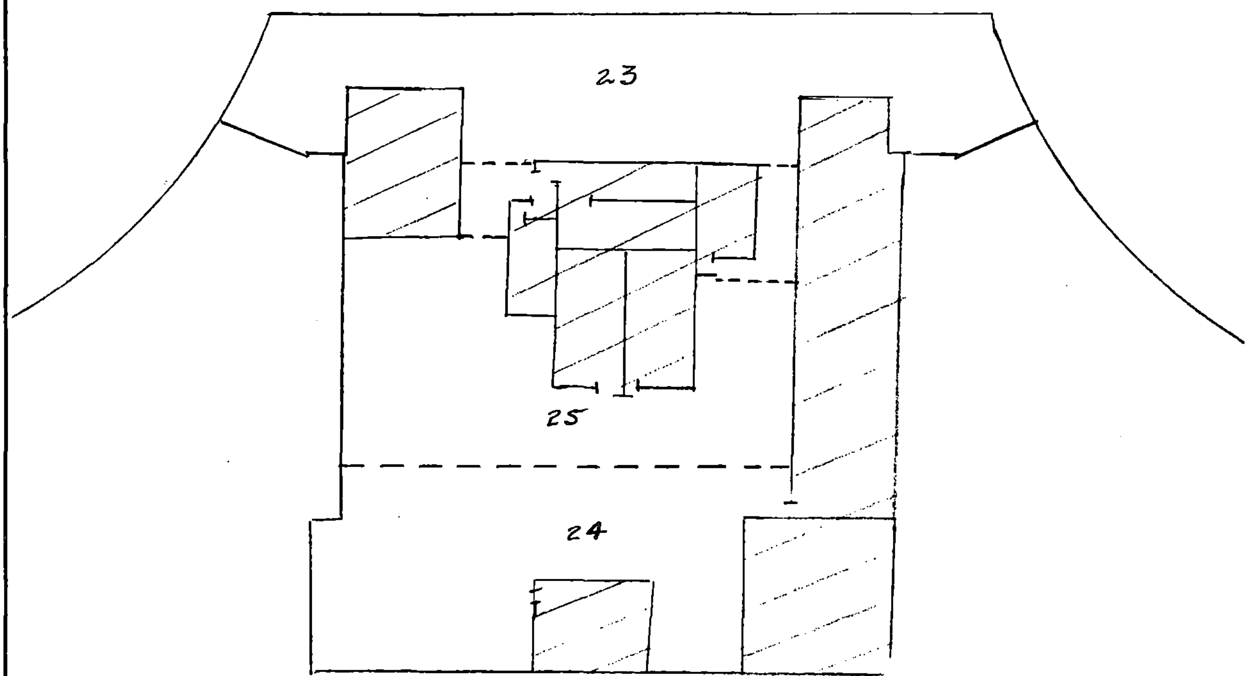
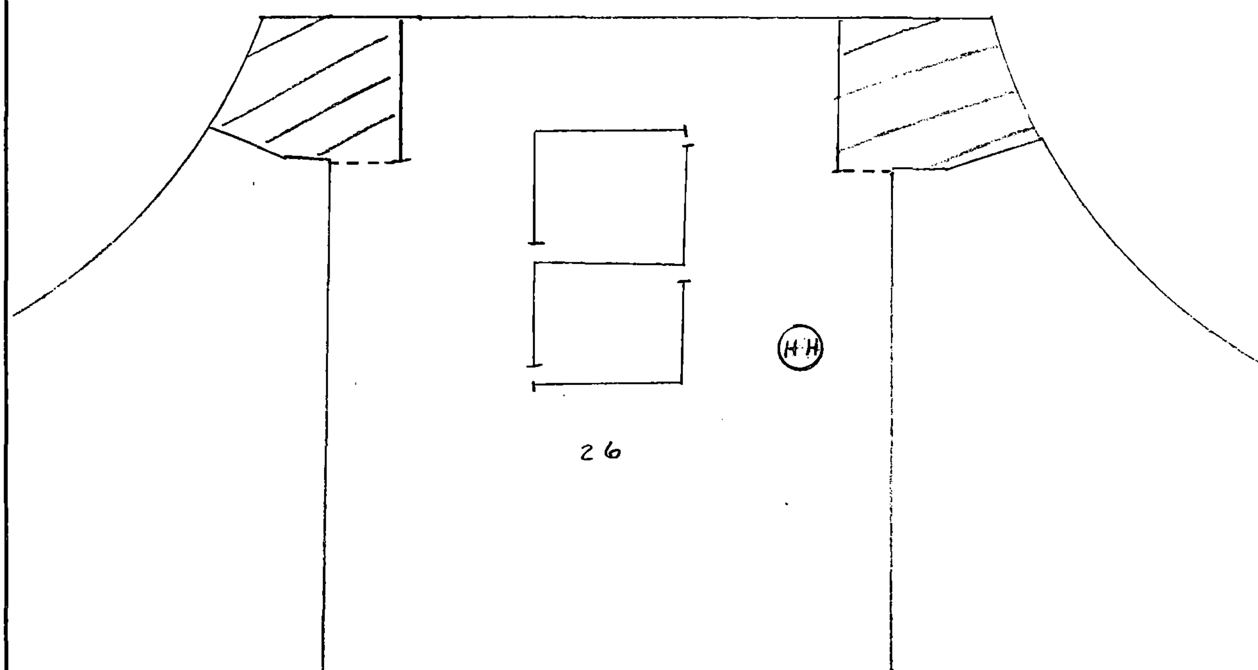
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
10846.44.		PE-050		



ELEV. 27'6"



ELEV 45'10"

1-E-21

CONCLUSION: EVALUATION OF THE TEMPERATURE PROFILE OBTAINED IN THE IDENTIFIED AREAS WHICH CONTAIN CLASS 1E ELECTRICAL COMPONENTS OF THE SURRY UNIT 1 & 2 AUXILIARY BUILDING AS A RESULT OF THE INSTALLATION OF PROPOSED MODIFICATIONS OUTLINED IN THIS CALCULATION IN RESPONSE TO THE I.E. BULLITEN 79-01B IS COMPLETE AND SUMMARIZED THROUGH THE USE OF TEMPERATURE "ENVELOPE" CURVES GIVEN ON PAGE 24.

SUMMARY

ATTACH. 2 OF THE REF. 2 CALCULATION PROVIDES THE GENERAL LOCATION WITHIN THE AUXILIARY BUILDING OF THE IDENTIFIED AREAS WHICH CONTAIN COMPONENTS OF CONCERN. FOR EACH AREA, AN 'ENVELOPE' CURVE IS DEVELOPED FROM THE RESULTANT PROFILES OBTAINED IN THIS CALCULATION, SIMILAR AREA PROFILES OR THOSE OF WHICH THE TRANSIENT OF ONE AREA IS CONSIDERED TO REPRESENTATIVE OF ANOTHER ARE COMBINED TO FORM A SINGLE 'ENVELOPE' CURVE IN THE FOLLOWING MANNER, THE CURVES SHOWN ON PAGE 24 OF THIS CALCULATION

1) - NODES 4, 5, 7, 8 — AREAS (A) & (E)
2) - NODES 2, 3, 31, 33, 34, 35 - AREAS (F) & (G)
3) - NODES 14, 15, 32, 36, 37, 38 - AREAS (T) & (S)
4) - NODES 16, 20, 21 - AREAS (O) & (N)
5) - NODE 26 - AREA (HH)

THE REF. 2 CALCULATION ANALYZED A 4" AUX. STEAM LINE CRACK FAILURE IN THE VENTILATION EQUIPMENT ROOM TO EVALUATE THE TEMPERATURE EFFECTS IN THIS AREA, INFORMATION OBTAINED SUBSEQUENT TO THAT ANALYSIS INDICATES THAT THIS PARTICULAR LINE IS NOT NORMALLY PRESSURIZED DURING POWER OPERATIONS FOR THIS REASON A CRACK FAILURE OF A 6" AUX. STEAM LINE IN NODE 23 (FROM THE REF. 17 DRAWING) WAS ANALYZED IN THIS CALCULATION INSTEAD AS POTENTIALLY LIMITING FOR THE COMPONENTS IN THIS AREA. WITH THE USE OF THE PROPOSED MODIFICATION OF SEALING THE WALL PIPING PENETRATION BETWEEN THE CHARGING PUMP CUBICLE AND THE PIPE TUNNEL, IT WAS DETERMINED THAT A CRACK FAILURE OF A 6" AUX. STEAM LINE IN NODE 22 (FROM REF 16) WOULD RESULT IN A MORE SEVERE TEMP. TRANSIENT FOR THE CHARGING PUMP CUBICLES THAN THE 8" AUX. STEAM LINE FAILURE IN NODE 6 ANALYZED IN REF. 2, WITHOUT THIS MODIFICATION DUE TO ITS CLOSER PROXIMITY TO THE AREAS IN QUESTION. THIS SAME MODIFICATION LED TO THE POSSIBILITY THAT A LETDOWN LINE CIRCUMFERENTIAL BREAK IN NODE 6 (REF 15) MAY BE A LIMITING CONSIDERATION FOR THE CHARGING PUMP CUBICLES, CONSEQUENTLY THAT ANALYSIS WAS MADE IN THIS CALCULATION.

GRAPHS OF REPRESENTIVE TEMPERATURE PROFILES FOR EACH AREA OF CONCERN WERE UTILIZED TO DEVELOPE THE FINAL 'ENVELOPE' CURVES. THOSE FAILURES WHICH WERE NOT OF LIMITING CONSIDERATION IN A PARTICULAR AREA WERE NOT PLOTTED FOR THE TRANSIENT, IF ANY, OBTAINED AND THUS ARE NOT INCLUDED IN THE CALCULATION. THE FOLLOWING IS A SUMMARY OF THE TYPES OF FAILURES ANALYZED AND THE LOCATION BY PAGE NUMBER OF THE INPUT AND RUN SUMMARY DATA SHEETS AS WELL AS THE RESULTANT REPRESENTATIVE TEMPERATURE

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 21
12846.44		PE-050		

PROFILE OBTAINED IN NODES FOR WHICH THE FAILURE WAS LIMITING AND AS A CONSEQUENCE UTILIZED IN THE DEVELOPEMENT OF THE FINAL 'ENVELOPE' CURVE.

FAILURE ANALYSIS SUMMARY.

1. CIRCUMFERENTIAL STEAM GENERATOR BLOWDOWN LINE BREAK. IN NODE 4 (REPRESENTATIVE OF AN IDENTICAL FAILURE IN NODE 8). TERMINATED BY AUTOMATIC ISOLATION 30.0 SECS AFTER THE OCCURENCE OF THE FAILURE, WITH ALL POSTULATED MODIFICATIONS INCLUDED. RUN # 3800128
   INPUT & RUN SUMMARY DATA SHEETS PAGES 44 to 71
   - TEMP. PROFILE NODE 2 - PAGE 72
   - TEMP. PROFILE NODE 14 - PAGE 73 PLOT SYMBOL ◇
   - TEMP. PROFILE NODE 4 - PAGE 73 PLOT SYMBOL (T)
   - TEMP. PROFILE NODE 5 - PAGE 73 PLOT SYMBOL Δ
   - TEMP. PROFILE NODE 16 - PAGE 73 PLOT SYMBOL ↑

2. CRACK FAILURE STEAM GENERATOR BLOWDOWN LINE IN NODE 4 (REPRESENTATIVE OF AN IDENTICAL FAILURE IN NODE 8), TERMINATED BY ASSUMED OPERATOR ACTION 900 SECS AFTER THE FAILURE OCCURS WITH ALL POSTULATED MODIFICATIONS INCLUDED. RUN # 3800124
   INPUT AND RUN SUMMARY DATA SHEETS, PAGES 25-32
   - TEMP. PROFILE NODE 2 - PAGE 33
   - TEMP. PROFILE NODE 4 - PAGE 34 PLOT SYMBOL (T)
   - TEMP. PROFILE NODE 5 - PAGE 34 PLOT SYMBOL Δ
   - TEMP. PROFILE NODE 14 - PAGE 34 PLOT SYMBOL ◇
   - TEMP. PROFILE NODE 16 - PAGE 34 PLOT SYMBOL ↑

3. CIRCUMFERENTIAL LETDOWN LINE BREAK IN NODE 6, TERMINATED BY ASSUMED OPERATOR ACTION 900 SECS AFTER THE FAILURE OCCURS WITH ALL POSTULATED MODIFICATIONS INCLUDED. RUN # 3800125
   INPUT AND RUN SUMMARY DATA SHEETS, PAGES 35-42
   - TEMP. PROFILE NODE 2, PAGE 43
   - TEMP. PROFILE NODE 4, PAGE 44 PLOT SYMBOL (T)
   - TEMP. PROFILE NODE 5, PAGE 44 PLOT SYMBOL Δ
   - TEMP. PROFILE NODE 14, PAGE 44 PLOT SYMBOL ◇
   - TEMP. PROFILE NODE 16, PAGE 44 PLOT SYMBOL ↑

4. CRACK FAILURE OF 6" AUX. STEAM LINE IN NODE 22, TERMINATED BY ASSUMED OPERATOR ACTION 900 SECS. AFTER THE FAILURE OCCURS WITH ALL POSTULATED MODIFICATIONS INCLUDED, RUN # 3800126
   INPUT AND RUN SUMMARY DATA SHEETS, PAGES 45-52
   - TEMP. PROFILE NODE 2, PAGE 53
   - TEMP. PROFILE NODE 14, PAGE 54 PLOT SYMBOL ◇

TEMP. PROFILE NODE 16, PAGE 54, PLOT SYMBOL 4
TEMP. PROFILE NODE 21, PAGE 54, PLOT SYMBOL Z

5. CRACK FAILURE 6" AUX STEAM LINE NODE 23 TERMINATED BY AN ASSUMED OPERATOR ACTION 900 SECS AFTER THE FAILURE OCCURS WITH ALL POSTULATED MODIFICATIONS INCLUDED
RUN # 3800127 ; INPUT AND RUN SUMMARY DATA SHEETS, PAGES 55-62
TEMP. PROFILE NODE 14, PAGE 63, PLOT SYMBOL ◇
TEMP. PROFILE NODE 20, PAGE 63, PLOT SYMBOL X
TEMP. PROFILE NODE 26, PAGE 63, PLOT SYMBOL +

6. COMPARITIVE CIRCUMFERENTIAL STEAM GENERATOR BLOWDOWN LINE BREAK IN NODE 4 TERMINATED BY AUTOMATIC ISOLATION 30 SECS. AFTER THE FAILURE OCCURS WITH ALL POSTULATED MODIFICATIONS INCLUDED EXCEPT THE PIPING PENETRATIONS IN THE WALL BETWEEN THE 2'0" ELEVATION OF THE CHARGING PUMP CUBICLES AND ITS ASSOCIATED PIPE TUNNEL FOR BOTH 1CH-P-1C AND 2-CH-P-1C ARE NOT SEALED,
RUN # 3800130 ; INPUT AND RUN SUMMARY DATA SHEETS, PAGES 74-81
TEMP. PROFILE NODE 3, PAGE 82, PLOT SYMBOL ⬡
TEMP. PROFILE NODE 15, PAGE 82, PLOT SYMBOL △

7. COMPARITIVE CRACK FAILURE STEAM GENERATOR BLOWDOWN LINE IN NODE 4 TERMINATED BY AN ASSUMED OPERATOR ACTION 900 SECS AFTER THE FAILURE OCCURS WITH ALL POSTULATED MODIFICATIONS INCLUDED EXCEPT THE PIPING PENETRATIONS IN THE WALL BETWEEN THE 2'0" ELEVATION OF THE CHARGING PUMP CUBICLES AND ITS ASSOCIATED PIPE TUNNEL FOR BOTH 1CH-P-1C AND 2CH-P-1C ARE NOT SEALED.
RUN # 3800130-A ; INPUT AND RUN SUMMARY DATA SHEETS, PAGES 83-90
TEMP. PROFILE NODE 3, PAGE 91, PLOT SYMBOL X
TEMP. PROFILE NODE 15, PAGE 91, PLOT SYMBOL Z

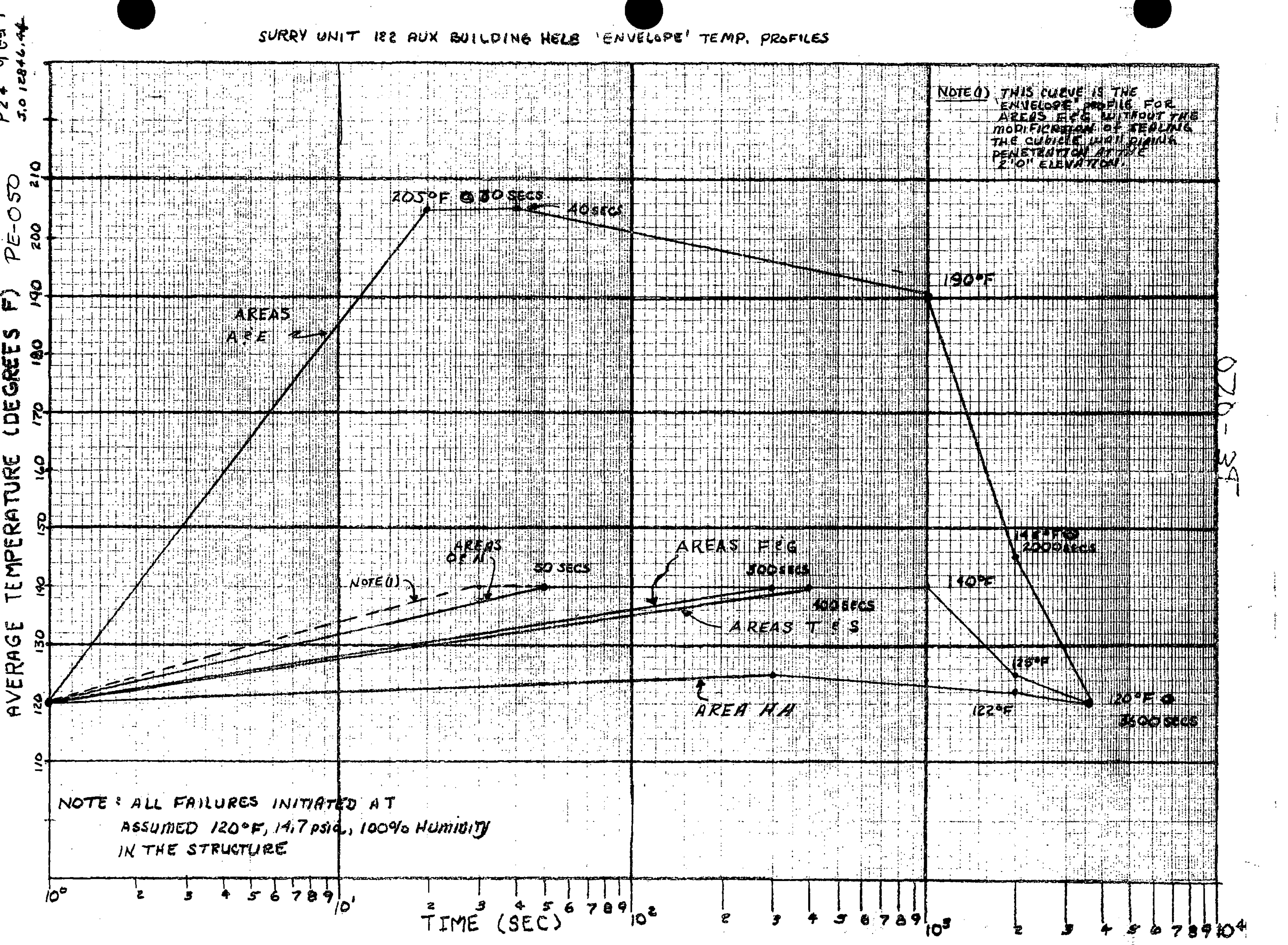
DISCUSSION: THE SINGLE MOST EFFECTIVE MODIFICATION IN REDUCING THE SEVERITY OF THE TEMPERATURE PROFILES OBTAINED IS A RESULT OF LIMITING THE DURATION OF FAILURES REQUIRING OPERATOR ACTION FOR ACCIDENT TERMINATION. THE PRINCIPLE EFFECT OF INCLUDING AN APPROXIMATION MODEL OF THE CENTRAL EXHAUST SYSTEM AND PASSIVE HEAT SINKS WAS REALIZED AS LIMITING THE TEMPERATURE RISE IN HYDRAULICALLY REMOTE AREAS FROM THE BREAK LOCATION AND PROVIDING A RAPID RATE OF TEMPERATURE DECREASE ONCE THE FAILURE WAS TERMINATED. FROM THE COMPARITIVE CALCULATIONS IT WAS DEMONSTRATED THAT FLOW PATTERNS WERE ESTABLISHED SUCH THAT EXCEPT DURING A SHORT INTERVAL DURING THE FAILURE INITIATION THE PRINCIPLE DIRECTION OF FLOW THROUGH THE WALL PIPING PENETRATION IS FROM THE CUBICLE TO THE PIPE TUNNEL. WHILE IT MUST BE NOTED THAT THIS ANALYSIS TECHNIQUE PROVIDES ONLY AN APPROXIMATION OF ACTUAL FLOW PATTERNS ESTABLISHED, UNDER THESE CONDITIONS, NO CALCULATED BENEFIT IN REDUCING THE RESULTING PEAK TEMPERATURE OF THE CHARGING PUMP CUBICLES IN EITHER COMPARITIVE ANALYSIS PERFORMED WAS OBTAINED. A COMPARISON OF THE CIRCUMFERENTIAL STEAM GENERATOR BLOWDOWN LINE BREAK ANALYSIS, SHOWN BY THE PROFILES OBTAINED FOR NODES 2 (SIMILAR TO NODE 3) ON P. 72 AND 3 AND 15 ON PAGE 82 DEMONSTRATES THAT FOR THIS FAILURE THE PRINCIPLE EFFECT OF THE MODIFICATION WAS TO DELAY THE OCCURRENCE OF THE PEAK TEMPERATURE BY APPROXIMATELY 100 SECS AND EFFECT A MORE RAPID TEMP.

DECREASE ONCE BLOWDOWN WAS TERMINATED. FOR THE CRACK FAILURE COMPARISION, SHOWN BY THE PROFILES OF THE SAME AREAS ON PAGE 83 AND PAGE 91, THE MODIFICATION RESULTED IN VIRTUALLY NO EFFECT ON THE PEAK TEMPERATURE OR PROFILES OBTAINED, PRINCIPALLY DUE TO THE RESULTANT FLOW PATTERNS ESTABLISHED BY THE CENTRAL EXHAUST SYSTEM PREVIOUSLY DISCUSSED WHICH THE MASS RELEASE RATE FROM THIS FAILURE COULD NOT OVERCOME. FROM THESE PROFILES IT IS CONCLUDED THAT NO CALCULATED BENEFIT IN LIMITING THE PEAK TEMPERATURE IS OBTAINED FROM THIS MODIFICATION AND THE PRINCIPLE EFFECT LIES IN SHIFTING THE PROFILE OF THE TRANSIENT SUCH THAT WITHOUT THE MODIFICATION THE INITIAL TEMPERATURE RISE IS GREATER AND THE RATE OF TEMPERATURE DECREASE IS LESS AFTER THE PEAK VALUE IS OBTAINED. THE "ENVELOPE" CURVE DEVELOPED FOR THE CHARGING PUMP CUBICLE UTILIZES THE MODIFICATION WHILE THE CURVE SHOWN BY --- LINES REPRESENTS THE PROFILE FOR THE INDICATED AREAS THAT RESULTS FROM NOT INCLUDING THIS MODIFICATION.

THE 8" AUX. STEAM LINE CRACK FAILURE IN NODE 6 ANALYZED IN THE REF. 2 CALCULATION IS NOT CONSIDERED LIMITING IN THIS CALCULATION DUE TO THE MODIFICATIONS UTILIZED AND AS A CONSEQUENCE IS NOT RE-ANALYZED.

THE STEAM GENERATOR BLOWDOWN LINE BREAK IN NODE 4 AS CALCULATED IN REF. 2 OBTAINED A PEAK VALUE OF 211.41°F IN THAT NODE AS SHOWN BY THE GRAPH ON PAGE 49 OF THAT CALCULATION WHEREAS IN THIS CALCULATION A PEAK VALUE OF 203°F WAS OBTAINED FOR THE SAME FAILURE. THIS IS ATTRIBUTABLE TO THE DIFFERENCE IN THE MASS-ENERGY RELEASE RATES USED, WHICH IN THE REF. 2 CALCULATION WERE CONSIDERABLY HIGHER. FOR THIS REASON, ALTHOUGH THIS CALCULATION IS PRINCIPALLY CONCERNED WITH ANALYZING MODIFICATIONS TO REDUCE THE SEVERITY OF THE TRANSIENTS IN THE CHARGING PUMP CUBICLES, REVISED PROFILES OF ALL THE "ENVELOPES" DEVELOPED IN REF 2. WERE MADE. AS NOTED PREVIOUSLY, THE DIAGRAMS GIVEN IN ATTACHMENT 3 OF REF. 2 PROVIDES A VISUAL REFERENCE FOR LOCATING THE RELATIVE POSITIONS OF THE AREAS OF INTEREST IN RELATION TO NODAL DESIGNATIONS. FOR PURPOSES OF CONVENIENCE THIS INFORMATION IS DUPLICATED ON PAGES 17 THRU 19 OF THIS CALCULATION WITH APPROPRIATE MODIFICATIONS TO REFLECT THE MODEL USED IN THIS CALCULATION. BASED ON THE RATE OF TEMPERATURE DECREASE IN ALL AREAS OF CONCERN AT THE TERMINATION OF THE ANALYSIS OF EACH FAILURE IT IS CONSERVATIVE TO PROJECT THAT AT 3600 SECS THE AVERAGE TEMPERATURE IN THESE AREAS IS 120°F AS SHOWN BY THE ENVELOPE CURVES. FOR INFORMATION PURPOSES ONLY, AIR MASS DENSITY AT THE "FAN JUNCTION" RESULTED IN A VALUE AS HIGH AS 0.087 lbm/ft^3 FROM THE LETDOWN LINE FAILURE ANALYSIS WHICH MAY BE A FACTOR IN EVALUATING THE CONTINUED OPERABILITY OF THE CENTRAL EXHAUST SYSTEM IN TERMS OF POWER REQUIREMENTS.

SURRY UNIT 1&2 AUX BUILDING HELB 'ENVELOPE' TEMP. PROFILES



UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

SURRY 1&2:AUX BLDG,SGBD-CRACK NODE4 WITH HEAT SINKS
*
*
*PROBLEM DIMENSION CARD
*
*
1 11 3 40 66 1 1 0 0 17
*
*
*IMPLICIT/EXPLICIT COEFICIENT CARD
*
*
1.0
*
*
*TIME STEP CONTROL DATA CARDS
*
*
 50  10  0  0  0.001 0.00001     2.2
  2  10  0  0  0.01  0.0001      3.0
  5  14  0  0  0.05  0.0001     10.0
  5  15  0  0  0.1   0.0001     30.0
  2  15  0  0  0.5   0.001      80.0
 10  20  0  0  1.0   0.001     901.0
  5  10  0  0  0.01  0.0001    903.0
  5  14  0  0  0.05  0.0001    910.0
 10  10  0  0  0.1   0.0001    930.0
  2  25  0  0  0.5   0.001     980.0
 10  20  0  0  1.0   0.001    1850.0
*
*
*TRIP CONTROL DATA CARDS
*
*
1  0  0 1800.0     0.0
1  0  0    0.0     2.0
1  0  0    0.0     0.2
*
*
*NODAL DATA CARDS
*
*
14.70  120. 1.0   1137.7    2.00   9.50  0.0  0
14.70  120. 1.0   2011.2    2.00  10.00  0.0  0
14.70  120. 1.0   2011.2    2.00  10.00  0.0  0
14.70  120. 1.0  26611.5    2.00  12.00  0.0  0
14.70  120. 1.0   5150.7    2.00   9.50  0.0  0
14.70  120. 1.0  18697.8    2.00  10.10  0.0  0
14.70  120. 1.0   5150.7    2.00   9.50  0.0  0
14.70  120. 1.0  26611.5    2.00  12.00  0.0  0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
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1-E-27

PE-05-D

P25 J.O 12846.44

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UNIT 55 (SEQ  1) INPUT ECHO       1         2         3         4         5         6         7         8
                         12345678901234567890123456789012345678901234567890123456789012345678901234567890

     14.70  120. 1.0   4050.0    2.00   9.00  0.0  0
     14.70  120. 1.0   5820.0    2.00   9.00  0.0  0
     14.70  120. 1.0   4050.0    2.00   9.00  0.0  0
     14.70  120. 1.0   1255.5    2.00   9.00  0.0  0
     14.70  120. 1.0   1400.2   13.00  12.50  0.0  0
     14.70  120. 1.0   2799.8   13.00  12.50  0.0  0
     14.70  120. 1.0   2696.6   13.00  12.50  0.0  0
     14.70  120. 1.0   5122.4   13.00  13.50  0.0  0
     14.70  120. 1.0   5678.    13.00  13.50  0.0  0
     14.70  120. 1.0   8035.2   13.00  13.50  0.0  0
     14.70  120. 1.0   5678.    13.00  13.50  0.0  0
     14.70  120. 1.0   5122.4   13.00  13.50  0.0  0
     14.70  120. 1.0  17220.2   13.00  12.50  0.0  0
     14.70  120. 1.0  17593.5   13.00  12.50  0.0  0
     14.70  120. 1.0  47234.0   27.5   17.0   0.0  0
     14.70  120. 1.0  31900.5   27.5   17.0   0.0  0
     14.70  120. 1.0  29622.1   27.5   17.0   0.0  0
     14.70  120. 1.0 149291.1   45.83  18.5   0.0  0
     14.70  120. 1.0 893025.0    9.0   49.0   0.0  0
     14.70  120. 1.0  13235.    11.5   15.15  0.0  0
     14.70  120. 1.0  13235.    11.5   15.15  0.0  0
     14.70  120. 1.0   1.0E20   27.5   50.0   0.0  0
     14.70  120. 1.0   2011.2    2.0   10.0   0.0  0
     14.70  120. 1.0   2799.8   13.0   12.5   0.0  0
     14.70  120. 1.0   2011.2    2.0   10.0   0.0  0
     14.70  120. 1.0   2011.2    2.0   10.0   0.0  0
     14.70  120. 1.0   2011.2    2.0   10.0   0.0  0
     14.70  120. 1.0   2799.8   13.0   12.5   0.0  0
     14.70  120. 1.0   2696.6   13.0   12.5   0.0  0
     14.70  120. 1.0   2799.6   13.0   12.5   0.0  0
     14.70  120. 1.0   2000.0    2.0   70.0   0.0  0
     15.0   120. 1.0    1.0E20  27.5   50.0   0.0  0
     *
     *
     *JUNCTION DATA CARDS
     *
     *
      1   6  0  0   32.5    .2888 2.219  1.476  2  1.0  0  0.0  7.58    1.0
      2   3  0  0    1.75   .894  1.61   1.61   2  1.0  0  0.0  9.2     1.0
      4   5  0  0  246.7    .062  1.062   .216  2  1.0  0  0.0  6.5     1.0
      5   6  0  0   78.6    .127  1.844  1.672  2  1.0  0  0.0  6.63    1.0
      7   6  0  0   78.6    .127  1.844  1.672  2  1.0  0  0.0  6.63    1.0
      8   7  0  0  246.7    .062  1.062  0.216  2  1.0  0  0.0  6.5     1.0
      1  12  0  0    3.75   .473  1.61   1.61   2  1.0  0  0.0  9.75    1.0
      1  12  0  0    1.13   .940  1.549  1.549  2  1.0  0  0.0  2.75    1.0
      7  11  0  0   20.25   .401  1.716  1.272  2  1.0  0  0.0  4.75    1.0
      8  11  0  0   56.7    .062  1.047  1.094  2  1.0  0  0.0  6.5     1.0
      4   9  0  0   56.7    .062  1.047  1.094  2  1.0  0  0.0  6.5     1.0
      5   9  0  0   20.25   .401  1.716  1.272  2  1.0  0  0.0  4.75    1.0
     10  12  0  0   60.75   .149  1.491 -0.123  2  1.0  0  0.0  4.75    1.0

     12345678901234567890123456789012345678901234567890123456789012345678901234567890
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1-E-29

UNIT 55 (SEQ 1) INPUT ECHO 1 2 3 4 5 6 7 8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

101	9	10	0	0	90.	.434	1.004	-0.45	2	1.0	0	0.0	4.5	1.0	101
102	11	10	0	0	90.	.434	1.004	-0.45	2	1.0	0	0.0	4.5	1.0	102
103	9	17	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	4.5	1.0	103
104	12	13	0	0	84.0	.102	.558	0.012	2	1.0	0	0.0	11.00	1.0	104
105	11	19	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	11.00	1.0	105
106	3	15	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.50	1.0	106
107	2	14	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.50	1.0	107
108	17	18	0	0	135.	.288	1.007	-0.451	2	1.0	0	0.0	19.75	1.0	108
109	18	19	0	0	135.	.288	-0.451	1.007	2	1.0	0	0.0	19.75	1.0	109
110	19	20	0	0	162.	.142	.696	-0.369	2	1.0	0	0.0	19.75	1.0	110
111	14	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	111
112	15	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	112
113	16	21	0	0	162.	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	113
114	17	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	114
115	19	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	115
116	20	21	0	0	162.0	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	116
117	18	13	0	0	21.	.329	2.250	2.497	2	1.0	0	0.0	19.25	1.0	117
118	16	17	0	0	162.	.142	-0.369	.696	2	1.0	0	0.0	19.75	1.0	118
119	21	22	0	0	496.5	.029	.831	-.418	2	1.0	0	0.0	19.25	1.0	119
120	22	24	0	0	66.5	.032	2.552	2.552	2	1.0	0	0.0	26.5	1.0	120
121	25	23	0	0	195.	.112	1.197	1.180	2	1.0	0	0.0	35.0	1.0	121
122	25	23	0	0	155.	.17	1.225	1.189	2	1.0	0	0.0	35.0	1.0	122
123	23	26	0	0	60.	.040	2.553	2.607	2	1.0	0	0.0	44.25	1.0	123
124	24	25	0	0	983.6	.030	.284	-0.131	2	1.0	0	0.0	35.0	1.0	124
125	24	26	0	0	63.	.035	2.673	2.672	2	1.0	0	0.0	44.25	1.0	125
126	24	26	0	0	83.2	.022	1.636	1.634	2	1.0	0	0.0	44.25	1.0	126
127	6	22	0	0	792.	.01	1.253	1.130	2	1.0	0	0.0	12.	1.0	127
128	6	27	0	0	27.1	2.83	3.05	3.05	2	1.0	0	0.0	5.0	1.0	128
129	4	28	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	129
130	8	29	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	130
131	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	131
132	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	132
133	2	31	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	133
134	31	32	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	134
135	32	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	135
136	33	34	0	0	1.75	.894	1.61	1.61	2	1.0	0	0.0	9.2	1.0	136
137	34	37	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.5	1.0	137
138	33	36	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.5	1.0	138
139	36	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	139
140	37	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	140
141	33	35	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	141
142	35	38	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	142
143	38	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	143
144	1	39	0	0	1.0	10.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	144
145	2	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	145
146	3	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	146
147	31	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	147
148	21	39	0	0	3.25	10.0	1.0	30.0	2	1.0	0	0.0	15.0	1.0	148
149	33	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	149
150	34	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	150

12345678901234567890123456789012345678901234567890123456789012345678901234567890

P3-050

UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

35  39  0  0   16.25  1.0     1.0    30.0     2  1.0  0  0.0  9.0     1.0
39  40  0  0    1.0   0.1     1.0    30.0     2  1.0  1  0.0 50.0     1.0
 0   4  1  0    1.0   0.0     0.0     0.0     0  1.0  0  0.0  9.7     1.0
*
*
*FILL TABLE DATA CARDS:SGBD-CRACK NODE4
*
*
   4  2
        0.0         10.71    5418.2
      900.0         10.71    5418.2
      900.000001     0.0        0.0
     1850.0          0.0        0.0
*
*
*FAN TABLE DATA CARDS
*
*
  2  3
     40300.0        0.0
     40300.0     3000.0
*
*
*PASSIVE HEAT SINK DATA CARDS
*
*
SINK1,NODE4
12  1  0  0.0  7073.1  4  0
12  1.0
1
T
1  1  1  .08 0 0 0 1.0
SINK2,NODE5
12  1  0  0.0  1768.0  5  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK3,NODE6
12  1  0  0.0  5635.9  6  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK4,NODE7
12  1  0  0.0  1768.0  7  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

1-E-30

PE-050

P28 J.O. 12846.44

UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

SINK5,NODE8
12  1  0  0.0  7073.1  8  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK6,NODE9
12  1  0  0.0  2273.5 9  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK7,NODE10
12  1  0  0.0  5167.5 10  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK8,NODE11
12  1  0  0.0  2273.5  11  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK9,NODE21
12  1  0  0.0  4974.0 21  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK10,NODE22
12  1  0  0.0 3335.0 22  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK11,NODE12
 9  1  0  0.0 562.5  12  0
 9  0.75
1
 T
1  1  1  .08 0 0  0 1.0
SINK12,NODE13
 9  1  0  0.0 660.25 13  0
 9  0.75
1
T
1  1  1  .08 0 0  0 1.0
SINK13,NODE16
 6  1  0  0.0 1275.0 16  0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

```
UNIT 55 (SEQ  1) INPUT ECHO         1         2         3         4         5         6         7         8
                           12345678901234567890123456789012345678901234567890123456789012345678901234567890

 6  0.5
1
T
1  1  1  .08 0 0  0 1.0
SINK14,NODE17
 6  1  0  0.0 1717.875 17 0
 6  0.5
1
T
1  1  1  .08 0 0  0 1.0
SINK15,NODE18
12  1  0  0.0 3008.0 18  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK16,NODE19
 6  1  0  0.0 1717.875 19 0
 6  0.5
1
T
1  1  1  .08 0  0  0 1.0
SINK17,NODE20
 6  1  0  0.0 1275.0 20  0
 6  0.5
1
T
1  1  1  .08 0  0  0 1.0
*
*
*DATA COMMON TO HEAT SINKS
*
*
120.0  T
0.79  24.93  'CONCRETE'/
END OF HEAT SLAB DATA

12345678901234567890123456789012345678901234567890123456789012345678901234567890  <EOF>  COPIED TO UNIT  5
                                                                                                   W/O CMTS
```

1-E-32

PE-250

P30
J.0.12846.44

R U N   S U M M A R Y   S H E E T

MISCELLANEOUS PROBLEM CONTROL DATA:

OUTPUT FLAG.................	1
NUMBER OF TIME STEP CARDS...	11
NUMBER OF TRIP CONTROLS.....	3
NUMBER OF VOLUMES...........	40
NUMBER OF JUNCTIONS.........	66
NUMBER OF FILL TABLES.......	1
NUMBER OF FAN TABLES........	1
NUMBER OF HT SOURCE CURVES..	0
IMPLICIT/EXPLICIT COEFF.....	1.000

TOTAL TIME OF RUN...........................	1801.000 SEC
NUMBER OF STANDARD TIME STEPS..............	5002
NUMBER OF ACTUAL TIME STEPS................	5013
NUMBER OF TIMES GAUSSIAN ELIMINATION USED..	2370
NUMBER OF TIMES GAUSS-SEIDEL USED..........	2643
NUMBER OF TRANSIENTS STORED FOR PLOTEMUP...	146
NUMBER OF SELECTED NODAL DIFF. PRESS.......	0
NUMBER OF HEAT SINKS.......................	17
NUMBER OF INTERNAL JUNCTIONS...............	65

STEAM TABLES USED (FT15) VOLUME SERIAL NO. = SHARE0 DATA SET NAME = HEATBAL.ME190.STH2OG.OUTPUT1

OUTPUT: TRANSIENTS TAPE (FT08) = 016308 FILE NUMBER = 20 DATA SET NAME = FE.GUARDS.PLOTTER
TRANSMITTAL FILE (FT09) WAS NOT USED

PEAK PRESSURE DIFFERENTIAL

JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC	JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC
1	1 TO 6	0.01	0.489	34	25 TO 23	0.00	0.546
2	2 TO 3	0.00	0.236	35	25 TO 23	0.00	0.546
3	4 TO 5	-0.01	0.394	36	23 TO 26	-0.01	0.000
4	5 TO 6	-0.01	0.396	37	24 TO 25	-0.01	0.080
5	7 TO 6	-0.01	0.396	38	24 TO 26	-0.01	0.000
6	8 TO 7	-0.01	0.394	39	24 TO 26	-0.01	0.000
7	1 TO 12	0.01	0.392	40	6 TO 22	-0.01	0.000
8	1 TO 12	0.01	0.392	41	6 TO 27	0.01	0.394
9	7 TO 11	0.01	0.394	42	4 TO 28	-0.02	0.408
10	8 TO 11	0.00	0.590	43	8 TO 29	-0.02	0.408
11	4 TO 9	0.00	0.590	44	26 TO 30	-0.01	0.098
12	5 TO 9	0.01	0.394	45	26 TO 30	-0.01	0.098
13	10 TO 12	-0.01	0.400	46	2 TO 31	-0.00	0.501
14	9 TO 10	-0.01	0.446	47	31 TO 32	-0.01	0.000
15	11 TO 10	-0.01	0.446	48	32 TO 16	-0.01	0.248
16	9 TO 17	0.01	0.593	49	33 TO 34	0.00	0.236
17	12 TO 13	-0.01	0.000	50	34 TO 37	-0.01	0.234
18	11 TO 19	0.01	0.593	51	33 TO 36	-0.01	0.000
19	3 TO 15	-0.01	0.234	52	36 TO 20	-0.01	0.249
20	2 TO 14	-0.01	0.000	53	37 TO 20	-0.01	0.251
21	17 TO 18	0.02	0.744	54	33 TO 35	-0.00	0.501
22	18 TO 19	-0.02	0.744	55	35 TO 38	-0.01	0.000
23	19 TO 20	0.01	0.271	56	38 TO 20	-0.01	0.248
24	14 TO 16	-0.01	0.249	57	1 TO 39	0.10	0.227
25	15 TO 16	-0.01	0.251	58	2 TO 39	0.09	0.225
26	16 TO 21	-0.02	0.268	59	3 TO 39	0.09	0.225
27	17 TO 23	-0.01	0.596	60	31 TO 39	0.09	0.225
28	19 TO 23	-0.01	0.596	61	21 TO 39	0.09	0.227
29	20 TO 21	-0.02	0.268	62	33 TO 39	0.09	0.225
30	18 TO 13	-0.01	0.321	63	34 TO 39	0.09	0.225
31	16 TO 17	-0.01	0.271	64	35 TO 39	0.09	0.225
32	21 TO 22	0.01	0.443	65	39 TO 40	-0.39	0.227
33	22 TO 24	-0.01	0.023				

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PE-82-D

J.O. 12846.04

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1-E-34

PEAK PRESSURES AND TEMPERATURES

NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)	NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)
1	14.73	0.584	136.20	908.300	21	14.72	0.724	121.20	720.000
2	14.73	0.691	135.69	956.500	22	14.72	0.393	121.35	675.000
3	14.73	0.691	135.70	956.000	23	14.71	0.283	120.11	0.283
4	14.73	0.541	185.08	902.000	24	14.71	0.395	120.09	0.394
5	14.73	0.576	155.69	902.000	25	14.71	0.264	120.11	0.264
6	14.73	0.578	133.49	902.040	26	14.70	0.326	120.04	0.326
7	14.73	0.576	142.25	915.000	27	14.71	4.650	120.13	4.650
8	14.73	0.541	135.84	1128.000	28	14.72	0.447	120.25	0.446
9	14.73	0.545	183.41	902.310	29	14.72	0.446	120.25	0.446
10	14.73	0.206	172.60	902.030	30	14.70	1801.000	120.00	1801.000
11	14.73	0.545	153.25	902.080	31	14.73	0.691	135.69	956.500
12	14.73	0.234	137.38	902.030	32	14.72	0.414	135.78	942.000
13	14.72	0.490	127.13	824.000	33	14.73	0.691	121.08	676.000
14	14.72	0.691	135.78	942.000	34	14.73	0.691	121.08	676.000
15	14.73	0.413	135.79	941.500	35	14.73	0.691	121.08	677.000
16	14.72	0.429	136.05	923.500	36	14.72	0.691	121.08	655.000
17	14.73	0.646	149.30	902.010	37	14.73	0.413	121.08	654.000
18	14.72	0.686	130.79	738.000	38	14.72	0.414	121.08	655.000
19	14.73	0.646	121.32	528.000	39	14.76	0.274	130.27	957.000
20	14.72	0.429	121.09	626.000	40	15.00	1801.000	120.00	1801.000

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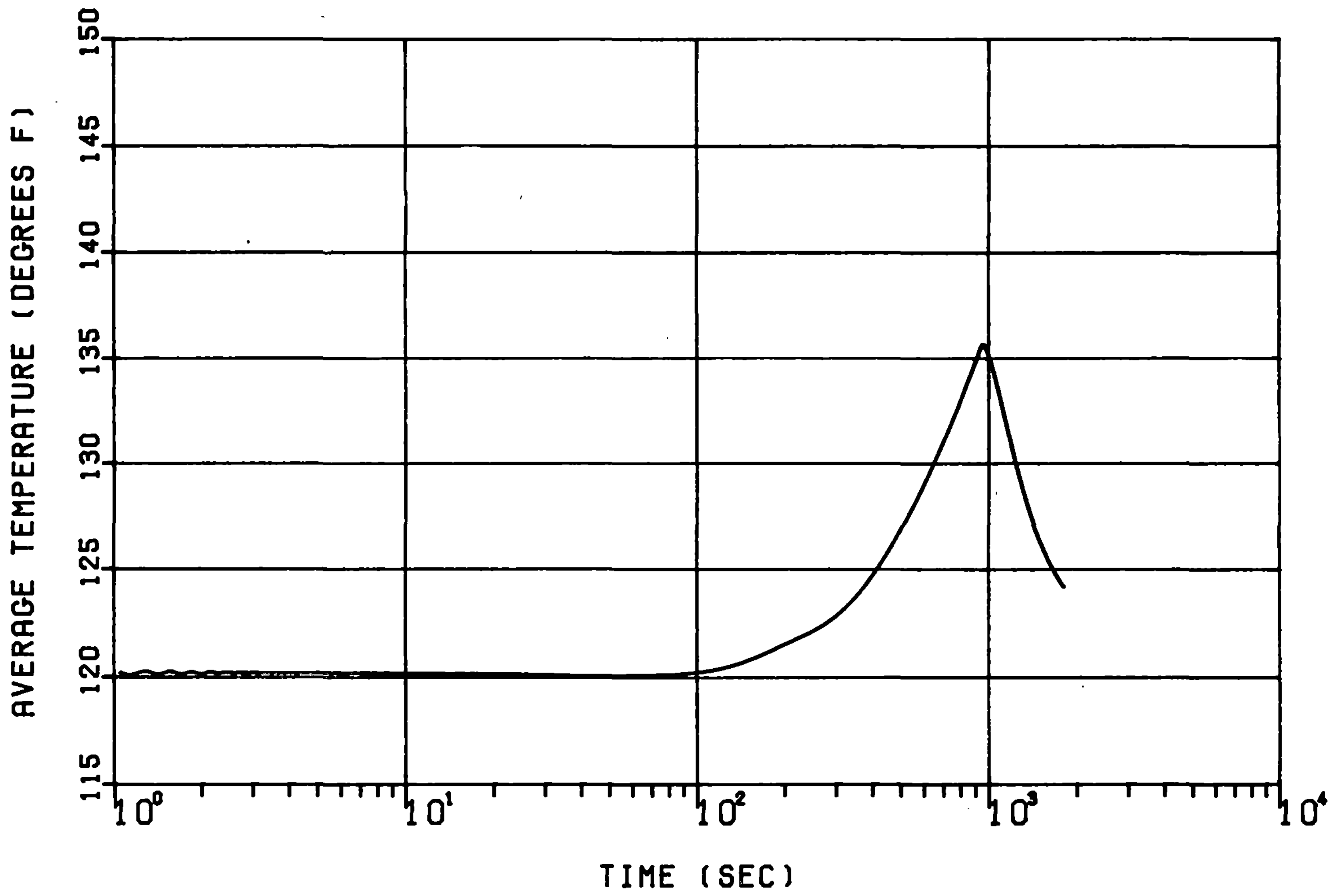
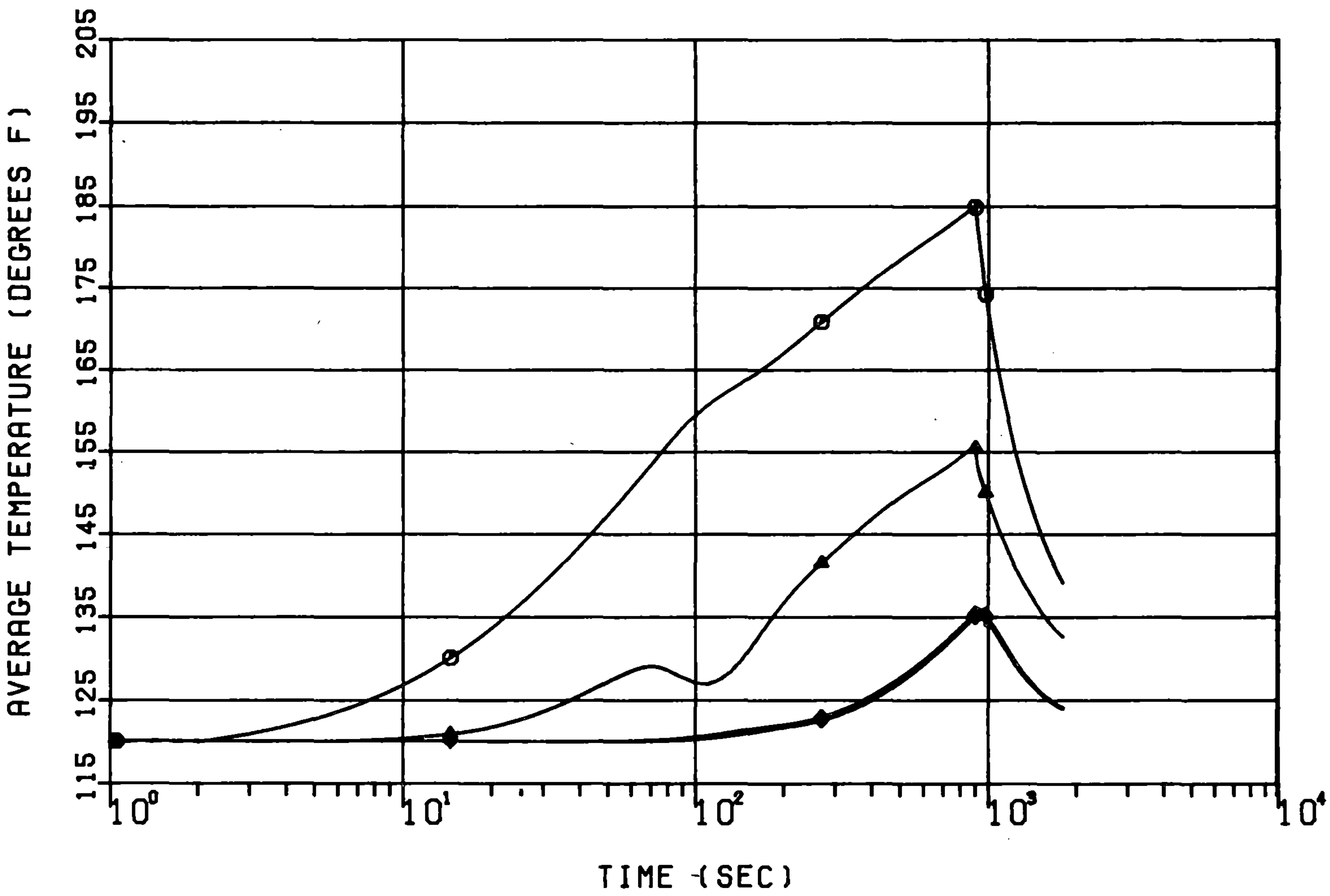


SURRY UNIT 1&2 AUX.BUILDING HELB
AVERAGE TEMPERATURE VERSUS TIME
NODE 2 SGBD LINE CRACK WITH HT.SINKS
RUN = 3800124

PE-050

1-E-36



SURRY UNIT 1&2 AUX.BUILDING HELB
AVERAGE TEMPERATURE VERSUS TIME
SGBD LINE CRACK NODE 4 WITH HT-SINKS
PLOT OF RUN = 3800124

PE-050

P34
J.O.12846.42

1-E-37

UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

SURRY 1&2:AUX BLDG,LETDOWN LINE CRACK NODE 6 WITH HT. SINKS
*
*
*PROBLEM DIMENSION CARD
*
*
1 11 3 40 66 1 1 0 0 17
*
*
*IMPLICIT/EXPLICIT COEFICIENT CARD
*
*
1.0
*
*
*TIME STEP CONTROL DATA CARDS
*
*
 50  10  0  0  0.001 0.00001    2.2
  2  10  0  0  0.01  0.0001     3.0
  5  14  0  0  0.05  0.0001    10.0
  5  15  0  0  0.1   0.0001    30.0
  2  15  0  0  0.5   0.001     80.0
 10  20  0  0  1.0   0.001    901.0
  5  10  0  0  0.01  0.0001   903.0
  5  14  0  0  0.05  0.0001   910.0
 10  10  0  0  0.1   0.0001   930.0
  2  25  0  0  0.5   0.001    980.0
 10  20  0  0  1.0   0.001   1850.0
*
*
*TRIP CONTROL DATA CARDS
*
*
1  0  0 1800.0    0.0
1  0  0    0.0    2.0
1  0  0    0.0    0.2
*
*
*NODAL DATA CARDS
*
*
14.70  120. 1.0   1137.7    2.00   9.50  0.0  0
14.70  120. 1.0   2011.2    2.00  10.00  0.0  0
14.70  120. 1.0   2011.2    2.00  10.00  0.0  0
14.70  120. 1.0  26611.5    2.00  12.00  0.0  0
14.70  120. 1.0   5150.7    2.00   9.50  0.0  0
14.70  120. 1.0  18697.8    2.00  10.10  0.0  0
14.70  120. 1.0   5150.7    2.00   9.50  0.0  0
14.70  120. 1.0  26611.5    2.00  12.00  0.0  0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

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J.O. 12846.44

1-E-38

UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

14.70  120. 1.0   4050.0    2.00    9.00  0.0  0
14.70  120. 1.0   5820.0    2.00    9.00  0.0  0
14.70  120. 1.0   4050.0    2.00    9.00  0.0  0
14.70  120. 1.0   1255.5    2.00    9.00  0.0  0
14.70  120. 1.0   1400.2   13.00   12.50  0.0  0
14.70  120. 1.0   2799.8   13.00   12.50  0.0  0
14.70  120. 1.0   2696.6   13.00   12.50  0.0  0
14.70  120. 1.0   5122.4   13.00   13.50  0.0  0
14.70  120. 1.0   5678.    13.00   13.50  0.0  0
14.70  120. 1.0   8035.2   13.00   13.50  0.0  0
14.70  120. 1.0   5678.    13.00   13.50  0.0  0
14.70  120. 1.0   5122.4   13.00   13.50  0.0  0
14.70  120. 1.0  17220.2   13.00   12.50  0.0  0
14.70  120. 1.0  17593.5   13.00   12.50  0.0  0
14.70  120. 1.0  47234.0   27.5    17.0   0.0  0
14.70  120. 1.0  31900.5   27.5    17.0   0.0  0
14.70  120. 1.0  29622.1   27.5    17.0   0.0  0
14.70  120. 1.0 149291.1   45.83   18.5   0.0  0
14.70  120. 1.0 893025.0    9.0    49.0   0.0  0
14.70  120. 1.0  13235.    11.5    15.15  0.0  0
14.70  120. 1.0  13835.    11.5    15.15  0.0  0
14.70  120. 1.0    1.0E20  27.5    50.0   0.0  0
14.70  120. 1.0   2011.2    2.0    10.0   0.0  0
14.70  120. 1.0   2799.8   13.0    12.5   0.0  0
14.70  120. 1.0   2011.2    2.0    10.0   0.0  0
14.70  120. 1.0   2011.2    2.0    10.0   0.0  0
14.70  120. 1.0   2011.2    2.0    10.0   0.0  0
14.70  120. 1.0   2799.8   13.0    12.5   0.0  0
14.70  120. 1.0   2696.6   13.0    12.5   0.0  0
14.70  120. 1.0   2799.6   13.0    12.5   0.0  0
14.70  120. 1.0   2000.0    2.0    70.0   0.0  0
15.0   120. 1.0     1.0E20 27.5    50.0   0.0  0
*
*
*JUNCTION DATA CARDS
*
*
 1   6  0  0   32.5   .2888 2.219  1.476  2  1.0  0  0.0  7.58  1.0
 2   3  0  0    1.75  .894  1.61   1.61   2  1.0  0  0.0  9.2   1.0
 4   5  0  0  246.7   .062  1.062   .216  2  1.0  0  0.0  6.5   1.0
 5   6  0  0   78.6   .127  1.844  1.672  2  1.0  0  0.0  6.63  1.0
 7   6  0  0   78.6   .127  1.844  1.672  2  1.0  0  0.0  6.63  1.0
 8   7  0  0  246.7   .062  1.062  0.216  2  1.0  0  0.0  6.5   1.0
 1  12  0  0    3.75  .473  1.61   1.61   2  1.0  0  0.0  9.75  1.0
 1  12  0  0    1.13  .940  1.549  1.549  2  1.0  0  0.0  2.75  1.0
 7  11  0  0   20.25  .401  1.716  1.272  2  1.0  0  0.0  4.75  1.0
 8  11  0  0   56.7   .062  1.047  1.094  2  1.0  0  0.0  6.5   1.0
 4   9  0  0   56.7   .062  1.047  1.094  2  1.0  0  0.0  6.5   1.0
 5   9  0  0   20.25  .401  1.716  1.272  2  1.0  0  0.0  4.75  1.0
10  12  0  0   60.75  .149  1.491 -0.123  2  1.0  0  0.0  4.75  1.0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
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J.O. 12846 P36

1-E-39

UNIT 55 (SEQ 1) INPUT ECHO 1 2 3 4 5 6 7 8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

101	9	10	0	0	90.	.434	1.004	-0.45	2	1.0	0	0.0	4.5	1.0	101
102	11	10	0	0	90.	.434	1.004	-0.45	2	1.0	0	0.0	4.5	1.0	102
103	9	17	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	4.5	1.0	103
104	12	13	0	0	84.0	.102	.558	0.012	2	1.0	0	0.0	11.00	1.0	104
105	11	19	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	11.00	1.0	105
106	3	15	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.50	1.0	106
107	2	14	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.50	1.0	107
108	17	18	0	0	135.	.288	1.007	-0.451	2	1.0	0	0.0	19.75	1.0	108
109	18	19	0	0	135.	.288	-0.451	1.007	2	1.0	0	0.0	19.75	1.0	109
110	19	20	0	0	162.	.142	.696	-0.369	2	1.0	0	0.0	19.75	1.0	110
111	14	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	111
112	15	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	112
113	16	21	0	0	162.	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	113
114	17	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	114
115	19	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	115
116	20	21	0	0	162.0	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	116
117	18	13	0	0	21.	.329	2.250	2.497	2	1.0	0	0.0	19.25	1.0	117
118	16	17	0	0	162.	.142	-0.369	.696	2	1.0	0	0.0	19.75	1.0	118
119	21	22	0	0	496.5	.029	.831	-.418	2	1.0	0	0.0	19.25	1.0	119
120	22	24	0	0	66.5	.032	2.552	2.552	2	1.0	0	0.0	26.5	1.0	120
121	25	23	0	0	195.	.112	1.197	1.180	2	1.0	0	0.0	35.0	1.0	121
122	25	23	0	0	155.	.17	1.225	1.189	2	1.0	0	0.0	35.0	1.0	122
123	23	26	0	0	60.	.040	2.553	2.607	2	1.0	0	0.0	44.25	1.0	123
124	24	25	0	0	983.6	.030	.284	-0.131	2	1.0	0	0.0	35.0	1.0	124
125	24	26	0	0	63.	.035	2.673	2.672	2	1.0	0	0.0	44.25	1.0	125
126	24	26	0	0	83.2	.022	1.636	1.634	2	1.0	0	0.0	44.25	1.0	126
127	6	22	0	0	792.	.01	1.253	1.130	2	1.0	0	0.0	12.	1.0	127
128	6	27	0	0	27.1	2.83	3.05	3.05	2	1.0	0	0.0	5.0	1.0	128
129	4	28	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	129
130	8	29	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	130
131	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	131
132	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	132
133	2	31	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	133
134	31	32	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	134
135	32	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	135
136	33	34	0	0	1.75	.894	1.61	1.61	2	1.0	0	0.0	9.2	1.0	136
137	34	37	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.5	1.0	137
138	33	36	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.5	1.0	138
139	36	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	139
140	37	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	140
141	33	35	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	141
142	35	38	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	142
143	38	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	143
144	1	39	0	0	1.0	10.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	144
145	2	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	145
146	3	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	146
147	31	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	147
148	21	39	0	0	3.25	10.0	1.0	30.0	2	1.0	0	0.0	15.0	1.0	148
149	33	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	149
150	34	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	150

12345678901234567890123456789012345678901234567890123456789012345678901234567890

PE-050

```
UNIT 55 (SEQ  1) INPUT ECHO          1         2         3         4         5         6         7         8
                            12345678901234567890123456789012345678901234567890123456789012345678901234567890

35  39  0  0    16.25  1.0     1.0    30.0    2  1.0  0  0.0  9.0     1.0
39  40  0  0     1.0   0.1     1.0    30.0    2  1.0  1  0.0 50.0     1.0
 0   6  1  0     1.0   0.0     0.0     0.0    0  1.0  0  0.0  9.7     1.0
*
*
*FILL TABLE DATA CARDS:LETDOWN LINE CRACK NODE 6 WITH HT.SINKS
*
*
   8  2
   0.0            563.0   146380.0
   0.71           563.0   146380.0
       0.710001   281.5   73190.0
       2.16       281.5   73190.0
       2.160001    25.5    6630.0
     900.0         25.5    6630.0
     900.000001     0.0       0.0
    1850.0          0.0       0.0
*
*
*FAN TABLE DATA CARDS
*
*
  2  3
    40300.0       0.0
    40300.0    3000.0
*
*
*PASSIVE HEAT SINK DATA CARDS
*
*
SINK1,NODE4
12  1  0  0.0  7073.1  4  0
12  1.0
1
T
1  1  1  .08 0 0 0 1.0
SINK2,NODE5
12  1  0  0.0  1768.0  5  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK3,NODE6
12  1  0  0.0  5635.9  6  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK4,NODE7
12  1  0  0.0  1768.0  7  0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

J-E-41

```
UNIT 55 (SEQ  1) INPUT ECHO         1         2         3         4         5         6         7         8
                           12345678901234567890123456789012345678901234567890123456789012345678901234567890

12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK5,NODE8
12  1  0  0.0  7073.1  8  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK6,NODE9
12  1  0  0.0  2273.5 9  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK7,NODE10
12  1  0  0.0  5167.5 10  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK8,NODE11
12  1  0  0.0  2273.5  11  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK9,NODE21
12  1  0  0.0  4974.0 21  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK10,NODE22
12  1  0  0.0 3335.0 22  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK11,NODE12
 9  1  0  0.0 562.5  12  0
 9  0.75
1
 T
1  1  1  .08 0 0  0 1.0
SINK12,NODE13
 9  1  0  0.0 660.25 13  0
 9  0.75
1

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

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p39
J.O. 12846.44

1-E-42


```
UNIT 55 (SEQ  1) INPUT ECHO        1         2         3         4         5         6         7         8
                          12345678901234567890123456789012345678901234567890123456789012345678901234567890

T
1  1  1  .08 0 0  0 1.0
SINK13,NODE16
 6  1  0  0.0 1275.0 16  0
 6  0.5
1
T
1  1  1  .08 0 0  0 1.0
SINK14,NODE17
 6  1  0  0:0 1717.875 17 0
 6  0.5
1
T
1  1  1  .08 0.0  0 1.0
SINK15,NODE18
12  1  0  0.0 3008.0 18  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK16,NODE19
 6  1  0  0.0 1717.875 19 0
 6  0.5
1
T
1  1  1  .08 0  0  0 1.0
SINK17,NODE20
 6  1  0  0.0 1275.0 20  0
 6  0.5
1
T
1  1  1  .08 0  0  0 1.0
*
*
*DATA COMMON TO HEAT SINKS
*
*
120.0  T
0.79  24.93  'CONCRETE'/
END OF HEAT SLAB DATA

12345678901234567890123456789012345678901234567890123456789012345678901234567890  <EOF>  COPIED TO UNIT  5
                                                                                                W/O CMTS
```

PE-050

P 40

I.0.12846.44

R3800125 SURRY 1&2:AUX BLDG,LETDOWN LINE CRACK NODE 6 WITH HT. SINKS — THREED 18 NOV 1980 15:04:18 — PAGE 7
S & W ENGR CORP NU-92 << SUBCOMPARTMENT ANALYSIS PROGRAM >> — THREED.VER12.LEV01 CREATED 80.106. 11:35:02 — UNIT 10

RUN SUMMARY SHEET

MISCELLANEOUS PROBLEM CONTROL DATA:

OUTPUT FLAG................. 1
NUMBER OF TIME STEP CARDS... 11
NUMBER OF TRIP CONTROLS..... 3
NUMBER OF VOLUMES........... 40
NUMBER OF JUNCTIONS......... 66
NUMBER OF FILL TABLES....... 1
NUMBER OF FAN TABLES........ 1
NUMBER OF HT SOURCE CURVES.. 0
IMPLICIT/EXPLICIT COEFF..... 1.000

TOTAL TIME OF RUN.........................1801.000 SEC
NUMBER OF STANDARD TIME STEPS............... 5002
NUMBER OF ACTUAL TIME STEPS................. 5013
NUMBER OF TIMES GAUSSIAN ELIMINATION USED.. 2295
NUMBER OF TIMES GAUSS-SEIDEL USED.......... 2718
NUMBER OF TRANSIENTS STORED FOR PLOTEMUP... 146
NUMBER OF SELECTED NODAL DIFF. PRESS....... 0
NUMBER OF HEAT SINKS....................... 17
NUMBER OF INTERNAL JUNCTIONS............... 65

STEAM TABLES USED (FT15) VOLUME SERIAL NO. = SHARE0 DATA SET NAME = HEATBAL.ME190.STH20G.OUTPUT1

OUTPUT: TRANSIENTS TAPE (FT08) = 016308 FILE NUMBER = 21 DATA SET NAME = FE.GUARDS.PLOTTER
TRANSMITTAL FILE (FT09) WAS NOT USED

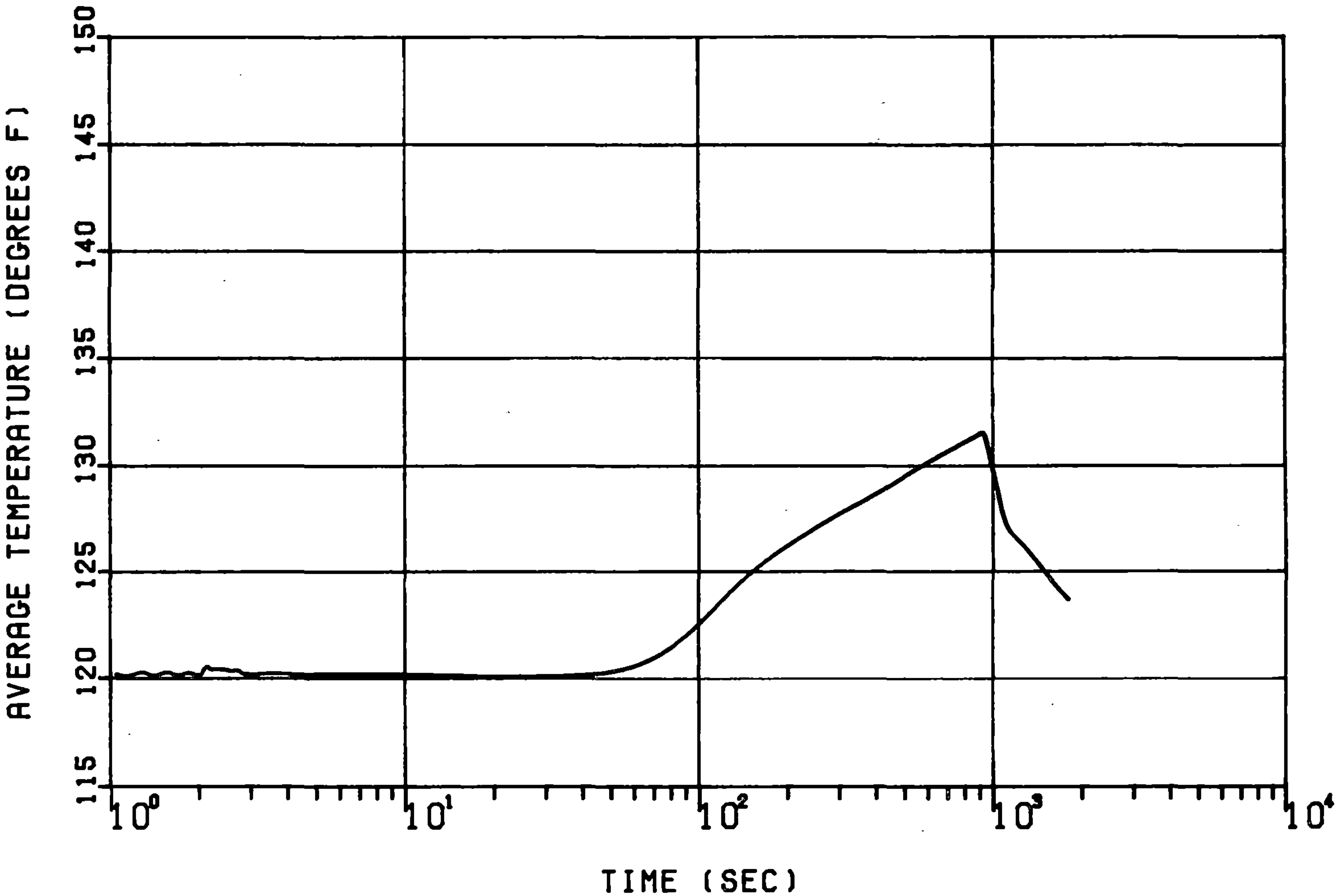
PEAK PRESSURE DIFFERENTIAL

JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC
1	1 TO 6	-0.03	2.016
2	2 TO 3	0.00	0.236
3	4 TO 5	-0.01	2.041
4	5 TO 6	-0.03	2.019
5	7 TO 6	-0.03	2.019
6	8 TO 7	-0.01	2.041
7	1 TO 12	0.02	2.041
8	1 TO 12	0.02	2.041
9	7 TO 11	0.01	2.041
10	8 TO 11	-0.00	2.192
11	4 TO 9	-0.00	2.192
12	5 TO 9	0.01	2.041
13	10 TO 12	-0.01	0.400
14	9 TO 10	-0.01	0.446
15	11 TO 10	-0.01	0.446
16	9 TO 17	0.01	0.593
17	12 TO 13	-0.01	0.000
18	11 TO 19	0.01	0.593
19	3 TO 15	-0.01	0.234
20	2 TO 14	-0.01	0.000
21	17 TO 18	0.02	0.744
22	18 TO 19	-0.02	0.744
23	19 TO 20	0.01	0.271
24	14 TO 16	0.01	2.117
25	15 TO 16	0.01	2.117
26	16 TO 21	-0.03	2.056
27	17 TO 23	0.02	2.195
28	19 TO 23	0.02	2.195
29	20 TO 21	-0.03	2.056
30	18 TO 13	-0.01	2.060
31	16 TO 17	-0.01	0.271
32	21 TO 22	-0.03	2.032
33	22 TO 24	0.03	2.034

JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC
34	25 TO 23	-0.01	2.142
35	25 TO 23	-0.01	2.142
36	23 TO 26	-0.01	0.000
37	24 TO 25	0.01	2.051
38	24 TO 26	0.01	2.054
39	24 TO 26	0.01	2.054
40	6 TO 22	0.02	2.014
41	6 TO 27	0.04	2.220
42	4 TO 28	-0.02	2.450
43	8 TO 29	-0.02	2.450
44	26 TO 30	0.01	2.290
45	26 TO 30	0.01	2.290
46	2 TO 31	-0.00	0.501
47	31 TO 32	-0.01	0.000
48	32 TO 16	0.01	2.117
49	33 TO 34	0.00	0.238
50	34 TO 37	-0.01	0.234
51	33 TO 36	-0.01	0.000
52	36 TO 20	0.01	2.117
53	37 TO 20	0.01	2.117
54	33 TO 35	-0.00	0.501
55	35 TO 38	-0.01	0.000
56	38 TO 20	0.01	2.117
57	1 TO 39	0.10	0.227
58	2 TO 39	0.09	0.225
59	3 TO 39	0.09	0.225
60	31 TO 39	0.09	0.225
61	21 TO 39	0.09	0.227
62	33 TO 39	0.09	0.225
63	34 TO 39	0.09	0.225
64	35 TO 39	0.09	0.225
65	39 TO 40	-0.39	0.227

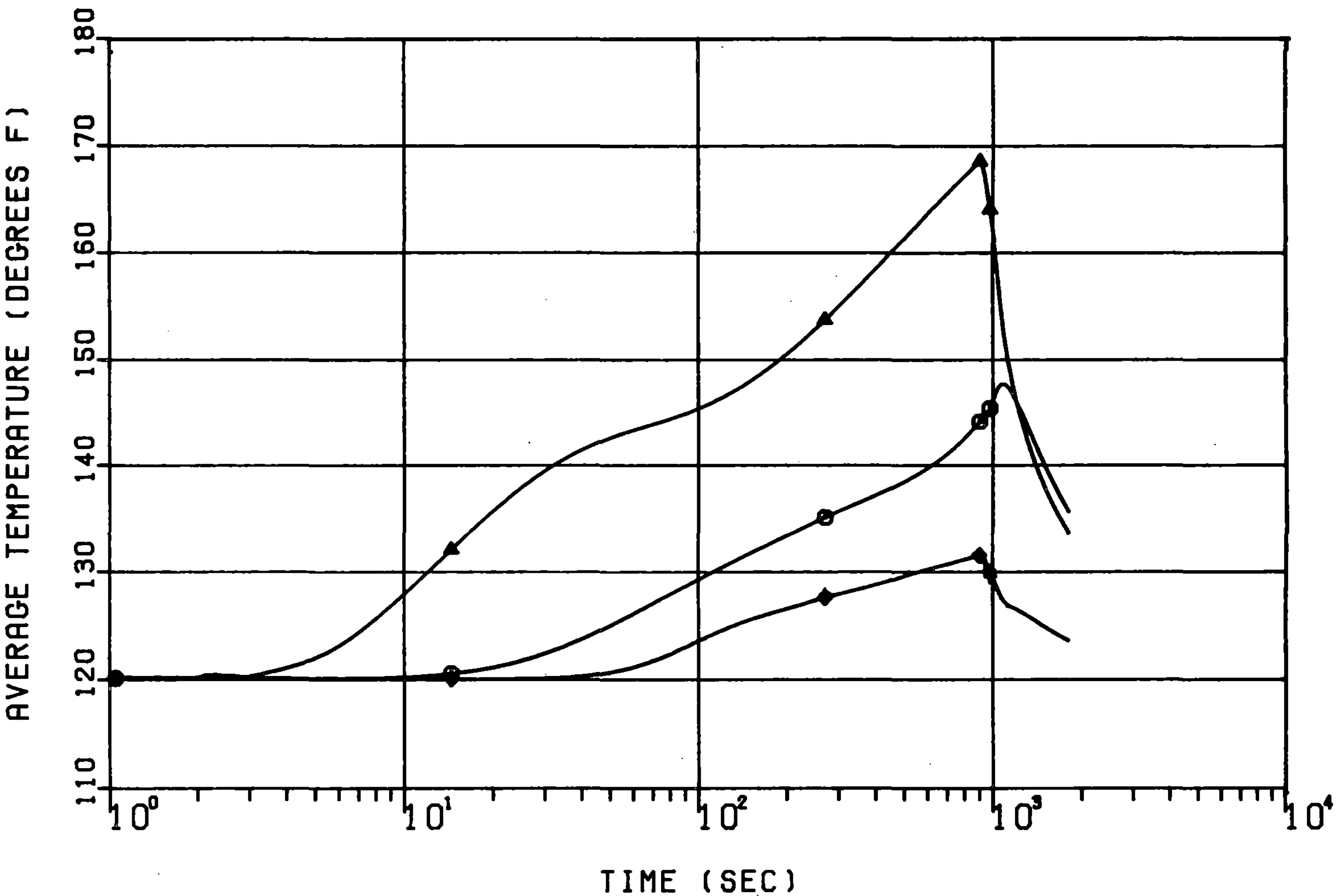
PEAK PRESSURES AND TEMPERATURES

NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)	NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)
1	14.76	2.220	136.96	910.600	21	14.75	2.062	120.54	2.062
2	14.75	2.127	131.55	918.800	22	14.75	2.035	121.97	4.150
3	14.75	2.125	131.55	918.700	23	14.72	2.150	120.27	2.150
4	14.75	2.290	147.77	1083.000	24	14.72	2.210	120.26	2.200
5	14.75	2.200	168.58	904.150	25	14.72	2.220	120.26	2.220
6	14.76	2.210	171.60	902.000	26	14.71	2.280	120.12	2.280
7	14.75	2.200	168.65	903.750	27	14.72	5.100	120.10	902.080
8	14.75	2.290	145.51	906.850	28	14.75	2.440	120.55	2.440
9	14.75	2.290	153.18	926.300	29	14.75	2.440	120.55	2.440
10	14.75	2.185	144.36	922.600	30	14.70	1801.000	120.00	1801.000
11	14.75	2.290	156.44	911.500	31	14.75	2.127	131.55	918.900
12	14.75	2.220	137.72	902.020	32	14.75	2.129	131.57	912.700
13	14.74	2.220	126.98	210.000	33	14.75	2.127	126.66	673.000
14	14.75	2.129	131.57	912.700	34	14.75	2.125	126.66	671.000
15	14.75	2.130	131.58	912.600	35	14.75	2.127	126.66	673.000
16	14.74	2.179	131.68	907.400	36	14.75	2.129	126.66	642.000
17	14.74	2.188	139.37	902.030	37	14.75	2.130	126.66	640.000
18	14.74	2.158	126.07	910.500	38	14.75	2.129	126.66	642.000
19	14.74	2.188	130.09	681.000	39	14.76	0.274	130.16	918.700
20	14.74	2.179	126.67	599.000	40	15.00	1801.000	120.00	1801.000



SURRY UNIT 142 AUX.BUILDING HELB
AVERAGE TEMPERATURE VERSUS TIME
MODE 2 LETDOWN LINE BREAK WITH HT.SINKS
RUN = 3800125

1-E-46



SURRY UNIT 1&2 AUX.BUILDING HELB
AVERAGE TEMPERATURE VERSUS TIME
LETDOWN LINE BREAK NODE 6 WITH HT.SINKS
RUN # 3800125

PE-050

P44
J.O. 12846.44

```
UNIT 55 (SEQ  1) INPUT ECHO        1         2         3         4         5         6         7         8
                          12345678901234567890123456789012345678901234567890123456789012345678901234567890

  SURRY 1&2:AUX BLDG,6"AUX STM LINE CRACK NODE22 WITH HT. SINKS
*
*
*PROBLEM DIMENSION CARD
*
*
1 11 3 40 66 1 1 0 0 17
*
*
*IMPLICIT/EXPLICIT COEFICIENT CARD
*
*
1.0
*
*
*TIME STEP CONTROL DATA CARDS
*
*
 50  10  0  0  0.001 0.00001     2.2
  2  10  0  0  0.01  0.0001      3.0
  5  14  0  0  0.05  0.0001     10.0
  5  15  0  0  0.1   0.0001     30.0
  2  15  0  0  0.5   0.001      80.0
 10  20  0  0  1.0   0.001     901.0
  5  10  0  0  0.01  0.0001    903.0
  5  14  0  0  0.05  0.0001    910.0
 10  10  0  0  0.1   0.0001    930.0
  2  25  0  0  0.5   0.001     980.0
 10  20  0  0  1.0   0.001    1850.0
*
*
*TRIP CONTROL DATA CARDS
*
*
1  0  0 1800.0    0.0
1  0  0    0.0    2.0
1  0  0    0.0    0.2
*
*
*NODAL DATA CARDS
*
*
14.70  120. 1.0   1137.7    2.00   9.50  0.0  0
14.70  120. 1.0   2011.2    2.00  10.00  0.0  0
14.70  120. 1.0   2011.2    2.00  10.00  0.0  0
14.70  120. 1.0  26611.5    2.00  12.00  0.0  0
14.70  120. 1.0   5150.7    2.00   9.50  0.0  0
14.70  120. 1.0  18697.8    2.00  10.10  0.0  0
14.70  120. 1.0   5150.7    2.00   9.50  0.0  0
14.70  120. 1.0  26611.5    2.00  12.00  0.0  0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

```
UNIT 55 (SEQ  1) INPUT ECHO         1         2         3         4         5         6         7         8
                           12345678901234567890123456789012345678901234567890123456789012345678901234567890

     14.70  120. 1.0   4050.0    2.00    9.00  0.0  0
     14.70  120. 1.0   5820.0    2.00    9.00  0.0  0
     14.70  120. 1.0   4050.0    2.00    9.00  0.0  0
     14.70  120. 1.0   1255.5    2.00    9.00  0.0  0
     14.70  120. 1.0   1400.2   13.00   12.50  0.0  0
     14.70  120. 1.0   2799.8   13.00   12.50  0.0  0
     14.70  120. 1.0   2696.6   13.00   12.50  0.0  0
     14.70  120. 1.0   5122.4   13.00   13.50  0.0  0
     14.70  120. 1.0   5678.    13.00   13.50  0.0  0
     14.70  120. 1.0   8035.2   13.00   13.50  0.0  0
     14.70  120. 1.0   5678.    13.00   13.50  0.0  0
     14.70  120. 1.0   5122.4   13.00   13.50  0.0  0
     14.70  120. 1.0  17220.2   13.00   12.50  0.0  0
     14.70  120. 1.0  17593.5   13.00   12.50  0.0  0
     14.70  120. 1.0  47234.0   27.5    17.0   0.0  0
     14.70  120. 1.0  31900.5   27.5    17.0   0.0  0
     14.70  120. 1.0  29622.1   27.5    17.0   0.0  0
     14.70  120. 1.0 149291.1   45.83   18.5   0.0  0
     14.70  120. 1.0 893025.0    9.0    49.0   0.0  0
     14.70  120. 1.0  13235.    11.5    15.15  0.0  0
     14.70  120. 1.0  13235.    11.5    15.15  0.0  0
     14.70  120. 1.0   1.0E20   27.5    50.0   0.0  0
     14.70  120. 1.0   2011.2    2.0    10.0   0.0  0
     14.70  120. 1.0   2799.8   13.0    12.5   0.0  0
     14.70  120. 1.0   2011.2    2.0    10.0   0.0  0
     14.70  120. 1.0   2011.2    2.0    10.0   0.0  0
     14.70  120. 1.0   2011.2    2.0    10.0   0.0  0
     14.70  120. 1.0   2799.8   13.0    12.5   0.0  0
     14.70  120. 1.0   2696.6   13.0    12.5   0.0  0
     14.70  120. 1.0   2799.6   13.0    12.5   0.0  0
     14.70  120. 1.0   2000.0    2.0    70.0   0.0  0
     15.0   120. 1.0    1.0E20  27.5    50.0   0.0  0
     *
     *
     *JUNCTION DATA CARDS
     *
     *
      1   6  0  0   32.5    .2888 2.219  1.476  2  1.0  0  0.0  7.58    1.0
      2   3  0  0    1.75   .894  1.61   1.61   2  1.0  0  0.0  9.2     1.0
      4   5  0  0  246.7    .062  1.062   .216  2  1.0  0  0.0  6.5     1.0
      5   6  0  0   78.6    .127  1.844  1.672  2  1.0  0  0.0  6.63    1.0
      7   6  0  0   78.6    .127  1.844  1.672  2  1.0  0  0.0  6.63    1.0
      8   7  0  0  246.7    .062  1.062  0.216  2  1.0  0  0.0  6.5     1.0
      1  12  0  0    3.75   .473  1.61   1.61   2  1.0  0  0.0  9.75    1.0
      1  12  0  0    1.13   .940  1.549  1.549  2  1.0  0  0.0  2.75    1.0
      7  11  0  0   20.25   .401  1.716  1.272  2  1.0  0  0.0  4.75    1.0
      8  11  0  0   56.7    .062  1.047  1.094  2  1.0  0  0.0  6.5     1.0
      4   9  0  0   56.7    .062  1.047  1.094  2  1.0  0  0.0  6.5     1.0
      5   9  0  0   20.25   .401  1.716  1.272  2  1.0  0  0.0  4.75    1.0
     10  12  0  0   60.75   .149  1.491 -0.123  2  1.0  0  0.0  4.75    1.0

     12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

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1-E-49

UNIT 55 (SEQ 1) INPUT ECHO

```
                              1         2         3         4         5         6         7         8
                     12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

101	9	10	0	0	90.	.434	1.004	-0.45	2	1.0	0	0.0	4.5	1.0	101
102	11	10	0	0	90.	.434	1.004	-0.45	2	1.0	0	0.0	4.5	1.0	102
103	9	17	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	4.5	1.0	103
104	12	13	0	0	84.0	.102	.558	0.012	2	1.0	0	0.0	11.00	1.0	104
105	11	19	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	11.00	1.0	105
106	3	15	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.50	1.0	106
107	2	14	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.50	1.0	107
108	17	18	0	0	135.	.288	1.007	-0.451	2	1.0	0	0.0	19.75	1.0	108
109	18	19	0	0	135.	.288	-0.451	1.007	2	1.0	0	0.0	19.75	1.0	109
110	19	20	0	0	162.	.142	.696	-0.369	2	1.0	0	0.0	19.75	1.0	110
111	14	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	111
112	15	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	112
113	16	21	0	0	162.	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	113
114	17	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	114
115	19	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	115
116	20	21	0	0	162.0	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	116
117	18	13	0	0	21.	.329	2.250	2.497	2	1.0	0	0.0	19.25	1.0	117
118	16	17	0	0	162.	.142	-0.369	.696	2	1.0	0	0.0	19.75	1.0	118
119	21	22	0	0	496.5	.029	.831	-.418	2	1.0	0	0.0	19.25	1.0	119
120	22	24	0	0	66.5	.032	2.552	2.552	2	1.0	0	0.0	26.5	1.0	120
121	25	23	0	0	195.	.112	1.197	1.180	2	1.0	0	0.0	35.0	1.0	121
122	25	23	0	0	155.	.17	1.225	1.189	2	1.0	0	0.0	35.0	1.0	122
123	23	26	0	0	60.	.040	2.553	2.607	2	1.0	0	0.0	44.25	1.0	123
124	24	25	0	0	983.6	.030	.284	-0.131	2	1.0	0	0.0	35.0	1.0	124
125	24	26	0	0	63.	.035	2.673	2.672	2	1.0	0	0.0	44.25	1.0	125
126	24	26	0	0	83.2	.022	1.636	1.634	2	1.0	0	0.0	44.25	1.0	126
127	6	22	0	0	792.	.01	1.253	1.130	2	1.0	0	0.0	12.	1.0	127
128	6	27	0	0	27.1	2.83	3.05	3.05	2	1.0	0	0.0	5.0	1.0	128
129	4	28	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	129
130	8	29	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	130
131	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	131
132	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	132
133	2	31	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	133
134	31	32	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	134
135	32	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	135
136	33	34	0	0	1.75	.894	1.61	1.61	2	1.0	0	0.0	9.2	1.0	136
137	34	37	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.5	1.0	137
138	33	36	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.5	1.0	138
139	36	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	139
140	37	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	140
141	33	35	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	141
142	35	38	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	142
143	38	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	143
144	1	39	0	0	1.0	10.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	144
145	2	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	145
146	3	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	146
147	31	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	147
148	21	39	0	0	3.25	10.0	1.0	30.0	2	1.0	0	0.0	15.0	1.0	148
149	33	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	149
150	34	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	150

```
                     12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

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UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

35  39  0  0   16.25  1.0     1.0   30.0    2  1.0  0  0.0  9.0     1.0
39  40  0  0    1.0   0.1     1.0   30.0    2  1.0  1  0.0 50.0     1.0
 0  22  1  0    1.0   0.0     0.0    0.0    0  1.0  0  0.0  9.7     1.0
*
*
*FILL TABLE DATA CARDS:LETDOWN LINE CRACK NODE 6 WITH HT.SINKS
*
*
   4  2
   0.0            1.613     1930.52
 900.0            1.613     1930.52
      900.000001      0.0       0.0
     1850.0           0.0       0.0
*
*
*FAN TABLE DATA CARDS
*
*
  2  3
     40300.0       0.0
     40300.0    3000.0
*
*
*PASSIVE HEAT SINK DATA CARDS
*
*
SINK1,NODE4
12  1  0  0.0  7073.1  4  0
12  1.0
1
F
1  1  1  .08 0 0 0 1.0
SINK2,NODE5
12  1  0  0.0  1768.0  5  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK3,NODE6
12  1  0  0.0  5635.9  6  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK4,NODE7
12  1  0  0.0  1768.0  7  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

1-E-30

PE-050

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J.O. 12846.44

1-E-51

UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

SINK5,NODE8
12  1  0  0.0  7073.1  8  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK6,NODE9
12  1  0  0.0  2273.5 9  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK7,NODE10
12  1  0  0.0  5167.5 10  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK8,NODE11
12  1  0  0.0  2273.5  11  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK9,NODE21
12  1  0  0.0  4974.0 21  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK10,NODE22
12  1  0  0.0 3335.0 22  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK11,NODE12
 9  1  0  0.0 562.5  12  0
 9  0.75
1
F
1  1  1  .08 0 0  0 1.0
SINK12,NODE13
 9  1  0  0.0 660.25 13  0
 9  0.75
1
F
1  1  1  .08 0 0  0 1.0
SINK13,NODE16
 6  1  0  0.0 1275.0 16  0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

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J.O. 128 46.44

```
UNIT 55 (SEQ  1) INPUT ECHO        1         2         3         4         5         6         7         8
                          12345678901234567890123456789012345678901234567890123456789012345678901234567890

 6  0.5
1
F
1  1  1  .08 0 0  0 1.0
SINK14,NODE17
 6  1  0  0.0 1717.875 17 0
 6  0.5
1
F
1  1  1  .08 0 0  0 1.0
SINK15,NODE18
12  1  0  0.0 3008.0 18  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK16,NODE19
 6  1  0  0.0 1717.875 19 0
 6  0.5
1
F
1  1  1  .08 0  0  0 1.0
SINK17,NODE20
 6  1  0  0.0 1275.0 20  0
 6  0.5
1
F
1  1  1  .08 0  0  0 1.0
*
*
*DATA COMMON TO HEAT SINKS
*
*
120.0  T
0.79  24.93  'CONCRETE'/
END OF HEAT SLAB DATA

12345678901234567890123456789012345678901234567890123456789012345678901234567890  <EOF>  COPIED TO UNIT  5
                                                                                                  W/O CMTS
```

1-E-53

R U N S U M M A R Y S H E E T

MISCELLANEOUS PROBLEM CONTROL DATA:

OUTPUT FLAG.................	1
NUMBER OF TIME STEP CARDS...	11
NUMBER OF TRIP CONTROLS.....	3
NUMBER OF VOLUMES...........	40
NUMBER OF JUNCTIONS.........	66
NUMBER OF FILL TABLES.......	1
NUMBER OF FAN TABLES........	1
NUMBER OF HT SOURCE CURVES..	0
IMPLICIT/EXPLICIT COEFF.....	1.000

TOTAL TIME OF RUN..........................	1801.000 SEC
NUMBER OF STANDARD TIME STEPS..............	5002
NUMBER OF ACTUAL TIME STEPS................	5013
NUMBER OF TIMES GAUSSIAN ELIMINATION USED..	2381
NUMBER OF TIMES GAUSS-SEIDEL USED..........	2632
NUMBER OF TRANSIENTS STORED FOR PLOTEMUP...	146
NUMBER OF SELECTED NODAL DIFF. PRESS.......	0
NUMBER OF HEAT SINKS.......................	17
NUMBER OF INTERNAL JUNCTIONS...............	65

STEAM TABLES USED (FT15) VOLUME SERIAL NO. = SHARE0 DATA SET NAME = HEATBAL.ME190.STH20G.OUTPUT1

OUTPUT: TRANSIENTS TAPE (FT08) = 016308 FILE NUMBER = 22 DATA SET NAME = FE.GUARDS.PLOTTER
TRANSMITTAL FILE (FT09) WAS NOT USED

PEAK PRESSURE DIFFERENTIAL

JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC	JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC
1	1 TO 6	0.01	0.489	34	25 TO 23	0.00	0.546
2	2 TO 3	0.00	0.236	35	25 TO 23	0.00	0.546
3	4 TO 5	-0.01	0.394	36	23 TO 26	-0.01	0.000
4	5 TO 6	-0.01	0.396	37	24 TO 25	-0.01	0.080
5	7 TO 6	-0.01	0.396	38	24 TO 26	-0.01	0.000
6	8 TO 7	-0.01	0.394	39	24 TO 26	-0.01	0.000
7	1 TO 12	0.01	0.392	40	6 TO 22	-0.01	0.000
8	1 TO 12	0.01	0.392	41	6 TO 27	0.01	0.394
9	7 TO 11	0.01	0.394	42	4 TO 28	-0.02	0.408
10	8 TO 11	0.00	0.590	43	8 TO 29	-0.02	0.408
11	4 TO 9	0.00	0.590	44	26 TO 30	-0.01	0.098
12	5 TO 9	0.01	0.394	45	26 TO 30	-0.01	0.098
13	10 TO 12	-0.01	0.400	46	2 TO 31	-0.00	0.501
14	9 TO 10	-0.01	0.446	47	31 TO 32	-0.01	0.000
15	11 TO 10	-0.01	0.446	48	32 TO 16	-0.01	0.248
16	9 TO 17	0.01	0.593	49	33 TO 34	0.00	0.236
17	12 TO 13	-0.01	0.000	50	34 TO 37	-0.01	0.234
18	11 TO 19	0.01	0.593	51	33 TO 36	-0.01	0.000
19	3 TO 15	-0.01	0.234	52	36 TO 20	-0.01	0.249
20	2 TO 14	-0.01	0.000	53	37 TO 20	-0.01	0.251
21	17 TO 18	0.02	0.744	54	33 TO 35	-0.00	0.501
22	18 TO 19	-0.02	0.744	55	35 TO 38	-0.01	0.000
23	19 TO 20	0.01	0.271	56	38 TO 20	-0.01	0.248
24	14 TO 16	-0.01	0.249	57	1 TO 39	0.10	0.227
25	15 TO 16	-0.01	0.251	58	2 TO 39	0.09	0.225
26	16 TO 21	-0.02	0.268	59	3 TO 39	0.09	0.225
27	17 TO 23	-0.01	0.596	60	31 TO 39	0.09	0.225
28	19 TO 23	-0.01	0.596	61	21 TO 39	0.09	0.227
29	20 TO 21	-0.02	0.268	62	33 TO 39	0.09	0.225
30	18 TO 13	-0.01	0.321	63	34 TO 39	0.09	0.225
31	16 TO 17	-0.01	0.271	64	35 TO 39	0.09	0.225
32	21 TO 22	0.01	0.443	65	39 TO 40	-0.39	0.227
33	22 TO 24	-0.01	0.023				

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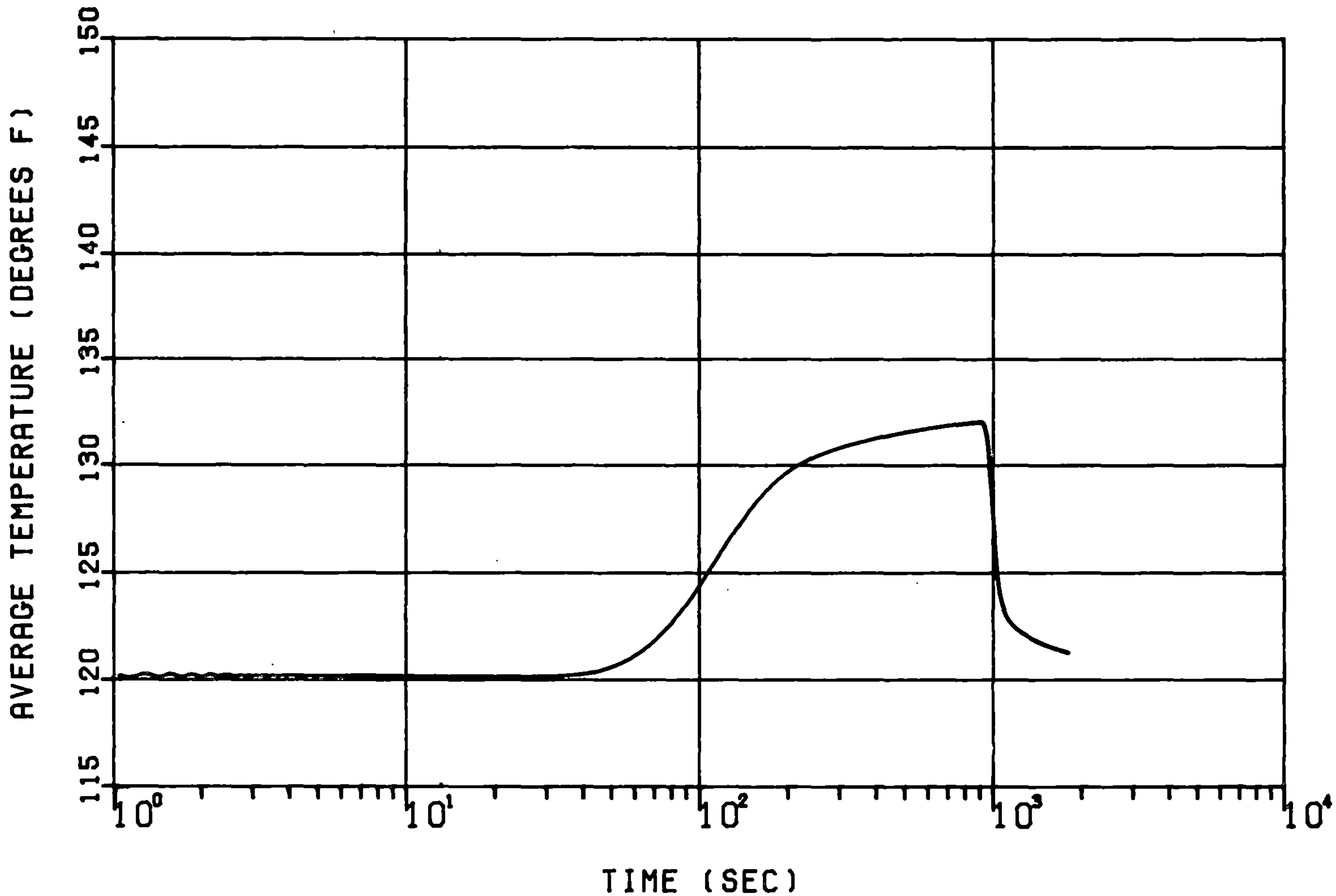
PSI
J.O. 12846.44

PEAK PRESSURES AND TEMPERATURES

NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)	NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)
1	14.73	0.584	120.31	0.584	21	14.72	0.724	134.33	902.000
2	14.73	0.691	132.08	909.400	22	14.72	0.393	135.00	902.000
3	14.73	0.691	132.08	909.400	23	14.71	0.283	120.11	0.283
4	14.73	0.541	120.30	0.541	24	14.71	0.395	120.09	0.394
5	14.73	0.576	120.30	0.576	25	14.71	0.264	120.11	0.264
6	14.73	0.578	120.28	0.578	26	14.70	0.326	120.04	0.326
7	14.73	0.576	120.30	0.576	27	14.71	4.550	120.12	4.550
8	14.73	0.541	120.30	0.541	28	14.72	0.447	120.25	0.446
9	14.73	0.545	120.31	0.545	29	14.72	0.446	120.25	0.446
10	14.73	0.206	120.29	0.206	30	14.70	1801.000	120.00	1801.000
11	14.73	0.545	120.31	0.545	31	14.73	0.691	132.08	909.400
12	14.73	0.234	120.29	0.234	32	14.72	0.414	132.08	903.200
13	14.72	0.490	120.24	0.490	33	14.73	0.691	132.08	909.450
14	14.72	0.691	132.08	903.200	34	14.73	0.691	132.08	909.200
15	14.73	0.413	132.08	903.200	35	14.73	0.691	132.08	909.450
16	14.72	0.429	132.10	902.000	36	14.72	0.691	132.08	903.200
17	14.73	0.646	120.28	0.646	37	14.73	0.413	132.08	903.200
18	14.72	0.686	120.24	0.686	38	14.72	0.414	132.08	903.200
19	14.73	0.646	120.28	0.646	39	14.76	0.274	131.99	904.900
20	14.72	0.429	132.10	902.000	40	15.00	1801.000	120.00	1801.000



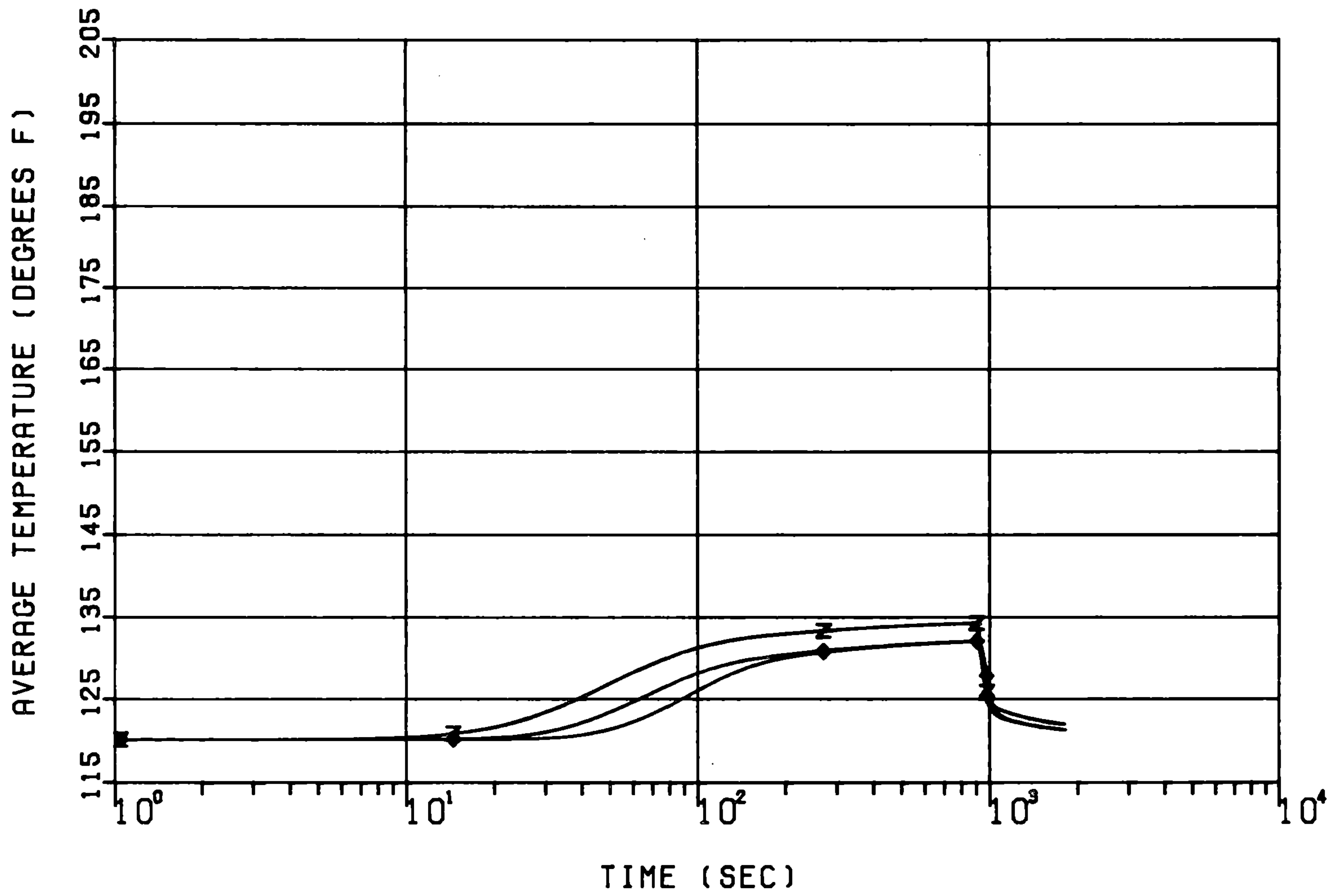
SURRY UNIT 1&2 AUX.BUILDING HELB
AVERAGE TEMPERATURE VERSUS TIME
MODE 2 AUX STM LINE CRACK WITH HT.SINKS
RUN = 3800126

PE-050

J.O. 12846.44

P53

1-E-56

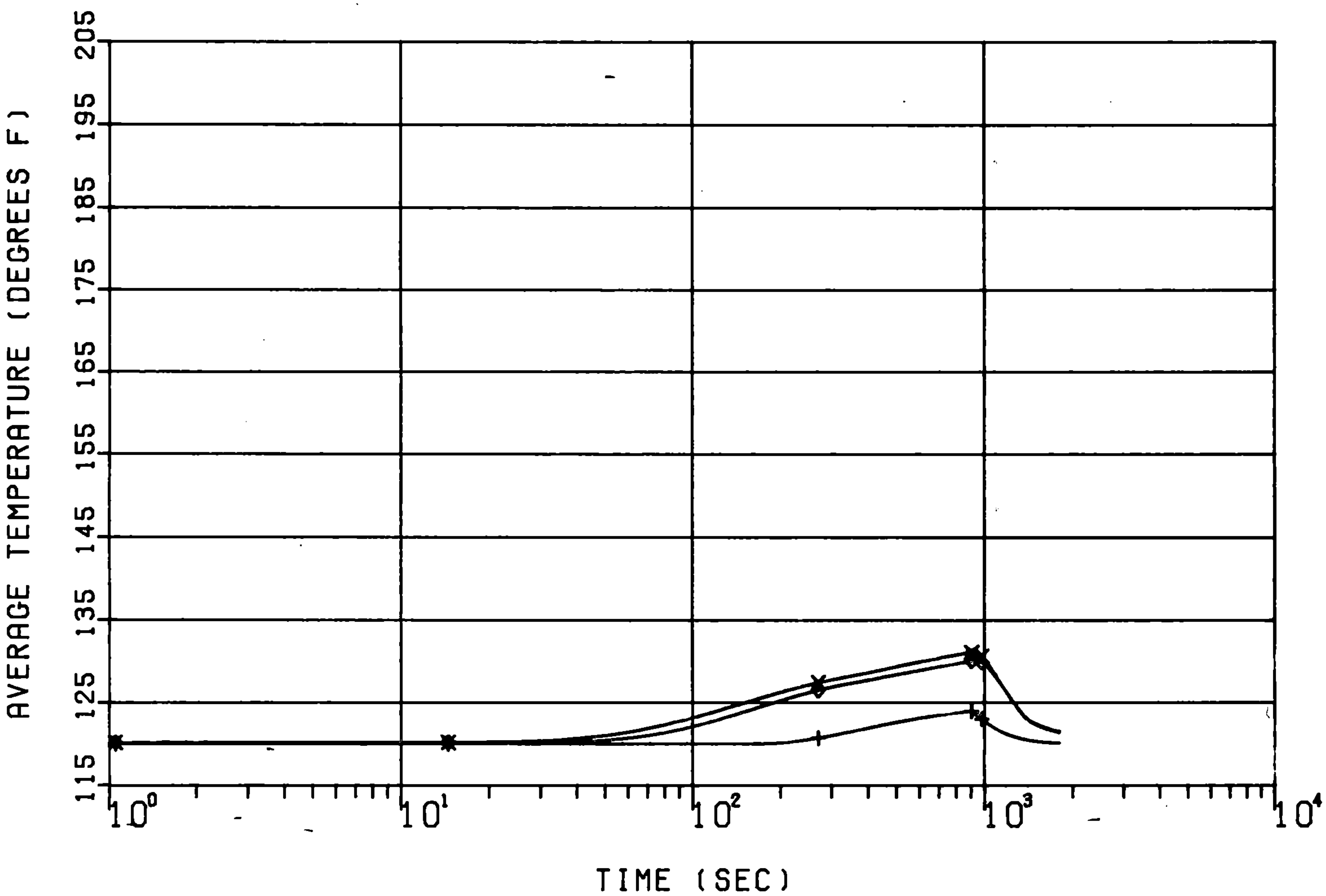


SURRY UNIT 1&2 AUX.BUILDING HELB
AVERAGE TEMPERATURE VERSUS TIME
6"AUX.STM.CRACK NODE 22 WITH HT.SINKS
PLOT OF RUN # 3800126

RE-050-0

PS4
J.O. 12846.44

1-E-57



SURRY UNIT 1&2 AUX.BUILDING HELB
AVERAGE TEMPERATURE VERSUS TIME
6"AUX.STM.CRACK NODE 23 WITH HT.SINKS
PLOT OF RUN # 3800127

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J.O. 17846.44
PE-050

1-E-58

UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

  SURRY 1&2:AUX BLDG,6"AUX STM LINE CRACK NODE23 WITH HT. SINKS
*
*
*PROBLEM DIMENSION CARD
*
*
1 11 3 40 66 1 1 0 0 17
*
*
*IMPLICIT/EXPLICIT COEFICIENT CARD
*
*
1.0
*
*
*TIME STEP CONTROL DATA CARDS
*
*
 50  10  0  0  0.001 0.00001     2.2
  2  10  0  0  0.01  0.0001      3.0
  5  14  0  0  0.05  0.0001     10.0
  5  15  0  0  0.1   0.0001     30.0
  2  15  0  0  0.5   0.001      80.0
 10  20  0  0  1.0   0.001     901.0
  5  10  0  0  0.01  0.0001    903.0
  5  14  0  0  0.05  0.0001    910.0
 10  10  0  0  0.1   0.0001    930.0
  2  25  0  0  0.5   0.001     980.0
 10  20  0  0  1.0   0.001    1850.0
*
*
*TRIP CONTROL DATA CARDS
*
*
1  0  0 1800.0    0.0
1  0  0    0.0    2.0
1  0  0    0.0    0.2
*
*
*NODAL DATA CARDS
*
*
14.70  120. 1.0   1137.7    2.00   9.50  0.0  0
14.70  120. 1.0   2011.2    2.00  10.00  0.0  0
14.70  120. 1.0   2011.2    2.00  10.00  0.0  0
14.70  120. 1.0  26611.5    2.00  12.00  0.0  0
14.70  120. 1.0   5150.7    2.00   9.50  0.0  0
14.70  120. 1.0  18697.8    2.00  10.10  0.0  0
14.70  120. 1.0   5150.7    2.00   9.50  0.0  0
14.70  120. 1.0  26611.5    2.00  12.00  0.0  0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

RE-050

PSS J.O. 12846.44

```
UNIT 55 (SEQ  1) INPUT ECHO         1         2         3         4         5         6         7         8
                           12345678901234567890123456789012345678901234567890123456789012345678901234567890

  51   14.70  120. 1.0    4050.0    2.00    9.00  0.0  0                                                    51
  52   14.70  120. 1.0    5820.0    2.00    9.00  0.0  0                                                    52
  53   14.70  120. 1.0    4050.0    2.00    9.00  0.0  0                                                    53
  54   14.70  120. 1.0    1255.5    2.00    9.00  0.0  0                                                    54
  55   14.70  120. 1.0    1400.2   13.00   12.50  0.0  0                                                    55
  56   14.70  120. 1.0    2799.8   13.00   12.50  0.0  0                                                    56
  57   14.70  120. 1.0    2696.6   13.00   12.50  0.0  0                                                    57
  58   14.70  120. 1.0    5122.4   13.00   13.50  0.0  0                                                    58
  59   14.70  120. 1.0    5678.    13.00   13.50  0.0  0                                                    59
  60   14.70  120. 1.0    8035.2   13.00   13.50  0.0  0                                                    60
  61   14.70  120. 1.0    5678.    13.00   13.50  0.0  0                                                    61
  62   14.70  120. 1.0    5122.4   13.00   13.50  0.0  0                                                    62
  63   14.70  120. 1.0   17220.2   13.00   12.50  0.0  0                                                    63
  64   14.70  120. 1.0   17593.5   13.00   12.50  0.0  0                                                    64
  65   14.70  120. 1.0   47234.0   27.5    17.0   0.0  0                                                    65
  66   14.70  120. 1.0   31900.5   27.5    17.0   0.0  0                                                    66
  67   14.70  120. 1.0   29622.1   27.5    17.0   0.0  0                                                    67
  68   14.70  120. 1.0  149291.1   45.83   18.5   0.0  0                                                    68
  69   14.70  120. 1.0  893025.0    9.0    49.0   0.0  0                                                    69
  70   14.70  120. 1.0   13235.    11.5    15.15  0.0  0                                                    70
  71   14.70  120. 1.0   13235.    11.5    15.15  0.0  0                                                    71
  72   14.70  120. 1.0    1.0E20   27.5    50.0   0.0  0                                                    72
  73   14.70  120. 1.0    2011.2    2.0    10.0   0.0  0                                                    73
  74   14.70  120. 1.0    2799.8   13.0    12.5   0.0  0                                                    74
  75   14.70  120. 1.0    2011.2    2.0    10.0   0.0  0                                                    75
  76   14.70  120. 1.0    2011.2    2.0    10.0   0.0  0                                                    76
  77   14.70  120. 1.0    2011.2    2.0    10.0   0.0  0                                                    77
  78   14.70  120. 1.0    2799.8   13.0    12.5   0.0  0                                                    78
  79   14.70  120. 1.0    2696.6   13.0    12.5   0.0  0                                                    79
  80   14.70  120. 1.0    2799.6   13.0    12.5   0.0  0                                                    80
  81   14.70  120. 1.0    2000.0    2.0    70.0   0.0  0                                                    81
  82   15.0   120. 1.0     1.0E20  27.5    50.0   0.0  0                                                    82
  83   *                                                                                                    83
  84   *                                                                                                    84
  85   *JUNCTION DATA CARDS                                                                                 85
  86   *                                                                                                    86
  87   *                                                                                                    87
  88    1   6  0  0    32.5     .2888 2.219  1.476   2  1.0  0  0.0  7.58    1.0                            88
  89    2   3  0  0     1.75    .894  1.61   1.61    2  1.0  0  0.0  9.2     1.0                            89
  90    4   5  0  0   246.7     .062  1.062   .216   2  1.0  0  0.0  6.5     1.0                            90
  91    5   6  0  0    78.6     .127  1.844  1.672   2  1.0  0  0.0  6.63    1.0                            91
  92    7   6  0  0    78.6     .127  1.844  1.672   2  1.0  0  0.0  6.63    1.0                            92
  93    8   7  0  0   246.7     .062  1.062  0.216   2  1.0  0  0.0  6.5     1.0                            93
  94    1  12  0  0     3.75    .473  1.61   1.61    2  1.0  0  0.0  9.75    1.0                            94
  95    1  12  0  0     1.13    .940  1.549  1.549   2  1.0  0  0.0  2.75    1.0                            95
  96    7  11  0  0    20.25    .401  1.716  1.272   2  1.0  0  0.0  4.75    1.0                            96
  97    8  11  0  0    56.7     .062  1.047  1.094   2  1.0  0  0.0  6.5     1.0                            97
  98    4   9  0  0    56.7     .062  1.047  1.094   2  1.0  0  0.0  6.5     1.0                            98
  99    5   9  0  0    20.25    .401  1.716  1.272   2  1.0  0  0.0  4.75    1.0                            99
 100   10  12  0  0    60.75    .149  1.491 -0.123   2  1.0  0  0.0  4.75    1.0                           100

                           12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

1-E-59

RE-080

PS6

J.O.17846.44

UNIT 55 (SEQ 1) INPUT ECHO 1 2 3 4 5 6 7 8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

101	9	10	0	0	90.	.434	1.004	-0.45	2	1.0	0	0.0	4.5	1.0	101
102	11	10	0	0	90.	.434	1.004	-0.45	2	1.0	0	0.0	4.5	1.0	102
103	9	17	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	4.5	1.0	103
104	12	13	0	0	84.0	.102	.558	0.012	2	1.0	0	0.0	11.00	1.0	104
105	11	19	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	11.00	1.0	105
106	3	15	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.50	1.0	106
107	2	14	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.50	1.0	107
108	17	18	0	0	135.	.288	1.007	-0.451	2	1.0	0	0.0	19.75	1.0	108
109	18	19	0	0	135.	.288	-0.451	1.007	2	1.0	0	0.0	19.75	1.0	109
110	19	20	0	0	162.	.142	.696	-0.369	2	1.0	0	0.0	19.75	1.0	110
111	14	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	111
112	15	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	112
113	16	21	0	0	162.	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	113
114	17	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	114
115	19	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	115
116	20	21	0	0	162.0	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	116
117	18	13	0	0	21.	.329	2.250	2.497	2	1.0	0	0.0	19.25	1.0	117
118	16	17	0	0	162.	.142	-0.369	.696	2	1.0	0	0.0	19.75	1.0	118
119	21	22	0	0	496.5	.029	.831	-.418	2	1.0	0	0.0	19.25	1.0	119
120	22	24	0	0	66.5	.032	2.552	2.552	2	1.0	0	0.0	26.5	1.0	120
121	25	23	0	0	195.	.112	1.197	1.180	2	1.0	0	0.0	35.0	1.0	121
122	25	23	0	0	155.	.17	1.225	1.189	2	1.0	0	0.0	35.0	1.0	122
123	23	26	0	0	60.	.040	2.553	2.607	2	1.0	0	0.0	44.25	1.0	123
124	24	25	0	0	983.6	.030	.284	-0.131	2	1.0	0	0.0	35.0	1.0	124
125	24	26	0	0	63.	.035	2.673	2.672	2	1.0	0	0.0	44.25	1.0	125
126	24	26	0	0	83.2	.022	1.636	1.634	2	1.0	0	0.0	44.25	1.0	126
127	6	22	0	0	792.	.01	1.253	1.130	2	1.0	0	0.0	12.	1.0	127
128	6	27	0	0	27.1	2.83	3.05	3.05	2	1.0	0	0.0	5.0	1.0	128
129	4	28	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	129
130	8	29	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	130
131	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	131
132	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	132
133	2	31	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	133
134	31	32	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	134
135	32	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	135
136	33	34	0	0	1.75	.894	1.61	1.61	2	1.0	0	0.0	9.2	1.0	136
137	34	37	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.5	1.0	137
138	33	36	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.5	1.0	138
139	36	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	139
140	37	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	140
141	33	35	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	141
142	35	38	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	142
143	38	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	143
144	1	39	0	0	1.0	10.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	144
145	2	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	145
146	3	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	146
147	31	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	147
148	21	39	0	0	3.25	10.0	1.0	30.0	2	1.0	0	0.0	15.0	1.0	148
149	33	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	149
150	34	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	150

12345678901234567890123456789012345678901234567890123456789012345678901234567890

```
UNIT 55 (SEQ  1) INPUT ECHO        1         2         3         4         5         6         7         8
                          12345678901234567890123456789012345678901234567890123456789012345678901234567890

35  39  0  0   16.25  1.0    1.0   30.0    2  1.0  0  0.0  9.0    1.0
39  40  0  0    1.0   0.1    1.0   30.0    2  1.0  1  0.0 50.0    1.0
 0  23  1  0    1.0   0.0    0.0    0.0    0  1.0  0  0.0  9.7    1.0
*
*
*FILL TABLE DATA CARDS:6"AUX.STM LINE CRACK NODE 23 WITH HT.SINKS
*
*
   4  2
   0.0           1.613    1930.52
 900.0           1.613    1930.52
     900.000001      0.0       0.0
    1850.0           0.0       0.0
*
*
*FAN TABLE DATA CARDS
*
*
  2  3
    40300.0        0.0
    40300.0     3000.0
*
*
*PASSIVE HEAT SINK DATA CARDS
*
*
SINK1,NODE4
12  1  0  0.0  7073.1  4  0
12  1.0
1
F
1  1  1  .08 0 0 0 1.0
SINK2,NODE5
12  1  0  0.0  1768.0  5  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK3,NODE6
12  1  0  0.0  5635.9  6  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK4,NODE7
12  1  0  0.0  1768.0  7  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

19-E-1

PE-050
J.O.12846.44
P58

UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

SINK5,NODE8
12  1  0  0.0  7073.1  8  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK6,NODE9
12  1  0  0.0  2273.5 9  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK7,NODE10
12  1  0  0.0  5167.5 10  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK8,NODE11
12  1  0  0.0  2273.5  11  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK9,NODE21
12  1  0  0.0  4974.0 21  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK10,NODE22
12  1  0  0.0 3335.0 22  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK11,NODE12
 9  1  0  0.0 562.5  12  0
 9  0.75
1
F
1  1  1  .08 0 0  0 1.0
SINK12,NODE13
 9  1  0  0.0 660.25 13  0
 9  0.75
1
F
1  1  1  .08 0 0  0 1.0
SINK13,NODE16
 6  1  0  0.0 1275.0 16  0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

1-E-62

PZ-050

PSG
5.0.12846.44

UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678890

 6  0.5
1
F
1  1  1  .08 0 0  0 1.0
SINK14,NODE17
 6  1  0  0.0 1717.875 17 0
 6  0.5
1
F
1  1  1  .08 0 0  0 1.0
SINK15,NODE18
12  1  0  0.0 3008.0 18  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK16,NODE19
 6  1  0  0.0 1717.875 19 0
 6  0.5
1
F
1  1  1  .08 0  0  0 1.0
SINK17,NODE20
 6  1  0  0.0 1275.0 20  0
 6  0.5
1
F
1  1  1  .08 0  0  0 1.0
*
*
*DATA COMMON TO HEAT SINKS
*
*
120.0  T
0.79  24.93  'CONCRETE'/
END OF HEAT SLAB DATA

1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678890  <EOF>  COPIED TO UNIT 5
                                                                                                   W/O CMTS
```

RUN SUMMARY SHEET

MISCELLANEOUS PROBLEM CONTROL DATA:

OUTPUT FLAG.................	1
NUMBER OF TIME STEP CARDS...	11
NUMBER OF TRIP CONTROLS.....	3
NUMBER OF VOLUMES...........	40
NUMBER OF JUNCTIONS.........	66
NUMBER OF FILL TABLES.......	1
NUMBER OF FAN TABLES........	1
NUMBER OF HT SOURCE CURVES..	0
IMPLICIT/EXPLICIT COEFF.....	1.000

TOTAL TIME OF RUN..........................	1801.000 SEC
NUMBER OF STANDARD TIME STEPS..............	5002
NUMBER OF ACTUAL TIME STEPS................	5013
NUMBER OF TIMES GAUSSIAN ELIMINATION USED..	2358
NUMBER OF TIMES GAUSS-SEIDEL USED..........	2655
NUMBER OF TRANSIENTS STORED FOR PLOTEMUP...	146
NUMBER OF SELECTED NODAL DIFF. PRESS.......	0
NUMBER OF HEAT SINKS.......................	17
NUMBER OF INTERNAL JUNCTIONS...............	65

STEAM TABLES USED (FT15) VOLUME SERIAL NO. = SHARE0 DATA SET NAME = HEATBAL.ME190.STH20G.OUTPUT1

OUTPUT: TRANSIENTS TAPE (FT08) = 016308 FILE NUMBER = 23 DATA SET NAME = FE.GUARDS.PLOTTER
TRANSMITTAL FILE (FT09) WAS NOT USED

PEAK PRESSURE DIFFERENTIAL

JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC
1	1 TO 6	0.01	0.489
2	2 TO 3	0.00	0.236
3	4 TO 5	-0.01	0.394
4	5 TO 6	-0.01	0.396
5	7 TO 6	-0.01	0.396
6	8 TO 7	-0.01	0.394
7	1 TO 12	0.01	0.392
8	1 TO 12	0.01	0.392
9	7 TO 11	0.01	0.394
10	8 TO 11	0.00	0.590
11	4 TO 9	0.00	0.590
12	5 TO 9	0.01	0.394
13	10 TO 12	-0.01	0.400
14	9 TO 10	-0.01	0.446
15	11 TO 10	-0.01	0.446
16	9 TO 17	0.01	0.593
17	12 TO 13	-0.01	0.000
18	11 TO 19	0.01	0.593
19	3 TO 15	-0.01	0.234
20	2 TO 14	-0.01	0.000
21	17 TO 18	0.02	0.744
22	18 TO 19	-0.02	0.744
23	19 TO 20	0.01	0.271
24	14 TO 16	-0.01	0.249
25	15 TO 16	-0.01	0.251
26	16 TO 21	-0.02	0.268
27	17 TO 23	-0.01	0.596
28	19 TO 23	-0.01	0.596
29	20 TO 21	-0.02	0.268
30	18 TO 13	-0.01	0.321
31	16 TO 17	-0.01	0.271
32	21 TO 22	0.01	0.443
33	22 TO 24	-0.01	0.023

JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC
34	25 TO 23	0.00	0.546
35	25 TO 23	0.00	0.546
36	23 TO 26	-0.01	0.000
37	24 TO 25	-0.01	0.080
38	24 TO 26	-0.01	0.000
39	24 TO 26	-0.01	0.000
40	6 TO 22	-0.01	0.000
41	6 TO 27	0.01	0.394
42	4 TO 28	-0.02	0.408
43	8 TO 29	-0.02	0.408
44	26 TO 30	-0.01	0.098
45	26 TO 30	-0.01	0.098
46	2 TO 31	-0.00	0.501
47	31 TO 32	-0.01	0.000
48	32 TO 16	-0.01	0.248
49	33 TO 34	0.00	0.236
50	34 TO 37	-0.01	0.234
51	33 TO 36	-0.01	0.000
52	36 TO 20	-0.01	0.249
53	37 TO 20	-0.01	0.251
54	33 TO 35	-0.00	0.501
55	35 TO 38	-0.01	0.000
56	38 TO 20	-0.01	0.248
57	1 TO 39	0.10	0.227
58	2 TO 39	0.09	0.225
59	3 TO 39	0.09	0.225
60	31 TO 39	0.09	0.225
61	21 TO 39	0.09	0.227
62	33 TO 39	0.09	0.225
63	34 TO 39	0.09	0.225
64	35 TO 39	0.09	0.225
65	39 TO 40	-0.39	0.227

PE-050

P61
5.0.12846.4#

1-E-65

PEAK PRESSURES AND TEMPERATURES

NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)	NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)
1	14.73	0.584	122.55	1053.000	21	14.72	0.724	123.08	970.000
2	14.73	0.691	130.16	951.000	22	14.72	0.393	123.65	934.500
3	14.73	0.691	130.16	950.500	23	14.71	0.283	151.14	902.000
4	14.73	0.541	120.81	1190.000	24	14.71	0.395	123.92	912.800
5	14.73	0.576	122.11	1034.000	25	14.71	0.264	123.65	967.000
6	14.73	0.578	122.65	986.000	26	14.70	0.326	123.99	902.010
7	14.73	0.576	122.11	1034.000	27	14.71	4.550	120.12	4.550
8	14.73	0.541	120.81	1190.000	28	14.72	0.447	120.25	0.446
9	14.73	0.545	120.73	1125.000	29	14.72	0.446	120.25	0.446
10	14.73	0.206	120.68	974.500	30	14.70	1801.000	120.00	1801.000
11	14.73	0.545	120.75	1158.000	31	14.73	0.691	130.16	951.000
12	14.73	0.234	122.83	972.500	32	14.72	0.414	130.17	937.500
13	14.72	0.490	124.32	964.000	33	14.73	0.691	131.15	953.000
14	14.72	0.691	130.17	937.500	34	14.73	0.691	131.15	953.000
15	14.73	0.413	130.17	937.000	35	14.73	0.691	131.15	953.000
16	14.72	0.429	130.21	921.900	36	14.72	0.691	131.17	939.500
17	14.73	0.646	135.52	902.000	37	14.73	0.413	131.17	939.500
18	14.72	0.686	126.39	954.000	38	14.72	0.414	131.17	939.500
19	14.73	0.646	137.21	902.000	39	14.76	0.274	130.25	955.500
20	14.72	0.429	131.22	925.300	40	15.00	1801.000	120.00	1801.000

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```
UNIT 55 (SEQ  1) INPUT ECHO        1         2         3         4         5         6         7         8
                          12345678901234567890123456789012345678901234567890123456789012345678901234567890

SURRY 1&2:AUX BLDG,SGBD LINE BREAK NODE 4 WITH HT. SINKS
*
*
*PROBLEM DIMENSION CARD
*
*
1 10 3 40 66 1 1 0 0 17
*
*
*IMPLICIT/EXPLICIT COEFICIENT CARD
*
*
1.0
*
*
*TIME STEP CONTROL DATA CARDS
*
*
 50  10  0  0  0.001 0.00001    2.2
  2  10  0  0  0.01  0.0001     3.0
  5  14  0  0  0.05  0.0001    10.0
  5  15  0  0  0.1   0.0001    31.9
  5  11  0  0  0.01  0.0001    33.0
  5   5  0  0  0.02  0.0001    34.0
  5  12  0  0  0.05  0.0001    40.0
  5  10  0  0  0.1   0.0001    50.0
  2  15  0  0  0.5   0.001     80.0
 10  20  0  0  1.0   0.001    950.0
*
*
*TRIP CONTROL DATA CARDS
*
*
1  0  0  900.0    0.0
1  0  0    0.0    2.0
1  0  0    0.0    0.2
*
*
*NODAL DATA CARDS
*
*
14.70  120. 1.0   1137.7    2.00   9.50  0.0  0
14.70  120. 1.0   2011.2    2.00  10.00  0.0  0
14.70  120. 1.0   2011.2    2.00  10.00  0.0  0
14.70  120. 1.0  26611.5    2.00  12.00  0.0  0
14.70  120. 1.0   5150.7    2.00   9.50  0.0  0
14.70  120. 1.0  18697.8    2.00  10.10  0.0  0
14.70  120. 1.0   5150.7    2.00   9.50  0.0  0
14.70  120. 1.0  26611.5    2.00  12.00  0.0  0
14.70  120. 1.0   4050.0    2.00   9.00  0.0  0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

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```
UNIT 55 (SEQ  1) INPUT ECHO          1         2         3         4         5         6         7         8
                           12345678901234567890123456789012345678901234567890123456789012345678901234567890

     14.70  120. 1.0   5820.0    2.00   9.00  0.0  0
     14.70  120. 1.0   4050.0    2.00   9.00  0.0  0
     14.70  120. 1.0   1255.5    2.00   9.00  0.0  0
     14.70  120. 1.0   1400.2   13.00  12.50  0.0  0
     14.70  120. 1.0   2799.8   13.00  12.50  0.0  0
     14.70  120. 1.0   2696.6   13.00  12.50  0.0  0
     14.70  120. 1.0   5122.4   13.00  13.50  0.0  0
     14.70  120. 1.0   5678.    13.00  13.50  0.0  0
     14.70  120. 1.0   8035.2   13.00  13.50  0.0  0
     14.70  120. 1.0   5678.    13.00  13.50  0.0  0
     14.70  120. 1.0   5122.4   13.00  13.50  0.0  0
     14.70  120. 1.0  17220.2   13.00  12.50  0.0  0
     14.70  120. 1.0  17593.5   13.00  12.50  0.0  0
     14.70  120. 1.0  47234.0   27.5   17.0   0.0  0
     14.70  120. 1.0  31900.5   27.5   17.0   0.0  0
     14.70  120. 1.0  29622.1   27.5   17.0   0.0  0
     14.70  120. 1.0 149291.1   45.83  18.5   0.0  0
     14.70  120. 1.0 893025.0    9.0   49.0   0.0  0
     14.70  120. 1.0  13235.    11.5   15.15  0.0  0
     14.70  120. 1.0  13235.    11.5   15.15  0.0  0
     14.70  120. 1.0   1.0E20   27.5   50.0   0.0  0
     14.70  120. 1.0   2011.2    2.0   10.0   0.0  0
     14.70  120. 1.0   2799.8   13.0   12.5   0.0  0
     14.70  120. 1.0   2011.2    2.0   10.0   0.0  0
     14.70  120. 1.0   2011.2    2.0   10.0   0.0  0
     14.70  120. 1.0   2011.2    2.0   10.0   0.0  0
     14.70  120. 1.0   2799.8   13.0   12.5   0.0  0
     14.70  120. 1.0   2696.6   13.0   12.5   0.0  0
     14.70  120. 1.0   2799.6   13.0   12.5   0.0  0
     14.70  120. 1.0   2000.0    2.0   70.0   0.0  0
     15.0   120. 1.0    1.0E20  27.5   50.0   0.0  0
     *
     *
     *JUNCTION DATA CARDS
     *
     *
      1  6  0  0   32.5    .2888 2.219  1.476  2  1.0  0  0.0  7.58   1.0
      2  3  0  0    1.75   .894  1.61   1.61   2  1.0  0  0.0  9.2    1.0
      4  5  0  0  246.7    .062  1.062   .216  2  1.0  0  0.0  6.5    1.0
      5  6  0  0   78.6    .127  1.844  1.672  2  1.0  0  0.0  6.63   1.0
      7  6  0  0   78.6    .127  1.844  1.672  2  1.0  0  0.0  6.63   1.0
      8  7  0  0  246.7    .062  1.062  0.216  2  1.0  0  0.0  6.5    1.0
      1 12  0  0    3.75   .473  1.61   1.61   2  1.0  0  0.0  9.75   1.0
      1 12  0  0    1.13   .940  1.549  1.549  2  1.0  0  0.0  2.75   1.0
      7 11  0  0   20.25   .401  1.716  1.272  2  1.0  0  0.0  4.75   1.0
      8 11  0  0   56.7    .062  1.047  1.094  2  1.0  0  0.0  6.5    1.0
      4  9  0  0   56.7    .062  1.047  1.094  2  1.0  0  0.0  6.5    1.0
      5  9  0  0   20.25   .401  1.716  1.272  2  1.0  0  0.0  4.75   1.0
     10 12  0  0   60.75   .149  1.491 -0.123  2  1.0  0  0.0  4.75   1.0
      9 10  0  0   90.     .434  1.004 -0.45   2  1.0  0  0.0  4.5    1.0

     12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

UNIT 55 (SEQ 1) INPUT ECHO   1   2   3   4   5   6   7   8
1234567890123456789012345678901234567890123456789012345678901234567890123456789O

101	11	10	0	0	90.	.434	1.004	-0.45	2	1.0	0	0.0	4.5	1.0	101
102	9	17	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	4.5	1.0	102
103	12	13	0	0	84.0	.102	.558	0.012	2	1.0	0	0.0	11.00	1.0	103
104	11	19	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	11.00	1.0	104
105	3	15	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.50	1.0	105
106	2	14	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.50	1.0	106
107	17	18	0	0	135.	.288	1.007	-0.451	2	1.0	0	0.0	19.75	1.0	107
108	18	19	0	0	135.	.288	-0.451	1.007	2	1.0	0	0.0	19.75	1.0	108
109	19	20	0	0	162.	.142	.696	-0.369	2	1.0	0	0.0	19.75	1.0	109
110	14	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	110
111	15	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	111
112	16	21	0	0	162.	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	112
113	17	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	113
114	19	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	114
115	20	21	0	0	162.0	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	115
116	18	13	0	0	21.	.329	2.250	2.497	2	1.0	0	0.0	19.25	1.0	116
117	16	17	0	0	162.	.142	-0.369	.696	2	1.0	0	0.0	19.75	1.0	117
118	21	22	0	0	496.5	.029	.831	-.418	2	1.0	0	0.0	19.25	1.0	118
119	22	24	0	0	66.5	.032	2.552	2.552	2	1.0	0	0.0	26.5	1.0	119
120	25	23	0	0	195.	.112	1.197	1.180	2	1.0	0	0.0	35.0	1.0	120
121	25	23	0	0	155.	.17	1.225	1.189	2	1.0	0	0.0	35.0	1.0	121
122	23	26	0	0	60.	.040	2.553	2.607	2	1.0	0	0.0	44.25	1.0	122
123	24	25	0	0	983.6	.030	.284	-0.131	2	1.0	0	0.0	35.0	1.0	123
124	24	26	0	0	63.	.035	2.673	2.672	2	1.0	0	0.0	44.25	1.0	124
125	24	26	0	0	83.2	.022	1.636	1.634	2	1.0	0	0.0	44.25	1.0	125
126	6	22	0	0	792.	.01	1.253	1.130	2	1.0	0	0.0	12.	1.0	126
127	6	27	0	0	27.1	2.83	3.05	3.05	2	1.0	0	0.0	5.0	1.0	127
128	4	28	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	128
129	8	29	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	129
130	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	130
131	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	131
132	2	31	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	132
133	31	32	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	133
134	32	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	134
135	33	34	0	0	1.75	.894	1.61	1.61	2	1.0	0	0.0	9.2	1.0	135
136	34	37	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.5	1.0	136
137	33	36	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.5	1.0	137
138	36	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	138
139	37	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	139
140	33	35	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	140
141	35	38	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	141
142	38	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	142
143	1	39	0	0	1.0	10.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	143
144	2	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	144
145	3	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	145
146	31	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	146
147	21	39	0	0	3.25	10.0	1.0	30.0	2	1.0	0	0.0	15.0	1.0	147
148	33	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	148
149	34	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	149
150	35	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	150

12345678901234567890123456789012345678901234567890123456789012345678901234567890

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```
UNIT 55 (SEQ  1) INPUT ECHO        1          2          3          4          5          6          7          8
                          12345678901234567890123456789012345678901234567890123456789012345678901234567890

                          39  40  0  0    1.0    0.1    1.0   30.0    2  1.0  1  0.0 50.0    1.0
                           0   4  1  0    1.0    0.0    0.0    0.0    0  1.0  0  0.0  9.7    1.0
                          *
                          *
                          *FILL TABLE DATA CARDS:SGBDLINE BREAK NODE 4 WITH HT.SINKS
                          *
                          *
                             8  2
                              0.0          656.2  333350.0
                              0.18         656.2  333350.0
                              0.180001     328.1  166675.0
                              0.27         328.1  166675.0
                              0.270001     189.6   96317.0
                             30.0          189.6   96317.0
                                30.000001     0.0       0.0
                               950.0          0.0       0.0
                          *
                          *
                          *FAN TABLE DATA CARDS
                          *
                          *
                            2  3
                              40300.0      0.0
                              40300.0   3000.0
                          *
                          *
                          *PASSIVE HEAT SINK DATA CARDS
                          *
                          *
                          SINK1,NODE4
                          12  1  0  0.0  7073.1  4  0
                          12  1.0
                          1
                          T
                          1  1  1  .08 0 0 0 1.0
                          SINK2,NODE5
                          12  1  0  0.0  1768.0  5  0
                          12  1.0
                          1
                          T
                          1  1  1  .08 0 0  0 1.0
                          SINK3,NODE6
                          12  1  0  0.0  5635.9  6  0
                          12  1.0
                          1
                          T
                          1  1  1  .08 0 0  0 1.0
                          SINK4,NODE7
                          12  1  0  0.0  1768.0  7  0
                          12  1.0

                          12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

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UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
1
T
1  1  1  .08 0 0  0 1.0
SINK5,NODE8
12  1  0  0.0  7073.1  8  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK6,NODE9
12  1  0  0.0  2273.5 9  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK7,NODE10
12  1  0  0.0  5167.5 10  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK8,NODE11
12  1  0  0.0  2273.5  11  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK9,NODE21
12  1  0  0.0  4974.0 21  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK10,NODE22
12  1  0  0.0 3335.0 22  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK11,NODE12
 9  1  0  0.0 562.5  12  0
 9  0.75
1
 T
1  1  1  .08 0 0  0 1.0
SINK12,NODE13
 9  1  0  0.0 660.25 13  0
 9  0.75
1
T

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

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UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890

1  1  1  .08 0 0  0 1.0
SINK13,NODE16
 6  1  0  0.0 1275.0 16  0
 6  0.5
1
T
1  1  1  .08 0 0  0 1.0
SINK14,NODE17
 6  1  0  0.0 1717.875 17 0
 6  0.5
1
T
1  1  1  .08 0 0  0 1.0
SINK15,NODE18
12  1  0  0.0 3008.0 18  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK16,NODE19
 6  1  0  0.0 1717.875 19 0
 6  0.5
1
T
1  1  1  .08 0  0  0 1.0
SINK17,NODE20
 6  1  0  0.0 1275.0 20  0
 6  0.5
1
T
1  1  1  .08 0  0  0 1.0
*
*
*DATA COMMON TO HEAT SINKS
*
*
120.0  T
0.79  24.93  'CONCRETE'/
END OF HEAT SLAB DATA

1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890  <EOF>  COPIED TO UNIT 5
                                                                                                                  W/O CMTS
```

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J.O. 17846.44

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R U N   S U M M A R Y   S H E E T

MISCELLANEOUS PROBLEM CONTROL DATA:

OUTPUT FLAG.................	1
NUMBER OF TIME STEP CARDS...	10
NUMBER OF TRIP CONTROLS.....	3
NUMBER OF VOLUMES...........	40
NUMBER OF JUNCTIONS.........	66
NUMBER OF FILL TABLES.......	1
NUMBER OF FAN TABLES........	1
NUMBER OF HT SOURCE CURVES..	0
IMPLICIT/EXPLICIT COEFF.....	1.000

TOTAL TIME OF RUN..........................	901.000 SEC
NUMBER OF STANDARD TIME STEPS..............	3900
NUMBER OF ACTUAL TIME STEPS................	3910
NUMBER OF TIMES GAUSSIAN ELIMINATION USED..	1287
NUMBER OF TIMES GAUSS-SEIDEL USED..........	2623
NUMBER OF TRANSIENTS STORED FOR PLOTEMUP...	146
NUMBER OF SELECTED NODAL DIFF. PRESS.......	0
NUMBER OF HEAT SINKS.......................	17
NUMBER OF INTERNAL JUNCTIONS...............	65

STEAM TABLES USED (FT15) VOLUME SERIAL NO. = SHARE0   DATA SET NAME = HEATBAL.ME190.STH20G.OUTPUT1

OUTPUT: TRANSIENTS TAPE (FT08) = 016308   FILE NUMBER = 24   DATA SET NAME = FE.GUARDS.PLOTTER
TRANSMITTAL FILE (FT09) WAS NOT USED

PEAK PRESSURE DIFFERENTIAL

JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC
1	1 TO 6	0.03	2.110
2	2 TO 3	0.00	0.236
3	4 TO 5	0.07	2.083
4	5 TO 6	0.16	2.059
5	7 TO 6	0.04	2.250
6	8 TO 7	0.02	2.210
7	1 TO 12	-0.04	2.148
8	1 TO 12	-0.04	2.148
9	7 TO 11	-0.01	2.210
10	8 TO 11	-0.01	2.143
11	4 TO 9	0.07	2.083
12	5 TO 9	0.03	2.220
13	10 TO 12	0.02	2.073
14	9 TO 10	0.15	2.053
15	11 TO 10	-0.09	2.118
16	9 TO 17	0.16	2.113
17	12 TO 13	0.01	2.080
18	11 TO 19	0.02	2.220
19	3 TO 15	-0.01	0.234
20	2 TO 14	-0.01	0.000
21	17 TO 18	0.04	2.073
22	18 TO 19	0.03	2.121
23	19 TO 20	-0.02	2.210
24	14 TO 16	-0.01	2.086
25	15 TO 16	-0.01	2.085
26	16 TO 21	-0.02	0.268
27	17 TO 23	0.05	2.080
28	19 TO 23	0.06	2.240
29	20 TO 21	-0.03	2.108
30	18 TO 13	-0.05	2.110
31	16 TO 17	-0.04	2.072
32	21 TO 22	0.01	2.210
33	22 TO 24	0.05	2.230
34	25 TO 23	-0.01	2.210
35	25 TO 23	-0.01	2.210
36	23 TO 26	0.02	2.230
37	24 TO 25	0.01	2.096
38	24 TO 26	0.01	2.104
39	24 TO 26	0.01	2.104
40	6 TO 22	0.01	2.067
41	6 TO 27	0.08	2.250
42	4 TO 28	0.21	2.083
43	8 TO 29	0.11	2.230
44	26 TO 30	0.04	2.350
45	26 TO 30	0.04	2.350
46	2 TO 31	-0.00	0.501
47	31 TO 32	-0.01	0.000
48	32 TO 16	-0.01	2.086
49	33 TO 34	0.00	0.236
50	34 TO 37	-0.01	0.234
51	33 TO 36	-0.01	0.000
52	36 TO 20	-0.01	2.120
53	37 TO 20	-0.01	2.119
54	33 TO 35	-0.00	0.501
55	35 TO 38	-0.01	0.000
56	38 TO 20	-0.01	2.119
57	1 TO 39	0.10	0.227
58	2 TO 39	0.09	0.225
59	3 TO 39	0.09	0.225
60	31 TO 39	0.09	0.225
61	21 TO 39	0.09	0.227
62	33 TO 39	0.09	0.225
63	34 TO 39	0.09	0.225
64	35 TO 39	0.09	0.225
65	39 TO 40	-0.39	0.227

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1-E-73

PEAK PRESSURES AND TEMPERATURES

NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)	NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)
1	14.80	2.116	139.70	102.000	21	14.81	2.240	129.16	52.000
2	14.82	2.230	131.81	119.000	22	14.80	2.250	140.95	32.080
3	14.83	2.230	131.90	117.000	23	14.76	2.310	121.62	32.080
4	14.95	2.088	202.72	32.000	24	14.76	2.310	122.03	32.060
5	14.92	2.119	196.08	32.010	25	14.76	2.290	120.64	2.290
6	14.80	2.240	159.92	32.050	26	14.74	2.340	120.47	2.340
7	14.84	2.240	137.63	65.500	27	14.73	4.650	120.31	4.650
8	14.85	2.240	131.33	187.000	28	14.82	2.270	120.69	901.000
9	14.92	2.110	194.13	32.010	29	14.81	2.410	121.19	2.410
10	14.85	2.136	176.13	32.060	30	14.70	901.000	120.00	901.000
11	14.84	2.240	161.40	36.100	31	14.82	2.230	131.81	119.000
12	14.84	2.138	155.53	32.060	32	14.82	2.230	132.37	95.000
13	14.83	2.161	136.92	32.080	33	14.85	2.230	125.22	124.000
14	14.82	2.230	132.37	96.000	34	14.85	2.230	125.26	123.000
15	14.82	2.230	132.48	94.000	35	14.85	2.230	125.22	124.000
16	14.81	2.210	134.68	64.000	36	14.84	2.230	125.54	101.000
17	14.79	2.182	151.82	32.040	37	14.84	2.230	125.59	100.000
18	14.81	2.170	129.56	276.000	38	14.84	2.230	125.54	101.000
19	14.82	2.240	129.68	32.330	39	14.83	2.230	129.00	122.000
20	14.83	2.230	126.40	69.000	40	15.00	901.000	120.00	901.000

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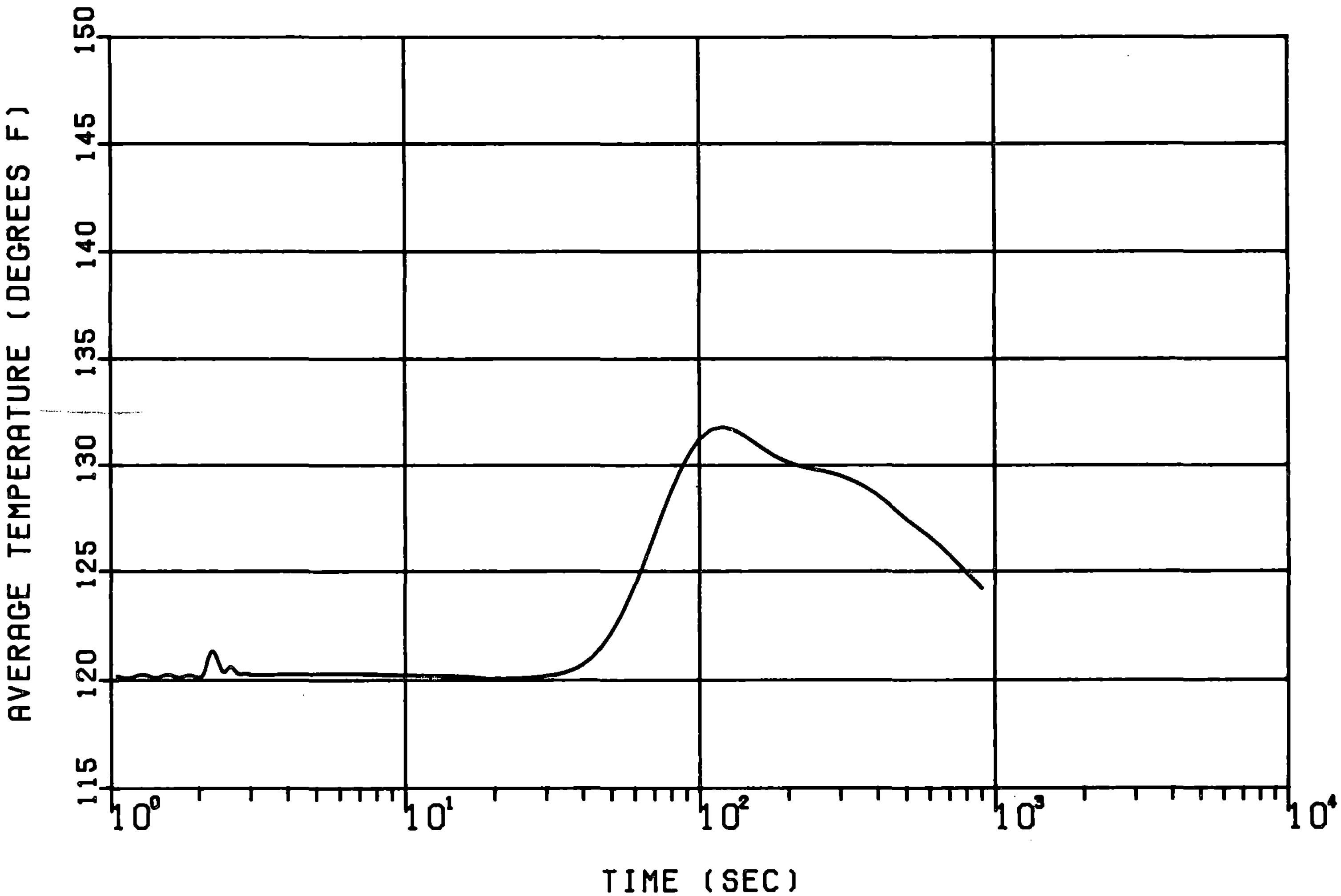

SURRY UNIT 1&2 AUX.BUILDING HELB
AVERAGE TEMPERATURE VERSUS TIME
NODE 2 SGBDLINE BREAK WITH HT.SINKS
RUN = 3600128

PE-050

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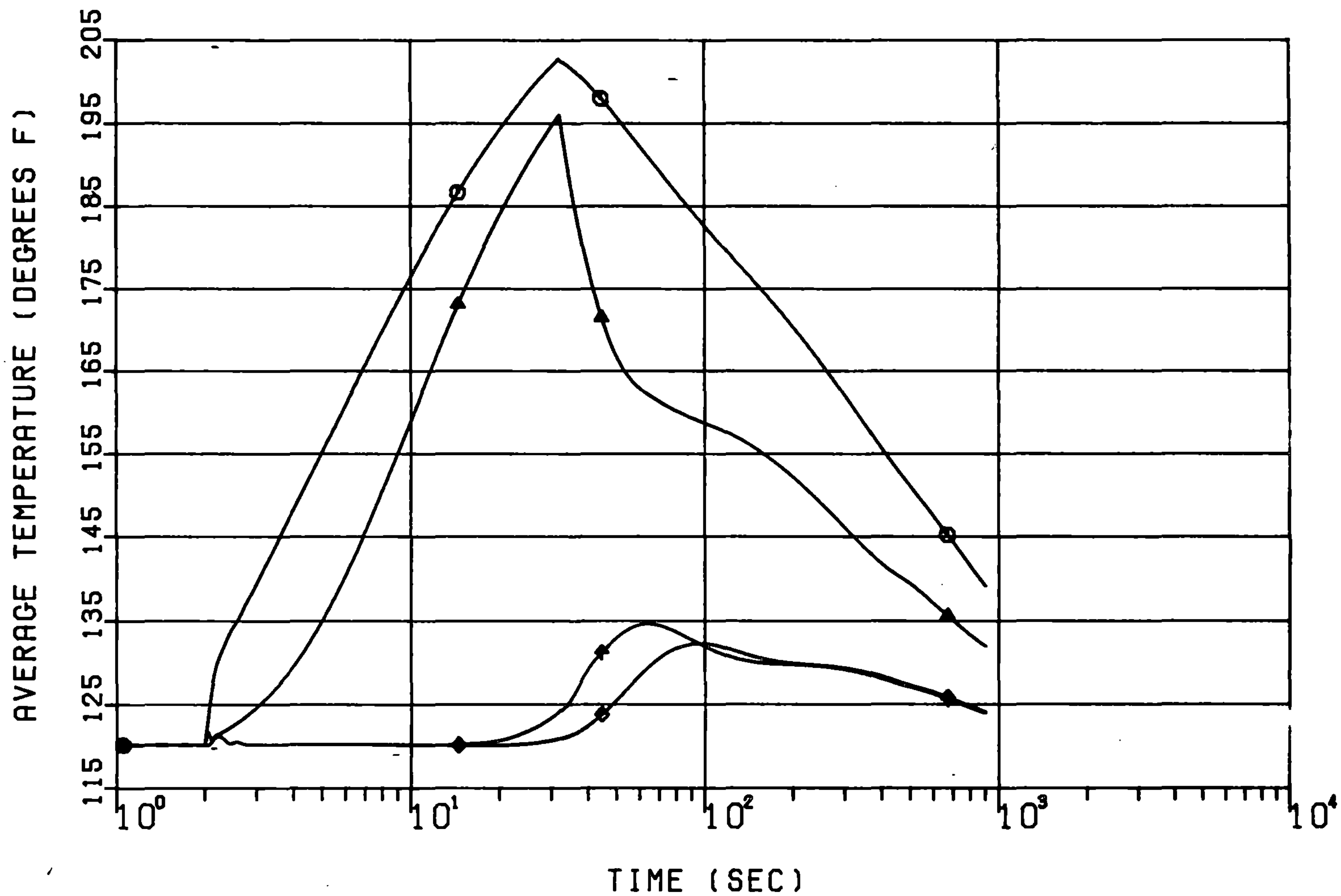

SURRY UNIT 1&2 AUX.BUILDING HELB
AVERAGE TEMPERATURE VERSUS TIME
SGBD LINE BREAK NODE 4 WITH HT.SINKS
PLOT OF RUN # 3800128

PE-050

JO.17846.44

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UNIT 55 (SEQ  1) INPUT ECHO         1         2         3         4         5         6         7         8
                           12345678901234567890123456789012345678901234567890123456789012345678901234567890

SURRY 1&2:SGBDLINE BREAK NODE4,COMPARITIVE: WITH HT. SINKS
*
*
*PROBLEM DIMENSION CARD
*
*
1 10 3 40 68 1 1 0 0 17
*
*
*IMPLICIT/EXPLICIT COEFICIENT CARD
*
*
1.0
*
*
*TIME STEP CONTROL DATA CARDS
*
*
 50  10  0  0  0.001 0.00001     2.2
  2  10  0  0  0.01  0.0001      3.0
  5  14  0  0  0.05  0.0001     10.0
  5  15  0  0  0.1   0.0001     31.9
  5  11  0  0  0.01  0.0001     33.0
  5   5  0  0  0.02  0.0001     34.0
  5  12  0  0  0.05  0.0001     40.0
  5  10  0  0  0.1   0.0001     50.0
  2  15  0  0  0.5   0.001      80.0
 10  20  0  0  1.0   0.001     950.0
*
*
*TRIP CONTROL DATA CARDS
*
*
1  0  0  900.0    0.0
1  0  0    0.0    2.0
1  0  0    0.0    0.2
*
*
*NODAL DATA CARDS
*
*
14.70  120. 1.0   1137.7    2.00   9.50  0.0  0
14.70  120. 1.0   2011.2    2.00  10.00  0.0  0
14.70  120. 1.0   2011.2    2.00  10.00  0.0  0
14.70  120. 1.0  26611.5    2.00  12.00  0.0  0
14.70  120. 1.0   5150.7    2.00   9.50  0.0  0
14.70  120. 1.0  18697.8    2.00  10.10  0.0  0
14.70  120. 1.0   5150.7    2.00   9.50  0.0  0
14.70  120. 1.0  26611.5    2.00  12.00  0.0  0
14.70  120. 1.0   4050.0    2.00   9.00  0.0  0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
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1-E-77


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UNIT 55 (SEQ  1) INPUT ECHO      1         2         3         4         5         6         7         8
                        12345678901234567890123456789012345678901234567890123456789012345678901234567890

                    51  14.70  120. 1.0    5820.0     2.00    9.00  0.0  0                                   51
                    52  14.70  120. 1.0    4050.0     2.00    9.00  0.0  0                                   52
                    53  14.70  120. 1.0    1255.5     2.00    9.00  0.0  0                                   53
                    54  14.70  120. 1.0    1400.2    13.00   12.50  0.0  0                                   54
                    55  14.70  120. 1.0    2799.8    13.00   12.50  0.0  0                                   55
                    56  14.70  120. 1.0    2696.6    13.00   12.50  0.0  0                                   56
                    57  14.70  120. 1.0    5122.4    13.00   13.50  0.0  0                                   57
                    58  14.70  120. 1.0    5678.     13.00   13.50  0.0  0                                   58
                    59  14.70  120. 1.0    8035.2    13.00   13.50  0.0  0                                   59
                    60  14.70  120. 1.0    5778.     13.00   13.50  0.0  0                                   60
                    61  14.70  120. 1.0    5122.4    13.00   13.50  0.0  0                                   61
                    62  14.70  120. 1.0   17220.2    13.00   12.50  0.0  0                                   62
                    63  14.70  120. 1.0   17593.5    13.00   12.50  0.0  0                                   63
                    64  14.70  120. 1.0   47234.0    27.5    17.0   0.0  0                                   64
                    65  14.70  120. 1.0   31900.5    27.5    17.0   0.0  0                                   65
                    66  14.70  120. 1.0   29622.1    27.5    17.0   0.0  0                                   66
                    67  14.70  120. 1.0  149291.1    45.83   18.5   0.0  0                                   67
                    68  14.70  120. 1.0  893025.0     9.0    49.0   0.0  0                                   68
                    69  14.70  120. 1.0   13235.     11.5    15.15  0.0  0                                   69
                    70  14.70  120. 1.0   13235.     11.5    15.15  0.0  0                                   70
                    71  14.70  120. 1.0    1.0E20    27.5    50.0   0.0  0                                   71
                    72  14.70  120. 1.0    2011.2     2.0    10.0   0.0  0                                   72
                    73  14.70  120. 1.0    2799.8    13.0    12.5   0.0  0                                   73
                    74  14.70  120. 1.0    2011.2     2.0    10.0   0.0  0                                   74
                    75  14.70  120. 1.0    2011.2     2.0    10.0   0.0  0                                   75
                    76  14.70  120. 1.0    2011.2     2.0    10.0   0.0  0                                   76
                    77  14.70  120. 1.0    2799.8    13.0    12.5   0.0  0                                   77
                    78  14.70  120. 1.0    2696.6    13.0    12.5   0.0  0                                   78
                    79  14.70  120. 1.0    2799.6    13.0    12.5   0.0  0                                   79
                    80  14.70  120. 1.0    2000.0     2.0    70.0   0.0  0                                   80
                    81  15.0   120. 1.0     1.0E20   27.5    50.0   0.0  0                                   81
                    82  *                                                                                    82
                    83  *                                                                                    83
                    84  *JUNCTION DATA CARDS                                                                 84
                    85  *                                                                                    85
                    86  *                                                                                    86
                    87   1   6   0   0   32.5    .2888 2.219   1.476  2  1.0  0  0.0  7.58    1.0           87
                    88   2   3   0   0    1.75    .894 1.61    1.61   2  1.0  0  0.0  9.2     1.0           88
                    89   4   5   0   0  246.7     .062 1.062    .216  2  1.0  0  0.0  6.5     1.0           89
                    90   5   6   0   0   78.6     .127 1.844   1.672  2  1.0  0  0.0  6.63    1.0           90
                    91   7   6   0   0   78.6     .127 1.844   1.672  2  1.0  0  0.0  6.63    1.0           91
                    92   8   7   0   0  246.7     .062 1.062   0.216  2  1.0  0  0.0  6.5     1.0           92
                    93   1  12   0   0    3.75    .473 1.61    1.61   2  1.0  0  0.0  9.75    1.0           93
                    94   1  12   0   0    1.13    .940 1.549   1.549  2  1.0  0  0.0  2.75    1.0           94
                    95   7  11   0   0   20.25    .401 1.716   1.272  2  1.0  0  0.0  4.75    1.0           95
                    96   8  11   0   0   56.7     .062 1.047   1.094  2  1.0  0  0.0  6.5     1.0           96
                    97   4   9   0   0   56.7     .062 1.047   1.094  2  1.0  0  0.0  6.5     1.0           97
                    98   5   9   0   0   20.25    .401 1.716   1.272  2  1.0  0  0.0  4.75    1.0           98
                    99  10  12   0   0   60.75    .149 1.491  -0.123  2  1.0  0  0.0  4.75    1.0           99
                   100   9  10   0   0   90.      .434 1.004  -0.45   2  1.0  0  0.0  4.5     1.0          100

                        12345678901234567890123456789012345678901234567890123456789012345678901234567890
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UNIT 55 (SEQ 1) INPUT ECHO

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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

101	11	10	0	0	90.	.434	1.004	-0.45	2	1.0	0	0.0	4.5	1.0	101
102	9	17	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	4.5	1.0	102
103	12	13	0	0	84.0	.102	.558	0.012	2	1.0	0	0.0	11.00	1.0	103
104	11	19	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	11.00	1.0	104
105	3	15	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.50	1.0	105
106	2	14	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.50	1.0	106
107	17	18	0	0	135.	.288	1.007	-0.451	2	1.0	0	0.0	19.75	1.0	107
108	18	19	0	0	135.	.288	-0.451	1.007	2	1.0	0	0.0	19.75	1.0	108
109	19	20	0	0	162.	.142	.696	-0.369	2	1.0	0	0.0	19.75	1.0	109
110	14	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	110
111	15	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	111
112	16	21	0	0	162.	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	112
113	17	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	113
114	19	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	114
115	20	21	0	0	162.0	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	115
116	18	13	0	0	21.	.329	2.250	2.497	2	1.0	0	0.0	19.25	1.0	116
117	16	17	0	0	162.	.142	-0.369	.696	2	1.0	0	0.0	19.75	1.0	117
118	21	22	0	0	496.5	.029	.831	-.418	2	1.0	0	0.0	19.25	1.0	118
119	22	24	0	0	66.5	.032	2.552	2.552	2	1.0	0	0.0	26.5	1.0	119
120	25	23	0	0	195.	.112	1.197	1.180	2	1.0	0	0.0	35.0	1.0	120
121	25	23	0	0	155.	.17	1.225	1.189	2	1.0	0	0.0	35.0	1.0	121
122	23	26	0	0	60.	.040	2.553	2.607	2	1.0	0	0.0	44.25	1.0	122
123	24	25	0	0	983.6	.030	.284	-0.131	2	1.0	0	0.0	35.0	1.0	123
124	24	26	0	0	63.	.035	2.673	2.672	2	1.0	0	0.0	44.25	1.0	124
125	24	26	0	0	83.2	.022	1.636	1.634	2	1.0	0	0.0	44.25	1.0	125
126	6	22	0	0	792.	.01	1.253	1.130	2	1.0	0	0.0	12.	1.0	126
127	6	27	0	0	27.1	2.83	3.05	3.05	2	1.0	0	0.0	5.0	1.0	127
128	4	28	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	128
129	8	29	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	129
130	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	130
131	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	131
132	2	31	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	132
133	31	32	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	133
134	32	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	134
135	33	34	0	0	1.75	.894	1.61	1.61	2	1.0	0	0.0	9.2	1.0	135
136	34	37	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.5	1.0	136
137	33	36	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.5	1.0	137
138	36	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	138
139	37	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	139
140	33	35	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	140
141	35	38	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	141
142	38	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	142
143	1	39	0	0	1.0	10.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	143
144	2	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	144
145	3	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	145
146	31	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	146
147	21	39	0	0	3.25	10.0	1.0	30.0	2	1.0	0	0.0	15.0	1.0	147
148	33	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	148
149	34	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	149
150	35	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	150

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12345678901234567890123456789012345678901234567890123456789012345678901234567890
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UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

39  40  0  0    1.0   0.1    1.0   30.0   2  1.0  1  0.0 50.0    1.0
 5   3  0  0    3.0   0.683  1.592  1.631  2  1.0  0  0.0 10.25   1.0
 7  34  0  0    3.0   0.683  1.592  1.631  2  1.0  0  0.0 10.25   1.0
 0   4  1  0    1.0   0.0    0.0    0.0    0  1.0  0  0.0  9.7    1.0
*
*
*FILL TABLE DATA CARDS:LETDOWN LINE BREAK NODE 5 WITH HT.SINKS
*
*
    8  2
     0.0            656.2  333350.0
     0.18           656.2  333350.0
     0.180001       328.1  166675.0
     0.27           328.1  166675.0
     0.270001       189.6   96317.0
    30.0            189.6   96317.0
    30.000001         0.0       0.0
   950.0              0.0       0.0
*
*
*FAN TABLE DATA CARDS
*
*
   2  3
     40300.0       0.0
     40300.0    3000.0
*
*
*PASSIVE HEAT SINK DATA CARDS
*
*
SINK1,NODE4
12  1  0  0.0  7073.1  4  0
12  1.0
1
F
1  1  1  .08 0 0 0 1.0
SINK2,NODE5
12  1  0  0.0  1768.0  5  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK3,NODE6
12  1  0  0.0  5635.9  6  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK4,NODE7

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

mislabled — numbers ok

UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

12  1  0  0.0  1768.0  7  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK5,NODE8
12  1  0  0.0  7073.1  8  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK6,NODE9
12  1  0  0.0  2273.5 9  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK7,NODE10
12  1  0  0.0  5167.5 10  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK8,NODE11
12  1  0  0.0  2273.5  11  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK9,NODE21
12  1  0  0.0  4974.0 21  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK10,NODE22
12  1  0  0.0 3335.0 22  0
12  1.0
1
F
1  1  1  .08 0 0  0 1.0
SINK11,NODE12
 9  1  0  0.0 562.5  12  0
 9  0.75
1
F
1  1  1  .08 0 0  0 1.0
SINK12,NODE13
 9  1  0  0.0 660.25 13  0
 9  0.75

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

```
UNIT 55 (SEQ  1) INPUT ECHO        1         2         3         4         5         6         7         8
                         12345678901234567890123456789012345678901234567890123456789012345678901234567890

                         1
                         F
                         1  1  1  .08 0 0   0 1.0
                         SINK13,NODE16
                          6  1  0  0.0 1275.0 16  0
                          6  0.5
                         1
                         F
                         1  1  1  .08 0 0   0 1.0
                         SINK14,NODE17
                          6  1  0  0.0 1717.875 17 0
                          6  0.5
                         1
                         F
                         1  1  1  .08 0 0   0 1.0
                         SINK15,NODE18
                         12  1  0  0.0 3008.0 18  0
                         12  1.0
                         1
                         F
                         1  1  1  .08 0 0   0 1.0
                         SINK16,NODE19
                          6  1  0  0.0 1717.875 19 0
                          6  0.5
                         1
                         F
                         1  1  1  .08 0   0   0 1.0
                         SINK17,NODE20
                          6  1  0  0.0 1275.0 20  0
                          6  0.5
                         1
                         F
                         1  1  1  .08 0   0   0 1.0
                         *
                         *
                         *DATA COMMON TO HEAT SINKS
                         *
                         *
                         120.0  F
                         0.79  24.93  'CONCRETE'/
                         END OF HEAT SLAB DATA

                         12345678901234567890123456789012345678901234567890123456789012345678901234567890  <EOF>  COPIED TO UNIT  5
                                                                                                                     W/O CMTS
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RUN SUMMARY SHEET

MISCELLANEOUS PROBLEM CONTROL DATA:

OUTPUT FLAG.................	1
NUMBER OF TIME STEP CARDS...	10
NUMBER OF TRIP CONTROLS.....	3
NUMBER OF VOLUMES...........	40
NUMBER OF JUNCTIONS.........	68
NUMBER OF FILL TABLES.......	1
NUMBER OF FAN TABLES........	1
NUMBER OF HT SOURCE CURVES..	0
IMPLICIT/EXPLICIT COEFF.....	1.000

TOTAL TIME OF RUN.........................	901.000 SEC
NUMBER OF STANDARD TIME STEPS..............	3900
NUMBER OF ACTUAL TIME STEPS................	3910
NUMBER OF TIMES GAUSSIAN ELIMINATION USED..	1296
NUMBER OF TIMES GAUSS-SEIDEL USED..........	2614
NUMBER OF TRANSIENTS STORED FOR PLOTEMUP...	148
NUMBER OF SELECTED NODAL DIFF. PRESS.......	0
NUMBER OF HEAT SINKS.......................	17
NUMBER OF INTERNAL JUNCTIONS...............	67

STEAM TABLES USED (FT15) VOLUME SERIAL NO. = SHARE0 DATA SET NAME = HEATBAL.ME190.STH2OG.OUTPUT1

OUTPUT: TRANSIENTS TAPE (FT08) = 016308 FILE NUMBER = 26 DATA SET NAME = FE.GUARDS.PLOTTER
TRANSMITTAL FILE (FT09) WAS NOT USED

PEAK PRESSURE DIFFERENTIAL

JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC	JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC
1	1 TO 6	0.03	2.109	35	25 TO 23	-0.01	2.210
2	2 TO 3	-0.02	2.068	36	23 TO 26	0.02	2.230
3	4 TO 5	0.07	2.080	37	24 TO 25	0.01	2.095
4	5 TO 6	0.15	2.058	38	24 TO 26	0.01	2.103
5	7 TO 6	0.04	2.250	39	24 TO 26	0.01	2.103
6	8 TO 7	0.01	2.210	40	6 TO 22	0.01	2.067
7	1 TO 12	-0.04	2.148	41	6 TO 27	0.08	2.250
8	1 TO 12	-0.04	2.148	42	4 TO 28	0.21	2.081
9	7 TO 11	-0.01	2.197	43	8 TO 29	0.11	2.230
10	8 TO 11	-0.01	2.145	44	26 TO 30	0.04	2.340
11	4 TO 9	0.07	2.083	45	26 TO 30	0.04	2.340
12	5 TO 9	0.03	2.220	46	2 TO 31	-0.01	2.156
13	10 TO 12	0.02	2.074	47	31 TO 32	-0.01	0.000
14	9 TO 10	0.15	2.053	48	32 TO 16	-0.02	2.085
15	11 TO 10	-0.09	2.117	49	33 TO 34	0.00	0.353
16	9 TO 17	0.15	2.112	50	34 TO 37	-0.01	0.232
17	12 TO 13	0.01	2.080	51	33 TO 36	-0.01	0.000
18	11 TO 19	0.02	2.270	52	36 TO 20	-0.01	2.119
19	3 TO 15	0.01	2.049	53	37 TO 20	0.01	2.240
20	2 TO 14	-0.01	0.000	54	33 TO 35	0.00	0.545
21	17 TO 18	0.04	2.074	55	35 TO 38	-0.01	0.000
22	18 TO 19	0.03	2.122	56	38 TO 20	-0.01	2.119
23	19 TO 20	-0.02	2.210	57	1 TO 39	0.10	0.227
24	14 TO 16	-0.02	2.084	58	2 TO 39	0.09	0.225
25	15 TO 16	0.01	2.067	59	3 TO 39	0.09	0.225
26	16 TO 21	-0.02	0.267	60	31 TO 39	0.09	0.225
27	17 TO 23	0.05	2.081	61	21 TO 39	0.09	0.227
28	19 TO 23	0.06	2.240	62	33 TO 39	0.09	0.225
29	20 TO 21	-0.03	2.107	63	34 TO 39	0.09	0.225
30	18 TO 13	-0.05	2.108	64	35 TO 39	0.09	0.225
31	16 TO 17	-0.03	2.070	65	39 TO 40	-0.39	0.227
32	21 TO 22	-0.01	2.073	66	5 TO 3	0.16	2.113
33	22 TO 24	0.05	2.230	67	7 TO 34	0.02	2.098

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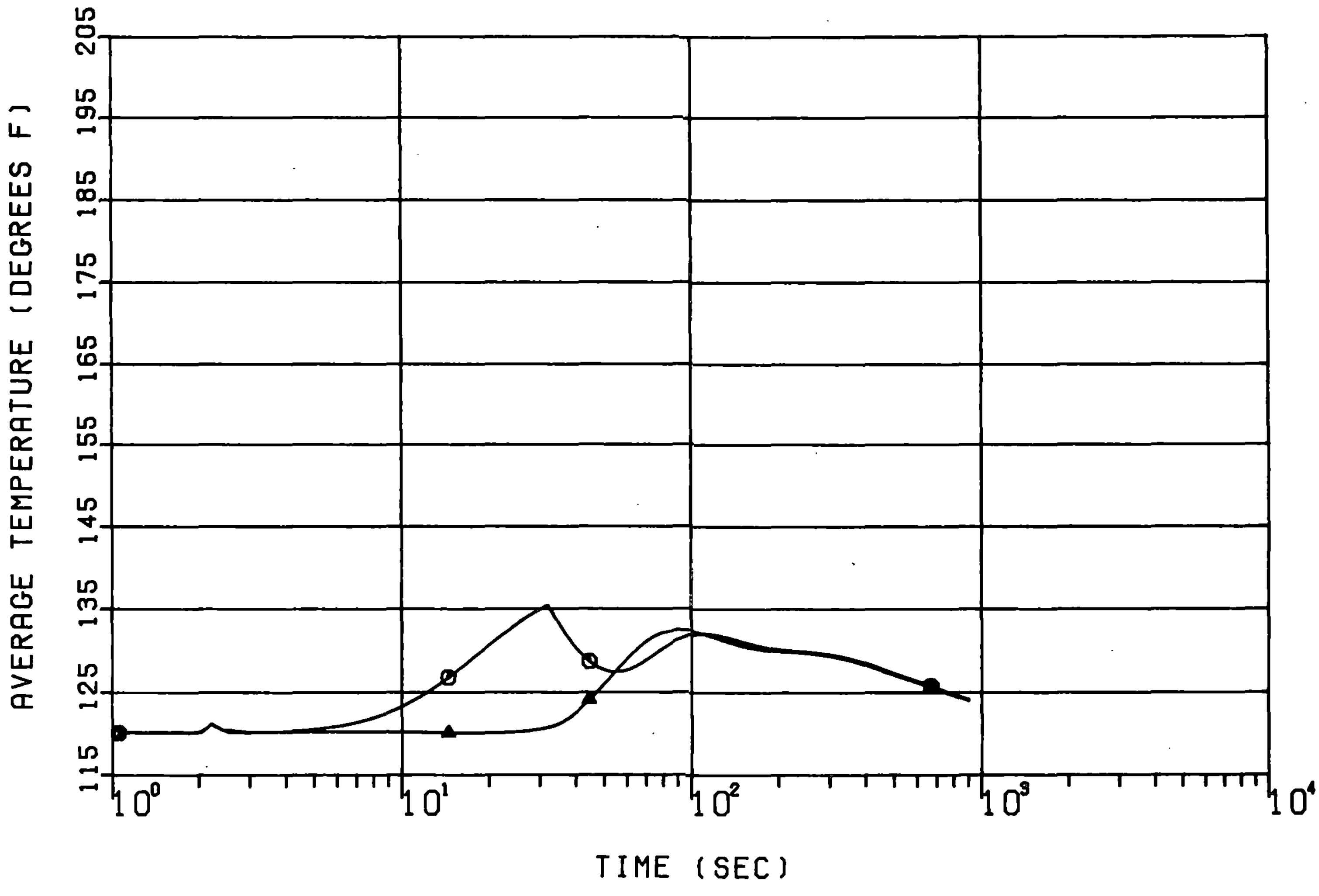
J.O. 12846.44

34	25 TO 23	-0.01	2.210

PEAK PRESSURES AND TEMPERATURES

NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)	NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)
1	14.80	2.117	139.60	103.000	21	14.81	2.230	128.73	53.000
2	14.82	2.230	131.65	120.000	22	14.80	2.240	140.43	32.080
3	14.81	2.210	135.48	32.020	23	14.76	2.310	121.58	32.080
4	14.95	2.087	202.72	32.000	24	14.76	2.300	121.99	32.060
5	14.92	2.116	196.13	32.010	25	14.76	2.290	120.64	2.290
6	14.80	2.240	159.80	32.060	26	14.74	2.330	120.47	2.330
7	14.84	2.240	137.57	70.500	27	14.73	4.650	120.31	4.650
8	14.85	2.240	131.53	180.000	28	14.81	2.270	120.68	901.000
9	14.91	2.110	194.06	32.010	29	14.81	2.410	121.18	2.410
10	14.85	2.136	175.91	32.060	30	14.70	901.000	120.00	901.000
11	14.85	2.240	161.18	36.300	31	14.82	2.240	131.65	120.000
12	14.84	2.138	154.79	32.060	32	14.81	2.240	132.19	96.000
13	14.83	2.162	136.25	32.080	33	14.85	2.220	125.00	127.000
14	14.81	2.230	132.18	96.000	34	14.85	2.230	126.35	118.000
15	14.81	2.210	132.57	91.000	35	14.85	2.220	124.98	127.000
16	14.80	2.210	134.50	64.000	36	14.84	2.220	125.27	103.000
17	14.79	2.181	151.42	32.040	37	14.84	2.230	125.23	104.000
18	14.81	2.170	128.70	273.000	38	14.84	2.220	125.28	103.000
19	14.82	2.230	129.18	32.330	39	14.82	2.230	129.02	121.000
20	14.83	2.230	126.09	71.500	40	15.00	901.000	120.00	901.000



SURRY UNIT 1&2 AUX.BUILDING HELB
AVERAGE TEMPERATURE VERSUS TIME
SGBD LINE CRACK NODE 4 COMPARITIVE
PLOT OF RUN # 3800130

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J.O. 12846.44
P82

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UNIT 55 (SEQ  1) INPUT ECHO         1         2         3         4         5         6         7         8
                           12345678901234567890123456789012345678901234567890123456789012345678901234567890

SURRY 1&2:SGBDLINE CRACK NODE4,COMPARITIVE: WITH HT. SINKS
*
*
*PROBLEM DIMENSION CARD
*
*
1 10 3 40 68 1 1 0 0 17
*
*
*IMPLICIT/EXPLICIT COEFICIENT CARD
*
*
1.0
*
*
*TIME STEP CONTROL DATA CARDS
*
*
 50  10   0   0  0.001 0.00001     2.2
  2  10   0   0  0.01  0.0001      3.0
  5  14   0   0  0.05  0.0001     10.0
  5  15   0   0  0.1   0.0001     31.9
  5  11   0   0  0.01  0.0001     33.0
  5   5   0   0  0.02  0.0001     34.0
  5  12   0   0  0.05  0.0001     40.0
  5  10   0   0  0.1   0.0001     50.0
  2  15   0   0  0.5   0.001      80.0
 10  20   0   0  1.0   0.001    1250.0
*
*
*TRIP CONTROL DATA CARDS
*
*
1  0  0 1200.0    0.0
1  0  0    0.0    2.0
1  0  0    0.0    0.2
*
*
*NODAL DATA CARDS
*
*
14.70  120. 1.0    1137.7    2.00    9.50  0.0  0
14.70  120. 1.0    2011.2    2.00   10.00  0.0  0
14.70  120. 1.0    2011.2    2.00   10.00  0.0  0
14.70  120. 1.0   26611.5    2.00   12.00  0.0  0
14.70  120. 1.0    5150.7    2.00    9.50  0.0  0
14.70  120. 1.0   18697.8    2.00   10.10  0.0  0
14.70  120. 1.0    5150.7    2.00    9.50  0.0  0
14.70  120. 1.0   26611.5    2.00   12.00  0.0  0
14.70  120. 1.0    4050.0    2.00    9.00  0.0  0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
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P 83
J.O. 12846.414

UNIT 55 (SEQ 1) INPUT ECHO

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         1         2         3         4         5         6         7         8
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890

14.70  120. 1.0    5820.0    2.00    9.00  0.0  0
14.70  120. 1.0    4050.0    2.00    9.00  0.0  0
14.70  120. 1.0    1255.5    2.00    9.00  0.0  0
14.70  120. 1.0    1400.2   13.00   12.50  0.0  0
14.70  120. 1.0    2799.8   13.00   12.50  0.0  0
14.70  120. 1.0    2696.6   13.00   12.50  0.0  0
14.70  120. 1.0    5122.4   13.00   13.50  0.0  0
14.70  120. 1.0    5678.    13.00   13.50  0.0  0
14.70  120. 1.0    8035.2   13.00   13.50  0.0  0
14.70  120. 1.0    5778.    13.00   13.50  0.0  0
14.70  120. 1.0    5122.4   13.00   13.50  0.0  0
14.70  120. 1.0   17220.2   13.00   12.50  0.0  0
14.70  120. 1.0   17593.5   13.00   12.50  0.0  0
14.70  120. 1.0   47234.0   27.5    17.0   0.0  0
14.70  120. 1.0   31900.5   27.5    17.0   0.0  0
14.70  120. 1.0   29622.1   27.5    17.0   0.0  0
14.70  120. 1.0 149291.1    45.83   18.5   0.0  0
14.70  120. 1.0 893025.0     9.0    49.0   0.0  0
14.70  120. 1.0   13235.    11.5    15.15  0.0  0
14.70  120. 1.0   13235.    11.5    15.15  0.0  0
14.70  120. 1.0    1.0E20   27.5    50.0   0.0  0
14.70  120. 1.0    2011.2    2.0    10.0   0.0  0
14.70  120. 1.0    2799.8   13.0    12.5   0.0  0
14.70  120. 1.0    2011.2    2.0    10.0   0.0  0
14.70  120. 1.0    2011.2    2.0    10.0   0.0  0
14.70  120. 1.0    2011.2    2.0    10.0   0.0  0
14.70  120. 1.0    2799.8   13.0    12.5   0.0  0
14.70  120. 1.0    2696.6   13.0    12.5   0.0  0
14.70  120. 1.0    2799.6   13.0    12.5   0.0  0
14.70  120. 1.0    2000.0    2.0    70.0   0.0  0
15.0   120. 1.0     1.0E20  27.5    50.0   0.0  0
*
*
*JUNCTION DATA CARDS
*
*
 1   6  0  0   32.5    .2888 2.219  1.476  2  1.0  0  0.0  7.58    1.0
 2   3  0  0    1.75   .894  1.61   1.61   2  1.0  0  0.0  9.2     1.0
 4   5  0  0  246.7    .062  1.062   .216  2  1.0  0  0.0  6.5     1.0
 5   6  0  0   78.6    .127  1.844  1.672  2  1.0  0  0.0  6.63    1.0
 7   6  0  0   78.6    .127  1.844  1.672  2  1.0  0  0.0  6.63    1.0
 8   7  0  0  246.7    .062  1.062  0.216  2  1.0  0  0.0  6.5     1.0
 1  12  0  0    3.75   .473  1.61   1.61   2  1.0  0  0.0  9.75    1.0
 1  12  0  0    1.13   .940  1.549  1.549  2  1.0  0  0.0  2.75    1.0
 7  11  0  0   20.25   .401  1.716  1.272  2  1.0  0  0.0  4.75    1.0
 8  11  0  0   56.7    .062  1.047  1.094  2  1.0  0  0.0  6.5     1.0
 4   9  0  0   56.7    .062  1.047  1.094  2  1.0  0  0.0  6.5     1.0
 5   9  0  0   20.25   .401  1.716  1.272  2  1.0  0  0.0  4.75    1.0
10  12  0  0   60.75   .149  1.491 -0.123  2  1.0  0  0.0  4.75    1.0
 9  10  0  0   90.     .434  1.094 -0.45   2  1.0  0  0.0  4.5     1.0

1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
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PS-050
J.O. 12846-14
P84

UNIT 55 (SEQ 1) INPUT ECHO

1234567890123456789012345678901234567890123456789012345678901234567890123456789O

101	11	10	0	0	90.	.434	1.004	-0.45	2	1.0	0	0.0	4.5	1.0	101
102	9	17	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	4.5	1.0	102
103	12	13	0	0	84.0	.102	.558	0.012	2	1.0	0	0.0	11.00	1.0	103
104	11	19	0	0	24.5	.337	2.088	2.048	2	1.0	0	0.0	11.00	1.0	104
105	3	15	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.50	1.0	105
106	2	14	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.50	1.0	106
107	17	18	0	0	135.	.288	1.007	-0.451	2	1.0	0	0.0	19.75	1.0	107
108	18	19	0	0	135.	.288	-0.451	1.007	2	1.0	0	0.0	19.75	1.0	108
109	19	20	0	0	162.	.142	.696	-0.369	2	1.0	0	0.0	19.75	1.0	109
110	14	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	110
111	15	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	111
112	16	21	0	0	162.	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	112
113	17	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	113
114	19	23	0	0	21.0	.328	1.893	1.886	2	1.0	0	0.0	18.43	1.0	114
115	20	21	0	0	162.0	.111	-0.197	1.456	2	1.0	0	0.0	19.75	1.0	115
116	18	13	0	0	21.	.329	2.250	2.497	2	1.0	0	0.0	19.25	1.0	116
117	16	17	0	0	162.	.142	-0.369	.696	2	1.0	0	0.0	19.75	1.0	117
118	21	22	0	0	496.5	.029	.831	-.418	2	1.0	0	0.0	19.25	1.0	118
119	22	24	0	0	66.5	.032	2.552	2.552	2	1.0	0	0.0	26.5	1.0	119
120	25	23	0	0	195.	.112	1.197	1.180	2	1.0	0	0.0	35.0	1.0	120
121	25	23	0	0	155.	.17	1.225	1.189	2	1.0	0	0.0	35.0	1.0	121
122	23	26	0	0	60.	.040	2.553	2.607	2	1.0	0	0.0	44.25	1.0	122
123	24	25	0	0	983.6	.030	.284	-0.131	2	1.0	0	0.0	35.0	1.0	123
124	24	26	0	0	63.	.035	2.673	2.672	2	1.0	0	0.0	44.25	1.0	124
125	24	26	0	0	83.2	.022	1.636	1.634	2	1.0	0	0.0	44.25	1.0	125
126	6	22	0	0	792.	.01	1.253	1.130	2	1.0	0	0.0	12.	1.0	126
127	6	27	0	0	27.1	2.83	3.05	3.05	2	1.0	0	0.0	5.0	1.0	127
128	4	28	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	128
129	8	29	0	0	5.69	1.723	2.809	2.822	2	1.0	0	0.0	19.08	1.0	129
130	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	130
131	26	30	0	0	42.24	.072	2.653	2.104	2	1.0	0	0.0	50.0	1.0	131
132	2	31	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	132
133	31	32	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	133
134	32	16	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	134
135	33	34	0	0	1.75	.894	1.61	1.61	2	1.0	0	0.0	9.2	1.0	135
136	34	37	0	0	211.1	.077	.264	.264	2	1.0	0	0.0	12.5	1.0	136
137	33	36	0	0	208.7	.060	.264	.264	2	1.0	0	0.0	12.5	1.0	137
138	36	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	138
139	37	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	139
140	33	35	0	0	1.31	1.182	1.66	1.66	2	1.0	0	0.0	9.2	1.0	140
141	35	38	0	0	208.7	.06	.264	.264	2	1.0	0	0.0	12.5	1.0	141
142	38	20	0	0	47.5	.164	1.027	1.718	2	1.0	0	0.0	19.25	1.0	142
143	1	39	0	0	1.0	10.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	143
144	2	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	144
145	3	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	145
146	31	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	146
147	21	39	0	0	3.25	10.0	1.0	30.0	2	1.0	0	0.0	15.0	1.0	147
148	33	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	148
149	34	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	149
150	35	39	0	0	16.25	1.0	1.0	30.0	2	1.0	0	0.0	9.0	1.0	150

12345678901234567890123456789012345678901234567890123456789012345678901234567890

UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
1234567890123456789012345678901234567890123456789012345678901234567890123456789 0
39  40  0   0     1.0     0.1     1.0    30.0     2  1.0  1  0.0 50.0      1.0
 5   3  0   0     3.0     0.683   1.592   1.631   2  1.0  0  0.0 10.25     1.0
 7  34  0   0     3.0     0.683   1.592   1.631   2  1.0  0  0.0 10.25     1.0
 0   4  1   0     1.0     0.0     0.0     0.0     0  1.0  0  0.0  9.7      1.0
*
*
*FILL TABLE DATA CARDS
*
*
   4  2
    0.0          10.71   5418.2
  900.0          10.71   5418.2
  900.000001      0.0       0.0
 1250.0           0.0       0.0
*
*
*FAN TABLE DATA CARDS
*
*
  2  3
    40300.0       0.0
    40300.0    3000.0
*
*
*PASSIVE HEAT SINK DATA CARDS
*
*
SINK1,NODE4
12  1  0  0.0  7073.1  4  0
12  1.0
1
T
1  1  1  .08 0 0 0 1.0
SINK2,NODE5
12  1  0  0.0  1768.0  5  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK3,NODE6
12  1  0  0.0  5635.9  6  0
12  1.0
1
T
1  1  1  .08 0 0  0 1.0
SINK4,NODE7
12  1  0  0.0  1768.0  7  0
12  1.0
1
T

1234567890123456789012345678901234567890123456789012345678901234567890123456789 0
```

```
UNIT 55 (SEQ  1) INPUT ECHO         1         2         3         4         5         6         7         8
                           12345678901234567890123456789012345678901234567890123456789012345678901234567890

     1  1  1  .08 0 0  0 1.0
     SINK5,NODE8
     12  1  0  0.0  7073.1  8  0
     12  1.0
     1
     T
     1  1  1  .08 0 0  0 1.0
     SINK6,NODE9
     12  1  0  0.0  2273.5 9  0
     12  1.0
     1
     T
     1  1  1  .08 0 0  0 1.0
     SINK7,NODE10
     12  1  0  0.0  5167.5 10  0
     12  1.0
     1
     T
     1  1  1  .08 0 0  0 1.0
     SINK8,NODE11
     12  1  0  0.0  2273.5  11  0
     12  1.0
     1
     T
     1  1  1  .08 0 0  0 1.0
     SINK9,NODE21
     12  1  0  0.0  4974.0 21  0
     12  1.0
     1
     T
     1  1  1  .08 0 0  0 1.0
     SINK10,NODE22
     12  1  0  0.0 3335.0 22  0
     12  1.0
     1
     T
     1  1  1  .08 0 0  0 1.0
     SINK11,NODE12
      9  1  0  0.0 562.5  12  0
      9  0.75
     1
      T
     1  1  1  .08 0 0  0 1.0
     SINK12,NODE13
      9  1  0  0.0 660.25 13  0
      9  0.75
     1
     T
     1  1  1  .08 0 0  0 1.0
     SINK13,NODE16

     12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

```
UNIT 55 (SEQ  1) INPUT ECHO         1         2         3         4         5         6         7         8
                           12345678901234567890123456789012345678901234567890123456789012345678901234567890

      6  1  0  0.0 1275.0 16  0
      6  0.5
     1
     T
     1  1  1  .08 0 0  0 1.0
     SINK14,NODE17
      6  1  0  0.0 1717.875 17 0
      6  0.5
     1
     T
     1  1  1  .08 0 0  0 1.0
     SINK15,NODE18
     12  1  0  0.0 3008.0 18  0
     12  1.0
     1
     T
     1  1  1  .08 0 0  0 1.0
     SINK16,NODE19
      6  1  0  0.0 1717.875 19 0
      6  0.5
     1
     T
     1  1  1  .08 0  0  0 1.0
     SINK17,NODE20
      6  1  0  0.0 1275.0 20  0
      6  0.5
     1
     T
     1  1  1  .08 0  0  0 1.0
     *
     *
     *DATA COMMON TO HEAT SINKS
     *
     *
     120.0  T
     0.79  24.93  'CONCRETE'/
     END OF HEAT SLAB DATA

     12345678901234567890123456789012345678901234567890123456789012345678901234567890   <EOF>   COPIED TO UNIT  5
                                                                                                   W/O CMTS
```

1-E-91

R3800130-ASURRY 1&2:SGBDLINE CRACK NODE4,COMPARITIVE: WITH HT. SINKS   THREED 29 JAN 1981 14:36:07   PAGE 7
S & W ENGR CORP NU-92   << SUBCOMPARTMENT ANALYSIS PROGRAM >>   THREED.VER12.LEV01 CREATED 80.106 11:35:02   UNIT 10

R U N   S U M M A R Y   S H E E T

MISCELLANEOUS PROBLEM CONTROL DATA:

OUTPUT FLAG................. 1
NUMBER OF TIME STEP CARDS... 10
NUMBER OF TRIP CONTROLS..... 3
NUMBER OF VOLUMES........... 40
NUMBER OF JUNCTIONS......... 68
NUMBER OF FILL TABLES....... 1
NUMBER OF FAN TABLES........ 1
NUMBER OF HT SOURCE CURVES.. 0
IMPLICIT/EXPLICIT COEFF..... 1.000

TOTAL TIME OF RUN...........................1201.000 SEC
NUMBER OF STANDARD TIME STEPS.............. 4200
NUMBER OF ACTUAL TIME STEPS................ 4210
NUMBER OF TIMES GAUSSIAN ELIMINATION USED.. 1641
NUMBER OF TIMES GAUSS-SEIDEL USED.......... 2569
NUMBER OF TRANSIENTS STORED FOR PLOTEMUP... 148
NUMBER OF SELECTED NODAL DIFF. PRESS....... 0
NUMBER OF HEAT SINKS....................... 17
NUMBER OF INTERNAL JUNCTIONS............... 67

STEAM TABLES USED (FT15) VOLUME SERIAL NO. = SHARE0 DATA SET NAME = HEATBAL.ME190.STH20G.OUTPUT1

OUTPUT: TRANSIENTS TAPE (FT08) = 016308 FILE NUMBER = 27 DATA SET NAME = FE.GUARDS.PLOTTER
TRANSMITTAL FILE (FT09) WAS NOT USED

PEAK PRESSURE DIFFERENTIAL

JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC	JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC
1	1 TO 6	0.01	0.488	35	25 TO 23	0.01	0.545
2	2 TO 3	0.00	0.353	36	23 TO 26	-0.01	0.000
3	4 TO 5	-0.01	0.394	37	24 TO 25	-0.01	0.080
4	5 TO 6	-0.01	0.391	38	24 TO 26	-0.01	0.000
5	7 TO 6	-0.01	0.391	39	24 TO 26	-0.01	0.000
6	8 TO 7	-0.01	0.394	40	6 TO 22	-0.01	0.000
7	1 TO 12	0.01	0.390	41	6 TO 27	0.01	0.393
8	1 TO 12	0.01	0.390	42	4 TO 28	0.02	0.179
9	7 TO 11	0.01	0.394	43	8 TO 29	0.02	0.179
10	8 TO 11	0.00	0.505	44	26 TO 30	-0.01	0.098
11	4 TO 9	0.00	0.504	45	26 TO 30	-0.01	0.098
12	5 TO 9	0.01	0.394	46	2 TO 31	0.00	0.545
13	10 TO 12	-0.01	0.399	47	31 TO 32	-0.01	0.000
14	9 TO 10	-0.01	0.444	48	32 TO 16	-0.01	0.248
15	11 TO 10	-0.01	0.444	49	33 TO 34	0.00	0.353
16	9 TO 17	0.01	0.500	50	34 TO 37	-0.01	0.232
17	12 TO 13	-0.01	0.000	51	33 TO 36	-0.01	0.000
18	11 TO 19	0.01	0.501	52	36 TO 20	-0.01	0.249
19	3 TO 15	-0.01	0.232	53	37 TO 20	-0.01	0.251
20	2 TO 14	-0.01	0.000	54	33 TO 35	0.00	0.545
21	17 TO 18	0.02	0.744	55	35 TO 38	-0.01	0.000
22	18 TO 19	-0.02	0.745	56	38 TO 20	-0.01	0.248
23	19 TO 20	0.01	0.270	57	1 TO 39	0.10	0.227
24	14 TO 16	-0.01	0.249	58	2 TO 39	0.09	0.225
25	15 TO 16	-0.01	0.251	59	3 TO 39	0.09	0.225
26	16 TO 21	-0.02	0.267	60	31 TO 39	0.09	0.225
27	17 TO 23	0.01	0.645	61	21 TO 39	0.09	0.227
28	19 TO 23	-0.01	0.298	62	33 TO 39	0.09	0.225
29	20 TO 21	-0.02	0.267	63	34 TO 39	0.09	0.225
30	18 TO 13	0.01	0.370	64	35 TO 39	0.09	0.225
31	16 TO 17	-0.01	0.270	65	39 TO 40	-0.39	0.227
32	21 TO 22	0.01	0.442	66	5 TO 3	0.02	0.257
33	22 TO 24	-0.01	0.023	67	7 TO 34	0.02	0.257

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P89

34	[illegible]5 TO 23	0.01	0.545

PEAK PRESSURES AND TEMPERATURES

NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)	NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)
1	14.73	0.594	137.04	909.000	21	14.72	0.543	121.13	696.000
2	14.73	0.672	135.63	956.000	22	14.72	0.392	121.28	650.000
3	14.73	0.404	135.66	954.000	23	14.71	0.284	120.11	0.284
4	14.73	0.519	184.94	902.000	24	14.71	0.395	120.10	0.395
5	14.73	0.504	156.17	902.000	25	14.71	0.407	120.11	0.407
6	14.73	0.392	132.99	903.000	26	14.70	0.325	120.03	0.326
7	14.73	0.504	142.04	915.000	27	14.71	4.650	120.13	4.650
8	14.73	0.519	136.05	1101.000	28	14.72	0.451	120.25	0.452
9	14.73	0.540	183.31	903.000	29	14.72	0.452	120.25	0.452
10	14.73	0.454	172.64	902.000	30	14.70	1201.000	120.00	1201.000
11	14.73	0.540	153.15	902.000	31	14.73	0.610	135.63	956.000
12	14.73	0.488	138.39	902.000	32	14.72	0.612	135.72	941.000
13	14.72	0.490	125.63	806.000	33	14.73	0.672	121.02	678.000
14	14.72	0.672	135.72	941.000	34	14.73	0.404	123.63	902.000
15	14.72	0.408	135.74	940.000	35	14.73	0.611	120.96	663.000
16	14.72	0.426	135.99	923.000	36	14.72	0.672	120.96	642.000
17	14.73	0.644	148.95	902.000	37	14.72	0.408	120.96	640.000
18	14.72	0.682	129.24	708.000	38	14.72	0.612	120.96	642.000
19	14.73	0.646	121.00	509.000	39	14.77	0.274	130.36	954.000
20	14.72	0.426	120.97	611.000	40	15.00	1201.000	120.00	1201.000

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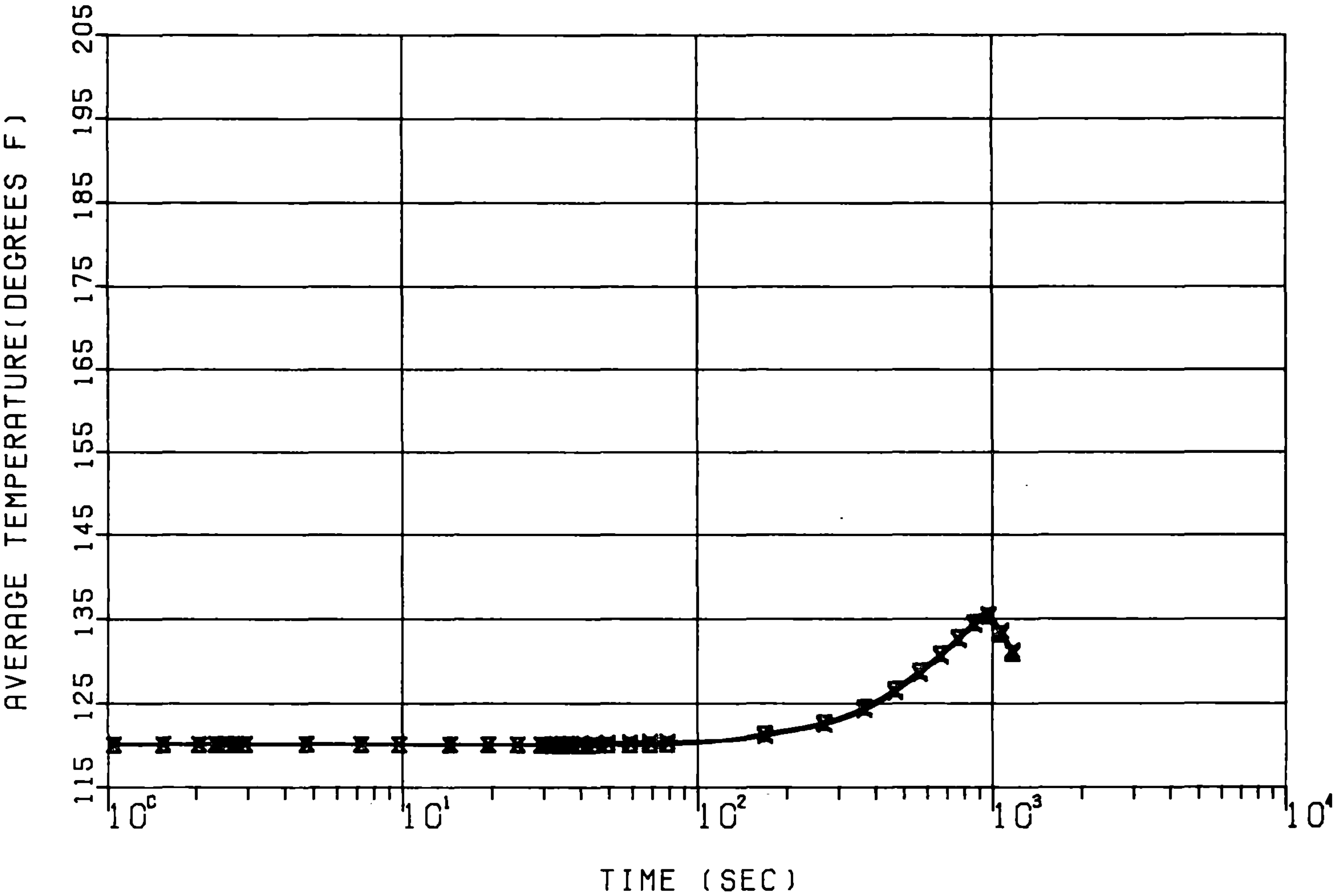

SURRY1&2 AUX.BLDG SGBD LINE CRK NODE 4
AVERAGE TEMPERATURE VERSUS TIME
COMPARITIVE PROFILES X=NODE3.Z=NODE15
PLOT OF RUN = 3800130-A

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 92
J.O. OR W.O. NO. 12846.44	DIVISION & GROUP	CALCULATION NO. PE-050	OPTIONAL TASK CODE	

REFERENCES:

1. S&W CALCULATION ES-12846.44-PE-041-0

2. S&W CALCULATION ES-12846.44-PE-046-D

3. HANDBOOK OF HYDRAULIC RESISTANCE BY I.E. IDEL'CHIK, 1966

4. S&W DRAWING 11448 FC-24N, ISSUE 4

5. S&W DRAWING 11448 FC-24A, ISSUE 7

6. S&W DRAWING 11448 FB-11D, ISSUE 4

7. S&W DRAWING 11448FB-11C, ISSUE 5

8. S&W DRAWING 11448FB-11B, ISSUE 5

9. S&W CALCULATION ES-12846.44, PE-042, REV. 1

10. SURRY UNIT 1 & 2 FSAR, APPENDIX D.

11. CRANE TECHNICAL PAPER 410, 1979

12. "CESSAR, APPENDIX 6B - DESCRIPTION OF SGN III DIGITAL COMP. CODE", AMEND. #1, JAN. 1974

13. SURRY UNIT 1 & 2 VALVE SPEC. # NUS-80-3

14. ESG-19-1, MAR. 3, 1980

15. S&W DRAWING 11448-FP-10C, ISSUE 4

16. S&W DRAWING 11448-FP-19G, ISSUE 5

17. S&W DRAWING 11448-FP-19J, ISSUE 7

18. HEAT TRANSFER BY J.P. HOLMAN © 1976, TABLE A-3

ATTACHMENT 1, P1 of 1 J.O. 12846.44

INTEROFFICE CORRESPONDENCE

PE-050

TO: BOGHOSSIAN, A.	LOCATION 14	SUBJECT / REFERENCE / J.O. NO. ENVIROMENTAL ANALYSIS SURRY 1 & 2 AUX. BUILDING 12846.44, VENT. SYSTEM MODIFICATIONS
FROM: DONAHUE, M.	LOCATION 9	

MESSAGE: —

IN LIGHT OF THE INFORMATION THAT THE CENTRAL EXHAUST SYSTEM, 1-HEF-14 OF THE SURRY UNIT 1 & 2 AUXILIARY BUILDING IS CURRENTLY UNDERGOING DESIGN MODIFICATIONS, PLEASE INDICATE THE INTENDED FINAL VOLUMETRIC DESIGN FLOW RATE OF THE FOLLOWING INTAKE DUCTS OF THE AREAS NOTED.

1. CHARGING PUMP CUBICLES, CURRENTLY RATED AT 8000 cfm
2. 2'0" ELEV. BETWEEN CHARGING PUMP CUBICLES, NEAR GRID LINES 9 AND J, CURRENTLY RATED AT 400 cfm
3. 13'0" ELEV., PURIFICATION AREA, NEAR GRID LINES 9 AND J CURRENTLY RATED AT 900 cfm.

THANK YOU FOR YOUR ASSISTANCE.

10/24/80 — DATE | M. Donahue — SIGNATURE | 8041 — TELEPHONE

REPLY:

1. CHANGED FROM 8000 TO 6500 cfm
2. Same
3. Same

11/24/80 — DATE | [signature] — SIGNATURE | 7192 — TELEPHONE

▲ 040.13B

1-E-95

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 5
EZD REFERENCE DESCRIPTION: IE Bulletin 79-01B, Surry Power Station Unit, Section 2.3
ENVIRONMENTAL ZONE(S): RC-3A, RC-47A

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)					$<2.4 \times 10^7$	2-5		

REMARKS: Also refer to EZD Reference No. 3 (LOCA Environment).

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 5
EZD REFERENCE DESCRIPTION: IE Bulletin 79-01B, Surry Power Station Unit, Section 2.3
ENVIRONMENTAL ZONE(S): RC-3B, RC-18B, RC-47B

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)					$<7.4 \times 10^6$	2-5		

REMARKS: Also refer to EZD Reference No. 3 (LOCA Environment).

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 5
EZD REFERENCE DESCRIPTION: IE Bulletin 79-01B, Surry Power Station Unit 1, Section 2.3.
ENVIRONMENTAL ZONE(S): RC-27A

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)					$<3.5 \times 10^7$	2-5		

REMARKS: Also refer to EZD Reference No. 3 (LOCA Environment).

USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 5
EZD REFERENCE DESCRIPTION: IE Bulletin 79-01B, Surry Power Station Unit 1, Section 2.3
ENVIRONMENTAL ZONE(S): RC-27B

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)					$<3.8 \times 10^7$	2-5		

REMARKS: Also refer to EZD Reference No. 3 (LOCA Environment).

2.2 EQUIPMENT IDENTIFICATION

Equipment addressed in this report includes all Class IE equipment affected by and required to mitigate an accident and/or safely shut down the plant, as defined by the guidelines of Enclosure 4 to IE Bulletin 79-01B, and as clarified by Answers 1 and 2 of NRC letter dated February 29, 1980. This encompasses equipment exposed to harsh environments including those where fluids are being recirculated from inside containment to accomplish long-term cooling following a loss-of-coolant accident (LOCA). Equipment required to maintain minimum boration capability has been addressed as to the effect of any high energy line break (HELB) to which it may be subjected, even though it is not required to mitigate the HELB accident. Equipment necessary to bring the plant from hot to cold shutdown, however, is not included, as it is not a licensing requirement to achieve cold shutdown for this plant. (Refer to NRC letter dated February 29, 1980, Generic Questions and Answers to IE Bulletin 79-01B, Answer 3, page 1.)

2.3 SERVICE CONDITIONS AS ADDRESSED IN ENCLOSURE 4 OF IE BULLETIN 79-01B

The remainder of this discussion is based on guidelines provided by Enclosure 4 of IE Bulletin 79-01B. The specific paragraphs of Enclosure 4 which concern each of the following sections are referenced in parentheses after the headings.

2.3.1 Service Conditions Inside Containment for a Loss of Coolant Accident (LOCA) (4.1)

Temperature and Pressure Steam Conditions (4.1.1)

The time dependent temperature and pressure established as a result of the low head safety injection and recirculation spray pumps net positive suction head modification are described in the attachments to VEPCO letter to NRC Serial No. 382A dated November 22, 1977.

Radiation (4.1.2)

The radiation environment for qualification of equipment and components is based on the design basis given in Section 11.3 of the FSAR over the life of the plant (40 years), plus that associated with the LOCA. Consideration was given to source strength, shielding source volume, and structural shielding arrangements.

The analysis to determine the LOCA radiation environment at Surry is based on the instantaneous release from the fuel to the containment atmosphere of 100 percent of the noble gases and 50 percent of the halogens.

1-F-1

Using the above LOCA source terms, the containment centerline 120-day integrated dose for LOCA is calculated to be 2.4×10^7 rads. When added to the 40-year normal operating dose of 1.3×10^7 rads, the total dose is 3.7×10^7 rads, which is the figure used in our review for components inside the cranewall. The analysis for the radiation environment assumed a release uniformly distributed in the containment, which is consistent with NUREG-0588, Appendix D, Page D-5, for a PWR.

The analysis for the LOCA radiation environment does not take into account the removal of airborne activity in the containment by the ESF systems or leakage. It does account for radioactivity decay. No plate-out for the iodines is assumed in the present analysis and the calculated dose is therefore conservative.

The present LOCA radiation environment is based on the dose and dose rate at the center point of the containment, and those values are used for unshielded equipment qualification. The dose rate for unshielded equipment is evaluated with respect to dose contribution of location dependent sources, such as the sump water. Integrated dose calculated for equipment qualification is based on a gamma source only.

Shielded components were reviewed based on a gamma source in accordance with NUREG-0588. IE Bulletin 79-01B, Section 4.1-2 states that "the conservative beta surface dose of 1.40×10^8 rads reported in Appendix D of NUREG-0588 would be reduced by approximately a factor of ten within 30 mils of the surface of electrical cable insulation of unit density. An additional 40 mils insulation (total of 70 mils) results in another factor of 10 reduction in dose. Any structures or other equipment in the vicinity of the equipment of interest would act as shielding to further reduce beta doses. If it can be shown, by assuming a conservative unshielded beta surface dose of 2.0×10^8 rads and considering the shielding factors discussed here, the beta dose to radiation sensitive equipment or component internals would be less than or equal to 10 percent of the total gamma dose to which an item of equipment has been qualified, then that equipment may be considered qualified for the total radiation environment (gamma plus beta)."

During the evaluation of NRC IE Bulletin 79-01B, a radiation "threshold" of 2,500 rads was used and all equipment exposed to less radiation was considered to be exempt from specific qualification requirements. This threshold value was based on an engineering review of material susceptibility to radiation damage as presented in existing literature[1,2]. We believe this threshold of 2,500 rads is reasonable and acceptable.

1. J. F. Kircher and R. E. Bowan, "Effects of Radiation on Materials and Components," Reinhold, 1964.

2. REIC Report No. 21, "The Effect of Nuclear Radiation in Elastomeric and Plastic Components and Materials," Battelle Memorial Institute, 1964.

Submergence (4.1.3)

The maximum water level on the containment floor following a LOCA is at elevation -21 feet 11 inches. This was determined by assuming that all water sources have been pumped into the containment and have drained to the floor.

Equipment located below this level is identified on the System Component Evaluation Work Sheets and has been reviewed for qualification in the submerged condition.

Chemical Sprays (4.1.4)

The caustic spray characteristics were addressed in VEPCO letter to NRC Serial No. 535 dated June 18, 1980. The most severe caustic spray environment was addressed and is reflected on the System Component Evaluation Work Sheets.

2.3.2 Service Conditions Inside Containment for a PWR Main Steam Line Break (MSLB) (4.2.1, 4.2.2, 4.2.3, 4.2.4)

The pressure and temperature transients for a main steam line break (MSLB), referenced in the Surry Units 1 and 2 45-Day Report, were taken from the plant specific analysis for North Anna Units 1 and 2. A plant specific MSLB analysis has not been performed for Surry Units 1 and 2. The North Anna transients are more severe than those that would result from a Surry plant specific analysis, due to a smaller break size and use of partial revaporization to model condensate behavior.

The main steam line flow restrictors for Surry Unit 2 are located in the steam generator (SG) nozzles; therefore the effective break diameter is 16 inches. These restrictors are located outside the steam generator in the main steam line at North Anna. Thus, at North Anna, a MSLB between the SG and the flow restrictor would have an effective break diameter of 30 inches. The smaller break size at Surry reduces the rate of steam release and would give lower containment pressure and temperature transients. The main steam flow restrictor modification is to be performed on Surry Unit 1 steam generator during the Surry Unit 1 steam generator replacement outage which started September 1980. 2

The North Anna MSLB analysis was performed with the then required conservative assumption of no condensate revaporization. As described in NUREG-0588, Section 1.2(2), a partial revaporization treatment of condensate is now acceptable. This effect significantly decreases the calculated containment temperature transient. Therefore, a Surry plant specific analysis performed

with current methods would yield a lower temperature transient than the North Anna transient.

After analyzing the thermal response of equipment inside containment to a MSLB temperature transient, the NRC staff developed the "best estimate" evaluation method for predicting the containment transients and the equipment temperature transient. This method is described in Appendix B to NUREG-0458. It recognizes the significant conservatisms in the analytical methods used to predict the containment temperature following a MSLB, and it considers the thermal capability of equipment exposed to the MSLB environment.

NUREG-0458, Section 4.1.2, describes a "best estimate" evaluation which indicates that the calculated MSLB thermal response of typical components will remain within the actual LOCA qualification temperature envelope. Based on this evaluation, Enclosure 4 to IE Bulletin 79-01B states that for a PWR MSLB inside containment, "equipment qualified for a LOCA environment is considered qualified for a MSLB accident environment in plants with automatic spray systems not subject to disabling single component failures." The Surry units meet this last condition.

The 45-Day Report included reference to the North Anna MSLB temperature and pressure profiles as conservative envelopes for equipment qualification in lieu of a plant specific Surry MSLB analysis. The 90-Day Report requires an evaluation of equipment qualification against the guidelines provided in Enclosure 4. The containment spray system is initiated automatically and is designed to meet single failure criteria. Therefore, the Surry 90-Day Report will use the guidelines of Enclosure 4, and the "best estimate" approach for MSLB service conditions. Therefore, equipment qualification for a MSLB inside containment will be based on the LOCA environment envelopes.

Radiation (4.2.2)

LOCA doses described in Paragraph 2.3.1 were used for MSLB equipment qualification within the containment. Using LOCA doses for radiation qualification for MSLB results in conservative doses for MSLB radiation qualification.

Submergence (4.2.3)

The maximum water level associated with an MSLB has been conservatively assumed to equal the LOCA level, as described in Paragraph 2.3.1.

Chemical Sprays (4.2.4)

The caustic spray characteristics for a LOCA, as specified in Paragraph 2.3.1, were used for MSLB equipment qualification. Using LOCA caustic spray characteristics is conservative for a MSLB accident. The most severe caustic spray environment was addressed and is reflected on the System Component Evaluation Work Sheets.

2.3.3 Service Conditions Outside Containment (4.3)

Areas Subject to a Severe Environment as a Result of a High Energy Line Break (HELB) (4.3.1)

HELB outside containment is addressed in FSAR Appendix D. Review of the postulated high energy line breaks has determined that electrical equipment required to mitigate each break is not physically affected by pipe whip or jet impingement. As part of the 90-Day Review this equipment has been reviewed against the environmental parameters listed in the System Component Evaluation Work Sheets.

An additional review was performed to identify equipment required to maintain a minimum charging and boration capability, to assure capability of adding borated water to the primary system. Therefore, portions of the Chemical and Volume Control Systems (CVCS) and supporting systems have been included in the qualification program and have been reviewed to the environmental parameters listed in the System Component Evaluation Work Sheets. The environmental qualification conditions within the auxiliary building, where the referenced CVCS equipment is located, are based on the worst case environment induced by potential HELBs in the area.

The breaks listed in Appendix D of the FSAR have been reanalyzed to produce temperature/pressure envelopes for equipment qualification review.

Areas Where Fluids are Recirculated from Inside Containment to Accomplish Long-Term Cooling Following a LOCA (4.3.2)

The areas through which fluids are recirculated from inside the containment following a LOCA for long-term cooling have been identified as the safeguards area, lower elevation of the containment spray pump area and main steam valve house, and the Auxiliary Building, particularly pipe penetration area and charging pump cubicles.

Temperature, Pressure, and Relative Humidity (4.3.2.1)

The systems recirculating fluids outside the containment have been designed to seismic Class I requirements. System components

have been selected to minimize or eliminate leakage. An augumented leak reduction program, as required in Paragraph 2.1.6a of NUREG-0578, is described in submittals made by VEPCO to the NRC dated January 10, 1980 and April 1, 1980.

The areas through which recirculation piping is routed are all ventilated by equipment that is remotely located with respect to the piping and its environmental effects. Therefore, harsh temperature, pressure, and relative humidity conditions are not assumed to result from the recirculation of fluids from inside the containment.

Radiation (4.3.2.2)

Post-LOCA radiation dose rates for areas outside the containment have been determined based upon TID-14844 and RG 1.4 source terms as required from the NUREG-0578 Review as follows:

1. Release from the fuel to the containment atmosphere of 100 percent of the noble gases, 25 percent of the halogens and 0 percent of the remaining solid fission products.

2. Release from the fuel to the reactor coolant system (RCS) and RCS sample lines of 100 percent of the noble gases, 50 percent of the halogens, and 1 percent of the remaining solid fission products.

3. Release from the fuel to the containment sump (and recirculation spray and recirculation portion of the high and low head safety injection system) of 0 percent of the noble gases, 50 percent of the halogens and 1 percent of the remaining fission products.

Consideration was given to source strength, source volume, structural shielding arrangments, and piping locations. These dose rates are given on the System Component Evaluation Work Sheets for equipment which must operate after a LOCA.

Submergence (4.3.2.3)

There has been no mechanism identified that would produce a significant amount of flooding near safety-related equipment in the Auxiliary Building.

Chemical Sprays (4.3.2.4)

Not Applicable

Areas Normally Maintained at Room Conditions (4.3.3)

As noted in the answer to Question 1 of the Supplemental Information to IE Bulletin 79-01B, dated February 29, 1980 (reference NRC letter to VEPCO dated February 29, 1980), these areas need not be addressed as part of the IE Bulletin 79-01B review.

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 6
EZD REFERENCE DESCRIPTION: 12846.01-PE-036-0
ENVIRONMENTAL ZONE(S): RC-27B

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
SUBMERGENCE (elev)			(-)21'11"	8	(-)21'11"	8		

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CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

▲5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF 8
VEPCO / Surry 1&2	
CALCULATION TITLE (Indicative of the Objective): Flooding elevation of Surry 1&2 Containment	QA CATEGORY (✓) ☑ I - NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ____ OTHER

CALCULATION IDENTIFICATION NUMBER				
J. O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12846.01	POWER / EGG	36	00086	

* APPROVALS – SIGNATURE & DATE			REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (✓)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE (S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
K. Chin 5/7/80	W.C. Lynch 5-16-80 See note	W.C. Lynch 5-16-80 see note				✓

NOTED MAY 1 6 1980 R.F.MILLER

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CALCULATION SHEET

Page No. 2

Preliminary

Item

12846.01-PE-36-0

Client	Location	Est. No.	J.O. No.
Subject		Date	By
		Checked	By
Based on		Revised	By

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Objective and Method

This calculation is to assess the absolute elevation, inside the containment, at which all the water sources are exhausted. Amount of water from various sources are maximized because we are interested in maximum flooding level. The corresponding flooding elevation is determined by the graph from reference 1

Assumptions: noted in the body of calculation

References:

1) S and W calculation 1284601-PE-030-0 4/3/80
2) Telecom (see Attachment 1) from Westinghouse to V.A. Suziedelis May 22, 1969
3) ASME Steam Table, 2nd Edition 1967
4) Telecom (see Attachment 2) from Westinghouse to G.J. Burrough Sept 19, 1972
5) S+W calc. 12846.07-14-0
6) S+W calc. 12846.07-21-1
7) IOC (see Attachment 3)
8) Surry 1&2 FSAR
9) IOC (see attachment 4)

Client	Location	Est. No.	J.O. No.
Subject		Date	By
		Checked	By
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10) S+W calc. 12846.01-4-0

11) S+W calc. 12846.01-38-0

Client	Location	Est. No.	J.O. No.
Subject		Date	By
		Checked	By
Based on		Revised	By

Water Sources

A. Reactor Coolant System

Mass inventory in the RCS (with 3% expansion)

$= 4.232 \times 10^5$ lbm (ref 2) ✓

Assuming that the ultimate temp is 140F at 1 atm, the volume occupied by this mass is

$4.232 \times 10^5 \text{ lbm} \left(0.01629 \frac{ft^3}{lbm}\right)$ (ref 3)

$= 6894 \; ft^3$ ✓

Since we'd like to maximize the water vol rejected onto the floor, we assume

water on floor$|_{RCS}$ = 6894 − vol below the top of core

Furthermore, since North Anna and Surry are similar, we assume (vol below top of core)$_{NA}$ = (vol below top of core)$_{Surry}$

water on floor from RCS

$= 6894 - 1947 \; ft^3$ (ref 4)

$= 4947 \; ft^3$

$= 37000$ gal ✓

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Client | Location | Est. No. | J.O. No.
Subject | Date | By
Checked | By
Based on | Revised | By

B. RWST and related pipings

From calc. 12846.07-14-0 (ref 5), the total volume of piping connecting (12" dia) RWST up to the isolation valves (for both trains) = 324 ft^3 *

From RWST:

top max level El: 72'8" + 6" (ref 6,7)

bottom El: 27'0" (ref 6)

diameter 38'0" (ref 6)

$\therefore$ vol = $(72'8" + 6" - 27'0")\left(\frac{38'}{2}\right)^2 \pi$

= 52362 ft^3
52358

$\therefore$ total vol = 52362 + 324 ft^3

= 52686 ft^3
52682

= 394091 gal ✓

C. Accumulators

Qty = 3 (ref 8) ✓

max vol = 989 ft^3 (ref 9) ✓

$\therefore$ total vol = 3 × 989 × 7.48 = 22193 gal ✓

* Checkers comment: This means the length of each train is ~206 ft. Compared to reference 5, this length seems long. Although this results in great conservatism, it would be better to take the actual length and add 20% for the conservatism.

WCLynch

1-G-6

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

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Client | Location | Est. No. | J.O. No.
Subject | Date | By
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D. <u>Boron Injection Tank</u>

max vol = 1000 gal (ref 10) ✓

E <u>Chemical Addition Tank</u>

From ref 11, we can assume that the CAT is a right circular tank with total height =

$= 36'-5'' + 2(Y_D)$

$= 36'-5'' + 2(9.05'')$

$= 37.93'$ ✓

$\therefore$ total vol $= (37.93')\left(\frac{\pi}{4}\right)\left(54'' - 2 \cdot \frac{3}{16}''\right)^2$

$= 595\ ft^3$ ✓

taken out the vol below nozzle

$= \left[(6'' - 1.25'') + 9.05''\right](\pi)\left(54'' - 2 \cdot \frac{3}{16}''\right)^2$

$= 18\ ft^3$ ✓

$\therefore$ total vol contribute by CAT

$= 595 - 18\ ft^3$

$= 577\ ft^3$

$= 4316$ gal ✓

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▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Preliminary

Item

12846.01-PE-36-0

Client	Location	Est. No.	J.O. No.
Subject		Date	By
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F Final Result

Total vol = 37000 + 394091 + 22193 + 1000 + 4316 gal

= 458600 gal

From ref 1 Fig 1, the corresponding flooding elevation is −21′11″

Conclusion

The most conservative estimate for flooding with all water sources appropiately emptied is at elevation −21′11″

1-G-8

12. Weight of secondary water in steam generator, at nominal power (one)

    a. Steam - 7,150 lb
    b. Water - 113,300 lb — 81,600 lbs

13. Heat transfer area in one steam generator - 51,500 ft^2

14. Internal energy of entire reactor coolant system at full nominal power (using properties at 2280 psia and T + 4°F)

    a. Without 3% volume expansion - 2.397 (10^8) Btu
    b. With 3% volume expansion - 2.469 (10^8) Btu

15. Weight of reactor coolant system water (using properties at 2280 psia and T + 4°F)

    a. Without 3% volume expansion - 4.108 (10^5) lb
    b. With 3% volume expansion - 4.232 (10^5) lb

16. Mass ratio (metal/water) of all metals, including fuel, to water within the confines of the thermal shield at 450°F.

    Volume water = 922 ft^3 ✓ (Inside thermal shield bottom to top)
    Mass fuel = 176,300 lbs ✓
    Mass clad = 36,300 lbs ✓ ≈ (8.65) → using 8.25 metal/water
    Mass metal (See 6)

17. Primary system piping diameters (ID)

    a. Hot leg - 29 in ✓
    b. Pump suction - 31 in —
    c. Cold leg - 27.5 in —

18. Core heat transfer coefficient (average at full power) - 5420 Btu/hr-ft^2-°F (steady-state film coefficient) ← 5570.0

19. Curves of the reactor power output as a function of time. (All curves less fission product decay heat)

    a. Double-ended primary pipe break - attached
    b. Surge line break - attached
    c. 4 in. line break - attached

Note that the detailed core kinetic calculations for the LOCA have not as yet been completed so that the best estimate curves are presented.

ATTACHMENT 1

1.	Maximum calculated thermal power (including pump heat)	2910 MWt
2.	Reactor coolant system volumes (excluding pressurizer and surge line)	
	a. Total primary system	8394 ft^3
	b. Vessel Vol below nozzle centerline	2448 ft^3
	c. Vessel Vol below top of core	1947 ft^3
	d. Vessel Vol below bottom of core	900 ft^3
3.	Primary system maximum operating pressure	2280 PSIA
4.	Coolant average temperature during full power operation (excluding pressurizer and surge line)	
	a. Algebraic average	586.8 °F
	b. Mass average	574.5 °F
5.	Reactor coolant system internal energy at full power (includes pressurizer)	241.8×10^6 Btu
6.	Reactor coolant system mass at full power (includes pressurizer)	414,700 lbs
7.	Flow information (total)	
	a. Coolant flow at full power	105.1×10^6 LB/hr
	b. Steam flow at full power/unit	4.04×10^6 LB/hr
8.	Reactor core	
	a. Average temperature	1940.0 °F
	b. Heat in core above algebraic average temperature	22.08×10^6 Btu
	c. Core heat transfer area	42,460 Ft^2
	d. Core average full power heat transfer coefficient	5700 Btu/hr-Ft^2-°F
9.	Pressurizer (including surge line)	
	a. Liquid Volume	932.9 ft^3
	b. Steam Volume	547.0 ft^3
	c. Surge Line minimum area	98.31 in^2 (89.71 in^2 through thermal sleeve)

INTEROFFICE CORRESPONDENCE

Attachment 12846.01-PE-3B-0 1 of 1

TO: H. CARLBERG — LOCATION 14	SUBJECT / REFERENCE / J.O. NO. 12846.07
FROM: R. REED — LOCATION 14	SURRY 1&2 VEPCO - CONT. SPRAY

MESSAGE: —

PER OUR CONVERSATION THE MAXIMUM TIME DELAY FROM THE SENSING OF CRITICAL LEVEL IN THE RWST UNTIL THE CHANGE OVER VALVES ARE SIGNALED TO MOVE WILL NOT EXCEED 10 SECONDS, AND IN FACT WILL BE SOMEWHAT LESS

THE MAXIMUM ERROR IN THE CHANGE OVER SIGNAL SET POINT WILL REQUIRE A CALCULATION (CAT I)

ED — Use 6" error for now

H E. Carlberg
4/24/80

NOTED . APR 24 1980 C.Woodworth

NOTED APR 2 1 1980 E.J.Adamson

NOTED APR 24 1980 R.REED

4/24/80 DATE

[signature] SIGNATURE

0405 TELEPHONE

REPLY:

THX

4/24/80 DATE

H Carlberg SIGNATURE

5068 TELEPHONE

▲ 040.1BB

1-G-11

Attachment 4 1 of 1

INTEROFFICE CORRESPONDENCE

12846.01-PE-36-0

TO: E. Siam	LOCATION 9	SUBJECT / REFERENCE / J.O. NO. 12846.19
FROM: H.A. Rasbrock	LOCATION 14	NASH Mods

MESSAGE: — Telephone conversation held 2-15-80 with myself and D. Benson / R. Cross of Vepco verifies that SI accumulator volume will remain at 975 ft^3 min / 989 ft^3 max.

Please incorporate into Surry's analyses

2-15-80 H.A. Rasbrock x7234

DATE SIGNATURE TELEPHONE

REPLY:

Will be used for extended Interim Fix + Final Fix

3-20-80 [signature]

DATE SIGNATURE TELEPHONE

▲ 040.13B

REPLIER RETURN WHITE COPY — RETAIN THIS COPY

1-G-12

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 7
EZD REFERENCE DESCRIPTION: 12846.38-RP-024-1
ENVIRONMENTAL ZONE(S): AB-2B

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	2.5×10^6	10	2.5×10^6	10				

USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 7
EZD REFERENCE DESCRIPTION: 12846.38-RP-024-1
ENVIRONMENTAL ZONE(S): AB-2C

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	2.8×10^6	11	8.0×10^6	11				

USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 7
EZD REFERENCE DESCRIPTION: 12846.38-RP-024-1
ENVIRONMENTAL ZONE(S): SFGD-1

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	8.8×10^2	13						

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CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

▲5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF 13
VEPCO - SURRY 1 & 2	
CALCULATION TITLE (Indicative of the Objective): EQUIPMENT QUALIFICATION IN AUX. & SAFEGUARDS BLDGS.	QA CATEGORY (✓) ☑ I - NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ____ OTHER

CALCULATION IDENTIFICATION NUMBER				
J. O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12846.38	power - RP	-RP-024-1		

* APPROVALS - SIGNATURE & DATE			REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (✓)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
Wu-hung peng 7/8/81	Shuwan Lin 7/8/81	Shuwan Lin 7/8/81		Supersedes RP-024-0	✓ Ref. (GAMIRNID) (Ad...) (R...)	

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CALCULATION SHEET

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CALCULATION IDENTIFICATION NUMBER				PAGE 2
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12846.38	Power RP	- 024 - 1		

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This calc. supersedes calc. 12846.38-RP-024-0 to

① include 40 year normal dose in safeguard area

② explicitly state 40 year and LOCA doses outside the charging pump cubicles in the aux. bldg

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CALCULATION IDENTIFICATION NUMBER				PAGE 3
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
12846.38	Power RP	024 - 1		

OBJECTIVE:

The objective of this calculation is to determine the integrated radiation dose (40 year normal operation plus 6 month LOCA) to the equipments located inside the auxiliary bldg and those equipments inside the safeguards bldg.

METHOD AND APPROACH

1. This calculation is based on the detailed equipment Qualification calc. performed for North Anna plant Ref. (1), Ref. (6). The equipment arrangements, flow diagrams, piping layouts of North Anna units and Surry units are compara

2. The North Anna's results are taken as reference values, which are then adjusted for the Surry units with the following adjustment factors: ① source strength – taking into account of the difference of power level and dilution water volume; ② source geometry – taking into account the diameter of the line source, the distance of the equipment to the source etc..

3. This calc. applies both to unit 1 and unit 2.

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CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 4
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CONCLUSIONS

1. Aux. bldg – outside cubicles : 6 Mo LOCA + 40 years normal operation 5×10^6 rads

   – Inside cubicles : " " " 1.1×10^7 rads

2. Safeguards bldg : 6 Mo LOCA dose – 8×10^6 rads

See also calc. # 12846-RP-037-0 "Direct γ dose rates and Integrated dose to electrical components in the safeguards area after a LOCA" in which a detailed mock-up for the pipes and walls was performed and the same conclusion was reached.

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CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 5
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REFERENCES

(1). NA2 Calc # 12050-RP-078-0, QA Cat. I, 11/10/79;
"Integrated Doses In Aux. Bldg. el. 244'6" for Mitigation"

(2). Stone and Webster, "shielding Design Summary for Surry Power Station, VEPCO", 12/70; JO # 11448

(3). NA2 Calc. # 12050-RP-077-0, QA Cat. I, 10/11/79;
"6 Month LOCA Doses from Various Sizes of 10 ft Long pipe"

✓ (4). IOC from M. Omeara to R. Vanasse / P. Karatzas; 11/27/79
"NUREG-0578 Surry shielding Review", J.O. 12846.38

(5). VEPCO Surry piping drawings as provided by the project marked up showing lines of systems used for mitigation:

11448 -FM-105B	11448 - FM - 101 A
-FM-106A	FP - 5 D
-FP-10R	FP - 60 A
FP-10C	FP - 60 B
FP-10E	FP - 60 C
FP-10F	FP - 60 D
FP-10S	
MSK-2A	

(6) NA2 Calc. # 12050-RP-091-0, QA Cat. I, 11/17/79;
"6 Mo. LOCA Integrated r doses in the NA 1 & 2 Safeguards Bldg, to components used for mitigation".

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CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 6
12846.38	power RP	024-1		

CALCULATIONS

1. Source strength

(1) The source strength is based on North-Anna's calculation(1)* and adjusted to the power level and the volume of sump water for the Surry. During the LOCA, 50% halogens and 1% fission product particulates of the equilibrium core inventories are assumed mixed up uniformly with the reactor coolant and water from RWST which are dumped to the containment sump during a LOCA. It is assumed 1% FF for the normal operation(2).

(2) $P_{N.A} = 2900\ MW$ (3) $\qquad P_{surry} = 2546\ MW$ (2)

$P.C._{N.A} = 9380\ ft^3$ (3) $\qquad P.C._{surry} = 9235\ ft^3$ (2)

$RWST_{NA} = 326\,000\ gal.$ (3) $\qquad RWST_{surry} = 250,000\ gal.$ (4)

$\text{Total sump water}_{N.A} = 1.5 \times 10^9\ cm^3 \qquad \text{Total Sump Water}_{Surry} = 1.2 \times 10^9\ cm^3$

(3) Adjustment factor for LOCA source $f_1 = \frac{2546}{2900} \times \frac{1.5 \times 10^9}{1.2 \times 10^9}$

$= 1.10$

Adjustment factor for normal operation $f_2 = \frac{2546}{2900} \times \frac{9380}{9235}$

$= 0.89$

* Numbers inside the parentheses are the reference numbers.

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J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 7
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2. Auxiliary Bldg - Outside Cubicles.

(1) We only consider low head & high head safety injection system used during the recirculation mode for mitigation of LOCA consequences. The systems had been marked up by the project.[5]

(2) The general arrangement dwgs show that the components used for mitigation purpose between NA-2 and Surry are similar except that

- The 6 charging pumps (3 for each unit) of NA are located in 6 pararrel cubicles, each in N-S direction. For the Surry, there are two bands of cubicles. 3 charing pumps are arranged in a band in E-W direction.

- The chemical mixing tank is at the west of control volume tank for NA-2 and it is at the south for the Surry.

(3) The flow diagrams between the two plants show that their mitigation systems are similar. In NA-2, a lot more piping are considered contaminated, including boron injection tank and its' piping, piping for the seal water injection filters. In Surry, these pipings are isolated.[5]

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

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CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 8
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– continued –

The piping arrangement between these two units (NA-2 & Surry 1) are different. For the space outside the cubicles, Surry's piping is less congested than North Anna's piping.

(4) The radiation sensitive equipments outside the cubicles are identified as the following: MOV 1289B, MOV 1867A, MOV 1867B, FE 1943, FE1160, FCV1160, MOV 1370, MOV1869A, MOV 1869B, MOV1842 and FE1940. The integrated dose of some of the corresponding equipments of NA-2 has been calculated. As a reference, they are listed in the following:

NA-2 Equipment	6 month LOCA Dose		40yrs operation		NA2 total
MOV 2289B	6.9×10^5 rads	+	5.4×10^5 rads	=	1.2×10^6 rads
MOV 2867A	1.3×10^6 "	+	1.1×10^6 "	=	2.4×10^6 "
MOV 2867B	1.2×10^6 "	+	1.1×10^6 "	=	2.3×10^6 "
FE 2943	1.1×10^6 "	+	9.1×10^5	=	2.0×10^6 "
FE 2160	1.7×10^6 "	+	2.0×10^6 "	=	3.7×10^6 "
FCV 2160	5.9×10^5 "	+	6.1×10^5 "	=	1.2×10^6 "

Since the dose contributions from LOCA and normal operation are comparable, the source strength adjustment factors are cancelled out. Surry's equipments have less piping around them and no contribution from boron injection tank; therefore, their doses can not be more than those listed above. It should be noted that the radiation from two 8" pipes (8"-SI-92 & 8"-SI-14) to MOV 1289B are essentially shielded by the concrete pole TN-10.

CALCULATION IDENTIFICATION NUMBER				PAGE 9
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
12846.38	Power RP	024 - 1		

- continued -

(5) MOV - 1869A, 1869B, 1842 of Surry-1 are adjacent to many 3" pipes. NA-2's calculation does not include those element. Comparison of the piping layout suggests that the doses at those equipments not more than that of NA-2 MOV-2867C, which has total integrated dose of 3.2×10^6 rads (1.7×10^6 rads for LOCA and 1.5×10^6 rads for 40 yrs operation.)

(6) MOV-1370 is only 4.5' to pipe 8"-SI-92 and 5' to 8"-SI-14. MOV-2289B of NA-2 is 12.3' away from 8"-SI-440 and 12.7' away from 8"-SI-449. The total integrated dose of MOV-2289B is 1.2×10^6 rads. Since the dose rate from a long line source is inversely proportional to the normal distance, the integrated dose of MOV-1370 of Surry-1 is estimated to be

$$1.2\times10^6 \times \frac{12.6'}{4.8'} \simeq 3\times10^6 \text{ rads}.$$

Judged from the doses of MOV-2863A, 2863B, 2115B, 2115D of NA-2, which are also near many pieces of 8" pipe, the above value is believed to be correct for MOV-1370 of Surry-1.

(7). FE-1940 of Surry-1 encloses a 4" pipe and adjacent to a number of 3" pipes. Comparison with flow elements of NA-2 suggests that its dose should not

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– continued –

exceed 4.7×10^6 rads, which is the maximum total dose among flow elements of NA-2.

(8) In conclusion, the total integrated dose to MOV's and FE's of mitigation system outside of cubicles in the aux. building is estimated, based upon comparison with NA-2, not more than 5×10^6 rads. (The LOCA contribution and 40 year contribution are comparable; that is, $\sim 2.5 \times 10^6$ rads for 40 year normal operation dose, and $\sim 2.5 \times 10^6$ rads for 6 month LOCA dose).

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3. Auxiliary Bldg - Inside Charging pump Cubicles

(1) According to Shielding Design Summary for Surry Power Station, VEPCO[2], p.19, the dose rate at pump surface due to pump and lines > 2" in diameter is 10000 mR/hr (1% FF). 40 year integrated dose at 80% operation fraction is

$$10 \times 40 \times 365 \times 0.8 \times 24 = 2.8 \times 10^6 \text{ rads}$$

(2) In NA-2 Calculation[1], the maximum equipment dose occurs at MOV-2863B and is 3.6×10^6 rads in 6 month after LOCA. MOV-2863B is located outside the cubicle for NA-2; this piece of equipment is inside the cubicle for Surry-1. Apply source strength adjustment factor, $D_1 = 3.6 \times 10^6 \times 1.1 = 4.0 \times 10^6$ rads. Based on engineering judgment, it is conservatively assumed the pump will contribute as much as the piping. The total LOCA dose is then $\sim 4.0 \times 10^6 \times 2 = 8 \times 10^6$ rads.

(3) Therefore, it is estimated that the total integrated dose of equipment inside the charging cubicle of Aux. bldg is not more than 1.1×10^7 rads.

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4. Safeguards Bldg

(1) Two systems are considered in safeguards bldg: low head safety injection system and containment-recirculation spray system. Equipments we consider critical to radiation damage are MOV's and FE's associated with these systems.

(2) The flow diagrams of SI and RS systems inside the safeguards bldg of NA and Surry are very similar. Three levels are considered in NA calculation[6]: under ground Level at 210'11", where we have two 12" pipes to the suction of the low-head pump; "ground level" at 256'11", where we have most of the pipes of the system; and upper level at 267'6", where we have less number of pipes and they are generally of smaller size. For the Surry, as they were marked up by the project, only underground Level at -32'7" and "ground level" at 12' are considered.

(3) The piping layout of RS system, and SI system at -32'7" Level, of Surry-1 is very similar to those of NA-2. The SI piping of Surry-1 at el.12' level is different from North Anna-2. However, the difference is minor, in my opinion for the equipment qualification, between Surry-1 and NA-2.

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(4) The SI and RS piping layouts at ground level (256′6″) between NA-1 and NA-2 are also different. The calculated integrated doses are listed below for reference.(Ref(6))

	NA 1		NA-2	
FE1945	6.8×10^6	rads	6.6×10^6	rads
FE1946	5.7×10^6	"	5.7×10^6	"
MOV 1864 A	4.7×10^6	"	5.6×10^6	"
MOV 1864 B	5.3×10^6	"	3.8×10^6	"
MOV 1890 A	5.3×10^6	"	5.3×10^6	"
MOV 1890 B	4.9×10^6	"	3.9×10^6	"
MOV 1890C	5.8×10^6	"	4.4×10^6	"

(at el. 210′11′ : MOV 1860 A 4.6×10^6 rads
MOV 1860 B 4.4×10^6 ")

It can be seen that althougth the detail piping layouts between NA-1 and NA-2 are different, the integrated doses do not differ much. Therefore, it is judged that doses to Surry equipments should also be of the same order, adjusted by the source stength. The maximum dose above is 6.8×10^6 rads.

LOCA source strength adjustment factor, $f_1 = 1.10$.

$6.8\times1.1 = 7.5\times10^6$ rads.

5. In conclusion, it is expected that the 6 month integrated doses to Surry-1 safeguard equipments after a [redacted] LOCA are not more than 8×10^6 rads.

6. 40 year normal dose is estimated to be $2.5\times10^{-3}\ \frac{\text{rads}}{\text{hr}}\times40\times365\times24$ hrs $= 880$ rads (Assuming radiation zone II with max. doserate $2.5\ ^{mR}/_{hr}$)

1-H-13

INTEROFFICE CORRESPONDENCE

TO: R. VANASSE / P. KARATZAS	LOCATION 9th	SUBJECT / REFERENCE / J.O. NO. 12846.38 NUREG-0578 ETA 00006 SURRY SHIELDING REVIEW
FROM: MIKE OMEARA	LOCATION 14	

MESSAGE:—

The minimum amount of water injected into the reactor coolant systems after a LOCA is about 250,000 gal. this assumes that water will be drawn from a full RWST until the level at which automatic switchover to the recirc. mode occurs. It is also assumed that switchover is immediate (conservative) and that Containment Spray is not initiated. Instrument error is also considered.

11/27/79
DATE

Michael S. OMeara 6836
SIGNATURE TELEPHONE
HGR 11-27-79

REPLY:

DATE SIGNATURE TELEPHONE

▲ 040.13B

1-H-14

USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 8
EZD REFERENCE DESCRIPTION: 12846.44-PE-049-0
ENVIRONMENTAL ZONE (S): SB-9B, TB-9, TB-35

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
TEMPERATURE (°F)							310, 0-30 min 130, 30-60 min	42
PRESSURE (psia)							15.0, 0-3500 sec 15.0-14.7, 3500-3600 sec	47*
RELATIVE HUMIDITY (%)							100	**
CHEMICAL SPRAY								

REMARKS: * Profile is based on bounding the results of the computer analysis as referenced in calculation.

** Relative humidity bounds are results of computer analysis referenced in calculation, but not included.

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CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

▲5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF 50
VEPCO SURRY UNIT 1 & 2	

CALCULATION TITLE (Indicative of the Objective):	QA CATEGORY (✓)
HIGH ENERGY LINE BREAK IN TURBINE BUILDING	☑ I – NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ______ OTHER

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12846.44	POWER / ESG	PE-049-0	00006	

* APPROVALS – SIGNATURE & DATE						
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)	REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (✓) YES	NO
M. Donahue 10/15/80	D. M. Wallen 11/12/80	D. M. Wallen 11/12/80	0			✓

NOTED DEC 9 1980 R.F.MILLER RFM

DISTRIBUTION*					
GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT. FILES (OR FIRE FILE IF NONE)	M. Cliffe 245/14	2			
Project	J. Barnhart	1			

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CALCULATION IDENTIFICATION NUMBER				PAGE 3
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
12846.44		PE-049-0		

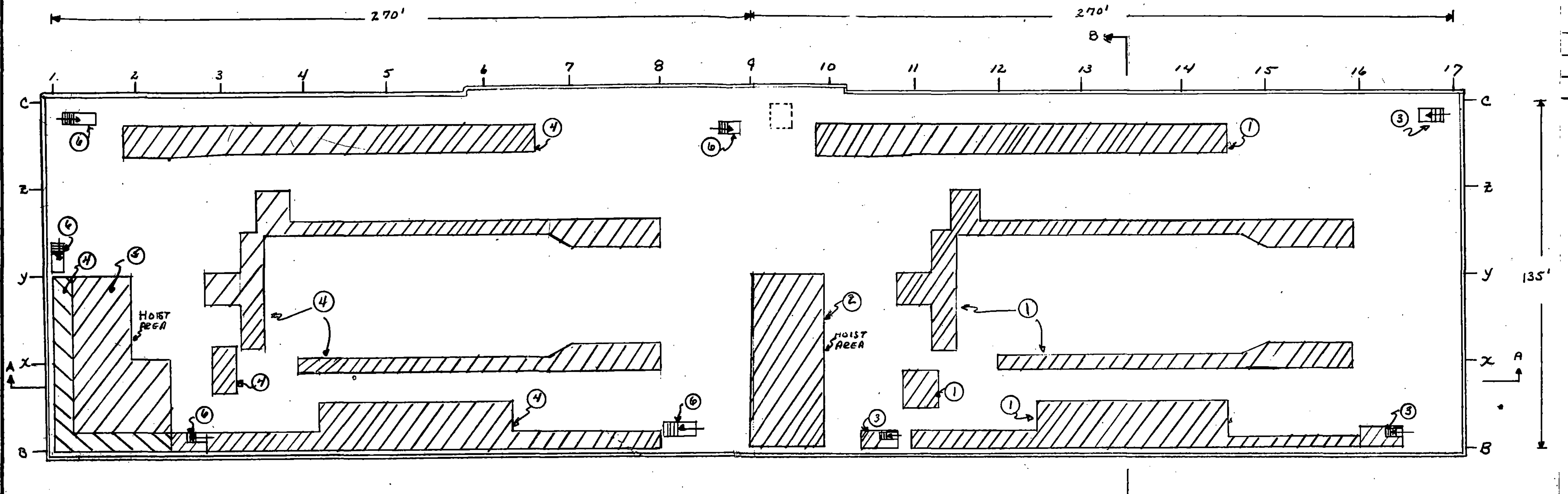
OBJECTIVE: TO EVALUATE THE EFFECTS OF A HIGH ENERGY LINE BREAK WITH RESPECT TO TEMPERATURE ON IDENTIFIED CLASS 1E ELECTRICAL COMPONENTS, LOCATED WITHIN THE SURRY UNIT 1 & 2 MECHANICAL EQUIPMENT ROOM #3 IN RESPONSE TO THE I.E. BULLITEN 79-01B.

METHOD: THE S&W ENG. CORP. NU-92 'THREED' SUBCOMPARTMENT ANALYSIS COMPUTER PROGRAM, VERSION 12, LEVEL 1 IS UTILIZED TO EVALUATE THE TEMPERATURE AND PRESSURE TRANSIENT THAT WOULD RESULT FROM A POSTULATED FAILURE OF A HIGH ENERGY PIPING SYSTEM. TO PROVIDE THE NECESSARY INPUT DATA OF THE STRUCTURE'S GEOMETRY, VOLUME, RESISTANCE TO FLOW AND TO CHANGES IN FLOW RATE, A 'NODALIZATION' OR SUBCOMPARTMENTATION OF THE STRUCTURE IS MODELED, USING THE GUIDELINES OF REFERENCE 32.

CALCULATION: REF. 43 LOCATES THE MECHANICAL EQUIPMENT #3 IN THE SERVICE BUILDING AT THE 9'6" ELEVATION, WHICH IS CONNECTED TO THE TURBINE BUILDING UNIT #2 9'6" ELEVATION BY TWO WALL OPENINGS FOR VENTILATION PURPOSES, ONE OF WHICH CONTAINS A FAN FOR CONTINOUS AIR CIRCULATION. SINCE THIS AREA IS MOST DIRECTLY CONNECTED TO A WORST CASE HIGH ENERGY LINE, THAT BEING A MAIN STEAM PIPING SYSTEM, IN THE TURBINE BUILDING, IT IS CONSERVATIVE AND REASONABLE TO EXPECT THAT THE TEMPERATURE TRANSIENT FOR THE TURBINE BUILDING 9'6" ELEVATION FOR UNIT 2 THAT WOULD RESULT FROM A FAILURE OF THE MAIN STEAM PIPE IN THAT AREA WOULD BE NEARLY THE SAME TRANSIENT THAT THE MECHANICAL EQUIPMENT ROOM WOULD EXPERIENCE. FOR THIS REASON, THE NODALIZATION MODEL DEVELOPED IS USED TO ANALYZE THE WORST CASE HELB TEMPERATURE TRANSIENT FOR THE UNIT 2 TURBINE BUILDING LOWER ELEVATION. THE RESULTS OF THIS TRANSIENT ARE THEN ASSUMED TO BE THE TRANSIENT THAT THE MECHANICAL EQUIPMENT ROOM WOULD UNDERGO. THE MODEL, THEREFORE, DOES NOT INCLUDE SPECIFICALLY THE MECHANICAL EQUIPMENT ROOM AND THE VALUES OF TEMPERATURE FOR NODE 1, AS SHOWN ON THE DIAGRAMS ON PAGE 4, IS THE TRANSIENT NODE OF INTEREST. PAGES 5 thru 11 provide the NODAL NET VOLUME CALCULATION AND PAGES 12 thru 38 PROVIDE THE JUNCTION AREA AND FLOW RESISTANCE CALCULATION. THE MASS ENERGY RELEASE RATES UTILIZED ARE SHOWN ON PAGES 39 to 40. FOR PURPOSES OF CONSERVATISM, THE LOUVERED OPENINGS FOR THE SUPPLY FAN PLENUMS FOR THE BUILDING ARE ASSUMED TO BE SHUT.

THE FOLLOWING PAGE PROVIDES THE SKETCHES OF THE NODAL SCHEME CHOSEN, BY ELEVATION VIEW AND PLAN VIEW OF THE OPENINGS THROUGH THE OPERATING FLOOR AS WELL AS A SINGLE LINE DIAGRAM OF THE NODE TO NODE RELATIONSHIPS. ALL ASSUMPTIONS CONSERNING THE CALCULATION OF VOLUMES, RESISTANCE TO FLOW AND INERTIA'S ARE CONTAINED IN THE TEXT WHERE APPLICABLE.

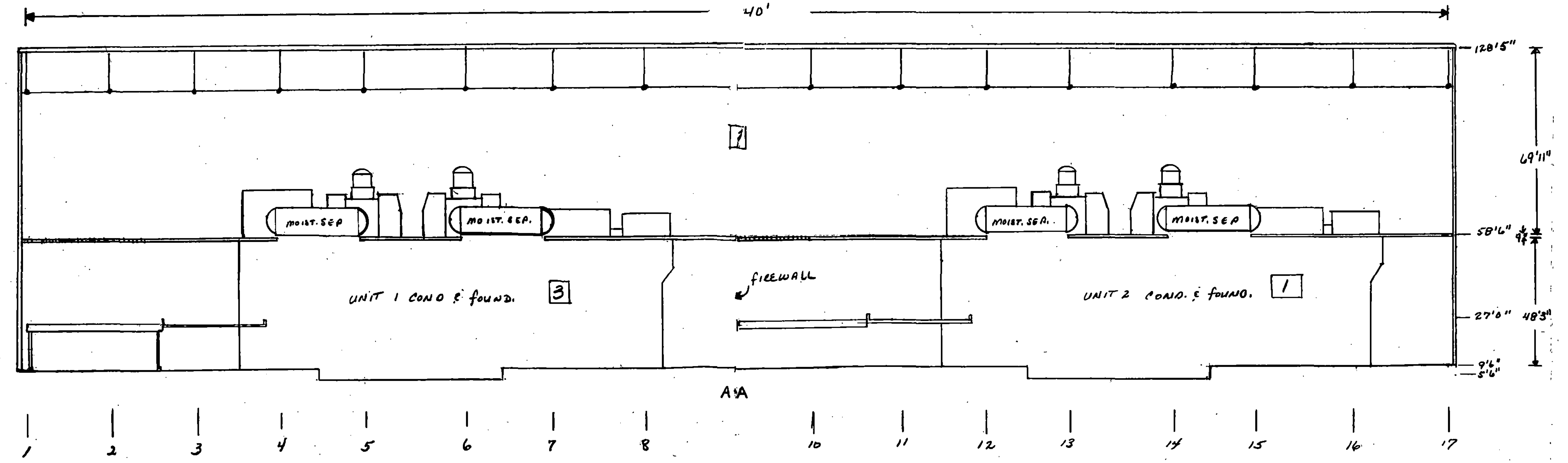
Client VEPCO SURRY UNIT 1 & 2	Location	Est. No.	J.O. No. 12846.04
Subject or Apparatus TURBINE BUILDING NODAL DIAGRAM		Date	By
		Checked	By
Based on		Revised	By



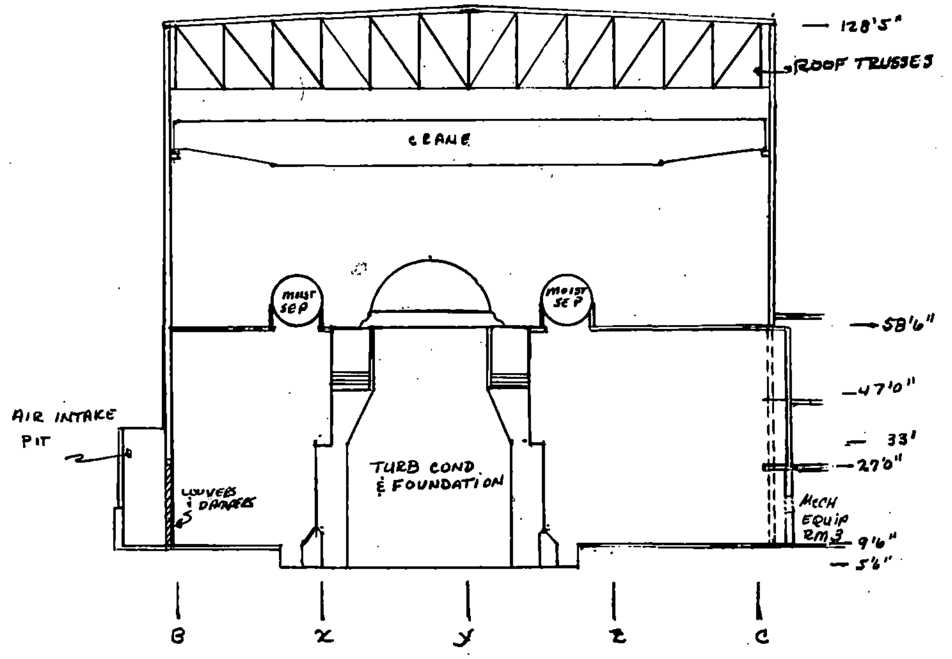
PLAN VIEW VERTICAL FLOW AREAS AT OPERATING PLATFORM.

○ = JUNCTION DESIGNATION (ABOVE)

□ = NODE DESIGNATION (BELOW)

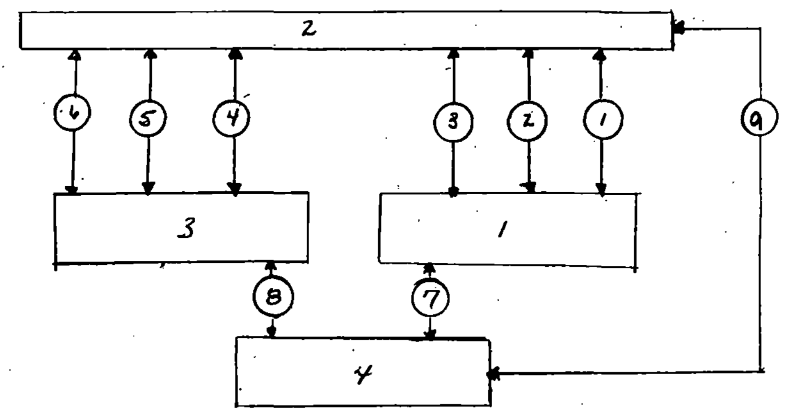


A-A



B-B

NODE DIAGRAM □ = NODE DESIGNATION ○ = JUNCTION DESIGNATION



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VOLUMES: *Checker: Note: Net Volumes are not exact calculations but are within an acceptable tolerance.

THE TURBINE BUILDING FOR THIS ANALYSIS IS DIVIDED INTO 3 AREAS OR NODES, TWO OF WHICH ARE BELOW THE OPERATING FLOOR SEPERATED BY A FIRE WALL WHICH DIVIDES THE BUILDING EVENLY AT LINE 9 ACROSS ITS WIDTH AS SHOWN ON REF 27. THE THIRD AREA IS THAT AT AND ABOVE THE OPERATING FLOOR FOR THE ENTIRE LENGTH OF STRUCTURE. REF 24 THRU 26 PROVIDES THE OVERALL DIMENSIONS FOR THE BUILDING. FOR CALCULATION PURPOSES, THE DIMENSION LENGTHS USED FOR EVALUATING NET VOLUMES ARE TAKEN FROM THE "B" LINE TO THE "C" FOR WIDTH, FROM LINE 1 TO LINE 17 FOR THE LENGTH OF THE ABOVE MENTIONED 3rd AREA (NODE 2), FROM LINE 1 TO LINE 9 FOR ONE OF THE LOWER AREAS (NODE 3), LINE 9 TO 17 FOR THE OTHER (NODE 1). FOR HEIGHT, FOR THE LOWER NODES THE ELEVATION USED IS FROM THE 9'6" LEVEL TO AN ELEVATION OF 57'9" AND FOR THE UPPER AREA FROM THE 58'6" LEVEL TO AN ELEVATION OF 128'5". THE STRUCTURE IS ACTUALLY SLIGHTLY LARGER THAN THIS, HOWEVER THE DIFFERENCE IS VERY SMALL AND WOULD NOT HAVE A SIGNIFICANT EFFECT ON RESULTS.

COMPONENTS UTILIZED IN THE UNIT 2 AREA ARE FOR THE MOST PART DUPLICATED IN THE UNIT 1 AREA FOR THAT UNIT. EQUIPMENT AND PIPING VOLUMES, THEREFORE, THAT ARE OBTAINED FOR ONE OF THE UNITS IS ASSUMED TO BE THE SAME FOR THE OTHER UNIT, EXCEPT WHERE NOTED. COMPONENT VOLUMES ARE ESTIMATED FROM THE MACHINERY ARRANGEMENT DRAWINGS AND PIPING ARRANGEMENT DRAWINGS FOR THOSE ARBITRARILY CONSIDERED TO BE OF SIGNIFICANT SIZE, THE ESTIMATES CONSIDERED TO BE CONSERVATIVELY LARGE. REMAINING EQUIPMENT, FOUNDATIONS, PIPING & SUPPORTS ETC. NOT SPECIFICALLY ADRESSED WILL BE ACCOUNTED FOR BY A GENERAL ASSUMPTION THAT THESE COMPONENTS WILL NOT OCCUPY MORE THAN 10% OF THE GROSS VOLUME OF NODE 2 AND 5% OF THE GROSS VOLUMES OF NODES 1 & 3, WHICH IS CONSERVATIVE.

PAGE 4 OF THIS CALCULATION SUMMARIZES THE NODAL ARRANGEMENT AND DIMENSIONING USED FOR THE TURBINE BUILDING.

NET VOLUMES: V_g = GROSS VOLUME ; V_c = VOLUME OF COMP. & PIPING ; V_N = NET VOL.

NODE 1: $V_g = (270')(135')(48'3") = 1758712.5\ ft^3$

$V_c = 418009\ ft^3$ (LINE 28, PAGE 9) + $15109\ ft^3$ (LINE 44, PAGE 11) [406045] [15113]

$+ V_g(5\%) = 521053.6\ ft^3 = \underline{521054\ ft^3}$ [i.e. 5?7?4]

$V_N = V_g - V_c = \underline{1237658\ ft^3}$ 1234118

NODE 2: $V_g = (540')(135')(69'11") = 5096925\ ft^3$ 660603 ?

$V_c = 150668\ ft^3 + V_g(10\%) = 660360.5\ ft^3$ (LINE 36, P 6) [150460]

$V_N = V_g - V_c = \underline{4{,}436{,}565\ ft^3}$ 4436273.

NODE 3: $V_g = (270')(135')(48'3") = 1758712.5\ ft^3$

$V_c = 15109\ ft^3$ (LINE 44, PAGE 11) + $441457\ ft^3$ (LINE 36, PAGE 9) [15113] [429385]

$+ V_g(5\%) = 544501.6\ ft^3$ 533134.6

$V_N = V_g - V_c = \underline{1{,}214{,}211\ ft^3}$ 1225579.

NODE 4: V_N IS ASSUMED TO $= \underline{10^{20}\ ft^3}$

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EQUIPMENT VOLUMES: (DIMENSIONS ARE APPROXIMATED FROM REF GIVEN)

OPERATING LEVEL AND ABOVE

1. ELEVATOR MACHINERY ROOM (REF 1 & 8)
   ESTIM. AS 13' × 9' × 10' = 810 ft^3 Should be 1170 ft^3
   ELEVATOR SHAFT EST. AS 8' × 8' × 17' = 1088 ft^3

2. VENTILATION FANS ALONG "C" LINE WALL (REF 8)
   6 FANS APPROX. AS 6' DIA × 11' = 311 ft^3 EA × 6 = 1866 ft^3
   6 PLENUMS APPROX. AS 12' × 20' × 8' = 1920 ft^3 EA × 6 = 11520 ft^3
   (6) DUCTS APPROX. AS 5 × 5 × 43' = 1075 ft^3 EA × 6 = 6450 ft^3

3. S.V. MANIFOLDS (4) (REF 1)
   APPROX. AS 4' DIA × 17.5' = 220 ft^3 EA × 4 = 880 ft^3

4. MOISTURE SEPARATORS (8) (REF 1)
   APPROX. AS 11' DIA × 37' = 3516 ft^3 EA × 8 = 28128 ft^3

5. GENERATOR (2) (REF 1 & 7)
   APPROX. AS 17' × 11' × 16' = 2992 ft^3 EA × 2 = 5984 ft^3
   32' 5984 11968

6. EXCITER (2) (REF 1 & 6)
   APPROX AS 18 × 12' × 10' = 2160 ft^3 EA × 2 = 4320 ft^3

7. TURBINES (2) (REF 1 & 4)
   CASINGS (4) APPROXIMATED AS ½ [(16' RAD) × 29'] = 11662 ft^3 EA × 4 = 46646 ft^3
   INLET HOUSINGS (2) APPROX. AS 17' × 28' × 35' = 16660 ft^3 × 2 = 33320 ft^3

8. CRANE (2) (REF 4 & 7)
   TROLLEY APPROX. AS. 14' × 5' × 29' = 2030 ft^3 × 2 = 4060 ft^3
   RAILS APPROX AS. 18" × 7' × 132' (REF 23) (2 SECTIONS) = 2772 ft^3 EA × 2 = 5544 ft^3

TOTAL 810 ft^3 + 1088 ft^3 + 1866 ft^3 + 11520 ft^3 + 6450 ft^3 + 880 ft^3 + 28128 ft^3 + 5984 ft^3 + 4320 ft^3 + 46646 ft^3 + 33320 ft^3 + 4060 ft^3 + 5544 ft^3
= 150 668 ft^3
156960 ft^3

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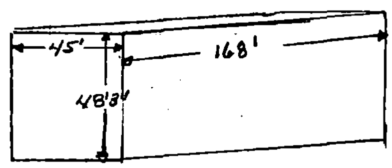
EQUIPMENT VOLUMES ELEV. 9'6" TO EL 58'6"

NOTE: UNLESS NOTED OTHERWISE THE VOLUMES ESTIMATED BELOW ARE ASSUMED TO BE THE SAME FOR BOTH UNIT 1 & UNIT 2 AREAS. (NOTES 1 & 3)

1.) TURBINE CONDENSOR AND FOUNDATION (REF 4 & 7)

IT IS CONSERVATIVE TO EVALUATE THESE COMPONENTS AS A SINGLE UNIT WHICH WOULD ALSO ACCOUNT FOR THE PLATFORM AT ELEVATION 33' & 35' AND MISCELLANEOUS SERVICE UNITS WITHIN THE BOUNDARIES OF THIS AREA



VOLUME = 168' x 48'3" x 45' = 364770 ft³

2.) FEED WATER HEATERS (REF 3, 4 & 5)

(6) EST. 5.5' DIA x 40' = 950 ft³ EA = 5702 ft³

(2) EST. 6.5' DIA x 33.5' = 1112 ft³ EA = 2224 ft³

TOTAL 7926 ft³

3.) STEAM GENERATOR FEED PUMPS (REF 3, 4) (2)

APPROX. AS 8' x 7' x 20' = 1120 ft³ EA x 2 = 2240 ft³

4.) ELEVATOR SHAFT (UNIT 2 ONLY) (REF 4)

APPROX. AS 8' x 8' x 49' = 3136 ft³

5) BEG WATER COOLING PUMPS (2) (REF 3, 5)

APPROX. AS 9' x 4' x 6' = 216 ft³ EA x 2 = 432 ft³

6) HIGH PRESSURE DRAIN HEATER (REF 3)

APPROX. AS 9' DIA x 23' = 1463 ft³
└ 8' dia 1156 ft³

7) BEARING COOLING WATER HEAT EXCH. (3) (REF 3, 5)

APPROX. AS 4' DIA x 25' = 314 ft³ EA x 3 = 942 ft³

8) SERVICE AIR & CONTROL AIR COOLERS (2 SETS OF 2) (REF 3 & 4) UNIT 2 ONLY

APPROX. AS 6' x 13.5' x 4' = 324 ft³ EA x 4 = 1296 ft³

9) SERVICE AIR & CONTROL AIR RECIEVERS (4) (REF 3 & 4) UNIT 2 ONLY

APPROX. AS 4' DIA x 10' = 126 ft³ EA x 4 = 503 ft³

10) TURB. L.O. RESEVOIR (REF 2)

APPROX. AS 10' DIA x 37' = 2906 ft³

11) L.O. COOLERS (2) (REF 2 & 5)

APPROX. AS 3' DIA x 30' = 212 ft³ EA x 2 = 424 ft³

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12) BEARING COOLING WATER HEAD TANK (REF 2 & 8) APPROX AS 6' DIA × 15' = 424 ft³

13) DEHYDRATORS (2) (REF 3 & 8)
APPROX. AS 3.5' × 3.5' × 6' = 74 ft³ EA × 2 = 148 ft³

14) REHEATER DRAIN RECIEVERS (4) (REF 2 & 8)
APPROX. AS ~~-'DIA × 11'~~ = 216 ft³ EA × 4 = 864 ft³ Tot. 786 ft³
3 @ 5' dia and 1 @ 4' dia.

15) FLASH EVAPORATOR (REF 2 & 8)
APPROX. AS 30' × 7' × 13' = 2730 ft³

16) 6th PT. HEATER DRAIN RECIEVER (2) (REF 3 & 6)
APPROX AS 5' DIA × 22' = 138 ft³ EA × 2 = 276 ft³
432 ft³ ea × 2 = 864 ft³

17) SERVICE WATER PUMPS (2) (REF 3 & 6)
APPROX. AS 6.5' × 3' × 4' = 78 ft³ EA × 2 = 156 ft³

18) CONDENSATE PUMPS (3) (REF 3 & 6)
APPROX. AS 4' DIA × 13' = 163 ft³ EA. × 3 = 490 ft³

19) CHILLED WATER TANK (REF 2 & 6)
APPROX AS 8' DIA × 13' = 654 ft³
120 ft³ should be included for connections between tank + condensers.

20) CHILLED WATER CONDENSOR (REF 2 & 6)
APPROX. AS 6' DIA × 20' = 566 ft³
4' dia 251 ft³

21) RECYCLE PUMPS (2) (REF 3 & 8) Not included since below 75' [illegible] Bld.
APPROX AS 9' × 5.5' × 5.5' = 272 ft³ EA × 2 = 544 ft³

22) FUTURE FILTERS (3) (REF 3 & 8)
APPROX. AS 9' DIA × 11' = 670 ft³ EA × 3 = 20100 ft³
700 ft³ ea. 2100 ft³

23) MAKEUP PUMP HEAD TANK (REF 3 & 7)
APPROX. AS 6' DIA × 11' = 104 ft³
311 ft³

24) CHILLED WATER CIRC PUMPS (2) (REF 3 & 7)
APPROX AS 2.5' × 4' × 6' = 60 ft³ EA × 2 = 120 ft³

25) FLASH EVAPORATOR ~~DEMINERIZER~~ (REF 3 & 6)
APPROX. AS. 5' DIA × 10' = 196 ft³

26) AIR EJECTORS AND CONDENSORS (2) (REF 2 & 6)
APPROX. AS 3' DIA × 8' = 57 ft³ EA × 2 = 114 ft³

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27) VACUUM PRIMING TANK (REF 2 & 6)
APPROX AS 5' DIA × 11' = 216 ft³

28) GLAND STEAM COND. (REF 2)
APPROX. AS 2' DIA × 8' = 25 ft³

29) CONCRETE PLATFORMS (REF 11)
a) TURB OIL RESERVOIR AT ELEV 27'0" (6" THICK)
APPROX [(50' × 29') + (10' × 22')] (0.5') = 835 ft³
b) LOADING PLATFORM (ELEV 27'0") 2'0" THICK (UNIT 2 ONLY)
APPROX. AS [(33'9") × (50'6")] (2') = 3409 ft³
(ref 12)
c) MEZZ. (UNIT 1 ONLY) APPROX AS (6")(76')(49') = 1862 ft³
(2') 7448 ft³

30) OIL ROOM (REF 13) UNIT 1 ONLY
APPROX AS 44'8" × 33'5" × 17'6" = 26121 ft³

31) COMPONENT COOLING WATER HEAT EXCHANGERS (4) (REF 13) UNIT 1 ONLY
APPROX. AS 48.5' × 5' DIA = 952.3 ft³ EA × 4 = 3809 ft³

NET COMPONENT VOLUMES FOR NODE 1 = 1156
344770 ft³ + 7926 ft³ + 2240 ft³ + 3134 ft³ + 432 ft³ + 1463 ft³ + 942 ft³ + 1296 ft³ + 503 ft³ + 3906 ft³ + 424 ft³ + 424 ft³ + 148 ft³ + 864 ft³ + 270 ft³ + 156 ft³ + 490 ft³ + 654 ft³ + 566 ft³ + 544 ft³ + 20100 ft³ + 104 ft³ + 120 ft³ + 196 ft³ + 114 ft³ + 216 ft³ + 25 ft³ + 835 ft³ + 3409 ft³ + 2730 ft³ = 418.009 ft³
400045 ft³

NET COMPONENT VOLUMES FOR NODE 3. = 1156
364770 ft³ + 7926 ft³ + 2240 ft³ + 432 ft³ + 1463 ft³ + 942 ft³ + 2906 ft³ + 424 ft³ + 424 ft³ + 148 ft³ + 864 ft³ + 2730 ft³ + 270 ft³ + 156 ft³ + 490 ft³ + 654 ft³ + 566 ft³ + 544 ft³ + 20100 ft³ + 104 ft³ + 120 ft³ + 196 ft³ + 114 ft³ + 216 ft³ + 25 ft³ + 835 ft³ + 1862 ft³ + 26121 ft³ + 3809 ft³ = 441457 ft³
7448
421?85 ft³

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

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<u>PIPING VOLUMES:</u>

NOTE: DUE TO THE SIMILARITY OF PIPING SYSTEMS AND ARRANGEMENTS IN BOTH UNIT #1 & 2 TURBINE BUILDING AREAS AND THE USE OF APPROXIMATIONS FOR THESE VALUES IT IS ASSUMED THE ESTIMATED PIPING VOLUME CALCULATED BELOW IS THE SAME FOR BOTH AREAS UNLESS OTHERWISE NOTED. THOUGH NOT STRICTLY CORRECT THIS ASSUMPTION WILL HAVE INSIGNIFICANT EFFECTS ON THE RESULTS OBTAINED.

AREA BELOW OPERATING LEVEL (NODES 1 & 3)

1. <u>STEAM GENERATOR FEEDWATER LINES</u> (REF. 20, 21)
   a) 18" DIA PIPE WITH ASSUMED 4" LAGGING = 26" DIA
      ESTIMATED 235' LENGTH
      VOLUME = $(1.08')^2 \pi (235') = \underline{866} ft^3$
   b) 14" DIA PIPE WITH ASSUMED 4" LAGGING = 22" DIA
      ESTIMATED 50' LENGTH
      VOLUME = $(0.917')^2 \pi (50') = \underline{132} ft^3$
   c. 12" DIA PIPE WITH ASSUMED 4" LAGGING = 20" DIA
      ESTIMATED 197' LENGTH
      VOLUME = $(0.83')^2 \pi (197') = \underline{430} ft^3$

2. <u>MAIN STEAM LINES</u> (REF 22)
   a) 36" DIA. MANIFOLD WITH ASSUMED 4" LAGGING = 44" DIA
      ESTIMATED 26.5' LENGTH
      VOLUME = $(1.83')^2 \pi (26.5') = \underline{280} ft^3$
   b) 30" DIA PIPE WITH ASSUMED 4" LAGGING = <u>38"</u> DIA
      ESTIMATED 130.5' LENGTH
      VOLUME = $(1.58')^2 \pi (130.5') = \underline{1024} ft^3$
   c) 28" PIPE WITH ASSUMED 4" LAGGING = 36" DIA
      ESTIMATED 452' LENGTH
      VOLUME = $(1.5')^2 \pi (452') = \underline{3195} ft^3$
   d) 14" PIPE WITH ASSUMED 4" LAGGING = 22" DIA (REF 46)
      ESTIMATED 203' LENGTH
      VOLUME = $(.917')^2 \pi (203') = \underline{536} ft^3$
   e) 12" PIPE WITH ASSUMED 4" LAGGING = 20" DIA (REF # 46)
      ESTIMATED 133'
      VOLUME = $(0.83')' \pi (133') = \underline{290} ft^3$

* <u>Checker's Note:</u> Piping Lengths + Volumes [illegible] exact calculations but since they are a small contribution to the overall volume the estimates are acceptable.

1-I-10

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3. COOLING WATER SYSTEM (REF 33)

a) 20" DIA PIPING WITH EST. 722' LENGTH

VOLUME = $(0.83')^2 \pi (722')$ = 1575 ft^3

b) 16" DIA PIPING WITH EST. 75' LENGTH

VOLUME = $(0.66')^2 \pi (75')$ = 105 ft^3

4. 1ST & 2ND POINT EXTRACTION STEAM LINES (REF 34)

a) 18" DIA PIPING WITH ASSUMED 3" LAGGING AND EST. 156' LENGTH

VOLUME = $(1')^2 \pi (156')$ = 490 ft^3

b) 20" DIA PIPING WITH ASSUMED 3" LAGGING AND EST 45' LENGTH

VOLUME = $(1.08')^2 \pi (45')$ = 166 ft^3

5. 3RD & 4TH POINT EXTRACTION STEAM LINES (REF 35)

a) 24" DIA PIPING WITH ASSUMED 3" LAGGING AND EST. 113' LENGTH

VOLUME = $(1.25')^2 \pi (133')$ = 653 ft^3

b) 18" DIA PIPING WITH ASSUMED 3" LAGGING AND EST. 219' LENGTH

VOLUME = $(1')^2 \pi (219')$ = 688 ft^3

c) 20" DIA PIPING WITH ASSUMED 3" LAGGING AND EST 70' LENGTH

VOLUME = $(1.08)^2 \pi (70')$ = 258 ft^3

6. 5TH & 6TH POINT EXTRACTION STEAM LINES (REF 36)

a) 24" PIPING WITH ASSUMED 3" LAGGING AND EST. 176' LENGTH

VOLUME = $(1.25')^2 \pi (176')$ = 864 ft^3

b) 30" PIPING WITH ASSUMED 3" LAGGING AND EST 20' LENGTH

VOLUME = $(1.5')^2 \pi (20')$ = 141 ft^3

c) 26" PIPING WITH ASSUMED 3" LAGGING AND EST 46' LENGTH

VOLUME = $(1.33')^2 \pi (46')$ = 240 ft^3

d) 36" PIPING WITH ASSUME 3" LAGGING AND EST 26' LENGTH

VOLUME = $(1.75')^2 \pi (26')$ = 250 ft^3

7. AUXILIARY STEAM LINES (REF 37)

a) 12" PIPING WITH ASSUMED 2" LAGGING AND EST. 368' LENGTH

VOLUME = $(0.66')^2 \pi (368')$ = 514 ft^3

8. CONDENSATE PIPING (REF 38)

a) 30" PIPING WITH EST. 176' LENGTH, VOL. = $(1.25')^2 \pi (176')$ = 864 ft^3

b) 18" PIPING WITH EST. 670' LENGTH, VOL = $(0.75')^2 \pi (670')$ = 1184 ft^3

c) 24" PIPING WITH EST. 335' LENGTH, VOL = $(1')^2 \pi (335')$ = 1052 ft^3

TOTAL PIPING VOLUME = 866 ft^3 + 132 ft^3 + 430 ft^3 + 280 ft^3 + 1024 ft^3 + 3195 ft^3 + 536 ft^3 + 290 ft^3 + 1575 ft^3 + 105 ft^3 + 490 ft^3 + 166 ft^3 + 653 ft^3 + 258 ft^3 + 864 ft^3 + 141 ft^3 + 240 ft^3 + 250 ft^3 + 514 ft^3 + 864 ft^3 + 1184 ft^3 + 1052 ft^3

= 15109 ft^3

15[illegible] ft^3

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JUNCTIONS:

PAGE 4 of THIS CALCULATION DENOTES by DIAGRAM THE JUNCTIONS USED AND DEPICTS THE LOCATION of VERTICAL JUNCTIONS THROUGH THE OPERATING FLOOR TO NODES 1 & 3 from NODE 2 by THE CROSS-HATCHED AREAS. IT IS NOTED THAT OPENINGS IN THE FLOOR BENEATH THE MOISTURE SEPARATORS EXIST, HOWEVER REF. 19 SHOWS THAT THESE OPENINGS ARE ESSENTIALLY BLOCKED by THE COMPONENT AND ITS FOUNDATION AND SO IS NOT CONSIDERED AS SIGNIFICANT. THE CONSERVATIVE ASSUMPTION IS MADE THAT ALL OPENINGS, ACCESSES AND DOORS THROUGH THE FIRE WALL AS WELL AS TO THE SERVICE BUILDING OR EXITS from THE STRUCTURE ARE CLOSED OR SEALED SUCH THAT THERE ARE NO EFFECTIVE VENT PATHS from THE BUILDING VIA THESE MEANS. IT IS further ASSUMED THAT THE SASHES DEPICTED ON REF. 24, 25 & 30 ARE INTACT AND CLOSED AS WELL. THE LOUVRED OPENINGS WITH DAMPERS SHOWN ON REF 25 ARE CONSIDERED TO BE OPEN fully AND ALL LOUVERS ARE ASSUMED TO BE INTACT AND NOT BLOCKED AS SHOWN ON REF 24, 25 AND 30. THE AREA OPENINGS DESIGNATED AS "HOIST AREA" AT THE OPERATING PLATform ARE ASSUMED TO BE CLEAR, ALL OTHER AREAS, WITH THE EXCEPTION of STAIRWELLS, HAVE 1½" GRATING AS SHOWN ON REF 28 & 29.

THE VERTICAL VENT AREAS THROUGH THE OPERATING floor ARE DIVIDED INTO 6 JUNCTIONS by "TYPE", SIMILAR TYPE OPENINGS BEING TREATED AS THE SAME JUNCTION IN THE MANNER of PARALLEL NETWORK flow PATHS DESCRIBED by fig. 19.3 of REF. 32. THERE ARE 3 "TYPES" CONSIDERED, OPENINGS WITH 1½" GRATING, CLEAR OPENINGS AND STAIRWELLS, THE JUNCTION DESIGNATION for EACH OPENING DEPICTED ON PAGE 4, Combining THESE AREAS IN THIS MANNER WHILE NOT STRICTLY CORRECT WILL HAVE INSIGNIFICANT EFFECT ON THE RESULTS.
THE LOUVERED OPENINGS SHOWN ON REF 25 from THE AIR INTAKE PIT TO NODES 1 & 3 ARE COMBINED IN THE SAME MANNER for A SINGLE JUNCTION TO EACH NODE. THE LOUVERED OPENING WITH DIMENSIONS OF 7'0" x 2.5' SHOWN ON REF 24 IS CONSIDERED INSIGNIFICANT DUE TO ITS SMALL SIZE AND REMOTE LOCATION from THE BREAK AND IS NOT CONSIDERED.

CALCULATIONS of INERTA AND MOMENTUM UTILIZE THE NODAL CROSS SECTIONAL flow AREA AS THE GROSS AREA PERPINDICULAR TO flow DIRECTION, THAT IS COMPONENT AREAS ARE NOT DEDUCTED from THIS VALUE. THIS METHOD WOULD NOT SIGNIFICANTLY AFFECT RESULTS AND IT IS CONSERVATIVE for TEMPERATURE CONCERNS IN THE BREAK NODE.

THE USE OF THE TERM NODE (a) to NODE (b) WHEN EVALUATING A JUNCTION DESCRIBES THE ARBITRARILY DETERMINED DIRECTION of forward flow LOSS COEFFICIENT.

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NODAL GEOMETRY

THE FOLLOWING DIMENSIONS ARE USED AS THE VALUES of LENGTH (L), WIDTH (W) AND HEIGHT (h) FOR THE NODES.

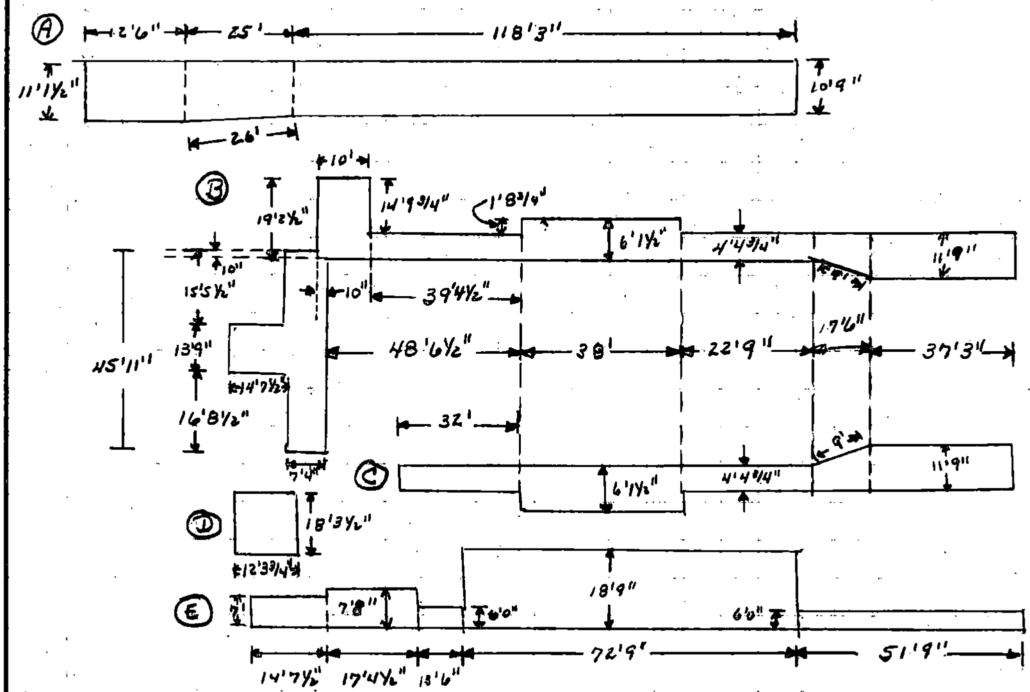
NODE 1 : L = 270' ; W = 135' ; h = 48'3"

NODE 2 : L = 540' ; W = 135' ; h = 69'11"

NODE 3 : L = 270' ; W = 135' ; h = 48'3"

JUNCTION #1 NODE 1 TO NODE 2 (REF 9 & 28)

THE AREAS COMPOSING THIS JUNCTION ARE DIMENSIONED AS follows:



AREA Ⓐ = (11'1½" × 12'6") + (118'3" × 10'9") + [(25' × 10'9") + ½(4.5")(25')] = <u>1684</u> ft²

AREA Ⓑ = (13'9" × 14'7½") + (7'4" × 45'11") + (10' × 14'9¾") + (48'6½" × 4'4¾") + (6'1½" × 38') + (22'9" × 4'4¾") + (7'6" × 4'4¾") + [½(17'6")(7'4¼")] + (11'9" × 37'3")] = <u>1758</u> ft²

AREA Ⓒ = (11'9" × 37'3") + [½(7'6")(7'4¼")] + (7'6" × 4'4¾") + (22'9" × 4'4¾") + (6'1½ × 38') + (32' × 4'4¾") = 999 ft²

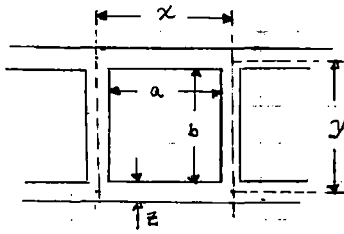
AREA Ⓓ = (18'3½") × (12'3¾") = <u>225</u> ft²

AREA Ⓔ = (7' × 14'7½") + (7'8" × 17'4½") + (6' × 13'6") + (18'9" × 72'9") + (6'0" × 51'9") = <u>2012</u> ft²

(NOTE: THE AREA of THIS OPENING ACTUALLY EXTENDS SLIGHTLY BEYOND THE "B" LINE, HOWEVER THIS DIFFERENCE IS CONSIDERED INSIGNIFICANT AND THIS SMALLER AREA IN ANY EVENT IS CONSERVATIVE).

THE EFFECTIVE OPENING AREA IS REDUCED by THE PRESENCE of THE GRATING, DISCUSSED BELOW.

THE GRATING ACROSS ALL OPENINGS IS ASSUMED TO BE BAR TYPE WITH CELL DIMENSIONS AS follows (NOTE: THE GRATING THICKNESS of 1½" of REF 28 IS TYPICAL of ALL GRATING ON THE OPERATING floor) REF 17, PAGE 5



$z = 3/16''$

$a = 1''$

$b = 3^{13}/16''$

$\therefore x = a + z = 1^{3}/16''$

$y = b + z = 4''$

Π (WETTED PERIMETER) $= 2x + 2y = 10.375$

$\ell = 1.5''$ (GRATING THICKNESS)

$\bar{f} = \frac{(ab)}{(xy)} = 0.80263$ for A GRATING NETWORK WITH THIS CELL DIMENSIONS

from p 330 REF 39 for BAR GRATING of TYPE I, 90° ANGLE TO STREAM for any $\frac{\ell}{d_m}$ (equat. b)

$\zeta = \beta_2 \zeta' \sin\theta$ where $\beta_2 = 1.0$ for bar type I and $\sin 90° = 1$

then $\zeta = \zeta'$

$d_h = \frac{4 f_o}{\Pi}$ (REF 39, p 324) where f_o = ORIFICE AREA $= ab = 3.8125$

$= \frac{4(3.8125)}{10.375} = 1.47$

$\frac{\ell}{d_h} = \frac{1.5}{1.47} = 1.02$

ζ from diagram 8-4 of SAME REF (p 325) for ℓ/d_h of 1.0 and $\bar{f}$ of 0.8 IS 0.29 WHICH CLOSELY APPROXIMATES THE VALUES of ℓ/d_h & $\bar{f}$ obtained HERE. THIS IS EVALUATED IN TERMS of UPSTREAM flow (w_1) HOWEVER AND MUST BE CONVERTED AS follows TO THE flow AREA of THE GRATING for PURPOSES of CONSISTENCY.

$\zeta_{gr} = \zeta(\bar{f})^2$ (REF 40, p. 2-10, EQUAT. 2-5)

$\zeta_{gr} = 0.29(0.80263)^2$

$\zeta_{gr} = 0.188$ which will BE ROUNDED TO $= 0.2$

(ζ_{gr} will BE USED TO IDENTIFY THE LOSS COEFFICIENT ATTRIBUTED TO THE GRATINING NETWORK THROUGHOUT THIS CALCULATIONS. From $\bar{f}$ it is seen that the GRATING occupies ≈ 20% of THE OPENING AREA, THUS EACH OPENING IS REDUCED BY THIS AMOUNT.

THE EFFECTS OF THE FRICTION COEFFICIENT for flow ACROSS THE NODES IS DETERMINED by EVALUATING THE LOSS IMPOSED by WALL FRICTION ONLY from THE CENTROID of THE NODE TO THE JUNCTION UTILIZING THE EXPRESSION found ON PAGE 30 of REF 39, PARAGRAPH 10 where

$\zeta_{fr} = \lambda \frac{\ell}{D_h}$.

BECAUSE ALL NODES ARE of REGULAR GEOMETRIC SHAPE, THE CENTROID of EACH NODE will = 1/2 THE VALUE of THE DIMENSION of THE NODE IN THE DIRECTION of flow, THAT IS THE CENTROID of NODE 1 RELATIVE TO flow THRU JUNCTION #1 = 1/2 h of NODE 1 AND THE CENTROID of NODE 2 RELATIVE TO flow THROUGH JUNCTION 1 IS 1/2 h of NODE 2, ETC. THE CROSS SECTIONAL AREA of flow IS TAKEN AT A PLANE

PERPINDICULAR TO THE DIRECTION of flow AT THE CENTROID, WHICH for flow THROUGH JUNCTION 1 IN NODE 1 will BE W×L of NODE 1, ETC

THUS D_h of THE EXPRESSION for flow from NODE 1 THROUGH JUNCTION 1 WILL = $\frac{4 \times \text{HYDRAULIC DIAMETER}}{\text{PERIMETER of THE flow AREA}}$ OR

$$D_h = \frac{4(w)(L)}{(2(w))+(2(L))} = \frac{4(135')(270')}{(2(135')+2(270'))} = 180 \text{ ft} \quad \text{(LINE 4, p 13)}$$

l of THE EXPRESSION IS THE flow LENGTH, OR THE LENGTH from THE CENTROID TO THE JUNCTION. FOR THIS NODE

$$l = \tfrac{1}{2} h \text{ of NODE 1}$$
$$= \tfrac{1}{2}(48'3'') \quad \text{(LINE 4, p 13)}$$
$$= 24.125'$$

λ (THE friction coefficient) IS EVALUATED AS SHOWN ON p 72 of REF 39 formula 1 where $\lambda = \frac{1}{\left(2 \log \frac{3.7}{\bar{\Delta}}\right)^2}$

$\bar{\Delta} = \frac{\Delta}{D_h}$ in mm (p 54, REF 39), which when CONVERTED TO INCHES

WOULD = $\frac{\Delta(0.03937)}{D_h(12)}$ where Δ IS THE MEAN ROUGHNESS PEAKS for THE MATERIAL SURFACE. IT IS ASSUMED THAT THE MATERIAL ROUGHNESS PEAKS of ALL WALLS WOULD BE NO GREATER THAN THE ESTIMATE GIVEN for AVERAGE CONDITION CONCRETE ON p 63 of REF 39 WHICH = 2.5 mm. THIS MATERIAL IS CHOSEN AS MOST of THE fire WALL IN NODE 1 IS CONCRETE, AND THOUGH THE OUTSIDE WALLS ARE of METAL, THE USE of 2.5 for ROUGHNESS WOULD BE CONSERVATIVE AS APPLIED TO ALL SURFACES.

thus $\bar{\Delta} = \frac{2.5(.03937)}{180(12)} = 0.000045$

$$\lambda = \frac{1}{\left(2 \log \frac{3.7}{\bar{\Delta}}\right)^2} = 0.01$$

$\therefore \quad \zeta_{fr} = \lambda \frac{l}{D_h} = \frac{0.01(24.125')}{180 \text{ ft}} = 0.0014$ for NODE 1 flow THROUGH JUNCTION 1

THE VALUE THEN USED will = 0.002

SIMILARILY THE NODAL friction LOSS from NODE 2 THROUGH JUNCTION 1 is EVALUATED, WHERE $l = \tfrac{1}{2} h$ of NODE 2 (LINE 5, p 13) $= \tfrac{1}{2}(69'11'') = 34.96$ ft

$$D_h = \frac{4(w)(L)}{(2w+2L)} = \frac{4(540')(135')}{(2(540')+2(135'))} = 216 \text{ ft}$$

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$$\bar{\Delta} = \frac{\Delta(0.03937\ in/mm)}{D_h(12\ in/ft)} = \frac{2.5(0.03937)}{216'(12)} = 0.000038$$ (THE VALUE of Δ = 2.5 IS RETAINED for CONSERVATISM)

$$\lambda = \frac{1}{\left(2\log\frac{3.7}{\bar{\Delta}}\right)^2} = 0.01005$$

$$\zeta_{fr} = \lambda\left(\frac{\ell}{d_h}\right) = \frac{0.01(34.96')}{216'} = 0.0016$$ for flow from NODE 2 TO JUNCT. #1 $= 0.002$

SINCE NODE 3 HAS THE SAME GEOMETRY AS NODE 1 AND flow THROUGH JUNCTIONS 2 THROUGH 6 ARE IN THE SAME DIRECTION AS THROUGH JUNCTION 1, THEN ζ_{fr} for THOSE JUNCTIONS WOULD ALSO BE 0.002

EACH AREA THAT COMPOSES THIS JUNCTION will NOW BE EVALUATED for INDIVIDUAL LOSS COEFFICIENTS (K) AND INERTIA (I) AS A THICK-EDGED ORIFACE IN THE MANNER DESCRIBED ON p.137 of REF 39, THE SLAB THICKNESS, THUS THE OPENING LENGTH (L_j) IS 9" for ALL AREAS AS SHOWN ON REF. 28. THE SYMBOL F IS UTILIZED TO DENOTE THE CROSS-SECTIONAL flow AREA AND THE SUBCRIPS j = JUNCTION, N(x) = NODE DESIGNATION. Π IS USED TO SIGNIFY flow PERIMITER of THE INLET TO THE CONTRACTING STRETCH AND SUBCRIPTS F & R REFER TO flow DIRECTION THROUGH THE OPENING, RESPECTIVELY, FORWARD AND REVERSE.

AREA (A)

$L_j = 9''$ OR $(0.75')$

$F_j = 1684\ ft^2\ (.80\%) = 1347.2\ ft^2$ (from LINE 30, p13)

$\Pi = 25'11\tfrac{1}{2}'' + 12'6'' + 118'3'' + 10'9'' + 118'3'' + 26' + 12'6'' = 334.375'$ (L12, p13)

$$D_h = \frac{4F_j}{\Pi} = \frac{4(1347.2\ ft^2)}{334.375'} = 16.12'$$

$$\tau = f\left(\frac{L_j}{D_h}\right) = \frac{0.75'}{16.12'} = 0.0465 = 1.32$$ by INTERPOLATION from DIAG. 4-11 p137, REF 39

$$\bar{\Delta} = \frac{\Delta(0.03937\ in/mm)}{D_h(12\ in/ft)} = \frac{2.5(0.03937)}{16.12(12)} = .000509$$ WHERE Δ = 2.5 for AVE. CONRETE (p63, REF 39)

$$\lambda = \frac{1}{\left(2\log\frac{3.7}{\bar{\Delta}}\right)^2} = 0.017$$

F_{N1} = W x L of NODE 1 = $135' \times 270' = 36450\ ft^2$

F_{N2} = W x L of NODE 2 = $135' \times 540' = 72900\ ft^2$

FOR FORWARD flow

$$\zeta_F = 0.5\left(1-\frac{F_j}{F_{N1}}\right) + \left(1-\frac{F_j}{F_{N2}}\right)^2 + \tau\sqrt{\left(1-\frac{F_j}{F_{N1}}\right)}\left(1-\frac{F_j}{F_{N2}}\right) + \lambda\left(\frac{L_j}{D_h}\right)$$

$$\zeta_F = 0.5\left(1-\frac{1347.2\ ft^2}{36450\ ft^2}\right) + \left(1-\frac{1347.2\ ft^2}{72900\ ft^2}\right)^2 + 1.32\sqrt{\left(1-\frac{1347.2\ ft^2}{36450\ ft^2}\right)}\left(1-\frac{1347.2\ ft^2}{72900\ ft^2}\right) + 0.017\left(\frac{0.75}{16.12'}\right) = 2.72$$

for REVERSE flow

$$\zeta_R = 0.5\left(1-\frac{F_J}{F_{N2}}\right)+\left(1-\frac{F_J}{F_{N1}}\right)^2+\tau_N\sqrt{\left(1-\frac{F_J}{F_{N2}}\right)\left(1-\frac{F_J}{F_{N1}}\right)}+\lambda\left(\frac{L_J}{D_h}\right)$$

$$=0.5\left(1-\frac{1347.2ft^2}{72900ft^2}\right)+\left(1-\frac{1347.2ft^2}{36450ft^2}\right)^2+1.32_N\sqrt{\left(1-\frac{1347.2ft^2}{72900ft^2}\right)\left(1-\frac{1347.2ft^2}{36450ft^2}\right)}+0.017\left(\frac{0.75'}{16.12'}\right)=\underline{2.68}$$

THE MOMENTUM FLUX TERM (K') IS EVALUATED AS DESCRIBED IN REF. 32.

FOR FORWARD FLOW

$$K'_F = \left(\frac{F_J}{F_{N2}}\right)^2-\left(\frac{F_J}{F_{N1}}\right)^2=\left(\frac{1347.2ft^2}{72900ft^2}\right)^2-\left(\frac{1347.2ft^2}{36450ft^2}\right)^2=-0.001$$

for REVERSE flow

$$K'_R = \left(\frac{F_J}{F_{N1}}\right)^2-\left(\frac{F_J}{F_{N2}}\right)^2=\left(\frac{1347.2ft^2}{36450ft^2}\right)^2-\left(\frac{1347.2ft^2}{72900ft^2}\right)^2=0.001$$

THUS THE TOTAL LOSS COEFFICIENT (K) FOR AREA ④ IS

FOR FORWARD FLOW

$$K_F = \zeta_F+\zeta_{fr}+\zeta_{gr}+K'_F = 2.72+0.002+0.2+(-0.001) = \underline{2.92}$$

for REVERSE FLOW

$$K_R = \zeta_R+\zeta_{fr}+\zeta_{gr}+K'_R = 2.68+0.002+0.2+0.001 = \underline{2.88}$$

THE INERTIA TERM (I) IS EVALUATED AS DESCRIBED IN REF 32.

$$I = L_J\left(\frac{1}{F_J}\right)+L_{N1}\left(\frac{1}{F_{N1}}\right)+L_{N2}\left(\frac{1}{F_{N2}}\right)$$ WHERE L_{N1} AND L_{N2} IS THE FLOW LENGTH FROM THE CENTROID OF THE NODE TO THE INLET OF THE JUNCTION, ASSUMED TO BE ½ h IN THIS CASE FOR THOSE NODES, THUS.

$$L_{N1} = \tfrac{1}{2}(h_{N1}) = \tfrac{1}{2}(48'3'') = 24.125'$$

$$L_{N2} = \tfrac{1}{2}(h_{N2}) = \tfrac{1}{2}(69'11'') = 34.958'$$

$$\therefore\ I = 0.75'\left(\frac{1}{1347.2ft^2}\right)+24.125'\left(\frac{1}{36450ft^2}\right)+34.958'\left(\frac{1}{72900ft^2}\right)=0.001698\ ft^{-1}$$

THE MINIMUM VALUE OF I THAT MAY BE USED AS INPUT TO THE 'THREED' SUBCOMPARTMENT ANALYSIS IS 0.01 ft^{-1}. AS DEMONSTRATED BY THIS CALCULATION FOR FLOWS THROUGH OPENINGS IN THE OPERATING DUE TO THE LARGE NODAL FLOW AREAS AS COMPARED TO FLOW LENGTHS AND THE RELATIVELY SHORT FLOW LENGTH THROUGH THE OPENING AS COMPARED TO THE OPENING AREA, IT IS EVIDENT THAT ALL VALUES OF I FOR THESE OPENINGS WILL DEFAULT TO THE MINIMUM INPUT VALUE. FROM THIS OBSERVATION, NO FURTHER CALCULATION FOR THE INERTIA TERM WILL BE PERFORMED FOR THE OTHER OPENINGS IN THIS AREA AND THE VALUE OF I FOR THIS JUNCTION IS SET TO EQUAL 0.01 ft^{-1}

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THE REMAINING AREAS ARE EVALUATED IN THE SAME MANNER AS USED FOR AREA A. AS NOTED BEFORE, THE VALUES OF ζ_{gr}, ζ_{fr} AND I ARE THE SAME FOR ALL AREAS. SIMILARILY, THE VALUES OF L_j, F_{N1}, F_{N2} AND Δ ARE THE SAME AS THAT USED IN AREA A FOR THE REMAINING AREAS

<u>AREA B.</u>

$L_j = 0.75'$

$F_j = 1758\,ft^2\,(80\%) = \underline{1406.4\,ft^2}$ (LINE 32, p 13)

$\Pi = 14'7\tfrac{1}{2}'' + 15'5\tfrac{1}{2}'' + 6'6'' + 19'2\tfrac{1}{2}'' + 10' + 14'9\tfrac{3}{4}'' + 39'4\tfrac{1}{2}'' + 1'8\tfrac{3}{4}'' + 38' + 1'8\tfrac{3}{4}'' + 22'9'' + 7'6'' + 37'3'' + 11'9'' + 37'3'' + 9' + 22'9'' + 38' + 48'6\tfrac{1}{2}'' + 45'11'' + 7'4'' + 16'8\tfrac{1}{2}'' + 14'7\tfrac{1}{2}'' + 13'9'' = \underline{494.56'}$ (LINE 17, p13)

$$D_h = \frac{4F_j}{\Pi} = \frac{4(1406.4\,ft^2)}{494.56'} = 11.38'$$

$$\tau = f\left(\frac{L_j}{D_h}\right) = \frac{0.75'}{11.38'} = 0.066 = 1.31$$ by INTERPOLATION DIAG. 4-11, p137, Ref 39

$$\bar{\Delta} = \frac{\Delta\,(0.03937\,in/mm)}{D_h\,(12\,in/ft)} = \frac{2.5(0.03937)}{11.38(12)} = 0.006721$$

$$\lambda = \frac{1}{\left(2\log\frac{3.7}{\bar{\Delta}}\right)^2} = 0.018$$

$$\zeta_F = 0.5\left(1-\frac{F_j}{F_{N1}}\right) + \left(1-\frac{F_j}{F_{N2}}\right)^2 + \tau\sqrt{\left(1-\frac{F_j}{F_{N1}}\right)\left(1-\frac{F_j}{F_{N2}}\right)} + \lambda\left(\frac{L_j}{D_h}\right)$$

$$= 0.5\left(1-\frac{1406.4\,ft^2}{36450\,ft^2}\right) + \left(1-\frac{1406.4\,ft^2}{72900\,ft^2}\right)^2 + 1.31\sqrt{\left(1-\frac{1406.4\,ft^2}{36450\,ft^2}\right)\left(1-\frac{1406.4\,ft^2}{72900\,ft^2}\right)} + 0.018\left(\frac{0.75'}{11.38'}\right) = \underline{2.70}$$

$$\zeta_R = 0.5\left(1-\frac{F_j}{F_{N2}}\right) + \left(1-\frac{F_j}{F_{N1}}\right)^2 + \tau\sqrt{\left(1-\frac{F_j}{F_{N2}}\right)\left(1-\frac{F_j}{F_{N1}}\right)} + \lambda\left(\frac{L_j}{D_h}\right)$$

$$= 0.5\left(1-\frac{1406.4\,ft^2}{72900\,ft^2}\right) + \left(1-\frac{1406.4\,ft^2}{36450\,ft^2}\right)^2 + 1.31\sqrt{\left(1-\frac{1406.4\,ft^2}{72900\,ft^2}\right)\left(1-\frac{1406.4\,ft^2}{36450\,ft^2}\right)} + 0.018\left(\frac{0.75'}{11.38'}\right) = 2.66$$

$$K'_F = \left(\frac{F_j}{F_{N2}}\right)^2 - \left(\frac{F_j}{F_{N1}}\right)^2 = \left(\frac{1406.4\,ft^2}{72900\,ft^2}\right)^2 - \left(\frac{1406.4\,ft^2}{36450\,ft^2}\right)^2 = -0.00112$$

$$K'_R = \left(\frac{F_j}{F_{N1}}\right)^2 - \left(\frac{F_j}{F_{N2}}\right)^2 = \left(\frac{1406.4\,ft^2}{36450\,ft^2}\right)^2 - \left(\frac{1406.4\,ft^2}{72900\,ft^2}\right)^2 = +0.00112$$

$\zeta_{gr} = 0.2$

$\zeta_{fr} = 0.002$

$K_F = K'_F + \zeta_F + \zeta_{fr} + \zeta_{gr} = (-0.00112) + 2.70 + 0.002 + 0.2 = \underline{2.90}$

$K_R = K'_R + \zeta_R + \zeta_{fr} + \zeta_{gr} = 0.00112 + 2.66 + 0.002 + 0.2 = \underline{2.86}$

$I = 0.01\,ft^{-1}$

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AREA C

$L_j = 0.75'$

$F_j = 999 ft^2 (80\%) = 799.2 ft^2$ (LINE 34, P13)

$\Pi = 32' + 38' + 22'9'' + 9' + 37'3'' + 11'9'' + 37'3'' + 7'6'' + 22'9'' + 38' + 1'8\frac{3}{4}'' + 1'8\frac{3}{4}'' + 32' + 4'4\frac{3}{4}'' = \underline{296.104'}$ (LINE 23, P13)

$$D_h = \frac{4F_j}{\Pi} = \frac{4(799.2 ft^2)}{296.104'} = 10.8'$$

$$\tau = f\left(\frac{L_j}{D_h}\right) = \frac{0.75'}{10.8'} = 0.069 = 1.31$$ by INTERP. from DIAG 4-11, P137, REF 39

$$\bar{\Delta} = \frac{\Delta(.03937 IN/mm)}{D_h(12 IN/ft)} = \frac{2.5(.03937)}{10.8'(12)} = 0.00076$$

$$\lambda = \frac{1}{\left(2\log\frac{3.7}{\bar{\Delta}}\right)^2} = 0.018$$

$$\zeta_F = 0.5\left(1-\frac{F_j}{F_{N1}}\right)+\left(1-\frac{F_j}{F_{N2}}\right)^2+\tau\sqrt{\left(1-\frac{F_j}{F_{N1}}\right)\left(1-\frac{F_j}{F_{N2}}\right)}+\lambda\left(\frac{L_j}{D_h}\right)$$

$$=0.5\left(1-\frac{799.2ft^2}{36450ft^2}\right)+\left(1-\frac{799.2ft^2}{72900ft^2}\right)^2+1.31\sqrt{\left(1-\frac{799.2ft^2}{36450ft^2}\right)\left(1-\frac{799.2ft^2}{72900ft^2}\right)}+0.018\left(\frac{0.75'}{10.8'}\right) = \underline{2.75}$$

$$\zeta_R = 0.5\left(1-\frac{F_j}{F_{N2}}\right)+\left(1-\frac{F_j}{F_{N1}}\right)^2+\tau\sqrt{\left(1-\frac{F_j}{F_{N2}}\right)\left(1-\frac{F_j}{F_{N1}}\right)}+\lambda\left(\frac{L_j}{D_h}\right)$$

$$=0.5\left(1-\frac{799.2ft^2}{72900ft^2}\right)+\left(1-\frac{799.2ft^2}{36450ft^2}\right)^2+1.31\sqrt{\left(1-\frac{799.2ft^2}{72900ft^2}\right)\left(1-\frac{799.2ft^2}{36450ft^2}\right)}+0.018\left(\frac{0.75'}{10.8'}\right) = \underline{2.73}$$

$$K'_F = \left(\frac{F_j}{F_{N2}}\right)^2-\left(\frac{F_j}{F_{N1}}\right)^2 = \left(\frac{799.2ft^2}{72900ft^2}\right)^2-\left(\frac{799.2ft^2}{36450ft^2}\right)^2 = -0.00036$$

$$K'_R = \left(\frac{F_j}{F_{N1}}\right)^2-\left(\frac{F_j}{F_{N2}}\right)^2 = \left(\frac{799.2ft^2}{36450ft^2}\right)^2-\left(\frac{799.2ft^2}{72900ft^2}\right)^2 = 0.00036$$

$\zeta_{gr} = 0.2$

$\zeta_{fr} = 0.002$

$$K_F = \zeta_F+\zeta_{gr}+\zeta_{fr}+K'_F = 2.75+0.2+0.002+(-0.00036) = \underline{2.95}$$

$$K_R = \zeta_R+\zeta_{gr}+\zeta_{fr}+K'_R = 2.73+0.2+0.002+(0.00036) = \underline{2.93}$$

$I = 0.01\ ft^{-1}$

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AREA D.

$L_j = 0.75'$

$F_j = 225\,ft^2 (80\%) = 180\,ft^2$ (LINE 35, p 13)

$\Pi = 18'3\tfrac{1}{2}'' + 18'3\tfrac{1}{2}'' + 12'3\tfrac{3}{4}'' + 12'3\tfrac{3}{4}'' = \underline{61.21'}$ (LINE 25, p 13)

$D_h = \dfrac{4F_j}{\Pi} = \dfrac{4(180\,ft^2)}{61.21'} = 11.76'$

$\tau = f\left(\dfrac{L_j}{D_h}\right) = \left(\dfrac{0.75'}{11.76'}\right) = .0638 = 1.31$ by INTERP. DIAG 4-11, P137, REF 39

$\bar{\Delta} = \dfrac{\Delta(0.03937\,in/mm)}{D_h(12\,in/ft)} = \dfrac{2.5(.03937)}{11.76(12)} = 0.0006975$

$\lambda = \dfrac{1}{\left(2\log\dfrac{3.7}{\bar{\Delta}}\right)^2} = 0.018$

$\zeta_F = 0.5\left(1-\dfrac{F_j}{F_{N1}}\right) + \left(1-\dfrac{F_j}{F_{N2}}\right)^2 + \tau\sqrt{\left(1-\dfrac{F_j}{F_{N1}}\right)\left(1-\dfrac{F_j}{F_{N2}}\right)} + \lambda\left(\dfrac{L_j}{D_h}\right)$

$= 0.5\left(1-\dfrac{180ft^2}{36450ft^2}\right) + \left(1-\dfrac{180ft^2}{72900ft^2}\right)^2 + 1.31\sqrt{\left(1-\dfrac{180ft^2}{36450ft^2}\right)\left(1-\dfrac{180ft^2}{72900ft^2}\right)} + 0.018\left(\dfrac{0.75'}{11.76'}\right) = 2.80$

$\zeta_R = 0.5\left(1-\dfrac{F_j}{F_{N2}}\right) + \left(1-\dfrac{F_j}{F_{N1}}\right)^2 + \tau\sqrt{\left(1-\dfrac{F_j}{F_{N2}}\right)\left(1-\dfrac{F_j}{F_{N1}}\right)} + \lambda\left(\dfrac{L_j}{D_h}\right)$

$0.5\left(1-\dfrac{180ft^2}{72900ft^2}\right) + \left(1-\dfrac{180ft^2}{36450ft^2}\right)^2 + 1.31\sqrt{\left(1-\dfrac{180ft^2}{72900ft^2}\right)\left(1-\dfrac{180ft^2}{36450ft^2}\right)} + 0.018\left(\dfrac{0.75}{11.76'}\right) = 2.80$

$K'_F = \left(\dfrac{F_j}{F_{N2}}\right)^2 - \left(\dfrac{F_j}{F_{N1}}\right)^2 = \left(\dfrac{180ft^2}{72900ft^2}\right)^2 - \left(\dfrac{180ft^2}{36450ft^2}\right)^2 = -.000018$

$K'_R = \left(\dfrac{F_j}{F_{N1}}\right)^2 - \left(\dfrac{F_j}{F_{N2}}\right)^2 = \left(\dfrac{180ft^2}{36450ft^2}\right)^2 - \left(\dfrac{180ft^2}{72900ft^2}\right)^2 = .000018$

$\zeta_{gr} = 0.2$

$\zeta_{fr} = 0.002$

$K_F = \zeta_F + \zeta_{gr} + \zeta_{fr} + K'_F = 2.80 + 0.2 + 0.002 + (-0.000018) = 3.00$

$K_R = \zeta_R + \zeta_{gr} + \zeta_{fr} + K'_R = 2.80 + 0.2 + 0.002 + 0.000018 = 3.00$

$I = 0.01\,ft^{-1}$

▲5010.65

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AREA E

$L_j = 0.75'$

$F_j = 2012\ ft^2 (80\%) = 1609.6\ ft^2$ (LINE 36, p13)

$\Pi = 14'7\tfrac{1}{2}'' + 8'' + 17'4\tfrac{1}{2}'' + 8'' + 13'6'' + 12'9'' + 72'9'' + 12'9'' + 51'9''$
$+ 4'0'' + 51'9'' + 72'9'' + 13'6'' + 17'4\tfrac{1}{2}'' + 14'7\tfrac{1}{2}'' + 7' = 394.5$ (LINE 27, p13)
378.54

$D_h = \dfrac{4(F_j)}{\Pi} = \dfrac{4(1609.6 ft^2)}{394.5'} = 16.32'$

$\tau = f\left(\dfrac{L_j}{D_h}\right) = \dfrac{0.75'}{16.32'} = 0.046 = 1.32$ by INTERP. from DIAG 4-11, p.137, REF 39

$\bar{\Delta} = \dfrac{\Delta(.03937 in/mm)}{D_h(12 in/ft)} = \dfrac{2.5(.03937)}{16.32'(12)} = 0.0005$

$\lambda = \dfrac{1}{\left(2\log\dfrac{3.7}{\bar{\Delta}}\right)^2} = 0.017$

$\zeta_F = 0.5\left(1-\dfrac{F_j}{F_{N1}}\right) + \left(1-\dfrac{F_j}{F_{N2}}\right)^2 + \tau\sqrt{\left(1-\dfrac{F_j}{F_{N1}}\right)\left(1-\dfrac{F_j}{F_{N2}}\right)} + \lambda\left(\dfrac{L_j}{D_h}\right)$

$= 0.5\left(1-\dfrac{1609.6 ft^2}{36450 ft^2}\right) + \left(1-\dfrac{1609.6 ft^2}{72900 ft^2}\right)^2 + 1.32\sqrt{\left(1-\dfrac{1609.6 ft^2}{36450 ft^2}\right)\left(1-\dfrac{1609.6 ft^2}{72900 ft^2}\right)} + 0.017\left(\dfrac{0.75'}{16.32'}\right) = 2.70$

$\zeta_R = 0.5\left(1-\dfrac{F_j}{F_{N2}}\right) + \left(1-\dfrac{F_j}{F_{N1}}\right)^2 + \tau\sqrt{\left(1-\dfrac{F_j}{F_{N2}}\right)\left(1-\dfrac{F_j}{F_{N1}}\right)} + \lambda\left(\dfrac{L_j}{D_h}\right)$

$= 0.5\left(1-\dfrac{1609.6 ft^2}{72900 ft^2}\right) + \left(1-\dfrac{1609.6 ft^2}{36450 ft^2}\right)^2 + 1.32\sqrt{\left(1-\dfrac{1609.6 ft^2}{72900 ft^2}\right)\left(1-\dfrac{1609.6 ft^2}{36450 ft^2}\right)} + 0.017\left(\dfrac{0.75'}{16.32'}\right) = 2.65$

$k'_F = \left(\dfrac{F_j}{F_{N2}}\right)^2 - \left(\dfrac{F_j}{F_{N1}}\right)^2 = \left(\dfrac{1609.6 ft^2}{72900 ft^2}\right)^2 - \left(\dfrac{1609.6 ft^2}{36450 ft^2}\right)^2 = -0.0015$

$k'_R = \left(\dfrac{F_j}{F_{N1}}\right)^2 - \left(\dfrac{F_j}{F_{N2}}\right)^2 = \left(\dfrac{1609.6 ft^2}{36450 ft^2}\right)^2 - \left(\dfrac{1609.6 ft^2}{72900 ft^2}\right)^2 = 0.0015$

$\zeta_{gr} = 0.2$
$\zeta_{fr} = 0.002$

$K_F = \zeta_F + \zeta_{fr} + \zeta_{gr} + k'_F = 2.70 + 0.002 + 0.2 + (-0.0015) = 2.90$

$K_R = \zeta_R + \zeta_{fr} + \zeta_{gr} + k'_R = 2.65 + 0.002 + 0.2 + 0.0015 = 2.85$

$I = 0.01\ ft^{-1}$

THE REFERENCE 32 DISCUSSION ON COMBINING PARALLEL NETWORK FLOW PATHS IS USED AS THE BASIS FOR EVALUATING THE EFFECTIVE LOSS COEFFICIENT RESULTING FROM COMBINING AREAS A THRU E INTO ONE JUNCTION. SINCE THE RATE OF CHANGE OF THE MASS FLOW RATE IS UNKNOWN FOR THE INERTA VALUES THE DISCUSSION STIPULATES THAT THE PARALLEL FLOW PATHS BE IDENTICAL, AND THEREFORE EVALUATES THE EFFECTIVE INERTAS AND LOSS COEFFICIENTS IN THAT MANNER. IN THIS CASE, HOWEVER, THE INERTA VALUES ARE DEFAULTED TO 0.01 ft^{-1} AND THUS AN ARITHMETIC COMBINATION OF THOSE VALUES IS MEANINGLESS, THEREFORE IT REMAINS VALID THAT A COMBINATION OF THESE AREAS INTO ONE JUNCTION, THOUGH NOT IDENTICAL, IS PERFORMED. SINCE THE FLOW AREAS ARE NOT SAME IT WILL BE NECESSARY TO EVALUATE THE EFFECTIVE LOSS COEFFICIENT THROUGH THE SUMMATION AS GIVEN BY FORMULA (19-19) OF THE DISCUSSION AS SHOWN BELOW

$$K_{eff} = \frac{A_{ref}^2}{\left(\sum_i^n \left(\frac{A_i^2}{K_i}\right)^{1/2}\right)^2}$$

WHERE A_{ref} IS THE SUM OF ALL AREAS (F_j) TO BE COMBINED

TO SUMMARIZE THE VALUES OF F_j AND K FOR EACH AREA, DENOTED BY SUBSCRIPT ◯ FOR ITS DESIGNATION.

$F_{j(A)} = 1347.2\ ft^2$; $F_{j(B)} = 1406.4\ ft^2$; $F_{j(C)} = 799.2\ ft^2$; $F_{j(D)} = 180\ ft^2$; $F_{j(E)} = 1609.6\ ft^2$

$K_{F(A)} = 2.92$; $K_{F(B)} = 2.90$; $K_{F(C)} = 2.95$; $K_{F(D)} = 3.00$; $K_{F(E)} = 2.90$

$K_{R(A)} = 2.88$; $K_{R(B)} = 2.86$; $K_{R(C)} = 2.93$; $K_{R(D)} = 3.00$; $K_{R(E)} = 2.85$

FOR FORWARD FLOW

$$K_{eff} = \frac{\left(F_{j(A)} + F_{j(B)} + F_{j(C)} + F_{j(D)} + F_{j(E)}\right)^2}{\left(\frac{F_{j(A)}}{(K_{F(A)})^{1/2}} + \frac{F_{j(B)}}{(K_{F(B)})^{1/2}} + \frac{F_{j(C)}}{(K_{F(C)})^{1/2}} + \frac{F_{j(D)}}{(K_{F(D)})^{1/2}} + \frac{F_{j(E)}}{(K_{F(E)})^{1/2}}\right)^2}$$

$$= \frac{\left(1347.2\,ft^2 + 1406.4\,ft^2 + 799.2\,ft^2 + 180\,ft^2 + 1609.6\,ft^2\right)^2}{\left(\frac{1347.2\,ft^2}{(2.92)^{1/2}} + \frac{1406.4\,ft^2}{(2.90)^{1/2}} + \frac{799.2\,ft^2}{(2.95)^{1/2}} + \frac{180\,ft^2}{(3.0)^{1/2}} + \frac{1609.6\,ft^2}{(2.90)^{1/2}}\right)^2} = \underline{2.92}$$

FOR REVERSE FLOW

$$K_{eff} = \frac{\left(F_{j(A)} + F_{j(B)} + F_{j(C)} + F_{j(D)} + F_{j(E)}\right)^2}{\left(\frac{F_{j(A)}}{K_{R(A)}^{1/2}} + \frac{F_{j(B)}}{K_{R(B)}^{1/2}} + \frac{F_{j(C)}}{K_{R(C)}^{1/2}} + \frac{F_{j(D)}}{K_{R(D)}^{1/2}} + \frac{F_{j(E)}}{K_{R(E)}^{1/2}}\right)^2}$$

$$= \frac{\left(1347.2\,ft^2 + 1406.4\,ft^2 + 799.2\,ft^2 + 180\,ft^2 + 1609.6\,ft^2\right)^2}{\left(\frac{1347.2\,ft^2}{(2.88)^{1/2}} + \frac{1406.4\,ft^2}{(2.86)^{1/2}} + \frac{799.2\,ft^2}{(2.93)^{1/2}} + \frac{180\,ft^2}{(3.0)^{1/2}} + \frac{1609.6\,ft^2}{(2.85)^{1/2}}\right)^2} = \underline{2.88}$$

IN SUMMARY

JUNCTION AREA = SUM OF $F_{j(A)} \rightarrow F_{j(E)}$ = 5342.4 ft^2 AT ELEVATION 58'6"

INERTA = 0.01 ft^{-1} $K_F = 2.92$; $K_R = 2.88$

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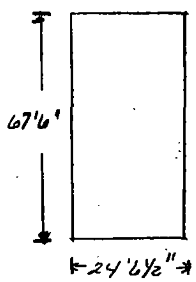
JUNCTION #2. (NODE 1 to NODE 2)



DIMENSIONS from REF. 28

0.75' THICK = L_j

$F_j = (67'6")(24'6½") = 1656.56\ ft^2$

$\Pi = (67'6") + 24'6½" + 67'6" + 24'6½" = 184.08\ ft$

$D_h = \frac{4F_j}{\Pi} = \frac{4(1656.56\ ft^2)}{184.08\ ft} = 35.996$

$\tau = f\left(\frac{L_j}{D_h}\right) = 0.0208 = 1.34$ by INTERPOLATION DIAG. 4-11 p 137, REF 39

$\bar{\Delta} = \frac{\Delta(.03937\ in/mm)}{D_h(12\ in/ft)} = \frac{2.5(0.03937)}{35.996(12)} = 0.000228$

where $\Delta = 2.5$ for AVE. CONCRETE p 68, REF. 39

$\lambda = \frac{1}{\left(2 \log \frac{3.7}{\bar{\Delta}}\right)^2} = 0.014$

from AREA A of JUNCTION 1, $F_{N1} = 36450\ ft^2$; I = 0.01

$F_{N2} = 72900\ ft^2$

AND $\zeta_{fr} = 0.002$

$$\zeta_F = 0.5\left(1 - \frac{F_j}{F_{N1}}\right) + \left(1 - \frac{F_j}{F_{N2}}\right)^2 + \tau\sqrt{\left(1 - \frac{F_j}{F_{N1}}\right)\left(1 - \frac{F_j}{F_{N2}}\right)} + \lambda\left(\frac{L_j}{D_h}\right)$$

$$= 0.5\left(1 - \frac{1656.56\ ft^2}{36450\ ft^2}\right) + \left(1 - \frac{1656.56\ ft^2}{72900\ ft^2}\right)^2 + 1.34\sqrt{\left(1 - \frac{1656.56\ ft^2}{36450\ ft^2}\right)\left(1 - \frac{1656.56\ ft^2}{72900\ ft^2}\right)} + 0.014\left(\frac{0.75'}{35.996'}\right)$$

$$= \underline{2.71}$$

$$\zeta_R = 0.5\left(1 - \frac{F_j}{F_{N2}}\right) + \left(1 - \frac{F_j}{F_{N1}}\right)^2 + \tau\sqrt{\left(1 - \frac{F_j}{F_{N2}}\right)\left(1 - \frac{F_j}{F_{N1}}\right)} + \lambda\left(\frac{L_j}{D_h}\right)$$

$$= 0.5\left(1 - \frac{1656.56\ ft^2}{72900\ ft^2}\right) + \left(1 - \frac{1656.56\ ft^2}{36450\ ft^2}\right)^2 + 1.34\sqrt{\left(1 - \frac{1656.56\ ft^2}{72900\ ft^2}\right)\left(1 - \frac{1656.56\ ft^2}{36450\ ft^2}\right)} + 0.014\left(\frac{0.75'}{35.996'}\right)$$

$$= \underline{2.67}$$

$$K'_F = \left(\frac{F_j}{F_{N2}}\right)^2 - \left(\frac{F_j}{F_{N1}}\right)^2 = \left(\frac{1656.56\ ft^2}{72900\ ft^2}\right)^2 - \left(\frac{1656.56\ ft^2}{36450\ ft^2}\right)^2 = -0.00155$$

$$K'_R = \left(\frac{F_j}{F_{N1}}\right)^2 - \left(\frac{F_j}{F_{N2}}\right)^2 = \left(\frac{1656.56\ ft^2}{36450\ ft^2}\right)^2 - \left(\frac{1656.56\ ft^2}{72900\ ft^2}\right)^2 = 0.00155$$

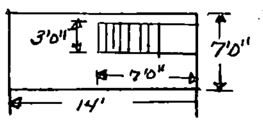
$$K_F = \zeta_F + K'_F + \zeta_{fr} = 2.71 + 0.002 + (-0.00155) = \underline{2.71}$$

$$K_R = \zeta_R + K'_R + \zeta_{fr} = 2.67 + 0.002 + (0.00155) = \underline{2.67}$$

JUNCTION #3 (NODE 1 TO NODE 2)

THIS JUNCTION IS COMPOSED OF 3 STAIRWELL OPENINGS AS SHOWN ON REF 9 & 28. THE STAIRS ASSUMED TO OCCUPY, CONSERVATIVELY, 50% OF THE OPENING LENGTH × THEIR WIDTH, THE NET EFFECT TO SIMPLY REDUCE FLOW AREA, FROM WHICH THE OPENINGS AS EVALUATED AS A THICK EDGED ORIFACE. THE OPENINGS WILL THEN BE COMBINED IN THE SAME MANNER AS WAS PERFORMED FOR JUNCTION #1, SAVE THAT AN APPROXIMATION OF THE INERTIA TERM WILL BE UTILIZED AS DISCUSSED BELOW. FROM REF 9 & 28 THE OPENINGS ARE DIMENSIONED AS INDICATED.

AREA (A) LOCATED ALONG SOUTH WALL NEAR LINE (11)



$L_j = 0.75'$ (REF 28)

$F_j = (7' \times 14') - (3' \times 7') = 77 ft^2$

$\Pi = 2(14') + 0(7') = 42 ft$

$D_h = \frac{4(F_j)}{\Pi} = \frac{4(77)}{42 ft} = 7.33'$

$\tau = f\left(\frac{L_j}{D_h}\right) = \frac{0.75'}{7.33'} = 0.102 = 1.28$ by INTERP. FROM DIAG 4-11, p137, REF 39

$\bar{\Delta} = \frac{\Delta(.03937 in/mm)}{D_h(12 in/ft)} = \frac{2.5(.03937)}{7.33'(12)} = .001119$ where $\Delta = 2.5$ FOR AVE. COND. CONCRETE p 43, REF 39

$\lambda = \frac{1}{\left(2\log\frac{3.7}{\bar{\Delta}}\right)^2} = 0.02$

FROM JUNCTION #1 $F_{N1} = 36450 ft^2$; $L_{N1} = 24.125'$
$F_{N2} = 72900 ft^2$; $L_{N2} = 34.958'$

$$\zeta_F = 0.5\left(1-\frac{F_j}{F_{N1}}\right) + \left(1-\frac{F_j}{F_{N2}}\right)^2 + \tau\sqrt{\left(1-\frac{F_j}{F_{N1}}\right)}\left(1-\frac{F_j}{F_{N2}}\right) + \lambda\left(\frac{L_j}{D_h}\right)$$

$$= 0.5\left(1-\frac{77ft^2}{36450ft^2}\right) + \left(1-\frac{77ft^2}{72900ft^2}\right)^2 + 1.28\sqrt{\left(1-\frac{77ft^2}{36450ft^2}\right)}\left(1-\frac{77ft^2}{72900ft^2}\right) + 0.02\left(\frac{.75'}{7.33'}\right) = 2.78$$

$$\zeta_R = 0.5\left(1-\frac{F_j}{F_{N2}}\right) + \left(1-\frac{F_j}{F_{N1}}\right)^2 + \tau\sqrt{\left(1-\frac{F_j}{F_{N2}}\right)}\left(1-\frac{F_j}{F_{N1}}\right) + \lambda\left(\frac{L_j}{D_h}\right)$$

$$= 0.5\left(1-\frac{77ft^2}{72900ft^2}\right) + \left(1-\frac{77ft^2}{36450ft^2}\right)^2 + 1.28\sqrt{\left(1-\frac{77ft^2}{70900ft^2}\right)}\left(1-\frac{77ft^2}{36450ft^2}\right) + 0.02\left(\frac{.75'}{7.33'}\right) = 2.77$$

$$K'_F = \left(\frac{F_j}{F_{N2}}\right)^2 - \left(\frac{F_j}{F_{N1}}\right)^2 = \left(\frac{77ft^2}{72900ft^2}\right)^2 - \left(\frac{77ft^2}{36450ft^2}\right)^2 = -0.0000035$$

$$K'_R = \left(\frac{F_j}{F_{N1}}\right)^2 - \left(\frac{F_j}{F_{N2}}\right)^2 = \left(\frac{77ft^2}{36450ft^2}\right)^2 - \left(\frac{77ft^2}{72900ft^2}\right)^2 = 0.0000035$$

FROM JUNCTION #1 $\zeta_{fr} = 0.002$

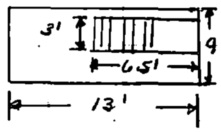
$$K_F = \zeta_F + \zeta_{fr} + K'_F = 2.78 + 0.002 + (-0.0000035) = 2.78$$

$$K_R = \zeta_R + \zeta_{fr} + K'_R = 2.77 + 0.002 + 0.0000035 = 2.77$$

$$I = L_j\left(\frac{1}{F_j}\right) + L_{N1}\left(\frac{1}{F_{N1}}\right) + L_{N2}\left(\frac{1}{F_{N2}}\right)$$

$$= 0.75'\left(\frac{1}{77ft^2}\right) + 24.125'\left(\frac{1}{36450ft^2}\right) + 34.958'\left(\frac{1}{72900ft^2}\right) = 0.0108 ft^{-1}$$

AREA B. LOCATED ALONG SOUTH WALL NEAR LINE ⑯



$L_j = 0.75$

$F_j = (13' \times 9') - (3' \times 6.5') = 97.5 ft^2$

$\Pi = 2(13') + 2(9') = 44 ft$

$D_h = \frac{4 F_j}{\Pi} = \frac{4(97.5 ft^2)}{44'} = 8.86'$

$\tau = f\left(\frac{L_j}{D_h}\right) = \left(\frac{0.75'}{8.86'}\right) = 0.0846 = 1.3$ by INTERP. DIAG 4-11, p137, REF 39

$\bar{\Delta} = \frac{\Delta(.03937 in/mm)}{D_h(12 in/ft)} = \frac{2.5(.03937)}{8.86'(12)} = 0.000926$ where $\Delta = 2.5$ for AVE. COND. CONCRETE p 63, REF 39

$\lambda = \frac{1}{(2 \log \frac{3.7}{\bar{\Delta}})^2} = 0.0193$

$\zeta_F = 0.5\left(1 - \frac{F_j}{F_{N1}}\right) + \left(1 - \frac{F_j}{F_{N2}}\right)^2 + \tau\sqrt{\left(1 - \frac{F_j}{F_{N1}}\right)}\left(1 - \frac{F_j}{F_{N2}}\right) + \lambda\left(\frac{L_j}{D_h}\right)$

$= 0.5\left(1 - \frac{97.5ft^2}{36450ft^2}\right) + \left(1 - \frac{97.5ft^2}{72900ft^2}\right)^2 + 1.3\sqrt{\left(1 - \frac{97.5ft^2}{36450ft^2}\right)}\left(1 - \frac{97.5ft^2}{72900ft^2}\right) + 0.0193\left(\frac{0.75'}{8.86'}\right) = 2.79$

$\zeta_R = 0.5\left(1 - \frac{F_j}{F_{N2}}\right) + \left(1 - \frac{F_j}{F_{N1}}\right)^2 + \tau\sqrt{\left(1 - \frac{F_j}{F_{N2}}\right)}\left(1 - \frac{F_j}{F_{N1}}\right) + \lambda\left(\frac{L_j}{D_h}\right)$

$= 0.5\left(1 - \frac{97.5ft^2}{72900ft^2}\right) + \left(1 - \frac{97.5ft^2}{36450ft^2}\right)^2 + 1.3\sqrt{\left(1 - \frac{97.5ft^2}{72900ft^2}\right)}\left(1 - \frac{97.5ft^2}{36450ft^2}\right) + 0.0193\left(\frac{0.75'}{8.86'}\right) = 2.79$

$k'_F = \left(\frac{F_j}{F_{N2}}\right)^2 - \left(\frac{F_j}{F_{N1}}\right)^2 = \left(\frac{97.5ft^2}{72900ft^2}\right)^2 - \left(\frac{97.5ft^2}{36450ft^2}\right)^2 = -.0000054$

$k'_R = \left(\frac{F_j}{F_{N1}}\right)^2 - \left(\frac{F_j}{F_{N2}}\right)^2 = \left(\frac{97.5ft^2}{36450ft^2}\right)^2 - \left(\frac{97.5ft^2}{72900ft^2}\right)^2 = .0000054$

FROM JUNCTION #1 $\zeta_{fr} = 0.002$

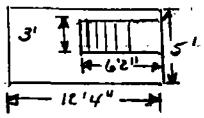
$K_F = \zeta_F + \zeta_{fr} + k'_F = 2.79 + 0.002 + (-0.0000054) = \underline{2.79}$

$K_R = \zeta_R + \zeta_{fr} + k'_R = 2.79 + 0.002 + 0.0000054 = \underline{2.79}$

$I = L_j\left(\frac{1}{F_j}\right) + L_{N1}\left(\frac{1}{F_{N1}}\right) + L_{N2}\left(\frac{1}{F_{N2}}\right)$

$= 0.75\left(\frac{1}{97.5ft^2}\right) + 34.125'\left(\frac{1}{36450ft^2}\right) + 34.958'\left(\frac{1}{72900ft^2}\right) = 0.0088$

AREA C LOCATED ALONG NORTH WALL NEAR LINE ⑰



$L_j = 0.75'$

$F_j = (12'4'' \times 5') - (6'2'' \times 3') = 43 ft^2$

$\Pi = 12'4'' + 5' + 12'4'' + 5' = 34.6 ft$

$D_h = \frac{4 F_j}{\Pi} = \frac{4(43 ft^2)}{34.6 ft} = 4.97 ft$

$\tau = f\left(\frac{L_j}{D_h}\right) = \left(\frac{0.75'}{4.97'}\right) = 0.1509 = 1.25$ by INTERP. FROM DIAG 4-11, p137 REF 39

$\bar{\Delta} = \frac{\Delta(0.03937 in/mm)}{D_h(12 in/ft)} = \frac{2.5(.03937)}{4.97'(12)} = 0.00165$ where $\Delta = 2.5$ for AVE. COND. CONCRETE p 63, REF 39

$\lambda = \frac{1}{(2 \log 3.7/\bar{\Delta})^2} = 0.022$

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO. 12846.44	DIVISION & GROUP	CALCULATION NO. PE-049-0	OPTIONAL TASK CODE	PAGE 26

$$\zeta_F = 0.5\left(1-\frac{F_J}{F_{N1}}\right)+\left(1-\frac{F_J}{F_{N2}}\right)^2+\tau\sqrt{\left(1-\frac{F_J}{F_{N1}}\right)\left(1-\frac{F_J}{F_{N2}}\right)}+\lambda\left(\frac{L_J}{D_h}\right)$$

$$=0.5\left(1-\frac{43ft^2}{36450ft^2}\right)+\left(1-\frac{43ft^2}{72900ft^2}\right)^2+1.25\sqrt{\left(1-\frac{43ft^2}{36450ft^2}\right)\left(1-\frac{43ft^2}{72900ft^2}\right)}+0.022\left(\frac{0.75'}{4.97'}\right)=2.75$$

$$\zeta_R = 0.5\left(1-\frac{F_J}{F_{N2}}\right)+\left(1-\frac{F_J}{F_{N1}}\right)^2+\tau\sqrt{\left(1-\frac{F_J}{F_{N2}}\right)\left(1-\frac{F_J}{F_{N1}}\right)}+\lambda\left(\frac{L_J}{D_h}\right)$$

$$=0.5\left(1-\frac{43ft^2}{72900ft^2}\right)+\left(1-\frac{43ft^2}{36450ft^2}\right)^2+1.25\sqrt{\left(1-\frac{43ft^2}{72900ft^2}\right)\left(1-\frac{43ft^2}{36450ft^2}\right)}+0.022\left(\frac{0.75'}{4.97'}\right)=2.75$$

$$K'_F=\left(\frac{F_J}{F_{N2}}\right)^2-\left(\frac{F_J}{F_{N1}}\right)^2=\left(\frac{43ft^2}{72900ft^2}\right)^2-\left(\frac{43ft^2}{36450ft^2}\right)^2=-0.000001$$

$$K'_R=\left(\frac{F_J}{F_{N1}}\right)^2-\left(\frac{F_J}{F_{N2}}\right)^2=\left(\frac{43ft^2}{36450ft^2}\right)^2-\left(\frac{43ft^2}{72900ft^2}\right)^2=0.000001$$

from JUNCTION #1 $\zeta_{fr} = 0.002$

$$K_F = \zeta_F + \zeta_{fr} + K'_F = 2.75 + 0.002 + (-0.000001) = \underline{2.75}$$

$$K_R = \zeta_R + \zeta_{fr} + K'_R = 2.75 + 0.002 + 0.000001 = \underline{2.75}$$

$$I = L_J\left(\frac{1}{F_J}\right)+L_{N1}\left(\frac{1}{F_{N1}}\right)+L_{N2}\left(\frac{1}{F_{N2}}\right)$$

$$=0.75'\left(\frac{1}{43ft^2}\right)+34.125'\left(\frac{1}{36450ft^2}\right)+34.958'\left(\frac{1}{72900ft^2}\right)=0.0186$$

TO COMBINE LOSS COEFFICIENTS (K), USING SAME TECHNIQUE AS FOR JUNCTION #1

$$K_{eff} = \frac{A^2_{ref}}{\left(\sum_i^n\left(\frac{A_i^2}{K_i}\right)^{1/2}\right)^2}$$ where A_{ref} = sum of F_J Ⓐ, Ⓑ & Ⓒ

F_JⒶ $= 77ft^2$; F_JⒷ $= 97.5ft^2$; F_JⒸ $= 43ft^2$
K_FⒶ $= 2.78$; K_FⒷ $= 2.79$; K_FⒸ $= 2.75$
K_RⒶ $= 2.77$; K_RⒷ $= 2.79$; K_RⒸ $= 2.75$

~~for~~ for forward flow

$$K_{eff} = \frac{(F_J Ⓐ + F_J Ⓑ + F_J Ⓒ)^2}{\left(\frac{F_J Ⓐ}{K_F Ⓐ^{1/2}}+\frac{F_J Ⓑ}{K_F Ⓑ^{1/2}}+\frac{F_J Ⓒ}{K_F Ⓒ^{1/2}}\right)^2} = \frac{(77ft^2+97.5ft^2+43ft^2)^2}{\left(\frac{77ft^2}{(2.78)^{1/2}}+\frac{97.5ft^2}{(2.79)^{1/2}}+\frac{43ft^2}{(2.75)^{1/2}}\right)^2} = 2.78$$

for REVERSE flow

$$K_{eff} = \frac{(F_J Ⓐ + F_J Ⓑ + F_J Ⓒ)^2}{\left(\frac{F_J A}{K_R Ⓐ^{1/2}}+\frac{F_J Ⓑ}{K_R Ⓑ^{1/2}}+\frac{F_J Ⓒ}{K_R Ⓒ^{1/2}}\right)^2} = \frac{(77ft^2+97.5ft^2+43ft^2)^2}{\left(\frac{77ft^2}{(2.77)^{1/2}}+\frac{97.5ft^2}{(2.79)^{1/2}}+\frac{43ft^2}{(2.75)^{1/2}}\right)^2} = 2.78$$

TO EVALUATE THE EFFECTIVE INERTIA FOR DISSIMILAR PARALLEL FLOWPATHS THE ASSUMPTION THAT FOR VALUES OF INERTIA'S THIS SMALL CAN BE AVERAGED AND THAT APPROXIMATION WOULD BE REASONABLE, AND ANY DIFFERENCE BETWEEN THE CALCULATED COEFFICIENT AND THE ACTUAL WOULD HAVE INSIGNIFICANT EFFECTS ON THE RESULTS. FOR THIS APPROXIMATION, THE ASSUMPTION IS MADE THAT THE RATE OF MASS FLOW RATE CHANGE IS PROPORTIONAL TO THE AREA OF THE JUNCTION, WHICH WHILE NOT STRICTLY CORRECT, DOES APPROXIMATE THE ACTUAL EFFECTS. FROM REF 32, FORMULA (19-26) I_{EFF} CAN THUS BE EVALUATED BY USING A SUMMATION WHICH TRANSPOSES THE RATE OF FLOW CHANGE TERMS WITH A RATIO OF INERTIA & AREA, AS FOLLOWS, WHERE THE EXPRESSION $\left(\frac{dw_i}{dt}\right)$ IS REPLACED BY F_j OF THE OPENING

$$I_{eff} = \frac{1}{n\left(\sum_i^n F_{ji}\right)} \sum_i^n I_i F_{ji}$$

which $= \dfrac{I_{Ⓐ} F_{jⒶ} + I_{Ⓑ} F_{jⒷ} + I_{Ⓒ} F_{jⒸ}}{3(F_{jⒶ} + F_{jⒷ} + F_{jⒸ})}$

$$= \frac{(0.0108\,ft^{-1})(77ft^2) + (0.0088\,ft^{-1})(97.5ft^2) + (0.0186\,ft^{-1})(43ft^2)}{3(77ft^2 + 97.5ft^2 + 43ft^2)}$$

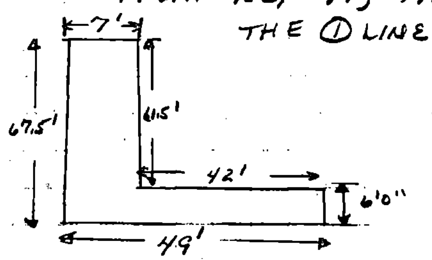
$= 0.0038$ which defaults to 0.01 as previously discussed

~~IN~~ SUMMARY JUNCTION #3 AREA = sum of $F_{jⒶ} \rightarrow F_{jⒸ}$ = 217.5 ft²
$I = 0.01\,ft^{-1}$; $K_F = 2.78$; $K_R = 5.78$ AT ELEVATION 58'6"

JUNCTION #4 NODE 2 to NODE 3. (REF 41)

THIS JUNCTION IS NEARLY IDENTICAL TO JUNCTION #1 WITH THE EXCEPTION THAT A GRATING AREA IS ADJACENT TO THE HOIST AREA AS SEEN ON REF. 41. ALL OTHER OPENINGS HAVE NEARLY IDENTICAL DIMENSIONS, THUS IT IS ASSUMED THAT THE JUNCTION AREAS AND LOSS COEFFICIENTS FOR CORRESPONDING OPENINGS IN THIS JUNCTION ARE THE SAME. THE ADDITIONAL AREA, THEN, WILL BE DESIGNATED AS AREA Ⓕ AND EVALUATED IN THE SAME MANNER AS WAS USED FOR JUNCTION #1, THEN COMBINED WITH THE OPENINGS Ⓐ thru Ⓔ of THAT JUNCTION TO EVALUATE THE K_{eff} FOR THIS JUNCTION

FROM REF 41, THE OPENING IS DIMENSIONED AS FOLLOWS FROM THE ① LINE & "B" LINE OF THE DRAWING



$L_j = 0.75'$ (REF 28)

$F_j = [(67.5')(7') + (6')(42')](80\%) = 579.6\,ft^2$

$\Pi = 67.5' + 7' + 61.5' + 42' + 6' + 49' = 233'$

$D_h = \dfrac{4F_j}{\Pi} = \dfrac{4(579.6ft^2)}{233'} = 9.95'$

$\tau = f\left(\frac{L_J}{D_h}\right) = \frac{0.75'}{9.95'} = 0.0754 = 1.30$ by INTERP. DIAG 4-11, P137, REF 39

$\bar{\Delta} = \frac{\Delta(.03937\ in/mm)}{D_h(in/ft)} = \frac{2.5(.03937)}{9.95'(12)} = 0.000824$ where $\Delta = 2.5$ for AVE COND CONCRETE, P63 REF 39

$\lambda = \frac{1}{\left(2\log\frac{3.7}{\bar{\Delta}}\right)^2} = 0.019$

from JUNCTION 1, $F_{N1} = 36450\,ft^2 = F_{N3}$
$F_{N2} = 72900\,ft^2$

$\zeta_R = 0.5\left(1-\frac{F_J}{F_{N3}}\right) + \left(1-\frac{F_J}{F_{N2}}\right)^2 + \tau\sqrt{\left(1-\frac{F_J}{F_{N3}}\right)\left(1-\frac{F_J}{F_{N2}}\right)} + \lambda\left(\frac{L_J}{D_h}\right)$

$= 0.5\left(1-\frac{579.6ft^2}{36450ft^2}\right) + \left(1-\frac{579.6ft^2}{72900ft^2}\right)^2 + 1.3\sqrt{\left(1-\frac{579.6ft^2}{36450ft^2}\right)\left(1-\frac{579.6ft^2}{72900ft^2}\right)} + 0.019\left(\frac{0.75'}{9.95'}\right) = 2.76$

$\zeta_F = 0.5\left(1-\frac{F_J}{F_{N2}}\right) + \left(1-\frac{F_J}{F_{N3}}\right)^2 + \tau\sqrt{\left(1-\frac{F_J}{F_{N2}}\right)\left(1-\frac{F_J}{F_{N3}}\right)} + \lambda\left(\frac{L_J}{D_h}\right)$

$= 0.5\left(1-\frac{579.6ft^2}{72900ft^2}\right) + \left(1-\frac{579.6ft^2}{36450ft^2}\right)^2 + 1.3\sqrt{\left(1-\frac{579.6ft^2}{72900ft^2}\right)\left(1-\frac{579.6ft^2}{36450ft^2}\right)} + 0.019\left(\frac{0.75'}{9.95'}\right) = 2.74$

$K'_R = \left(\frac{F_J}{F_{N2}}\right)^2 - \left(\frac{F_J}{F_{N3}}\right)^2 = \left(\frac{579.6ft^2}{72900ft^2}\right)^2 - \left(\frac{579.6ft^2}{36450ft^2}\right)^2 = -.000019$

$K'_F = \left(\frac{F_J}{F_{N3}}\right)^2 - \left(\frac{F_J}{F_{N2}}\right)^2 = \left(\frac{579.6ft^2}{36450ft^2}\right)^2 - \left(\frac{579.6ft^2}{72900ft^2}\right)^2 = .000019$

from JUNCTION 1 $\zeta_{fr} = 0.002$ & $\zeta_{gr} = 0.2$

$K_R = K'_R + \zeta_R + \zeta_{fr} + \zeta_{gr} = (-.000019) + 2.76 + 0.002 + 0.2 = \underline{2.86}$ 2.96

$K_F = K'_F + \zeta_F + \zeta_{fr} + \zeta_{gr} = .000019 + 2.74 + 0.002 + 0.2 = \underline{2.84}$ 2.94

from JUNCTION 1 $I = 0.01\ ft^{-1}$

SUMMED USING THE VALUES OF $F_{J(A)} \to F_{J(E)}$ & $K_{(A)} \to K_{(E)}$ of JUNCTION 1

for REVERSE flow

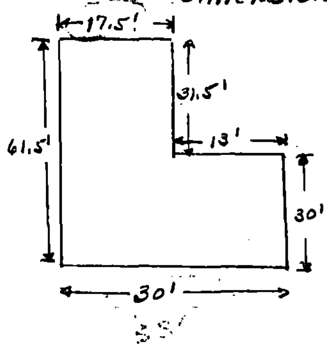
$K_{eff} = \frac{(1347.2ft^2 + 1406.4ft^2 + 799.2ft^2 + 180ft^2 + 1609.6ft^2 + 579.6ft^2)^2}{\left(\frac{1347.2ft^2}{(2.92)^{1/2}} + \frac{1406.4ft^2}{(2.90)^{1/2}} + \frac{799.2ft^2}{(2.95)^{1/2}} + \frac{180ft^2}{(3.0)^{1/2}} + \frac{1609.6ft^2}{(2.90)^{1/2}} + \frac{579.6ft^2}{(2.86)^{1/2}}\right)^2} = \underline{2.91}$ 2.92

for FORWARD flow

$K_{eff} = \frac{(1347.2ft^2 + 1406.4ft^2 + 799.2ft^2 + 180ft^2 + 1609.6ft^2 + 579.6ft^2)^2}{\left(\frac{1347.2ft^2}{(2.88)^{1/2}} + \frac{1406.4ft^2}{(2.86)^{1/2}} + \frac{799.2ft^2}{(2.93)^{1/2}} + \frac{180ft^2}{(3.0)^{1/2}} + \frac{1609.6ft^2}{(2.85)^{1/2}} + \frac{579.6ft^2}{(2.84)^{1/2}}\right)^2} = \underline{2.87}$ 2.88

IN SUMMARY, JUNCTION AREA $= F_{j(a)} \rightarrow F_{j(E)} = 5922\ ft^2$, $K_F = 2.87$
$K_R = 2.91$ $\quad I = 0.01\ ft^{-1}$ AT ELEVATION 58'6"

JUNCTION #5 NODE 2 to NODE 3 (REF 41)
DIMENSIONED AS follows.



$L_j = 0.75'$

$F_j = (17.5')(61.5') + (30')(13') = 1466.25\ ft^2$

$\Pi = 61.5' + 17.5' + 31.5' + 13' + 30' + 30' = 183.5'$

$D_h = \frac{4F_j}{\Pi} = \frac{4(1466.25\ ft^2)}{183.5'} = 31.96' \cong 32'$

$\gamma = f\left(\frac{L_j}{D_h}\right) = \frac{0.75}{32'} = 0.0235 = 1.34$ by INTERPOLATION from DIAG 4-11, p137, REF 39.

$\bar{\Delta} = \frac{\Delta(.03937\ in/mm)}{D_h(12\ in/ft)} = \frac{2.5(.03937)}{32(12)} = .000256$

$\lambda = \frac{1}{\left(2\log\frac{3.7}{\bar{\Delta}}\right)^2} = 0.015$

from JUNCTION #1, $F_{N1} = F_{N3} = 36450\ ft^2$
$F_{N2} = 72900\ ft^2$

$$\zeta_F = 0.5\left(1 - \frac{F_j}{F_{N2}}\right) + \left(1 - \frac{F_j}{F_{N3}}\right)^2 + \gamma\sqrt{\left(1 - \frac{F_j}{F_{N2}}\right)\left(1 - \frac{F_j}{F_{N3}}\right)} + \lambda\left(\frac{L_j}{D_h}\right)$$

$$= 0.5\left(1 - \frac{1466\ ft^2}{72900\ ft^2}\right) + \left(1 - \frac{1466\ ft^2}{36450\ ft^2}\right)^2 + 1.34\sqrt{\left(1 - \frac{1466\ ft^2}{72900\ ft^2}\right)\left(1 - \frac{1466\ ft^2}{36450\ ft^2}\right)} + 0.015\left(\frac{0.75'}{32'}\right) = 2.69$$

2.68

$$\zeta_R = 0.5\left(1 - \frac{F_j}{F_{N3}}\right) + \left(1 - \frac{F_j}{F_{N2}}\right)^2 + \gamma\sqrt{\left(1 - \frac{F_j}{F_{N3}}\right)\left(1 - \frac{F_j}{F_{N2}}\right)} + \lambda\left(\frac{L_j}{D_h}\right)$$

$$= 0.5\left(1 - \frac{1466\ ft^2}{36450\ ft^2}\right) + \left(1 - \frac{1466\ ft^2}{72900\ ft^2}\right)^2 + 1.34\sqrt{\left(1 - \frac{1466\ ft^2}{36450\ ft^2}\right)\left(1 - \frac{1466\ ft^2}{72900\ ft^2}\right)} + 0.015\left(\frac{0.75'}{32'}\right) = 2.73$$

2.7

$$K'_F = \left(\frac{F_j}{F_{N3}}\right)^2 - \left(\frac{F_j}{F_{N2}}\right)^2 = \left(\frac{1466\ ft^2}{36450\ ft^2}\right)^2 - \left(\frac{1466\ ft^2}{72900\ ft^2}\right)^2 = 0.0012$$

$$K'_R = \left(\frac{F_j}{F_{N2}}\right)^2 - \left(\frac{F_j}{F_{N3}}\right)^2 = \left(\frac{1466\ ft^2}{72900\ ft^2}\right)^2 + \left(\frac{1466\ ft^2}{36450\ ft^2}\right)^2 = -0.0012$$

$\zeta_{fr} = 0.002$ (from JUNCTION #1)

$K_F = \zeta_F + \zeta_{fr} + K'_F = 2.69 + 0.002 + 0.0012 = \underline{2.69}$ 2.68

$K_R = \zeta_R + \zeta_{fR} + K'_R = 2.73 + 0.002 + (-0.0012) = \underline{2.73}$ 2.7

$I = 0.01$ from junction 1

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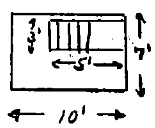
JUNCTION #6. (NODE 2 to NODE 3)

THIS JUNCTION CONSISTS OF 5 STAIRWAY OPENINGS AS SHOWN ON REF. 41 AND IS EVALUATED IN THE SAME MANNER AS WAS PERFORMED FOR JUNCTION #3. THE OPENINGS ARE DIMENSIONED AS FOLLOWS:

AREA Ⓐ LOCATED ALONG SOUTH WALL NEAR LINE ③



$L_j = 0.75'$

$F_j = (7')(10') - (3')(5') = 55 ft^2$

$\Pi = 2(10') + 2(7') = 34 ft$

$D_h = \frac{4F_j}{\Pi} = \frac{4(55 ft^2)}{34 ft} = 4.47'$

$\tau = f\left(\frac{L_j}{D_h}\right) = \left(\frac{0.75'}{4.47'}\right) = 0.116 = \underline{1.28}$ by INTERPOLATION DIAG 4-11, p137, REF 39

$\bar{\Delta} = \frac{\Delta(0.03937 in/mm)}{D_h(12 in/ft)} = \frac{2.5(.03937)}{4.47'(12)} = 0.00127$ where $\Delta = 2.5$ for AVE. COND. CONCRETE, p63 REF 39

$\lambda = \frac{1}{\left(2 \log \frac{3.7}{\bar{\Delta}}\right)^2} = \underline{0.021}$; from JUNCTION #1 $F_{N2} = 72900 ft^2$, $F_{N1} = F_{N3} = 36450 ft^2$

$\zeta_F = 0.5\left(1 - \frac{F_j}{F_{N2}}\right) + \left(1 - \frac{F_j}{F_{N3}}\right)^2 + \tau\sqrt{\left(1 - \frac{F_j}{F_{N2}}\right)\left(1 - \frac{F_j}{F_{N3}}\right)} + \lambda\left(\frac{L_j}{D_h}\right)$

$= 0.5\left(1 - \frac{55ft^2}{72900ft^2}\right) + \left(1 - \frac{55ft^2}{36450ft^2}\right)^2 + 1.28\sqrt{\left(1 - \frac{55ft^2}{72900ft^2}\right)\left(1 - \frac{55ft^2}{36450ft^2}\right)} + 0.021\left(\frac{0.75'}{4.47'}\right) = 2.78$

$\zeta_R = 0.5\left(1 - \frac{F_j}{F_{N3}}\right) + \left(1 - \frac{F_j}{F_{N2}}\right)^2 + \tau\sqrt{\left(1 - \frac{F_j}{F_{N3}}\right)\left(1 - \frac{F_j}{F_{N2}}\right)} + \lambda\left(\frac{L_j}{D_h}\right)$

$= 0.5\left(1 - \frac{55ft^2}{36450ft^2}\right) + \left(1 - \frac{55ft^2}{72900ft^2}\right) + 1.28\sqrt{\left(1 - \frac{55ft^2}{36450ft^2}\right)\left(1 - \frac{55ft^2}{72900ft^2}\right)} + 0.021\left(\frac{0.75'}{4.47'}\right) = 2.78$

$K'_F = \left(\frac{F_j}{F_{N3}}\right)^2 - \left(\frac{F_j}{F_{N2}}\right)^2 = \left(\frac{55ft^2}{36450ft^2}\right)^2 - \left(\frac{55ft^2}{72900ft^2}\right)^2 = 0.0000017$

$K'_R = \left(\frac{F_j}{F_{N2}}\right)^2 - \left(\frac{F_j}{F_{N3}}\right)^2 = \left(\frac{55ft^2}{72900ft^2}\right)^2 - \left(\frac{55ft^2}{36450ft^2}\right)^2 = -0.0000017$

from JUNCTION #1, $\zeta_{fr} = 0.002$

$K_F = \zeta_F + \zeta_{fr} + K'_F = 2.78 + 0.002 + 0.0000017 = \underline{2.78}$

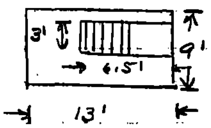
$K_R = \zeta_R + \zeta_{fr} + K'_R = 2.78 + 0.002 + (-0.0000017) = \underline{2.78}$

from JUNCTION #1 $L_{N1} = 24.125'$; $L_{N2} = 34.958'$

$I = L_j\left(\frac{1}{F_j}\right) + L_{N3}\left(\frac{1}{F_{N3}}\right) + L_{N2}\left(\frac{1}{F_{N2}}\right)$ $(L_{N1} = L_{N3})$

$= 0.75\left(\frac{1}{55ft^2}\right) + 24.125'\left(\frac{1}{36450ft^2}\right) + 34.958'\left(\frac{1}{72900ft^2}\right) = 0.0148$

AREA Ⓑ LOCATED ALONG SOUTH WALL NEAR LINE Ⓑ



THIS OPENING IS NEARLY IDENTICAL TO THAT OF AREA B IN JUNCTION #3, THUS THE VALUES OF F_j, K_F, K_R & I ARE CONSIDERED TO BE THE SAME.

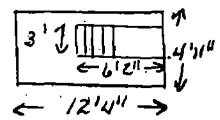
$F_j = 97.5 ft^2$

$K_F = 2.79$

$K_R = 2.79$

$I = 0.0088$

AREA Ⓒ LOCATED ALONG NORTH WALL NEAR LINE ⑨



THIS OPENING IS NEARLY IDENTICAL TO THAT OF AREA C IN JUNCTION #3, THUS THE VALUES OF F_j, K_F & K_R & I ARE CONSIDERED TO BE THE SAME.

$F_j = 43.0 ft$

$K_F = 2.75$

$K_R = 2.75$

$I = 0.0186$

AREA Ⓓ LOCATED ALONG NORTH WALL NEAR LINE ①

from REF 41, THIS IS THE SAME SIZE AS AREA Ⓒ, thus

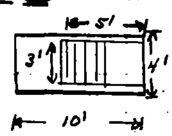
$F_j = 43.0 ft^2$

$K_F = 2.75$

$K_R = 2.75$

$I = 0.0186$

AREA Ⓔ LOCATED ALONG WEST WALL NEAR LINE ①



$L_j = 0.75'$

$F_j = 4'(10') - (3')(5') = 25 ft^2$

$\Pi = 2(10') + 2(4') = 28'$

$D_h = \frac{4(F_j)}{\Pi} = \frac{4(25 ft^2)}{28'} = 3.57$

$\tau = f\left(\frac{L_j}{D_h}\right) = \frac{0.75'}{3.57'} = 0.21 = 1.21$ by INTERPOLATION from DIAG 4-11, p137, R39

$\bar{\Delta} = \frac{\Delta(.03937 in/mm)}{D_h(12 in/ft)} = \frac{2.5(.03937)}{3.57(12)} = 0.002298$ where $\Delta = 2.5$ for AVE. COND. CONCRETE, p63, REF 39

$\lambda = \left(\left(2 \log \frac{3.7}{\bar{\Delta}}\right)^2\right)^{-1} = 0.024$

from JUNCTION #1 $F_{N2} = 72900 ft^2$; $F_{N1} = F_{N3} = 36450 ft^2$

$$\zeta_F = 0.5\left(1 - \frac{F_j}{F_{N2}}\right) + \left(1 - \frac{F_j}{F_{N3}}\right)^2 + \tau\sqrt{\left(1 - \frac{F_j}{F_{N2}}\right)\left(1 - \frac{F_j}{F_{N3}}\right)} + \lambda\left(\frac{L_j}{D_h}\right)$$

$$= 0.5\left(1 - \frac{25 ft^2}{72900 ft^2}\right) + \left(1 - \frac{25 ft^2}{36450 ft^2}\right)^2 + 1.21\sqrt{\left(1 - \frac{25 ft^2}{72900 ft^2}\right)\left(1 - \frac{25 ft^2}{36450 ft^2}\right)} + 0.024\left(\frac{0.75'}{3.57'}\right) = 2.73$$

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$$\varphi_R = 0.5\left(1-\frac{F_j}{F_{N3}}\right)+\left(1-\frac{F_j}{F_{N2}}\right)^2+\tau\sqrt{\left(1-F_j/F_{N3}\right)\left(1-F_j/F_{N2}\right)}+\lambda\left(L_j/D_h\right)$$

$$\varphi_R = 0.5\left(1-\frac{25ft^2}{36450ft^2}\right)+\left(1-\frac{25ft^2}{72900ft^2}\right)^2+1.21\sqrt{\left(1-\frac{25ft^2}{36450ft^2}\right)\left(1-\frac{25ft^2}{72900ft^2}\right)}+0.024\left(\frac{0.75'}{3.57'}\right)=2.73$$

$$K'_F = \left(\frac{F_j}{F_{N3}}\right)^2-\left(\frac{F_j}{F_{N2}}\right)^2=\left(\frac{25ft^2}{36450ft^2}\right)^2-\left(\frac{25ft^2}{72900ft^2}\right)^2 = 0.0000004$$

$$K'_R = \left(\frac{F_j}{F_{N2}}\right)^2-\left(\frac{F_j}{F_{N3}}\right)^2=\left(\frac{25ft^2}{72900ft^2}\right)^2-\left(\frac{25ft^2}{36450ft^2}\right)^2 = -0.0000004$$

from JUNCTION #1, $\varphi_{fr} = 0.002$; $L_{N1} = 24.125' = L_{N3}$; $L_{N2} = 34.958'$

$K_F = \varphi_F + \varphi_{FR} + K'_F = \underline{2.73}$

$K_R = \varphi_R + \varphi_{fr} + K'_R = \underline{2.73}$

$$I = L_j\left(\frac{1}{F_j}\right)+L_{N3}\left(\frac{1}{F_{N3}}\right)+L_{N2}\left(\frac{1}{F_{N2}}\right) = 0.75'\left(\frac{1}{25ft^2}\right)+24.125'\left(\frac{1}{36450ft^2}\right)+34.958'\left(\frac{1}{72900ft^2}\right)$$

$= 0.0311$

THE EFFECTIVE COMBINED VALUES OF (K) AND I FOR THIS JUNCTION IS CALCULATED IN THE SAME MANNER AS WAS FOR JUNCTION #3 WHERE

$F_A = 55ft^2$; $F_B = 97.5ft^2$; $F_C = 43.0ft^2$; $F_D = 43.0ft^2$; $F_E = 25ft^2$

$K_{FA} = 2.78$; $K_{FB} = 2.79$; $K_{FC} = 2.75$; $K_{FD} = 2.75$; $K_{FE} = 2.73$

$K_{RA} = 2.78$; $K_{RB} = 2.79$; $K_{RC} = 2.75$; $K_{RD} = 2.75$; $K_{RE} = 2.73$

$I_A = 0.0148$; $I_B = 0.0088$; $I_C = 0.0186$; $I_D = 0.0186$; $I_E = 0.0311$

FOR FORWARD & REVERSE FLOW (K_F & K_R of EACH COMPONENT ARE THE SAME VALUE)

$$K_{eff} = \frac{(F_A+F_B+F_C+F_D+F_E)^2}{\left(\frac{F_A}{K_A^{1/2}}+\frac{F_B}{K_B^{1/2}}+\frac{F_C}{K_C^{1/2}}+\frac{F_D}{K_D^{1/2}}+\frac{F_E}{K_E^{1/2}}\right)^2} = \frac{(55ft^2+97.5ft^2+34.6ft^2+34.6ft^2+25ft^2)^2}{\left(\frac{55ft^2}{(2.78)^{1/2}}+\frac{97.5ft^2}{(2.79)^{1/2}}+\frac{34.6ft^2}{(2.75)^{1/2}}+\frac{34.6ft^2}{(2.75)^{1/2}}+\frac{25ft^2}{(2.73)^{1/2}}\right)^2} = \underline{2.77}$$

$$I_{eff} = \frac{I_A F_A + I_B F_B + I_C F_C + I_D F_D + I_E F_E}{n\left(F_A+F_B+F_C+F_D+F_E\right)}$$

$$= \frac{0.0148(55ft^2)+0.0088(97.5ft^2)+(0.0186)(34.6ft^2)+(0.0186)(34.6ft^2)+(0.0311)(25ft^2)}{5(55ft^2+97.5ft^2+34.6ft^2+34.6ft^2+25ft^2)}$$

$= 0.003$ which defaults to 0.01

JUNCTION AREA = SUM $F_{jA} \rightarrow F_{jE}$ = ~~246.7 ft²~~ 263.5 ft² ; $K_F = 2.77$, $K_R = 2.77$ & is AT ELEVATION 58'6"

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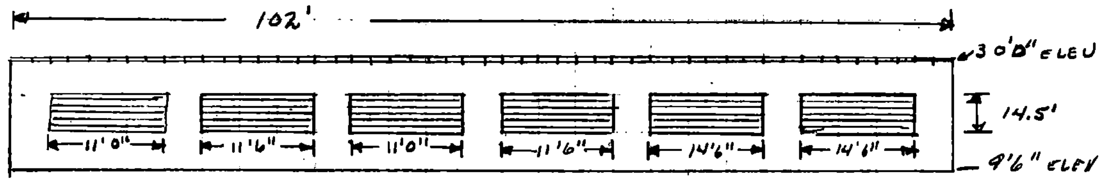
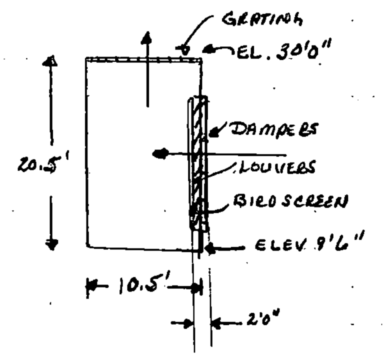
JUNCTION # 7 NODE 1 TO NODE 4

FROM REF. 25, 3 & 4 THIS JUNCTION CONSISTS OF THE FOLLOWING





THE LOUVERS ARE DETAILED ON REF 31 AND ARE DIMENSIONED AS SHOWN ABOVE. MANUFACTURERS DRAWING S&W 11448/11548-9-55C INDICATES THAT THE LOUVERS ARE CONSTRUCTION SPECIALTY CORPORATION MODEL 4830 WITH #2 1/2" MESH BIRD SCREEN, WHICH, ACCORDING TO THAT VENDORS CATALOG, CONSISTS OF STORMPROOF BLADING IN A 4" DEEP FRAME, VERY SIMILAR TO THE LOUVER MODEL 4110 ANALYZED IN THE REF. 42, JUNCTION 51 CALCULATION. THE DAMPERS ARE ASSUMED TO BE OF THE SAME CONSTRUCTION AS THAT ANALYZED IN REF. 42. FROM THIS, THEN IT IS ASSUMED THAT THE VALUES OF COMPONENT RESISTANCE TO FLOW FOR THE BIRD SCREEN, LOUVER AND DAMPER ARE SIMILAR TO THOSE VALUES OF THE NETWORK ANALYZED HERE AND THAT ANY DIFFERENCE BETWEEN THOSE OF REF 42 AND ACTUAL WOULD BE INSIGNIFICANT, THUS, FROM PP 7-9 REF 42 WHERE $K'_{screen} = 0.1372 = 0.14$, $K'_{louver} = 1.2$ AND $\bar{f}$ OF 0.8 FOR THE DAMPER IS USED HERE. ADDITIONALLY, WHILE THESE LOUVERS ARE PNEUMATIC, THE APPROXIMATION OF NET FREE AREA OF 44% OF THE GROSS USED IN REF. 42 IS HIGHLY CONSERVATIVE AND WILL BE RETAINED HERE AS VALID EVEN THOUGH THE COMPONENTS ARE NOT IN FACT IDENTICAL. REF 42 INDICATES $\bar{f} = 0.88$ FOR THE BIRD SCREEN ALSO.

THE GRATING COEFFICIENT IS ASSUMED TO BE THE SAME AS THAT IDENTIFIED FOR JUNCTION # 1 OF THIS CALCULATION. THE AIR INTAKE PIT WILL BE MODELED AS A SHARP 90° ELBOW IN THE MANNER UTILIZED ON P 215 OF REF 39 AND THE ENTIRE JUNCTION COMBINED FOR THE EFFECTIVE LOSS COEFFICIENT AND INERTIA IN THE MANNER UTILIZED IN REF. 42.

FOR PURPOSES OF SIMPLIFICATION, THE LOUVERED NETWORK WILL BE TREATED AS A SINGLE CONTINUOUS COMPONENT WITH THE COMBINED DIMENSIONS GIVEN ABOVE. THOUGH THIS APPROACH IS NOT TECHNICALLY CORRECT, THE RESULTS WILL NOT SIGNIFICANTLY DIFFER FROM ACTUAL VALUES. THUS THE GROSS OPENING AREA OF THIS NETWORK WILL BE

$$14.5'(11' + 11.5' + 11' + 11.5' + 14.5' + 14.5') = 1073\ ft^2$$

THE NET FREE AREA OF EACH COMPONENT (F) WILL EQUAL GROSS AREA × $\bar{f}$ OF THAT COMPONENT (THE SUBSCRIPTS S = SCREEN, ℓ = LOUVER & D = DAMPER), THUS

$F_s = 1073\ ft^2 (0.88) = 944.24\ ft^2$ $(K'_s = 0.14)$

$F_\ell = 1073\ ft^2 (0.44) = 472.12\ ft^2$ $(K'_\ell = 1.2)$

$F_D = 1073\ ft^2 (0.8) = 858.4\ ft^2$

THE PERIMETER (Π) OF THIS OPENING, THEN, IS TAKEN TO BE THE AS FOLLOWS

$\Pi = 2(11' + 11.5 + 11' + 11.5' + 14.5' + 14.5') + 2(14.5') = 177\ ft$

C_{fr} for NODE 2 IS EVALUATED IN THE SAME MANNER AS USED IN JUNCTION #1 OF THIS CALCULATION, WHERE L_{N1} = ½ W of NODE 1

$= \frac{1}{2}(135') = 67.5'$

AND F_{N1} = h (L) of NODE 1

$= 48'3'' \times 270' = 13027.5 ft^2 = 37028 ft^2$ ~~13028 ft²~~

Π of NODE 2 = 2(h) + 2(L) of NODE 1

$= 2(48'3'') + 2(270') = 636.5 ft$

Thus, $D_h = \frac{4(F_{N2})}{\Pi} = \frac{4(37028 ft^2)}{636.5 ft^2} = 81.87$

$\bar{\Delta} = \frac{\Delta(.03937 in/mm)}{D_h(12 in/FT)} = \frac{2.5(.03937)}{81.87(12)} = 0.0001$ where $\Delta = 2.5$ for AVE. COND. CONCRETE, p63, REF 39

$\lambda = \frac{1}{\left(2 \log \frac{3.7}{\bar{\Delta}}\right)^2} = 0.012$

$\therefore C_{fr} = \lambda\left(\frac{L_{N1}}{D_h}\right) = 0.012\left(\frac{67.5'}{81.87'}\right) = 0.0099 = 0.01$

THE LOSS COEFFICIENT REALIZED by THE DAMPER IS EVALUATED AS A SHARP ORIFACE AS PERFORMED IN REF 42., WHERE THE VALUE of THE OUTLET AREA (A_o) IS THE AREA BETWEEN THE DAMPER AND THE LOUVER = 1073 ft², SUCH THAT, from P.135 of REF 39

for forward flow $K'_{DF} = \left(1 + .707\sqrt{\left(1 - \frac{F_D}{F_{N1}}\right)} - \frac{F_D}{A_o}\right)^2$

$= \left(1 + .707\sqrt{\left(1 - \frac{858.4 ft^2}{37028 ft^2}\right)} - \frac{858.4 ft^2}{1073 ft^2}\right)^2 = 0.81$ ~~.79~~

for REVERSE flow $K'_{DR} = \left(1 + .707\sqrt{\left(1 - \frac{F_D}{A_o}\right)} - \frac{F_D}{F_{N1}}\right)^2$

$= \left(1 + .707\sqrt{\left(1 - \frac{858.4 ft^2}{1073 ft^2}\right)} - \frac{858.4 ft^2}{37028 ft^2}\right)^2 = 1.67$ ~~1.56~~

THE EFFECTIVE RESISTANCE of THESE COMPONENTS CAN THE BE SUMMED, USING THE SAME TECHNIQUE EMPLOYED IN REF 42, THIS VALUE SYMBOLED AS C_A. THE REFERENCE AREA USED IS THE MOST RESTRICTIVE VALUE IMPOSED by THE LOUVERS, F_L = 472.12 ft²

for forward flow

$C_{AF} = (F_L)^2\left(\frac{K'_S}{F_S^2} + \frac{K'_L}{F_L^2} + \frac{K'_{DF}}{F_D^2}\right)$

$= (472.12 ft)^2\left(\frac{0.14}{(944.24 ft^2)^2} + \frac{1.2}{(472.12 ft^2)^2} + \frac{0.81}{(858.4 ft^2)^2}\right) = 1.48$ (.78; 1.47)

for REVERSE flow

$C_{AR} = (F_L)^2\left(\frac{K'_S}{F_S^2} + \frac{K'_L}{F_L^2} + \frac{K'_{DR}}{F_D^2}\right)$

$= (472.12 ft^2)^2\left(\frac{0.14}{(944.24 ft^2)^2} + \frac{1.2}{(472.12 ft^2)^2} + \frac{1.67}{(858.4 ft^2)^2}\right) = 1.74$

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UPON EXITING THE BIRD SCREEN for flow IN THE forward DIRECTION, AN EXPANSION of THE STREAM OCCURS, THIS VALUE THEN WOULD BE (p128, REf 39)

$K_{EXPA} = \left(1 - \frac{F_L}{A_1}\right)^2$ WHERE A_1 IS THE CROSS SECTIONAL flow AREA of THE AIR INTAKE PIT, $(20.5')(102') = 2091\ ft^2$)

$K_{EXPA} = \left(1 - \frac{472.12\ ft^2}{2091\ ft^2}\right)^2 = \underline{0.6}$

for REVERSE flow (p 98, REf 39)

$K_{CONT\ A} = 0.5\left(1 - \frac{F_L}{A_1}\right)$

$= 0.5\left(1 - \frac{472.12\ ft^2}{2091\ ft^2}\right) = \underline{0.39}$

THE AIR INTAKE PIT, THEN, IS EVALUATED AS A 90° ELBOW AS DESCRIBED by pp 215 & 216 of REFERENCE 39, THE RESISTANCE DENOTED AS ζ_B

where, for ROUGH WALLS ($\Delta > 0$)

$\zeta_B = k_\Delta k_{RE} C_1 A \zeta_1$ (+ friction coefficient for THIS STRETCH)

where k_Δ & k_{RE} ARE A function of $\bar{\Delta}$

TO DETERMINE $\bar{\Delta}$ for THIS AREA, THE VALUE of D_h MUST BE OBTAINED. FOR ALL PRACTICAL PURPOSES, THE STREAM flow ENTERS THE PIT ALONG NEARLY 70% of ITS HEIGHT, NOT THROUGH A NARROW CHANNEL AT ONE END of THE flow STRETCH AS IS NORMALLY THE CASE, AND THE flow DIRECTION CHANGE OCCURS HYDRAULICALLY NEARLY IMMEDIATELY AFTER THE EXPANSION INTO THE AREA. FROM THIS OBSERVATION, THE HYDRAULIC AREA, D_h, IS TAKEN TO BE ON A PARALLEL PLANE WITH THE floor of THE PIT, THE Π THEN WOULD BE THE LENGTH + WIDTH of THE PIT by DIMENSION.

$A_B = (102')(10.5') = \underline{1071\ ft^2}$

$\Pi = 2(102') + 2(10.5') = 225'$

$D_h = \frac{4A}{\Pi} = \frac{4(1071\ ft^2)}{225} = 19.1$

$\bar{\Delta} = \frac{\Delta\ (.03937\ mm/in)}{D_h\ (12\ in/FT)} = \frac{2.5\ (.03937)}{19.1\ (12)} = 0.00043$ where $\Delta = 2.5$ for AVE. COND. CONCRETE p 63, REf 39

from TABLE 6-11, REf 39 $\bar{\Delta}$ 0 – 0.001 & $R_E \geq 4 \cdot 10^4$

$k_{RE} = 1.0$

$k_\Delta = 1 + 0.5 \times 10^3 \bar{\Delta} = 1 + 0.5 \times 10^3 (0.00043) = 1.22$

C_1 is a function of THE INLET PERIMETER of $\frac{L}{W} = \frac{102'}{20.5'}$ AS THE MOST CONSERVATIVE APPROXIMATION $\frac{102'}{20.5'} = 4.97 = 5$

from DIAG 6-7, p215 $C_1 = 0.75$ for $\frac{a_0}{b_0} = 5$

ζ_1 & A is determined from graph (b) p216 as A function of δ° which is 90° thus $\zeta_1 = 0.99$ AND $A = 1.2$

$\therefore \zeta_B = 1.22(1.0)(0.75)(0.99)(1.2) + \zeta_{fr} = 1.09 + \zeta_{fr}$

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$\mathcal{C}_{fr}$ for THIS AREA IS APPROXIMATED by USING THE $\bar{\Delta}$ obtained for THE $D_h = 19.1$, THE flow LENGTH IS TAKEN TO BE 10.5' AS A CONSERVATIVE ESTIMATE.

$$\lambda = \frac{1}{\left(2\log \frac{3.7}{\bar{\Delta}}\right)^2} = 0.016$$

$$\mathcal{C}_{fr} = \lambda\left(\frac{L}{D_h}\right) = 0.016\left(\frac{10.5}{19.1}\right) = 0.0089$$

$$\therefore \mathcal{C}_B = 1.09 + 0.0089 \doteq \underline{1.1}$$

THE LOSS COEFFICIENT ATTRIBUTABLE TO THE GRATING IS ASSUMED TO BE THAT DETERMINED for 1½" GRATING IN JUNCTION #1

$$\mathcal{C}_{gr} = \underline{0.2} \quad \& \quad F_{gr} = (102')(10.5')(0.8) = \underline{856.8\ ft^2}$$

finally AN EXPANSION TERM TO ATMOSPHERE for forward flow from THE JUNCTION (AND A CONTRACTION TERM for REVERSE flow) MUST BE INCLUDED. F_{N4} (THE ATMOSPHERE) will REDUCE THE EXPRESSION $\frac{F_j}{F_{N4}}$ TO A VALUE SO SMALL AS TO BE INSIGNIFICANT. THUS,

for FORWARD flow $K_{EXP\,B} = \left(1 - \frac{F_j}{F_{N4}}\right)^2 = \underline{1.0}$ (with $\frac{F_j}{F_{N4}} \to 0$)

for REVERSE flow $K_{CONT\,B} = 0.5\left(1 - \frac{F_j}{F_{N4}}\right) = \underline{0.5}$ (with $\frac{F_j}{F_{N4}} \to 0$)

THE EFFECTIVE JUNCTION LENGTH IS CONSIDERED TO BE THE WIDTH of THE AIR INTAKE PIT (10.5') + THE LENGTH of THE LOUVER/DAMPER NETWORK (2')

$$L_j = (10.5') + (2') = 12.5'$$

THE MOMENTUM flux TERM THEN IS EVALUATED AS A THICK ORIFACE for THIS JUNCTION WHERE F_j is THE MOST RESTRICTIVE flow AREA of THE NETWORK $= F_\ell = 472.12\ ft^2$

$$K'_F = \left(\frac{F_j}{F_{N4}}\right)^2 - \left(\frac{F_j}{F_{N1}}\right)^2 = \left(\frac{472.12\ ft^2}{F_{N2}}\right)^2 - \left(\frac{472.12\ ft^2}{37028\ ft^2}\right)^2 = -0.00016$$

(first term struck through → 0; 37028 annotated 13628)

$$K'_R = \left(\frac{F_j}{F_{N1}}\right)^2 - \left(\frac{F_j}{F_{N4}}\right)^2 = \left(\frac{472.12\ ft^2}{37028\ ft^2}\right)^2 = 0.00016$$

(37028 annotated 13628)

THE SUMMATION of THESE RESISTANCES THEN IS

for FORWARD flow

$$K_{Eff} = (F_\ell)^2\left(\frac{\mathcal{C}_{AF}}{(F_\ell)^2} + \frac{\mathcal{C}_D}{(A_D)^2} + \frac{\mathcal{C}_{gr}}{(F_{gr})^2}\right) + K'_F + K_{EXP\,A} + K_{EXP\,B} + \mathcal{C}_{fr}$$

$$= (472.12\ ft^2)^2\left(\frac{1.48}{(472.12\ ft^2)^2} + \frac{1.1}{(1071\ ft^2)^2} + \frac{0.2}{(856.8\ ft^2)^2}\right) + (-0.00016) + 0.6 + 1.0 + 0.01 = \underline{3.37}$$

(annotated 3.24)

for REVERSE flow

$$K_{Eff} = (F_\ell)^2\left(\frac{\mathcal{C}_{AR}}{(F_\ell)^2} + \frac{\mathcal{C}_D}{(A_D)^2} + \frac{\mathcal{C}_{gr}}{(F_{gr})^2}\right) + K'_R + K_{CONT\,A} + K_{CONT\,B} + \mathcal{C}_{fr}$$

$$= (472.12\ ft^2)^2\left(\frac{1.74}{(472.12\ ft^2)^2} + \frac{1.1}{(1071\ ft^2)^2} + \frac{0.2}{(856.8\ ft^2)^2}\right) + 0.00016 + 0.39 + 0.5 + 0.01 = \underline{2.18}$$

(annotated 2.71)

THE INERTA TERM IS EVALUATED AS follows.

$$I = L_J\left(\frac{1}{F_J}\right) + L_{N1}\left(\frac{1}{F_{N1}}\right) + L_{N4}\left(\frac{1}{F_{N4}}\right) \to 0$$

$$I = 12.5'\left(\frac{1}{472.12 ft^2}\right) + 67.5'\left(\frac{1}{37028 ft^2}\right) = 0.028 \quad ,032$$

13028

THIS JUNCTION IS CONSIDERED TO BE AT ELEVATION 15'0"

JUNCTION # 8 (NODE 3 TO NODE 4)

THIS JUNCTION IS IDENTICAL TO JUNCTION #7, THEREFORE

$F_j = 472.12 ft^2$

$K_f = 3.37$ 3.35

$K_R = 0.18$ 2.91

$I = 0.028$,032

AT ELEVATION 15'0"

JUNCTION #9 NODE 2 TO NODE 4

THIS JUNCTION IS composed of 4 openings in THE Roof of THE Building for THE STRUCTURE EXHAUST fans. IT IS ASSUMED THAT THE OPENINGS ARE IDENTICAL AND will BE TREATED AS ONLY CLEAR OPENINGS, ANY BENIFIT of EXHAUSTING THE MASS-ENERGY from THE BUILDING TO THE ATMOSPHERE By THE OPERATION of THE fans is NOT CONSIDERED. THE OPENINGS ARE CONSIDERED CIRCULAR AND ARE combined into ONE JUNCTION USING THE METHOD DESCRIBED IN THE REFERENCE 32 discussion on parallel NETWORK flow paths.

from Ref 14, THE DIAMETER of THE OPENING IS APPROXIMATED AS 6'0" AND THE LENGTH, TAKEN AS THE APPROXIMATE HEIGHT of THE FAN HOUSING, IS ESTIMATED TO BE 5'0". THIS, THEN, will BE ANALYZED AS A THICK EDGED ORIFACE

$$L_j = 5'$$

$$F_j = \frac{\pi d^2}{4} = \frac{\pi (6')^2}{4} = 28.27 ft^2$$

$$\Pi = \pi d = \pi (6') = 18.85 ft$$

$$D_h = \frac{4 F_j}{\Pi} = \frac{4(28.27 ft^2)}{18.85 ft} = 6'$$

$$\bar{\Delta} = \frac{\Delta(.03937 in/mm)}{D_h(12 in/ft)} = \frac{0.18(0.03937)}{6'(12)} = 0.000098$$ for USED GALVANIZED SHEET STEEL, p 63, Ref 39

$$\lambda = \frac{1}{\left(2\log\frac{3.7}{\bar{\Delta}}\right)^2} = 0.012$$

$\zeta = ,39$

$$L_{N2} = \tfrac{1}{2} h\ N_2 = \tfrac{1}{2}(69'11'') = 34.96 ft$$

$$F_{N2} = L \times W \text{ of } N_2 = 270'(135') = 36450 ft^2$$

$$\zeta_F = 0.5\left(1 - \frac{F_j}{F_{N2}}\right) + \left(1 - \frac{F_j}{F_{N4}}\right)^2 + \zeta\sqrt{\left(1-\frac{F_j}{F_{N2}}\right)\left(1-\frac{F_j}{F_{N4}}\right)} + \lambda\left(\frac{L_j}{D_h}\right)$$

$$\zeta_F = 0.5\left(1 - \frac{28.27 ft^2}{36450 ft^2}\right) + (1)^2 + 0.012\left(\frac{5'}{6'}\right) + ,39\sqrt{1 - \frac{28.27}{36450}} = 1.51 \quad 1.9$$

$$\zeta_R = 0.5\left(1-\frac{F_j}{F_{N4}}\right)^{0} + \left(1-\frac{F_j}{F_{N2}}\right)^2 + \tau N\sqrt{\left(1-\frac{F_j}{F_{N4}}\right)^{0}\left(1-\frac{F_j}{F_{N2}}\right)} + \lambda\frac{L_i}{D_h}$$

$$= 0.5(1) + \left(1-\frac{28.27ft^2}{36450ft^2}\right)^2 + 0.012\left(\frac{5'}{6'}\right) + .39\sqrt{1}\left(1-\frac{28.27}{36450}\right) = \sout{1.51}\ 1.90$$

$$K'_F = \left(\frac{F_j}{F_{N4}}\right)^2 - \left(\frac{F_j}{F_{N2}}\right)^2 = \left(\frac{28.27ft^2}{F_{N4}}\right)^{0\,2} - \left(\frac{28.27ft^2}{36450ft^2}\right)^2 = -0.00078$$

$$K'_R = \left(\frac{F_j}{F_{N2}}\right)^2 - \left(\frac{F_j}{F_{N4}}\right)^2 = \left(\frac{28.27ft^2}{36450ft^2}\right)^2 - \left(\frac{28.27ft^2}{F_{N4}}\right)^{0\,2} = 0.00078$$

$\zeta_{fr} = 0.002$ FROM JUNCTION #1

$$K_F = \zeta_F + \zeta_{fr} + K'_F = 1.51 + 0.002 + (-0.00078) = \sout{1.51}\ 1.90$$

$$K_R = \zeta_R + \zeta_{fr} + K'_R = 1.51 + 0.002 + 0.00078 = \sout{1.51}\ 1.90$$

K_{eff} FOR n IDENTICAL PARALLEL FLOWPATHS IS EQUAL TO K_i

$$I_{eff} = \frac{1}{n} I_i = \frac{1}{4}\left[L_j\left(\frac{1}{F_j}\right) + L_{N2}\left(\frac{1}{F_{N2}}\right) + L_{N4}\left(\frac{1}{F_{N4}}\right)^{0}\right]$$

$$= \frac{1}{4}\left[5'\left(\frac{1}{28.27ft^2}\right) + 34.96ft\left(\frac{1}{36450ft^2}\right)\right] = 0.04445 = 0.045$$

THE JUNCTION AREA $= 28.27ft^2(4) = 113.1ft^2$ at elevation 128.42'
$= 44.18 ft^2 (4) = 176.72 ft^2$
$K_F = 1.9$ $K_R = 1.9$

THE INITIAL CONDITIONS OF 120°F AND 14.7psia ARE UTILIZED AS APPROXIMATIONS, THE TEMPERATURE BASED ON THE VALUE GIVEN FOR UNOCCUPIED MACHINERY SPACES TAKEN FROM REF 45, PAGE 9.13.2-1 TO MAXIMIZE RESULTS.

* [illegible] Note: The vent area assumed out of node 2 is less than what exists. When a larger vent area and different K_R & K_F values are applied to the model the peak temp in Node 1 did not change but occurred earlier in time. A computer run was made with the different area [illegible]. The temperature of Node 1 [illegible] at h = 1[illegible], which is the same as the [illegible]. The peak temp. is therefore limited by the enthalpies.

STONE & WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

▲5010.65

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THE FOLLOWING TABLES SUMMARIZE THE NODAL AND JUNCTION DATA TO BE USED AS INPUT TO THE "THREED" SUBCOMPARTMENT ANALYSIS COMPUTER PROGRAM.

A. NODAL DATA

#	TEMP (°F)	PRESS (PSIA)	VOLUME (FT³)	ELEVATION (FT)	HEIGHT (FT)
1	120	14.7	1237658.0	9.5	48.25
2	120	14.7	4436565.0	58.5	69.92
3	120	14.7	1214211.0	9.5	48.25
4	120	14.7	$1.0e^{20}$	9.5	70.0

B. JUNCTION DATA

#	NODE TO	NODE	F_j (FT²)	I (FT⁻¹)	K_F	K_R			ELEVATION (FT)
1	1	2	5342.4	0.01	2.92	2.88			58.5
2	1	2	1656.6	0.01	2.71	2.67			58.5
3	1	2	217.5	0.01	2.78	2.78			58.5
4	2	3	5922.0	0.01	2.87	2.91	2.88	2.92	58.5
5	2	3	1466.3 / 1809.5	0.01	2.69	2.73	2.65	2.7	58.5
6	2	3	246.7 / 243.5	0.01	2.77	2.77			58.5
7	1	4	472.1	0.028 / .032	3.37	2.18	2.35	2.91	15.0
8	3	4	472.1	0.028	3.37	2.18			15.0
9	2	4	113.1 / 176.7	0.045	1.51	1.51	1.9	1.9	128.42

MASS-ENERGY RELEASE RATES FROM A CRACK FAILURE OF THE MAIN STEAM LINE.

IT IS CONSERVATIVE FOR TEMPERATURE CONSIDERATIONS THAT THE MOST LIMITING FAILURE WOULD BE SUCH THAT THE RESULTANT FLOW RATE WOULD NOT ACTUATE AN AUTOMATIC ISOLATION SEQUENCE. REF 44 INDICATES THAT THE LARGEST SIZE FAILURE THAT DOES NOT RESULT IN A FLOW RATE OF ADEQUATE MAGNITUDE TO ACTUATE AUTOMATIC ISOLATION WOULD BE A 0.7065 FT² SPLIT RUPTURE AT 30% POWER FOR A 3 LOOP PLANT GIVEN ON TABLE IV-12, P. 48. ANY FAILURE, THEREFORE, WHICH RESULTS IN A FLOW RATE SLIGHTLY LESS THAN THOSE GIVEN BY THE TABLE IS ASSUMED TO REQUIRE OPERATOR ACTION FOR ISOLATION. IT IS FURTHER ASSUMED THAT A FAILURE OF THIS SIZE WOULD NOT, IN A SHORT TIME PERIOD, ADVERSELY AFFECT THE OPERATION OF THE SECONDARY STEAM SYSTEM SUCH THAT AN AUTOMATIC ACTUATION OF A RELATED SAFETY FUNCTION WOULD TAKE PLACE PRIOR TO AT LEAST 20 MINUTES AFTER THE FAILURE OCCURS. THIS ASSUMPTION IS BASED ON THE OBSERVATION THAT THE NORMAL OPERATING INVENTORY OF CONDENSATE IN THE TURBINE HOTWELL, AS INDICATED BY REF 45, PG. 10.3.5-1, IS DESIGNED TO PROVIDE ABOUT 4 MINUTES OF CONDENSATE FLOW (65,000 GPM), SUCH THAT, EVEN IF NO MAKE-UP CAPABILITIES WERE CONSIDERED AND THE FEED REQUIREMENTS WERE OF THAT FLOW, IT WOULD TAKE APPROXIMATELY 26 MINUTES TO DEPLETE THAT INVENTORY WITH AN ESTIMATED 10,000 GPM LOSS OF MASS FROM THE SYSTEM. IT IS CONSERVATIVE THEN, TO ESTABLISH A MASS-ENERGY RELEASE RATE BASED ON THE FLOW RATES GIVEN BY THE ABOVE MENTIONED TABLE. ADDITIONALLY IT IS ASSUMED THAT

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ALL BLOWDOWN INTO THE STRUCTURE IS EFFECTIVELY TERMINATED AT 1800 SECS AFTER THE FAILURE OCCURS, WHICH IS CONSIDERED REASONABLE AND INCLUDES POST ISOLATION EVACUATION OF ONE GENERATOR ASSUMING A SINGLE STEAM GENERATOR STEAM ISOLATION VALVE FAILS TO OPERATE. THE FOLLOWING TABLE IS USED AS THE MASS-ENERGY RELEASE RATE FOR THE 'THREED' SUBCOMPARTMENT ANALYSIS

TIME (SECS)	$\dot{m}$ (LBM/SEC) (FOR 3 GEN.)	ENTHALPY (BTU/lbm)	$\dot{Q}$ (BTU/SEC)
0.0	1617.0	1188.1	1921157.7
1.0	1602.0	1188.7	1904297.4
2.0	1581.0	1189.3	1880283.3
3.0	1560.0	1189.8	1856088.0
4.0	1539.0	1190.3	1831871.7
5.0	1521.0	1190.8	1811206.8
6.0	1506.0	1191.2	1793947.2
7.0	1488.0	1191.6	1773100.8
8.0	1473.0	1192.0	1755816.0
9.0	1461.0	1192.3	1741950.3
10.0	1449.0	1192.6	1728077.4
11.0	1473.0 14370	1192.9	1714197.3
12.0	1425.0	1193.2	1700310.0
13.0	1413.0	1193.4	1686274.2
14.0	1404.0	1193.7	1675954.8
15.0	1392.0	1193.9	1661908.8
17.5	1371.0	1194.4	1637522.4
20.0	1350.0	1194.9	1613115.0
22.5	1332.0	1195.3	1592139.6
25.0	1314.0	1195.7	1573777.8
27.5	1299.0	1196.0	1553604.0
30.0	1287.0	1196.3	1539638.1
35.0	1266.0	1196.7	1515022.2
40.0	1254.0	1196.9	1500912.6
45.0	1248.0	1197.1	1493980.8
50.0	1242.0	1197.2	1486922.4
60.0	1239.0	1197.2	1483330.8
70.0	1242.0	1197.2	1486922.4
80.0	1242.0	1197.2	1486922.4
90.0	1245.0	1197.1	1490389.5
100.0	1245.0	1197.1	1490389.5
1800.0	1245.0	1197.1	1490389.5

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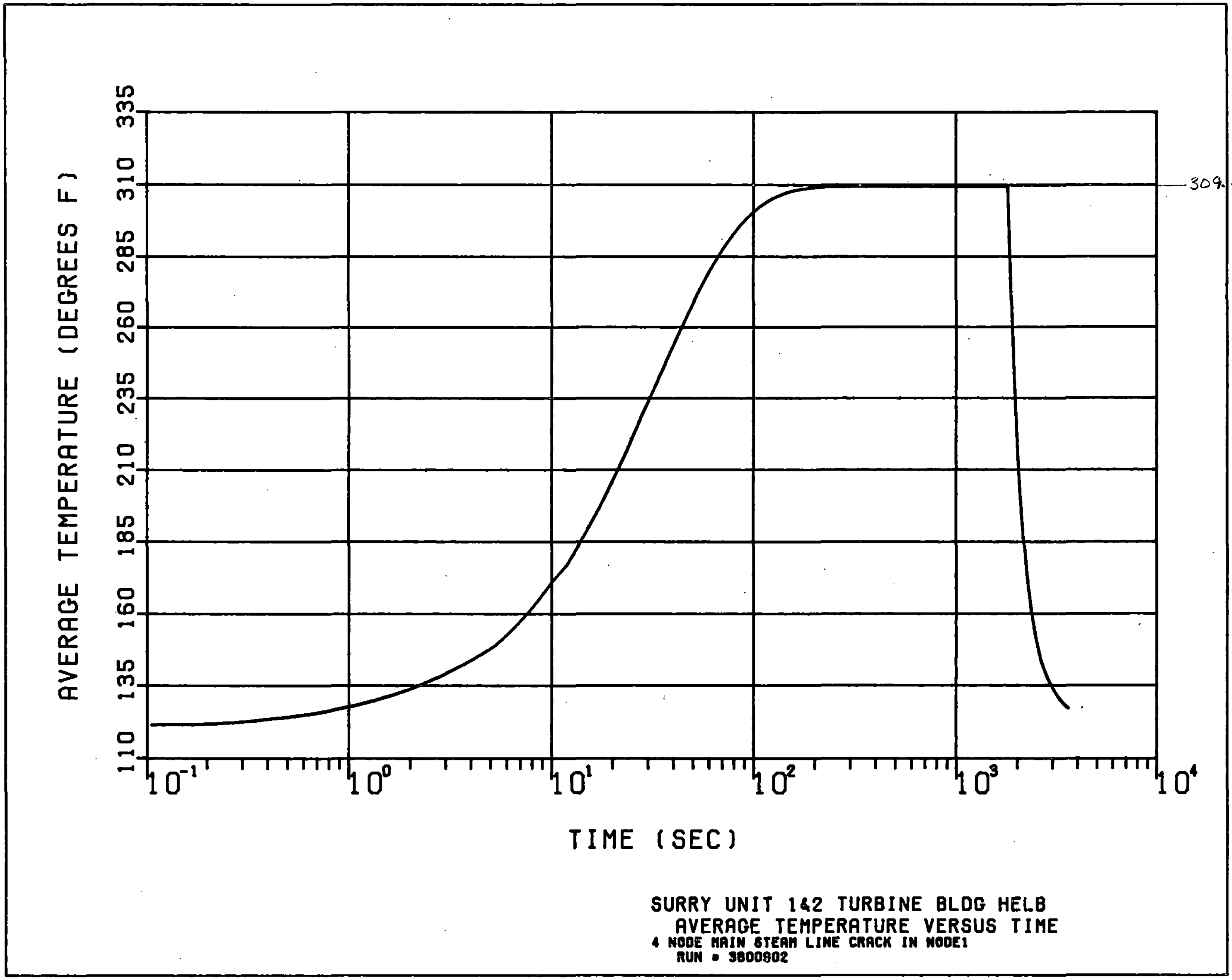
LIST OF ATTACHMENT

1. ATTACHMENT 1, 1 PAGE; I.O.C. TO BOB MILLER FROM MIKE O'MEARA DATED 9/23/80

CONCLUSIONS. THE ANALYSIS OF THE EFFECTS OF A HIGH ENERGY LINE BREAK OUTSIDE CONTAINMENT WITH RESPECT TO TEMPERATURE FOR EQUIPMENT LOCATED IN THE SURRY UNIT 1&2 MECHANICAL EQUIPMENT ROOM #3 IS COMPLETE AND SUMMARIZED BY THE GRAPH OF TEMPERATURE VS TIME ON PAGE 42 OF THIS CALCULATION.

SUMMARY: THE GRAPH ON P 42 OF THE TEMPERATURE TRANSIENT FOR NODE 1 OF THE TURBINE BUILDING, AS DISCUSSED PREVIOUSLY, IS ASSUMED TO BE THE TRANSIENT EXPERIENCED BY THE MECHANICAL EQUIPMENT ROOM #3 FOR THE FAILURE ANALYZED. THE FAILURE MODE AND DURATION IS CONSIDERED TO BE REASONABLE AND CONSERVATIVE, ALTHOUGH SOME APPROXIMATIONS OF DURATION ARE ARBITRARY. HOWEVER, REVIEW OF THE RESULTANT TRANSIENT INDICATES THAT THE STRUCTURE TENDS TO REACH AN EQUILIBRIUM TEMPERATURE CONDITION OF 309°F TO 310°F IN THE NODE OF INTEREST AFTER ABOUT 330SEC. FROM THIS IT IS REASONABLE TO POSTULATE THAT THE MAXIMUM TEMPERATURE FROM THIS SIZE FAILURE IS 310°F REGARDLESS OF DURATION, FOR ANY CONTINUED RELEASE OF ENERGY AFTER 330SECS. IT IS ALSO EVIDENT THAT AFTER TERMINATION OF THE FAILURE, THE TEMPERATURE DECREASE IS RELATIVELY RAPID FOR THIS AREA, SUCH THAT AT 30 MINUTES AFTER THE FAILURE IS ISOLATED, TEMPERATURES IN THE NODE OF INTEREST WILL BE BELOW 130°F. THIS ANALYSIS DOES NOT CONSIDER THE EFFECTS OF AN ACTIVE VENTILATION SYSTEM, WITH THE EXCEPTION OF EQUATING TEMPERATURES IN NODE 1 TO THAT OF THE MECHANICAL EQUIPMENT ROOM #3, NOR THAT OF PASSIVE HEAT SINKS. A SUMMARY OF THE INPUT DATA FOR THE ANALYSIS AND RESULTANT PEAK TEMPERATURES AND PRESSURES ARE CONTAINED IN PAGES 43 TO 47.


AVERAGE TEMPERATURE (DEGREES F)
TIME (SEC)
309.5 °F
SURRY UNIT 1&2 TURBINE BLDG HELB
AVERAGE TEMPERATURE VERSUS TIME
4 NODE MAIN STEAM LINE CRACK IN NODE1
RUN # 3800802

UNIT 55 (SEQ 1) INPUT ECHO

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

SURRY UNIT 2 TURBINE BLDG HELB
*
*
*PROBLEM DIMENSION DATA CARD
*
*
1 12 2  4 10 1 0 0 0 0
*
*
*IMPLICIT/EXPLICIT COEFFICIENT DATA CARD
*
*
1.0
*
*
*TIME STEP CONTROL DATA CARDS
*
*
 5 20 0 0 0.001  0.0001      .2
 2 20 0 0 0.01   0.001      1.0
 2 10 0 0 0.02   0.001      2.0
 8 10 0 0 0.05   0.001     10.0
 9 20 0 0 0.1    0.001    100.0
10 20 0 0 0.2    0.001    200.0
15 15 0 0 0.5    0.001   1799.0
 2 20 0 0 0.05   0.001   1805.0
 5 20 0 0 0.1    0.001   1850.0
 5 10 0 0 0.2    0.001   1900.0
 2 10 0 0 0.5    0.001   2000.0
10  5 0 0 1.0    0.01    3650.0
*
*
*TRIP CONTROL DATA CARDS
*
*
1  0  0 3600.0  0.00
1  0  0    0.0  0.0
*
*
*NODAL DATA CARDS
*
*
14.7  120. 1.0  1237658.0     9.5  48.25   0.0  0
14.7  120. 1.0  4436565.0    58.5  69.92   0.0  0
14.7  120. 1.0  1214211.0     9.5  48.25   0.0  0
14.7  120. 1.0     1.0E20     9.5  70.00   0.0  0
*
*
*JUNCTION DATA CARDS
*

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

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PG 047

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E.O. 12846.44

```
UNIT 55 (SEQ  1) INPUT ECHO         1         2         3         4         5         6         7         8
                           12345678901234567890123456789012345678901234567890123456789012345678901234567890

    *
     1  2 0 0 5342.4  .01     2.92     2.88   2 1.0 0    0.0     58.5  1.0
     1  2 0 0 1656.6  .01     2.71     2.67   2 1.0 0    0.0     58.5  1.0
     1  2 0 0   217.5  .01    2.78     2.78   2 1.0 0    0.0     58.5  1.0
     2  3 0 0 5922.0  .01     2.87     2.91   2 1.0 0    0.0     58.5  1.0
     2  3 0 0 1466.3  .01     2.69     2.73   2 1.0 0    0.0     58.5  1.0
     2  3 0 0   246.7  .01    2.77     2.77   2 1.0 0    0.0     58.5  1.0
     1  4 0 0   472.1  .028   3.37     2.18   2 1.0 0    0.0     15.0  1.0
     3  4 0 0   472.1  .028   3.37     2.18   2 1.0 0    0.0     15.0  1.0
     2  4 0 0   113.1  .045   1.51     1.51   2 1.0 0    0.0    128.42 1.0
     0  1 1 0     1.0  .0     0.0      0.0    0 1.0 0    0.0     27.00 1.0
    *
    *
    *FILL TABLE DATA CARDS
    *
    *
     34  2
       0.0            1617.0  1921157.7
       1.0            1602.0  1904297.4
       2.0            1581.0  1880283.3
       3.0            1560.0  1856088.0
       4.0            1539.0  1831871.7
       5.0            1521.0  1811206.8
       6.0            1506.0  1793947.2
       7.0            1488.0  1773100.8
       8.0            1473.0  1755816.0
       9.0            1461.0  1741950.3
      10.0            1449.0  1728077.4
      11.0            1473.0  1714197.3
      12.0            1425.0  1700310.0
      13.0            1413.0  1686274.2
      14.0            1404.0  1675954.8
      15.0            1392.0  1661908.8
      17.5            1371.0  1637522.4
      20.0            1350.0  1613115.0
      22.5            1332.0  1592139.6
      25.0            1314.0  1573777.8
      27.5            1299.0  1553604.0
      30.0            1287.0  1539638.1
      35.0            1266.0  1515022.2
      40.0            1254.0  1500912.6
      45.0            1248.0  1493980.8
      50.0            1242.0  1486922.4
      60.0            1239.0  1483330.8
      70.0            1242.0  1486922.4
      80.0            1242.0  1486922.4
      90.0            1245.0  1490389.5
     100.0            1245.0  1490389.5
    1800.0            1245.0  1490389.5
    1800.00001           0.0        0.0

    12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

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PE-040

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J.O.12846.41

```
UNIT 55 (SEQ  1) INPUT ECHO        1         2         3         4         5         6         7         8
                          12345678901234567890123456789012345678901234567890123456789012345678901234567890

                    101   3600.0            0.0        0.0                                                    101

                          12345678901234567890123456789012345678901234567890123456789012345678901234567890  <EOF>  COPIED TO UNIT  5
                                                                                                                      W/O CMTS
```

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I-I-45

94-I-4

RUN SUMMARY SHEET

MISCELLANEOUS PROBLEM CONTROL DATA:

OUTPUT FLAG.................	1	TOTAL TIME OF RUN..........................	3601.000 SEC
NUMBER OF TIME STEP CARDS...	12	NUMBER OF STANDARD TIME STEPS..............	7709
NUMBER OF TRIP CONTROLS.....	2	NUMBER OF ACTUAL TIME STEPS................	7721
NUMBER OF VOLUMES...........	4	NUMBER OF TIMES GAUSSIAN ELIMINATION USED..	7721
NUMBER OF JUNCTIONS.........	10	NUMBER OF TIMES GAUSS-SEIDEL USED..........	0
NUMBER OF FILL TABLES.......	1	NUMBER OF TRANSIENTS STORED FOR PLOTEMUP...	18
NUMBER OF FAN TABLES........	0	NUMBER OF SELECTED NODAL DIFF. PRESS.......	0
NUMBER OF HT SOURCE CURVES..	0	NUMBER OF HEAT SINKS.......................	0
IMPLICIT/EXPLICIT COEFF.....	1.000	NUMBER OF INTERNAL JUNCTIONS...............	9

STEAM TABLES USED (FT15) VOLUME SERIAL NO. = SHARE0 DATA SET NAME = HEATBAL.ME190.STH20G.OUTPUT1

OUTPUT: TRANSIENTS TAPE (FT08) = 016308 FILE NUMBER = ____ DATA SET NAME = FE.GUARDS.PLOTTER
TRANSMITTAL FILE (FT09) WAS NOT USED

PEAK PRESSURE DIFFERENTIAL

JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC
1	1 TO 2	0.05	0.104
2	1 TO 2	0.05	0.104
3	1 TO 2	0.05	0.104
4	2 TO 3	0.03	0.000
5	2 TO 3	0.03	0.000
6	2 TO 3	0.03	0.000
7	1 TO 4	0.07	0.108
8	3 TO 4	0.05	0.680
9	2 TO 4	0.05	1.120

PE-049-0

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J.O. 12846.44

PEAK PRESSURES AND TEMPERATURES

NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)
1	14.77	0.107	309.50	806.500
2	14.73	1.100	309.40	1800.000
3	14.76	0.670	309.51	1800.000
4	14.70	3601.000	120.00	3601.000

PE-049-0

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12846.44		PE-049-0		

REFERENCES

1. S & W DRAWING 11548-FM-6A, ISSUE 5
2. S & W. DRAWING 11548-FM-6B, ISSUE 6
3. S & W. DRAWING 11548-FM-6C, ISSUE 6
4. S&W DRAWING 11548-FM-6D, ISSUE 5
5. S&W DRAWING 11548-FM-6E, ISSUE 5
6. S&W DRAWING 11548-FM-6F, ISSUE 6
7. S&W DRAWING 11548-FM-6G, ISSUE 6
8. S&W DRAWING 11548-FM-6H, ISSUE 6
9. S&W DRAWING 11548-FC-7A, ISSUE 2
10. S&W DRAWING 11548-FC-7B, ISSUE 1
11. S&W DRAWING 11448-FM-6A, ISSUE 6
12. S&W DRAWING 11448-FM-6B, ISSUE 7
13. S&W DRAWING 11448-FM-6C, ISSUE 10
14. S&W DRAWING 11448-FM-6D, ISSUE 4
15. S&W DRAWING 11448-FM-6E, ISSUE 4
16. S&W DRAWING 11448-FM-6F, ISSUE 7
17. S&W. DRAWING 11448-FM-6G, ISSUE 7
18. S&W DRAWING 11448-FM-6H, ISSUE 7
19. S&W DRAWING 11548-FS-3C, ISSUE 4
20. S&W DRAWING 11548-FP-2D, ISSUE 6
21. S&W DRAWING 11548-FP-2E, ISSUE 5
22. S&W DRAWING 11448-FP-1C, ISSUE 7

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23. S&W DRAWING 11548-FS-4D, ISSUE 3

24. S&W DRAWING 11448-FA-2A, ISSUE 6

25 S&W DRAWING 11448-FA-2B, ISSUE 7

26. S&W DRAWING 11448-FA-2C, ISSUE 7

27 S&W DRAWING 11448-FA-11A, ISSUE 3

28 S&W DRAWING 11548-FS-3A, ISSUE 6

29. S&W DRAWING 11448-FS-3A, ISSUE 9

30 S&W DRAWING 11548-FA-2A, ISSUE 5

31. S&W DRAWING 11448-FA-7B, ISSUE 7

32. ENGINEERED SAFEGUARDS GUIDELINES 19-1, MARCH 3, 1980

33. S&W DRAWING 11448-FP-44A, ISSUE 7
FP-44B, ISSUE 6
FP-44C, ISSUE 7

34. S&W DRAWING 11548-FP-29A, ISSUE 6
29B, ISSUE 4

35 S&W DRAWING 11548-FP-30A, ISSUE 3

36. S&W DRAWING 11548-FP-31A, ISSUE 2
31B, ISSUE 1

37. S&W DRAWING 11548-FP-32A, ISSUE 5
32B, ISSUE 5

38. S&W DRAWING 11548-FP-33A, ISSUE 8
33B, ISSUE 4
33C, ISSUE 5
33D, ISSUE 6
33E, ISSUE 7
33F, ISSUE 6
33G, ISSUE 7
33H, ISSUE 8

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J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 50
12846.44		PE-049-0		

39. HAND BOOK of HYDRAULIC RESISTANCE, I.E. IDEL'CHIK, 1960

40. CRANE TECHNICAL PAPER #410, 1979

41 S&W DRAWING - 11448 FC-7A, ISSUE 2

42. S&W CALCULATION 12846.44 -PE-046-0

43. S&W DRAWING - 11448 -FB-24A, ISSUE 5

44. WESTINGHOUSE ELECTRIC CORP. ANALYSIS 12.2, REV. 1, 12/11/75

45. SURRY POWER STATION UNIT 1 & 2 FSAR

46. S&W DRAWING 11448 - FP - 10, ISSUE 8

47. S&W CALCULATION ES - 13075.44 - ES-224-0

INSTRUCTIONS

5453/79

SENDER — RETAIN YELLOW COPY.
FORWARD WHITE AND PINK COPIES.

REPLIER — RETURN WHITE COPY.
RETAIN PINK COPY FOR FILE.

J.O. 12846.44
ATTACHMENT 1, P1 of 1

INTEROFFICE CORRESPONDENCE

PE-0440

TO: BOB MILLER	LOCATION 9	SUBJECT / REFERENCE / J.O. NO. 12846.44 SURRY 1 & 2 ENVIRONMENTAL QUALIFICATION OF SAFETY GRADE EQUIPMENT.
FROM: MIKE O'MEARA	LOCATION 14	

MESSAGE: —

REQUEST YOU PERFORM AN ANALYSIS OF A STEAM LINE BREAK (SLB) IN THE SURRY UNIT #2 TURBINE BLDG. (UNIT #2 IS MORE CONSERVATIVE AS IT COULD AFFECT MECH. EQUIP. ROOM #3). DETERMINE THE ENVIRONMENTAL CONDITIONS (TEMP - PRESS - HUMIDITY) FOR BREAKS/CRACKS POSTULATED IN FSAR APPENDIX D. PER OUR DISCUSSION THE BREAKS TO BE ANALYZED SHOULD BE BOUND BY A "CRITICAL CRACK SIZE" AS DEFINED IN APP. D SECTION D.2.2.1, AND A BREAK WHICH RESULTS IN TOTAL STEAM FLOW FROM ~~ALL THREE~~ EACH STEAM GENERATOR~~S~~ UP TO THE HIGH STEAM FLOW TRIP SETPOINT.

DATE SIGNATURE TELEPHONE

REPLY:

* PLEASE CALL IF YOU HAVE ANY QUESTIONS
* PLEASE PROVIDE AN ESTIMATED COMPLETION DATE FOR THIS ANALYSIS
* CHARGE TIME TO J.O. 12846.44 ETA-00006

9/23/80 — DATE

[signature] — SIGNATURE

6836 — TELEPHONE

1-I-51

▲ 040.13B

ATTACH 2, P1 of 1

INTEROFFICE CORRESPONDENCE

ES-230-0

TO: R Miller	LOCATION 9	SUBJECT / REFERENCE / J.O. NO. 13075 HELB Analysis North Anna - Units 1&2
FROM: J McCumber	LOCATION 14	

MESSAGE: — Reference attached memo, W. Emerson to W Dodson dated 6-24-80.

The attached sheet provides additional information related to a letdown line break.

The time to break isolation (automatic) or operator action to isolate break is difficult to determine based on system instrumentation.

Based on our discussion it would be best to assume that operator action would be required to isolate break and to use the 1/2 hour time for that action to occur (as provided by VEPCO). A maximum letdown flow of 120 gpm prior to break should be assumed.

I also understand that you do not require my input on item 2 of the referenced memo.

DATE: 7/3/80 SIGNATURE: Joe McCumber TELEPHONE: 2313

REPLY:

Thank you.

DATE: 7/22/80 SIGNATURE: R F Miller TELEPHONE: 6816

1-I-52

▲ 040.13B

REPLIER RETURN WHITE COPY — RETAIN THIS COPY

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 9
EZD REFERENCE DESCRIPTION: 12846.54-RP-037-0
ENVIRONMENTAL ZONE(S): SFGD-1

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)			8.0×10^6	25				

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CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

▲5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF 25
VEPCO - SURRY 1&2	

CALCULATION TITLE (Indicative of the Objective):	QA CATEGORY (✓)
Direct γ-dose rates and Integrated dose to electrical components in The Safeguards Area after a LOCA.	☒ I - NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ______ OTHER

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12846.54	Power RP	037-0		

* APPROVALS - SIGNATURE & DATE			REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (✓)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
J. Cahill 8/11/80 8/11/80	Shuwan Lin 9-5-80	Shuwan Lin 9-5-80			✓ GAMTRAN I (Activity 2) (radionuclides)	

DISTRIBUTION*

GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT. FILES (OR FIRE FILE IF NONE)					
Op. Serv.	J. BARNHART - 14	✓			
project	M. OMEARA - 14	✓			

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CALCULATION SHEET

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Objective

This Calculation will estimate the exposure to The following components in The event of a LOCA for Surry power Station: from low head safety injection (LHSI) and recirculatory spray (RS) lines in The safeguards area:

MOV1862A
MOV1862B
MOV-RS156A
MOV-RS156B
MOV1864A
MOV1864B
MOV1840A
MOV1840B
MOV1840C
MOV1860A
MOV1860B
FE1945
FE1946

(MOV1862A through MOV1860B:) The doses to The motors which operate These values are calculated.

DATA

Source terms (ref. 3) (MeV/cm³·sec)

Time (hrs)	Group Energy (MeV) 0.4	0.8	1.3	1.7	2.2	2.5	3.5
0.0	5.16+8	8.40+9	5.67+9	2.86+9	5.65+8	6.14+8	2.93+9
1.0	3.64+8	5.38+9	3.26+9	2.64+9	3.19+8	2.98+8	4.62+8
2.0	3.49+8	3.74+9	2.44+9	1.73+9	2.51+8	4.89+7	2.76+8
8.0	3.30+8	1.51+9	9.64+8	6.68+8	1.04+8	4.21+6	4.68+7
24.0	3.08+8	7.98+8	1.79+8	1.85+8	1.46+7	4.13+6	8.78+5
96.0	2.34+8	2.12+8	8.55+6	6.06+7	1.24+6	3.74+6	1.50-2
142.0	1.64+8	1.30+8	5.13+6	4.81+7	5.21+5	2.75+6 (3.08 *)	-
360.0	9.09+7	9.48+7	2.83+6	3.28+7	1.17+5	2.12+6	-
720.0	2.68+7	6.51+7	1.24+6	1.44+7	4.68+3	9.42+5	-
2160.0	1.11+6	3.36+7	1.55+5	5.95+5	-	3.67+5	-
43200	3.44+5	1.52+7	5.34+4	3.23+4	-	2.83+2	-

Density of Concrete = 145 lb/ft³ (ref 2)

Density of Water = 62.4 lbm/ft³

* the value of 3.08+6 was corrected in Ref. 3 Calculation. However, this will not introduce significant difference in the results.

SL

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Pipe Data (ref. 5):

Nominal Size	Inside Dia.	Wall Thickness
4"	4.026"	0.237"
6"	6.065"	0.280"
8"	7.981"	0.322"
10"	10.020"	0.365"
12"	12.000"	0.375"
24"	23.250"	0.375"

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References

① Surry drawings: 11448-FP-60A, 11448-FP-60B, 11448-FP-60C, 11448-FP-60D } marked up by project to show pertinent piping

② "Shielding Design Summary for Surry Power Station, VEPCO", Stone and Webster, J.O. #11448; 12/70

③ Calculation 12846-46-RP-025-0, "Dose Rates From Aux. Bldg. Sump" 1/10/80

④ "Gamma transport by Point Kernal Technique (GAMTRAN1)" by J.A. Mayer, Jr. and E.A. Brown, User's Manual NU-3, 4/77

⑤ Crane technical Paper #410, "Flow of Fluids Through Valves, Fittings, and Pipes", Crane Co., 1979

⑥ S+W Computer Code, NU-3, <u>GAMTRAN1</u>, 2/77, version 1, level 3

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Approach

The piping and shield walls shown in Figures 1 Thru 4 were modeled and used in GAMTRAN1. Successive runs were made to obtain dose rates for various components for times up to 6 months, however only the higher doses were considered past time = 0 hrs in order to conserve computer expense.

It was assumed that the RS and LHSI lines contained undiluted sump water containing 50% of the halogens and 1% of the remainder uniformly mixed. The source strengths as given in calc. 12846-RP-025-0 (ref. 3) for various times were then input into GAMTRAN1.

Finally, the integrated doses were calculated using exponential interpolation as follows:

$$D(t) = \alpha e^{-\beta t} \; ; \; \beta = \frac{\ln \frac{D(t_1)}{D(t_2)}}{t_2 - t_1} \; , \; \alpha = D(t_1) e^{\beta t_1} \; ; \; D = \text{dose rate}$$

$$\Delta D = \int_{T_1}^{T_2} D(t)\,dt = \frac{\alpha}{\beta}\left[e^{-\beta t_1} - e^{-\beta t_2}\right] = \text{integrated dose between } T_1 \text{ and } T_2$$

$$\text{accumulated dose} = \sum_{i=1}^{n} (\Delta D)_i \; ; \text{ where } n = \#\text{ time intervals}$$

12846 Power RP 037-0 Pg 8

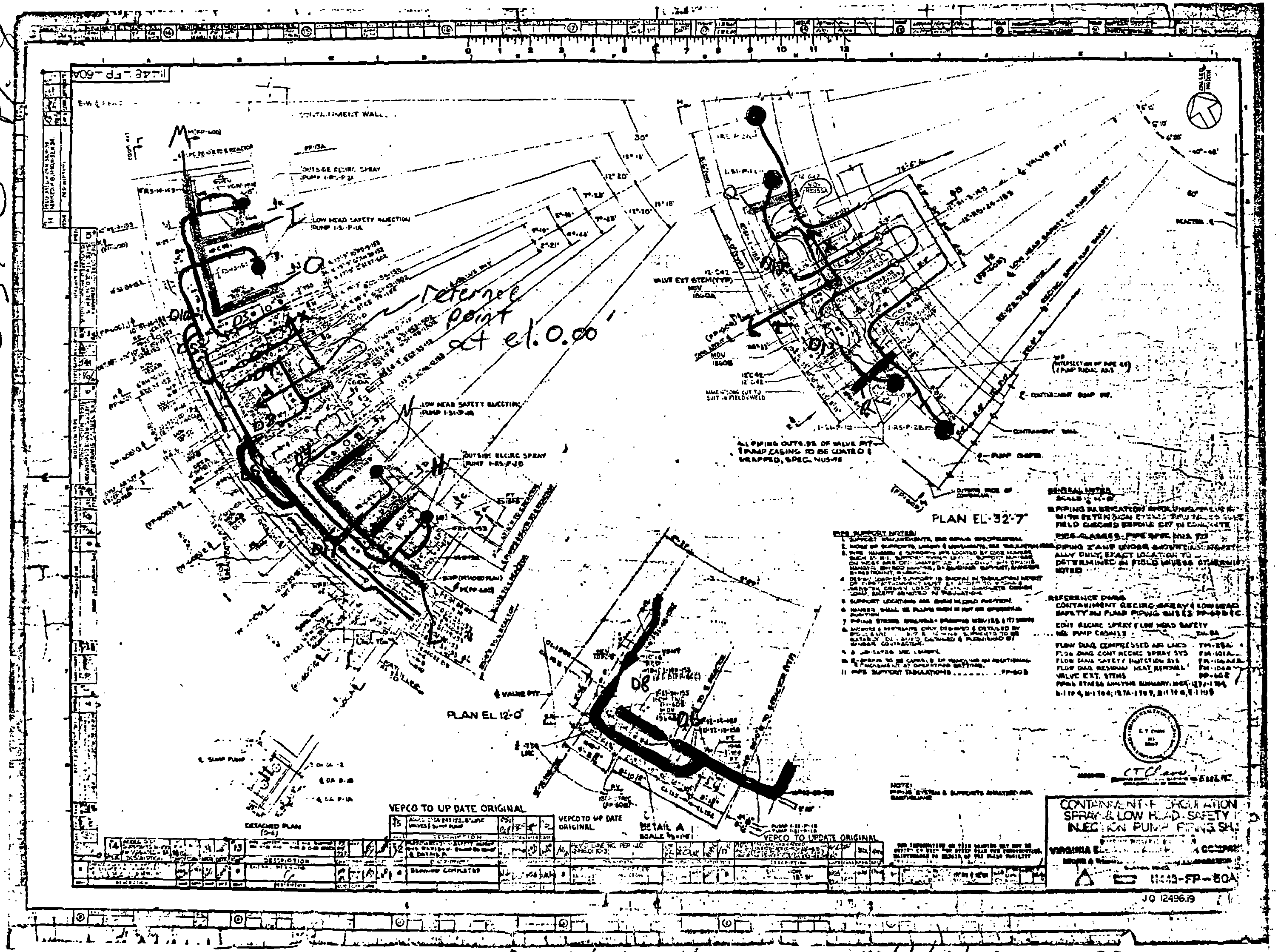

Fig. 1

X - detector pt. locations
Modeled Valves — RS lines
▬ - shields = LHSI Lines

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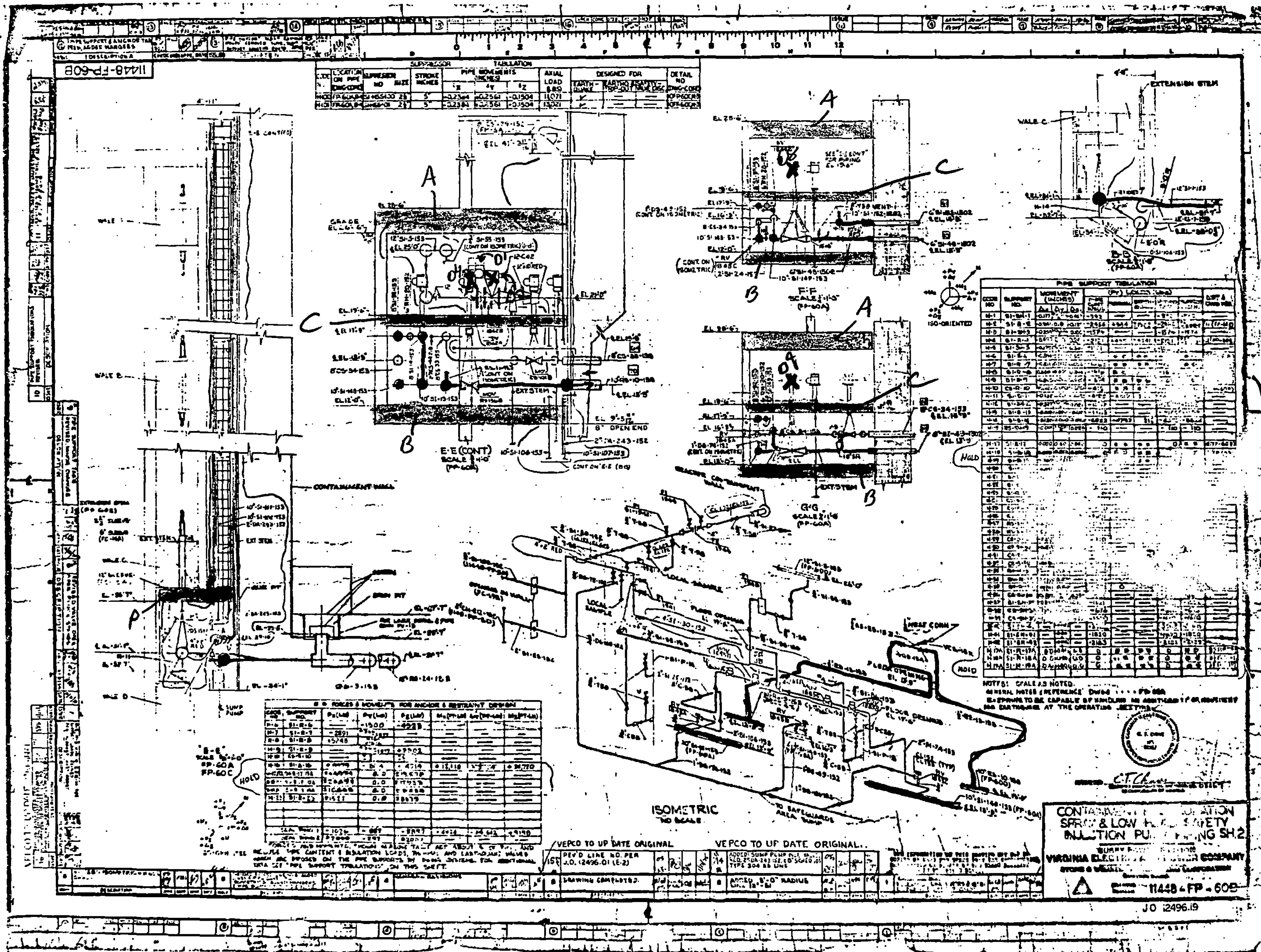

fig. 2

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X-deleted supp.

-modeled valves

-shields

-RS lines

-LI lines

pg. 10

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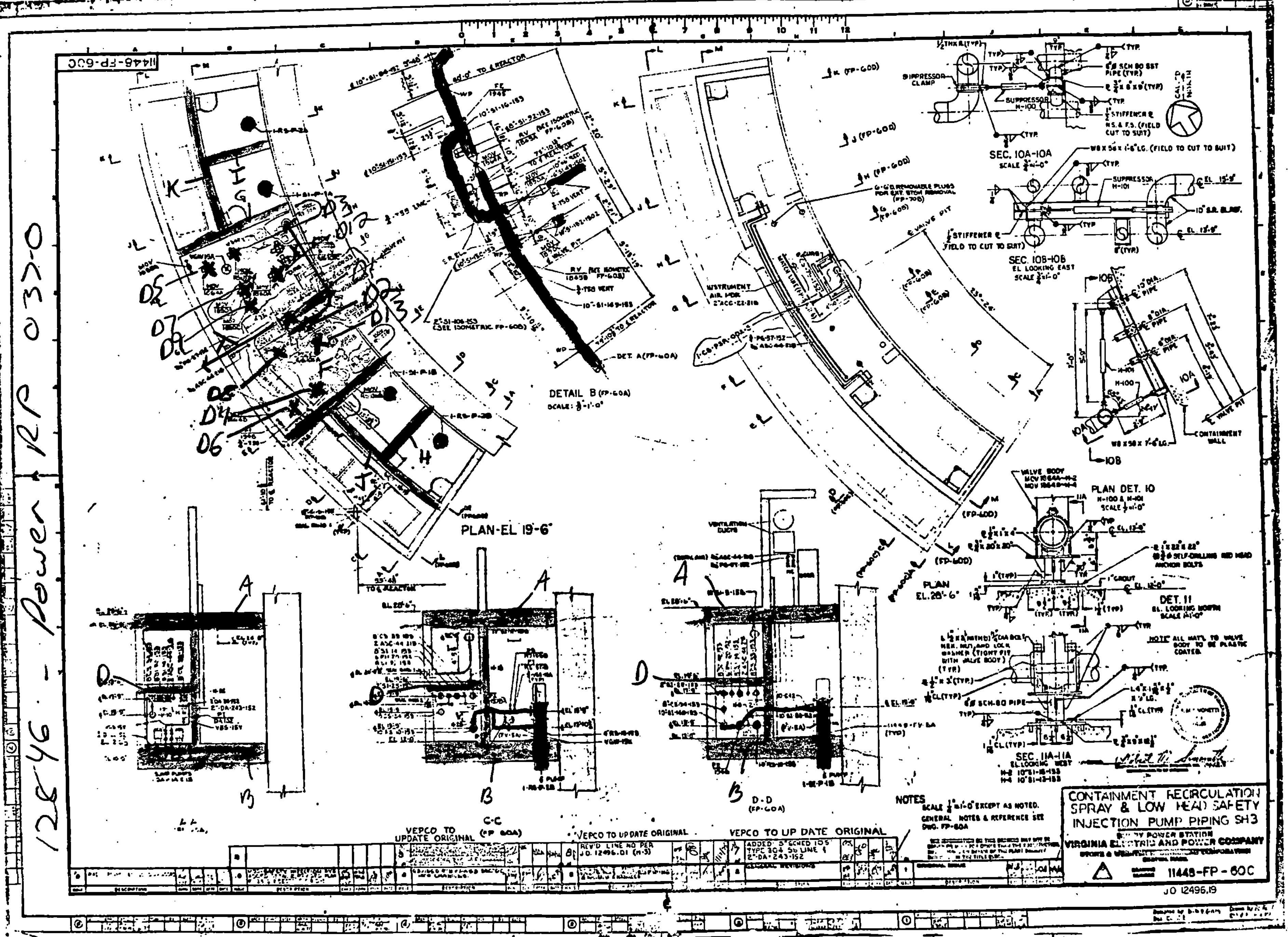

Fig. 3

1-5-10

X - detector pt. Locations

- Valves corresponding to modeled dt. pts.

- Shields

— RS Lines

— LHSI Lines

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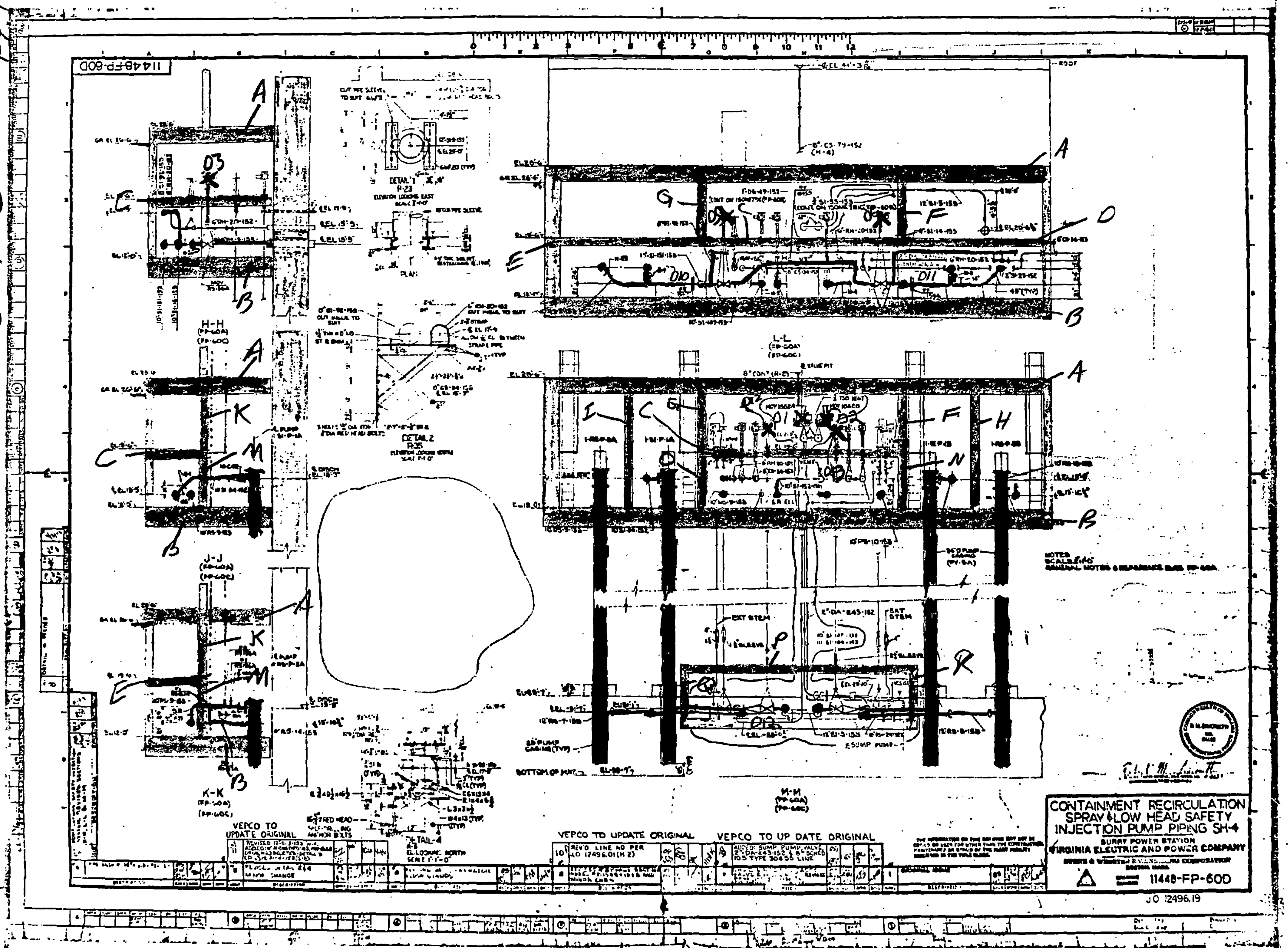

X- detector Pt. Locations -modeled valves -shields — LS Lines HSI Lines 1-5-11

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Calculation

The SI and RS lines shown in figures 1 thru 4 (red for SI, blue for RS) were modeled so as to be used in computer code GAMTRAN I. The reference origin is at the point of intersection of the valve pit center line and the containment wall (67.75' from center) at sea level (el. 0.00'), as shown in fig. 1. The pipes which were modeled are listed in Table I with their corresponding model sections. The coordinates of the model sections as input into GAMTRAN I are given in Table II.

Detector points were located at the components listed in the Objective Section of this Calculation. The coordinates of the detector pts. are listed in Table III. The detector pts. were generally located at the base of the motor drives except of D12 and D13 which were located at the top of the motor drives, but only for time = 0 hrs. In order to conserve computer time, the number of dose pts. were reduced by choosing

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The higher dose rate of a pair of symmetric components. After Time = 0 hrs, only dose points D2, D4, D6, D8, D10, D11, D13 were considered.

The walls of the safeguards area as shown in figs. 1-4 were modeled in the input to GAMTRAN2. The coordinates of the modeled walls are given in Table IV. Walls D1, D2, D3 and E1, E2, E3 consitute the floor at el. 14.5' in front of walls K and J, respectively. Each floor was modeled in three parts due to the curvature of the building.

The modeled data was input in two parts for each time after T=0 hrs (at 0 hrs the data was input in 4 runs). Table V contains a list of the computer runs made in this calculation for the various time intervals. The outputs of the GAMTRAN2 runs are given in Table VI. These dose rates were then used to find the integrated doses (using exponential interpolation) which

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are given in Table VII

There was some question as to whether or not pipes 10"-SI-106-153 and 10"-SI-107-153 would be contaminated after a LOCA. Computer runs were made for dose points D1 and D2 without these lines modeled (Sections 55-59). However these pts. are at el. 20.5' in these runs, and the motors are at el. 22.5' but this 2' difference shouldn't introduce significant error in the calculation of the dose rates at D1 and D2 since there are no pipes near these dose points.

The following method was used to find dose rates at times greater than 0hrs.:

$$D.R.^{w/o}(t=T) = D.R.^{w/o}(t=0) \times \frac{D.R.^{w}(t=T)}{D.R.^{w}(t=0)} \quad \text{-----(Eq A)}$$

Where w/o signifies a value without lines 10"-SI-106-153 and 10"-SI-107-153 modeled. Since these lines are very close to D1 and D2 with no shielding separating them, the dose rates calculated are conservative

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Since there is proportionately less shielding between the radioactive pipes and D2 (and D1) than what has been calculated. This occurs because in the case with the pipes modeled the dose points see a harder γ-spectrum from the pipes than from γ's penetrating concrete.

Note

Eq. (A) can be used to estimate dose rates at D1 & D2 for $t > 0$ for the case without pipes 10"-SI-106 & 10"SI-107 because:

① source spectrum for $t > 0$ is softer and

② there is at least 1' concrete floor between the detector and other line sources.

The calculated results by eq. (A) are conservative.

w. peng 9/17/80

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Modeled Pipe	Model Section #'s
10"-SI-84-152 (WITH 10"-SI-16-153)	1,2,3
10"SI-151-153	4,5,6
6"-SI-49-1502	7
8"SI-92-153	8,9,10,11,12,13
10"-SI-149-153	14,15,16,17
10"-SI-83-152 (WITH 10"-SI-13-153)	18,19,20
8"-SI-14-153	21,22
10"-SI-148-153	23,24,25
10"-SI-152-1502	26,27,28,29
10"-SI-150-153	30,31
10"-RS-9-153	32,33,34
10"-RS-10-153	35,36,37
12"-SI-1-153	38,39
12"-RS-7-153	40,41
12"-SI-2-153	42,43
12"-RS-8-153	44,45
1-SI-P-1B	46
1-RS-P-2B	47
1-SI-P-1A	48
1-RS-P-2A	49

Table I

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Table I (continued)

Modeled Pipe	Model / Section #'s
6"-SI-48-1502	50
4"-RS-14-153	51, 53
4"-RS-15-153	52, 54
10"-SI-106-153	55, 56, 57*
10"-SI-107-153	57, 58, 59*

*note: Lines 10"-SI-106-153 and 10"-SI-107-153 share section 57. This is because both lines have a section of pipe around el. -32'. As can be seen in figure 1, the two sections of pipe can apparently be modeled as one pipe since the closest detector point is at el. 14.25'.

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Computer Pipe Data for GAMTRAN1

Section number	Section End Point Coordinates (ft.) X_1	Y_1	Z_1	X_2	Y_2	Z_2	O.D. (in)	Thick (wall) (in)
1	17.0	0.5	15.75	18.50	8.5	15.75	10.02	0.365
2	18.5	8.5	15.75	18.75	9.25	13.75	10.02	0.365
3	18.75	9.25	13.75	9.50	11.50	13.75	10.02	0.365
4	12.50	11.00	13.75	12.50	13.00	13.75	10.02	0.365
5	12.50	13.00	13.75	5.50	14.00	13.75	10.02	0.365
6	5.50	14.00	13.75	5.50	9.50	13.75	10.02	0.365
7	5.50	9.50	13.75	5.00	0.00	13.75	6.065	0.280
8	11.50	11.00	13.75	11.50	11.00	17.75	7.981	0.322
9	11.50	11.00	17.75	11.50	13.00	17.75	7.981	0.322
10	11.50	13.00	17.75	-14.00	13.00	17.75	7.981	0.322
11	-14.00	13.00	17.75	-27.00	8.50	17.75	7.981	0.322
12	-27.00	8.50	17.75	-28.00	7.00	17.75	7.981	0.322
13	-28.00	7.00	17.75	-33.00	5.00	17.75	7.981	0.322
14	9.50	11.50	13.75	5.50	11.50	16.00	10.020	0.365
15	5.50	11.50	16.00	-6.00	11.50	16.00	10.020	0.365
16	-6.00	11.50	16.00	-6.00	11.50	13.75	10.020	0.365
17	-6.00	11.50	13.75	-10.00	11.00	13.75	10.020	0.365
18	-10.00	11.00	13.75	-19.50	9.00	13.75	10.020	0.365
19	-19.50	9.00	13.75	-19.00	8.00	15.75	10.020	0.365
20	-19.00	8.00	15.75	-16.50	0.00	15.75	10.020	0.365
21	-11.00	11.75	13.75	-11.00	11.75	17.75	7.981	0.322
22	-11.00	11.75	17.75	-32.00	4.50	17.75	7.981	0.322
23	-12.50	10.50	13.75	-12.50	12.50	13.75	10.020	0.365
24	-12.50	12.50	13.75	-3.50	13.50	13.75	10.020	0.365
25	-3.50	13.50	13.75	-3.50	9.50	13.75	10.020	0.365
26	-2.50	3.50	15.75	-2.50	0.00	15.75	10.020	0.365
27	3.50	3.50	15.75	-2.50	3.50	15.75	10.020	0.365
28	3.50	3.50	13.75	3.50	3.50	15.75	10.020	0.365
29	3.50	9.50	13.75	3.50	3.50	13.75	10.020	0.365
30	3.50	12.00	13.75	3.50	9.50	13.75	10.020	0.365
31	3.50	12.00	16.00	3.50	12.00	13.75	10.020	0.365
32	8.50	0.00	13.75	9.50	9.00	13.75	10.020	0.365
33	9.50	9.00	13.75	26.00	6.00	13.75	10.020	0.365
34	25.00	6.00	15.75	23.00	-0.50	15.75	10.020	0.365
35	-8.50	-1.00	13.75	-10.00	9.00	13.75	10.020	0.365
36	-10.00	9.00	13.75	-26.00	5.00	13.75	10.020	0.365
37	-25.00	5.00	15.75	-23.00	-1.50	15.75	10.020	0.365
38	2.00	-4.50	-31.00	2.00	4.00	-31.00	12.000	0.375
39	2.00	4.00	-31.00	16.00	3.50	-31.00	12.000	0.375
40 *	6.00	-7.00	-31.00	6.00	0.00	-31.00	12.000	0.375
41	6.00	0.00	-31.00	14.00	-1.00	-31.00	12.000	0.375
42	-2.00	-4.50	-31.00	-2.00	4.00	-31.00	12.000	0.375
43 *	-2.00	4.00	-31.00	-16.00	3.50	-31.00	12.000	0.375
44	-6.00	-7.00	-31.00	-6.00	0.00	-31.00	12.000	0.375
45	-6.00	0.00	-31.00	-14.00	-1.00	-31.00	12.000	0.375
46	-14.50	0.00	16.75	-14.50	0.00	-37.00	23.250	0.375
47	-22.50	-2.50	16.75	-22.50	-2.50	-37.00	23.250	0.375
48	14.00	0.50	16.75	14.00	0.50	-37.00	23.250	0.375
49	22.50	-1.50	16.75	22.50	-1.50	-37.00	23.250	0.375
50	-3.50	9.50	13.75	-2.50	0.00	13.75	6.065	0.280
51	25.00	3.00	15.75	26.50	-2.00	15.75	4.026	0.237
52	-24.00	-2.00	15.75	-26.50	3.00	15.75	4.026	0.237
53	26.50	3.00	15.75	24.00	3.50	15.75	4.026	0.237
54	-26.50	3.00	15.75	-24.00	3.50	15.75	4.026	0.237
55	-0.50	1.00	21.00	-0.50	1.00	-33.00	10.020	0.365
56	-0.50	1.00	21.00	-0.50	6.50	21.00	10.020	0.365
57	13.00	2.00	-31.00	-12.00	2.00	-31.00	10.020	0.365
58	-1.00	0.00	-30.00	-1.00	0.00	21.00	10.020	0.365
59	-1.00	0.00	21.00	-2.00	6.00	21.00	10.020	0.365

* Coordinates for these sections vary (as shown above) from the Drawings. However, due to the large distances from dose points, this should not produce significant errors. SLW

1-J-18

Table II

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 19
12845	Power RP	037-0		

Detector Point Coordinates

Component	Detector point	X	Y	Z (Ft.)
MOV1862A	01	-0.50	6.50	22.50
MOV1862B	02	-2.00	6.00	22.50
MOV-RS156A	03	4.50	7.50	21.70
MOV-RS156B	04	-4.50	7.50	21.70
MOV1864A	D5	4.50	11.50	21.70
MOV1864B	D6	-4.50	11.50	21.70
MOV 1840A	07	5.50	9.50	21.70
MOV 1890B	D8	-3.50	9.50	21.70
MOV 1890C	09	3.50	9.50	21.70
FE1945	D10	13.50	10.50	14.25
FE 1946	D11	-13.50	10.50	14.25
MOV 1860A	D12	4.50	4.50	22.50
MOV 1860B	D13	-4.50	4.50	22.50*

* note: in runs for times greater than 0 hrs, the Z coordinate for D13 was changed to 21.70 as the value of 22.50 was slightly higher than desirable.

Table III

1-5-19

1-J-20

* * * * * * * * * * * * RECTANGULAR SHIELD DATA * * * * * * * *

NO.	......CORNER NO.1...... X1 (FT.)	Y1 (FT.)	Z1 (FT.)	......CORNER NO.2...... X2 (FT.)	Y2 (FT.)	Z2 (FT.)	......CORNER NO.3...... X3 (FT.)	Y3 (FT.)	Z3 (FT.)	.........WALL......... THICK (FT.)	MAT	DENSITY (LB/CUFT)
A	-32.00	16.00	26.50	32.00	16.00	26.50	32.00	-7.00	26.50	2.000	2	145.000
B	-32.00	16.00	9.50	32.00	16.00	9.50	32.00	-7.00	9.50	2.500	2	145.000
C	12.50	16.00	18.50	12.50	-1.00	18.50	-12.50	-1.00	18.50	1.000	2	145.000
D1	-32.00	14.00	18.50	-12.50	14.00	18.50	-12.50	7.00	18.50	1.000	2	145.000
D2	-32.00	7.00	18.50	-17.00	7.00	18.50	-17.00	5.00	18.50	1.000	2	145.000
D3	-32.00	5.00	18.50	-22.00	5.00	18.50	-22.00	3.00	18.50	1.000	2	145.000
E1	12.50	7.00	18.50	12.50	14.00	18.50	32.00	14.00	18.50	1.000	2	145.000
E2	17.00	5.00	18.50	17.00	7.00	18.50	32.00	7.00	18.50	1.000	2	145.000
E3	22.00	3.00	18.50	22.00	5.00	18.50	32.00	5.00	18.50	1.000	2	145.000
F	-13.00	16.00	26.50	-10.00	-1.00	26.50	-10.00	-1.00	19.50	1.000	2	145.000
G	10.00	-1.00	19.50	10.00	-1.00	26.50	13.00	16.00	26.50	1.000	2	145.000
H	-19.00	-3.00	12.00	-19.00	-3.00	26.50	-21.00	5.00	26.50	1.000	2	145.000
I	19.00	-3.00	12.00	21.00	5.00	12.00	21.00	5.00	26.50	1.000	2	145.000
J	-13.00	7.50	19.50	-13.00	7.50	26.50	-31.00	2.00	26.50	1.000	2	145.000
K	31.00	2.00	26.50	13.00	7.50	26.50	13.00	7.50	19.50	1.000	2	145.000
L	-12.50	6.50	12.00	-12.50	6.50	18.50	-31.00	2.00	18.50	1.000	2	145.000
M	31.00	2.00	18.50	13.0	7.5	18.50	13.0	7.5	12.00	1.000	2	145.000
N	-11.50	8.00	18.50	-10.0	-1.0	18.50	-10.0	-1.0	12.00	1.000	2	145.000
O	10.00	-1.00	12.00	10.0	-1.00	18.50	11.5	8.00	18.50	1.000	2	145.000
P	-11.0	7.00	-25.00	11.0	7.00	-25.00	11.0	-5.00	-25.00	1.000	2	145.000
Q	11.0	7.00	-25.00	11.0	-5.00	-25.00	11.0	-5.00	-34.00	1.000	2	145.000
R	-11.0	-5.00	-34.00	-11.0	-5.00	-25.00	-11.0	7.00	-25.00	1.000	2	145.000

Table IV

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 21
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
12846	Power RP	037-0		

Time	Run #'s	Job#'s	Date
0	R2819301	2378	7/8/80
	302	2539	7/9/80
	303	2361	8/6/80
	304	2544	8/6/80
1 hr	R2819305	557	8/7/80
	306	528	8/7/80
2 hrs	R2819305	573	8/7/80
	308	819	8/7/80
8 hrs	R2819309	540	8/7/80
	310	833	8/7/80
24 hrs	R2819311	605	8/7/80
	312	849	8/7/80
96 hrs	R2819313	626	8/7/80
	314	866	8/7/80
192 hrs	R2819315	640	8/7/80
	316	879	8/7/80
360 hrs	R2819317	649	8/7/80
	318	892	8/7/80
720 hrs	R2819319	662	8/7/80
	320	901	8/7/80
2160 hrs	R2819321	784	8/7/80
	322	911	8/7/80
4320 hrs	R2819323	798	8/7/80
	324	924	8/7/80
0 hrs	R2819301	1962	8/5/80
	303	766	8/6/80

Table V

1-5-22

Dose Rates to various Valve Motors in The Safeguards Area

Dose Point / Component / Time (hrs)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13
	MOV1862A	MOV1862B	MOV-RS156A	MOV-RS156B	MOV1864A	MOV1864B	MOV1890A	MOV1890B	MOV1890C	FE1945	FE1946	MOV1860A	MOV1860B
0	4.96+7	5.66+7	5.49+6	6.72+6	5.02+6	5.26+6	7.77+6	1.01+7	9.55+6	3.21+8	3.24+8	1.60+7	3.05+7
1	*	3.43+7	*	3.97+6	*	3.02+6	*	5.94+6	*	1.95+8	1.97+8	*	2.07+7
2		2.41+7		2.78+6		2.10+6		4.15+6		1.37+8	1.37+8		1.45+7
8		1.01+7		1.06+6		8.46+5		1.71+6		5.75+7	5.82+7		6.11+6
24		4.46+6		4.89+5		3.37+5		7.21+5		2.54+7	2.57+7		2.70+6
96		1.66+6		1.79+5		1.16+5		2.61+5		9.47+6	9.62+6		1.02+6
192		1.12+6		1.21+5		7.85+4		1.76+5		6.38+6	6.48+6		6.87+5
360		7.04+5		7.62+4		5.01+4		1.11+5		4.01+6	4.07+6		4.31+5
720		3.31+5		3.60+4		2.42+4		5.29+4		1.89+6	1.91+6		2.02+5
2160		1.07+5		1.15+4		7.80+3		1.70+4		6.09+5	6.17+5		6.46+4
4320		4.67+4		5.03+3		3.38+3		7.40+3		2.67+5	2.70+5		2.83+4

Table VI

J.O. OR W.O. NO. 12846
DIVISION & GROUP Power RP
CALCULATION IDENTIFICATION NUMBER
CALCULATION NO. 037-0
OPTIONAL TASK CODE

STONE & WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET
5010.65

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 23
J.O. OR W.O. NO. 12846	DIVISION & GROUP Power RP	CALCULATION NO. 0370	OPTIONAL TASK CODE	

Integrated Doses to Valve Motors in Safeguards Area

Time (hrs)	Cumulative Dose (Rads)						
	MOV1862B	MOV-RS156B	MOV1864B	MOV1890B	MOV1860B	FE1945	FE1946
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	4.45+4	5.22+3	4.04+3	7.84+3	2.53+4	2.53+5	2.55+5
2	7.34+4	8.56+3	6.57+3	1.28+4	4.27+4	4.17+5	4.20+5
8	1.70+5	1.93+4	1.48+4	2.93+4	1.01+5	9.66+5	9.73+5
24	2.80+5	3.11+4	2.37+4	4.77+4	1.68+5	1.60+6	1.61+6
96	4.84+5	5.33+4	3.86+4	8.03+4	2.92+5	2.76+6	2.79+6
192	6.16+5	6.75+4	4.78+4	1.01+5	3.73+5	3.51+6	3.55+6
360	7.67+5	8.38+4	5.85+4	1.25+5	4.65+5	4.38+6	4.42+6
720	9.45+5	1.03+5	7.13+4	1.53+5	5.74+5	5.39+6	5.45+6
2160	1.23+6	1.34+5	9.21+4	1.98+5	7.47+5	7.02+6	7.10+6
4320	1.39+6	1.51+5	1.04+5	2.24+5	8.45+5	7.94+6	8.03+6

Table VII

1-5-23

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 24
J.O. OR W.O. NO. 12846	DIVISION & GROUP Power RP	CALCULATION NO. 0370	OPTIONAL TASK CODE	

Dose to MOV1862B without Lines 10"SI-106-153 and 10"SI-107-153 modeled

Time (hrs)	Dose Rate (mR/hr)	Δ Dose (R)	Cumulative Dose (R)
0	1.14+6	0.0	0.0
1	6.41+5	8.97+2	8.97+2
2	4.85+5	1.48+3	1.48+3
8	2.03+5	3.42+3	3.42+3
24	8.98+4	5.64+3	5.64+3
96	3.34+4	9.75+3	9.75+3
192	2.26+4	1.24+4	1.24+4
360	1.42+4	1.54+4	1.54+4
720	6.67+3	1.90+4	1.90+4
2160	2.16+3	2.48+4	2.48+4
4320	9.41+2	2.80+4	2.80+4

Table VIII

1-J-24

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 25
12846	Power RP	0370-0		

Conclusion

The six month integrated dose to the components studied are:

Component	6 mo. dose (Rads)	
MOV1862B	1.39+6	motors which operate these values
MOV-RS-156B	1.51+6	
MOV1864B	1.04+5	
MOV 1890B	2.24+5	
Mov 1860B	8.45+5	
FE1945	7.94+6	
FE1946	8.03+6	
* MOV1862B	2.80+4 } →	

* note: This value was arrived at without lines 10"-SI-106-153 and 10"-SI-107-153 modeled and with the detector point (D2) located 2' below the motor (in center of valve, but this should be an acceptable location to render and estimate of the dose to the component under question).

It is noted that the maximum 6 Month LOCA dose is 8×10^6 rads, the same as the number in calc. # 12846.38-RP-024-0.

1-J-25

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 10
EZD REFERENCE DESCRIPTION: 12846.44-UR(B)-043-0
ENVIRONMENTAL ZONE(S): AB-13A

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	2.66×10^7	6	9.3×10^5	6				

USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 10
EZD REFERENCE DESCRIPTION: 12846.44-UR(B)-043-0
ENVIRONMENTAL ZONE(S): AB-13B

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	1.96×10^{4}	6	3.2×10^{4}	6				

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 10
EZD REFERENCE DESCRIPTION: 12846.44-UR(B)-043-0
ENVIRONMENTAL ZONE(S): AB-27

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	1.26×10^6	6	6.8×10^2	6				

USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 10
EZD REFERENCE DESCRIPTION: 12846.44-UR(B)-043-0
ENVIRONMENTAL ZONE(S): AB-45

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	1.1×10^5	6	2.7×10^5	6				

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

▲5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF 6
VEPCO Surry 1 & 2	
CALCULATION TITLE (Indicative of the Objective): 6 Month LOCA Dose and 40 year Normal Dose Inside the Aux. Bldg According to Environmental zone Designations	QA CATEGORY (✓) ☑ I - NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ______ OTHER

CALCULATION IDENTIFICATION NUMBER				
J. O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12846.44	NT RP	UR(B)-043-0		

* APPROVALS - SIGNATURE & DATE			REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION * REQUIRED (✓)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
Wuhung Peng 6/29/81	Joseph Lin 7/6/81	Joseph Lin 7/6/81			GAMTRAN II QADMOD RADIOISOTOPE ACTIVITY2	

DISTRIBUTION *

GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT. FILES (OR FIRE FILE IF NONE)	J. Barnhart (14)	✓			

1-K-1

CALCULATION IDENTIFICATION NUMBER				PAGE 2
J.O. OR W.O. NO. 12846.44	DIVISION & GROUP NT RP	CALCULATION NO. UR(B)-043-0	OPTIONAL TASK CODE	

Objective

The objective of this calc. is to list the 40 year normal and 6 Month LOCA dose inside the auxilliary bldg according to Environmental zone designation..

Approach

1. Aux bldg has been divided in 8 zones according to Environmental conditions following a LOCA and 38 zones according to Radiation Level. Each environmental zone includes several Radiation zones.
2. The 6 Month LOCA dose and 40 year normal dose of each radiation zone have been calulated and tabulated in calc. 12846.38-RP-026-0[1] and 1284654-RP-035-0[2], respectively.
3. The total integrated dose (LOCA plus 40 year) for each environmental zone is determined by choosing the radiation zone which gives the most conservative value.
4. Doses in penetration areas and charging pump cubicles are based on ref. (3).

References:

(1) S & W Calc. 12846.38-RP-026-0, "NUREG-0578 Shielding Review - Aux Bldg Rad. Zone Maps Following a LOCA" Surry stations

(2) S & W Surry Calc. 12846.54-RP-035-0, "40 year normal operating dose in Aux bldg for Equipment Qualification" 7-17-80

(3) Surry calc. 12846.38-RP-024-0 1, "Equipment Qual. in Aux & S.G Bldgs"

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 3
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
12846.44	NT - RP	UK(B)-043-0		

6 MONTHS' LOCA DOSE FROM UNIT #1
(DOSE RATE IN MR/HR)(ref.(1))

ZONE	0 HR	1	2	8	24	96	192	360	720	2160	4320	INTEGRATED* DOSE
	1	1	6	16	72	96	168	360	1440	2160		(RADS)
A	2.1 +5	1.2 +5	7.5 +4	3.3 +4	1.2 +4	3.6 +3	2.5 +3	1.6 +3	7.9 +2	2.7 +2	1.1 +2	3.8 +3
B	1.8 +4	9.8 +3	5.9 +3	2.7 +3	9.1 +2	2.7 +2	1.9 +2	1.2 +2	5.9 +1	2.0 +1	8.3 +0	2.9 +2
C	2.5 +7	1.4 +7	9.7 +6	4.0 +6	1.7 +6	6.2 +5	4.2 +5	2.6 +5	1.2 +5	4.0 +4	1.7 +4	5.5 +5
D	5.0 +7	2.9 +7	2.1 +7	8.0 +6	2.8 +6	9.3 +5	6.3 +5	3.9 +5	2.0 +5	6.5 +4	2.7 +4	9.3 +5
E	1.6 +8	1.0 +8	7.2 +7	3.0 +7	1.4 +7	5.1 +6	3.5 +6	2.1 +6	1.0 +6	3.3 +5	1.4 +5	4.5 +6
F	1.4 +8	9.1 +7	6.3 +7	2.6 +7	1.2 +7	4.5 +6	3.1 +6	1.9 +6	8.9 +5	2.9 +5	1.2 +5	3.9 +6
G	1.4 +5	7.1 +4	4.8 +4	1.8 +4	6.2 +3	1.8 +3	1.3 +3	8.1 +2	4.1 +2	1.3 +2	5.6 +1	2.0 +3
H	4.4 +7	2.5 +7	1.8 +7	7.0 +6	2.8 +6	9.6 +5	6.4 +5	4.1 +5	2.0 +5	6.8 +4	2.9 +4	9.2 +5
I	7.1 +6	4.3 +6	3.1 +6	1.2 +6	5.6 +5	2.1 +5	1.4 +5	8.8 +4	4.1 +4	1.3 +4	5.9 +3	1.8 +5
J	4.5 +6	2.2 +6	1.5 +6	5.8 +5	2.3 +5	8.5 +4	5.7 +4	3.3 +4	1.5 +4	5.1 +3	2.1 +3	7.5 +4
K	2.4 +2	1.4 +2	9.6 +1	3.9 +1	4.5 +0	1.6 +0	1.0 +0	6.6 -1	—	—	—	1.7 +0
L	1.0 +3	5.5 +2	3.8 +2	1.5 +2	3.1 +1	9.6 +0	6.5 +0	3.7 +0	1.9 +0	3.8 -1	—	1.0 +1
M	3.0 +6	1.8 +6	1.2 +6	5.2 +5	1.9 +5	6.9 +4	4.7 +4	3.0 +4	1.4 +4	4.5 +3	2.0 +3	6.4 +4
N	1.7 +4	1.0 +4	6.8 +3	2.7 +3	5.0 +2	1.7 +2	1.2 +2	7.3 +1	3.6 +1	1.1 +1	4.7 +0	2.0 +2
O	3.1 +6	1.2 +6	8.1 +5	3.2 +5	1.2 +5	3.6 +4	2.2 +4	1.4 +4	5.1 +3	1.0 +3	4.0 +2	3.1 +4
P	4.2 +5	2.0 +5	1.4 +5	5.1 +4	1.5 +4	3.9 +3	2.8 +3	1.8 +3	9.5 +2	2.8 +2	1.2 +2	4.8 +3
Q	4.8 +7	2.8 +7	2.0 +7	7.9 +6	2.8 +6	9.5 +5	6.4 +5	4.0 +5	2.0 +5	6.6 +4	2.8 +4	9.3 +5
R	4.0 +6	1.2 +6	8.8 +5	3.4 +5	1.3 +5	4.8 +4	2.9 +4	1.4 +4	3.8 +3	4.6 +2	1.9 +2	3.2 +4
S	7.8 +4	4.2 +4	2.9 +4	1.1 +4	3.9 +3	1.2 +3	8.1 +2	5.2 +2	2.6 +2	8.8 +1	3.7 +1	1.3 +3
T	1.0 +7	6.1 +6	4.2 +6	1.7 +6	7.1 +5	2.3 +5	1.6 +5	1.0 +5	5.0 +4	1.4 +4	7.0 +3	2.2 +5
U	4.7 +6	2.8 +6	2.0 +6	8.3 +5	3.6 +5	1.3 +5	9.1 +4	5.7 +4	2.6 +4	8.6 +3	3.8 +3	1.2 +5
V	3.6 +6	1.6 +6	1.1 +6	4.2 +5	1.6 +5	6.4 +4	4.0 +4	2.2 +4	9.9 +3	3.7 +3	1.3 +3	5.2 +4
W	2.1 +4	1.4 +4	1.0 +4	6.9 +3	2.4 +3	1.1 +3	1.1 +3	1.0 +3	5.4 +2	9.0 +0	8.0 -3	1.2 +3
X	5.0 +4	1.8 +4	1.3 +4	5.1 +3	2.1 +3	7.0 +2	4.7 +2	2.9 +2	1.5 +2	4.9 +1	2.0 +1	6.8 +2
Y	1.3 +7	5.3 +6	3.7 +6	1.4 +6	5.4 +5	2.1 +5	1.3 +5	7.4 +4	3.3 +4	1.3 +4	4.3 +3	1.8 +5
Z	6.1 +3	2.0 +3	1.4 +3	5.0 +2	1.7 +2	6.7 +1	4.3 +1	2.5 +1	1.1 +1	3.3 +0	1.1 +0	5.8 +1
AA	6.0 +4	2.1 +4	1.4 +4	5.5 +3	2.2 +3	7.4 +2	5.0 +2	3.1 +2	1.5 +2	5.0 +1	2.1 +1	7.2 +2
BB	2.7 +3	4.7 +2	3.2 +2	9.2 +1	2.0 +1	6.2 +0	4.0 +0	2.0 +0	6.0 -1	—	—	7.0 +0
CC	3.9 +4	1.2 +4	7.8 +3	2.5 +3	7.5 +2	2.4 +2	1.7 +2	1.0 +2	5.0 +1	1.4 +1	5.1 +0	2.6 +2
DD	2.5 +4	1.4 +4	1.0 +4	6.3 +3	2.2 +3	9.9 +2	9.7 +2	9.2 +2	4.9 +2	9.2 +0	7.1 -3	1.1 +3
EE	7.0 +4	2.4 +4	1.5 +4	5.0 +3	1.3 +3	3.4 +2	2.5 +2	1.6 +2	7.7 +1	1.8 +1	5.8 +0	4.4 +2
FF	2.3 +4	3.5 +3	2.6 +3	5.2 +2	3.9 +1	1.7 +0	6.7 -1	—	—	—	—	3.2 +1
GG	1.6 +7	3.8 +6	2.8 +6	9.8 +5	3.5 +5	1.1 +5	6.9 +4	3.1 +4	6.5 +3	2.9 +1	2.8 -2	8.0 +4
HH	8.4 +4	3.0 +4	2.2 +4	8.6 +3	2.9 +3	1.1 +3	6.9 +2	4.2 +2	2.0 +2	5.6 +1	1.9 +1	9.7 +2
II	2.2 +6	1.4 +6	1.1 +6	8.0 +5	3.4 +5	2.3 +5	2.5 +5	2.4 +5	1.3 +5	2.3 +3	2.9 +1	2.7 +5
JJ	9.7 +4	3.4 +4	2.5 +4	1.0 +4	3.6 +3	1.3 +3	8.5 +2	4.9 +2	2.3 +2	5.6 +1	1.9 +1	1.1 +3
KK	4.2 +4	1.4 +4	1.1 +4	5.7 +3	1.6 +3	4.0 +2	3.3 +2	2.9 +2	1.5 +2	2.4 +0	2.2 -3	5.0 +2
LL	7.9 +4	2.7 +4	2.0 +4	9.5 +3	9.3 +3	9.2 +2	6.7 +2	4.6 +2	2.2 +2	2.3 +1	7.0 +0	1.2 +3

* Integrated doses are calculated by linear integration.

1-K-3

STONE & WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET

5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 4
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6 MONTHS' LOCA DOSE FROM UNIT #2
(DOSE RATE IN MR/HR) ref (4)

ZONE	0 HR	1	2	8	24	96	192	360	720	2160	4320	INTEGRATE DOSE (RADS)
				16	72	96	168	360	1440	2160		
A	1.5 +8	9.6 +7	6.7 +7	2.8 +7	1.3 +7	4.8 +6	3.3 +6	2.0 +6	9.3 +5	3.0 +5	1.3 +5	4.2 +6
B	4.5 +6	2.1 +6	1.4 +6	5.0 +5	1.4 +5	3.5 +4	2.5 +4	1.7 +4	8.6 +3	2.5 +3	9.6 +2	4.5 +4
C	2.5 +7	1.4 +7	9.7 +6	4.0 +6	1.7 +6	6.2 +5	4.2 +5	2.6 +5	1.2 +5	4.0 +4	1.7 +4	5.5 +5
D	4.6 +7	2.7 +7	1.9 +7	7.5 +6	2.6 +6	8.9 +5	6.1 +5	3.8 +5	1.9 +5	6.3 +4	2.6 +4	8.8 +5
E	1.3 +7	8.0 +6	5.6 +6	2.4 +6	1.0 +6	3.9 +5	2.6 +5	1.6 +5	7.7 +4	2.5 +4	1.1 +4	3.4 +5
F	5.2 +5	2.9 +5	2.0 +5	8.3 +4	3.5 +4	1.3 +4	8.9 +3	5.5 +3	2.6 +3	8.5 +2	3.7 +2	1.2 +4
G	1.4 +8	9.0 +7	6.3 +7	2.6 +7	1.2 +7	4.5 +6	3.1 +6	1.9 +6	8.9 +5	2.9 +5	1.2 +5	3.9 +6
H	4.4 +7	2.5 +7	1.8 +7	7.0 +6	2.8 +6	9.6 +5	6.4 +5	4.1 +5	2.0 +5	6.8 +4	2.9 +4	9.2 +5
I	7.1 +6	4.3 +6	3.1 +6	1.2 +6	5.6 +5	2.1 +5	1.4 +5	8.8 +4	4.1 +4	1.3 +4	5.9 +3	1.8 +5
J	4.5 +6	2.2 +6	1.5 +6	5.8 +5	2.3 +5	8.5 +4	5.7 +4	3.3 +4	1.5 +4	5.1 +3	2.1 +3	7.5 +4
K	4.0 +6	1.1 +6	8.2 +5	3.3 +5	1.3 +5	4.7 +4	2.8 +4	1.4 +4	3.4 +3	3.3 +2	1.3 +2	3.1 +4
L	3.1 +5	9.5 +4	6.8 +4	2.6 +4	9.8 +3	3.6 +3	2.1 +3	1.1 +3	3.0 +2	4.7 +1	1.6 +1	2.5 +3
M	3.0 +6	1.8 +6	1.2 +6	5.2 +5	1.9 +5	6.9 +4	4.7 +4	3.0 +4	1.4 +4	4.5 +3	2.0 +3	6.4 +4
N	3.1 +6	1.1 +6	7.8 +5	3.2 +5	1.2 +5	3.5 +4	2.2 +4	1.3 +4	5.0 +3	9.6 +2	3.9 +2	3.0 +4
O	7.7 +4	4.2 +4	2.9 +4	1.1 +4	2.3 +3	6.6 +2	4.6 +2	3.0 +2	1.5 +2	4.9 +1	2.0 +1	8.4 +2
P	4.2 +5	2.0 +5	1.4 +5	5.1 +4	1.5 +4	3.9 +3	2.8 +3	1.8 +3	9.5 +2	2.8 +2	1.2 +2	4.8 +3
Q	4.8 +7	2.8 +7	2.0 +7	7.8 +6	2.8 +6	9.5 +5	6.4 +5	4.0 +5	2.0 +5	6.6 +4	2.8 +4	9.3 +5
R	2.0 +5	1.2 +5	8.0 +4	3.2 +4	6.1 +3	2.0 +3	1.4 +3	8.9 +2	4.4 +2	1.4 +2	6.0 +1	2.4 +3
S	1.0 +7	6.1 +6	4.2 +6	1.7 +6	7.0 +5	2.3 +5	1.5 +5	9.9 +4	4.9 +4	1.3 +4	7.0 +3	2.2 +5
T	1.4 +5	8.0 +4	5.7 +4	2.3 +4	9.3 +3	3.3 +3	2.2 +3	1.4 +3	6.6 +2	2.2 +2	9.4 +1	3.0 +3
U	4.7 +6	2.8 +6	2.0 +6	8.3 +5	3.6 +5	1.3 +5	9.1 +4	5.7 +4	2.6 +4	8.6 +3	3.8 +3	1.2 +5
V	3.6 +6	1.6 +6	1.1 +6	4.2 +5	1.6 +5	6.4 +4	4.0 +4	2.2 +4	9.9 +3	3.7 +3	1.3 +3	5.2 +4
W	2.1 +4	1.4 +4	1.0 +4	6.9 +3	2.4 +3	1.1 +3	1.1 +3	1.0 +3	5.4 +2	9.0 +0	8.0 -3	1.2 +3
X	5.0 +4	1.8 +4	1.3 +4	5.1 +3	2.1 +3	7.0 +2	4.7 +2	2.9 +2	1.5 +2	4.9 +1	2.0 +1	6.8 +2
Y	1.3 +7	5.3 +6	3.7 +6	1.4 +6	5.4 +5	2.1 +5	1.3 +5	7.4 +4	3.3 +4	1.3 +4	4.3 +3	1.8 +5
Z	6.0 +4	2.1 +4	1.4 +4	5.5 +3	2.2 +3	7.4 +2	5.0 +2	3.1 +2	1.5 +2	5.0 +1	2.1 +1	7.2 +2
AA	6.2 +3	2.0 +3	1.4 +3	5.1 +2	1.7 +2	6.7 +1	4.3 +1	2.5 +1	1.1 +1	3.3 +0	1.1 +0	5.8 +1
BB	3.0 +4	8.7 +3	5.5 +3	1.7 +3	4.4 +2	1.4 +2	9.8 +1	6.0 +1	2.8 +1	7.3 +0	2.4 +0	1.6 +2
CC	1.1 +4	3.9 +3	2.6 +3	9.3 +2	3.3 +2	1.1 +2	7.4 +1	4.6 +1	2.2 +1	6.8 +0	2.7 +0	1.1 +2
DD	2.5 +4	1.4 +4	1.0 +4	6.3 +3	2.2 +3	9.9 +2	9.7 +2	9.2 +2	4.9 +2	9.2 +0	7.1 -3	1.1 +3
EE	7.0 +4	2.4 +4	1.5 +4	5.0 +3	1.3 +3	3.4 +2	2.5 +2	1.6 +2	7.7 +1	1.8 +1	5.8 +0	4.4 +2
FF	1.6 +7	3.8 +6	2.8 +6	9.8 +5	3.5 +5	1.1 +5	6.9 +4	3.1 +4	6.5 +3	2.9 +1	2.8 -2	8.0 +4
GG	2.3 +4	3.5 +3	2.6 +3	5.2 +2	3.9 +1	1.7 +0	6.7 -1	0.0	0.0	0.0	0.0	3.2 +1
HH	9.7 +4	3.4 +4	2.5 +4	1.0 +4	3.6 +3	1.3 +3	8.5 +2	4.9 +2	2.3 +2	5.6 +1	1.9 +1	1.1 +3
II	2.2 +6	1.4 +6	1.1 +6	8.0 +5	3.4 +5	2.3 +5	2.5 +5	2.4 +5	1.3 +5	2.3 +3	2.9 +1	2.7 +5
JJ	8.4 +4	3.0 +4	2.2 +4	8.6 +3	2.9 +3	1.1 +3	6.9 +2	4.2 +2	2.0 +2	5.6 +1	1.9 +1	9.7 +2
KK	4.2 +4	1.4 +4	1.1 +4	5.7 +3	1.6 +3	4.0 +2	3.3 +2	2.9 +2	1.5 +2	2.4 +0	2.2 -3	5.0 +2
LL	7.9 +4	2.7 +4	2.0 +4	9.5 +3	9.3 +3	9.2 +2	6.7 +2	4.6 +2	2.2 +2	2.3 +1	7.0 +0	1.2 +3

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STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 5
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3. TOTAL DOSES

ZONE	40 YEAR DOSE ref(2)	UNIT # 1 ACCIDENT LOCA	UNIT # 1 ACCIDENT TOTAL	UNIT # 2 ACCIDENT LOCA	UNIT # 2 ACCIDENT TOTAL
A	2.50 +6	3.8 +3	2.5 +6	4.2 +6	6.7 +6
B	7.01 +6	2.9 +2	7.0 +6	4.5 +4	7.1 +6
C	1.11 +6	5.5 +5	1.7 +6	5.5 +5	1.7 +6
D	5.43 +6	9.3 +5	6.4 +6	8.8 +5	6.3 +6
E	2.50 +6	4.5 +6	7.0 +6	3.4 +5	2.8 +6
F	3.50 +6	3.9 +6	7.4 +6	1.2 +4	3.5 +6
G	3.50 +6	2.0 +3	3.5 +6	3.9 +6	7.4 +6
H	1.11 +6	9.2 +5	2.0 +6	9.2 +5	2.0 +6
I	1.11 +6	1.8 +5	1.3 +6	1.8 +5	1.3 +6
J	5.26 +5	7.5 +4	6.0 +5	7.5 +4	6.0 +5
K	1.96 +4	1.7 +0	2.0 +4	3.1 +4	5.1 +4
L	2.98 +6	1.0 +1	3.0 +6	2.5 +3	3.0 +6
M	2.18 +3	6.4 +4	6.6 +4	6.4 +4	6.6 +4
N	4.87 +3	2.0 +2	5.1 +3	3.0 +4	3.5 +4
O	4.87 +3	3.1 +4	3.6 +4	8.4 +2	5.7 +3
P	8.41 +2	4.8 +3	5.6 +3	4.8 +3	5.6 +3
Q	2.66 +7	9.3 +5	2.8 +7	9.3 +5	2.8 +7
R	1.96 +4	3.2 +4	5.2 +4	2.4 +3	2.2 +4
S	1.40 +5	1.3 +3	1.4 +5	2.2 +5	3.6 +5
T	1.40 +5	2.2 +5	3.6 +5	3.0 +3	1.4 +5
U	2.18 +3	1.2 +5	1.2 +5	1.2 +5	1.2 +5
V	5.26 +5	5.2 +4	5.8 +5	5.2 +4	5.8 +5
W	3.50 +2	1.2 +3	1.6 +3	1.2 +3	1.6 +3
X	1.26 +8	6.8 +2	1.3 +8	6.8 +2	1.3 +8
Y	3.88 +4	1.8 +5	2.2 +5	1.8 +5	2.2 +5
Z	5.26 +3	5.8 +1	5.3 +3	7.2 +2	6.0 +3
AA	5.26 +3	7.2 +2	6.0 +3	5.8 +1	5.3 +3
BB	3.50 +4	7.0 +0	3.5 +4	1.6 +2	3.5 +4
CC	4.91 +3	2.6 +2	5.2 +3	1.1 +2	5.0 +3
DD	5.26 +3	1.1 +3	6.4 +3	1.1 +3	6.4 +3
EE	2.45 +4	4.4 +2	2.9 +4	4.4 +2	2.9 +4
FF	8.76 +2	3.2 +1	9.1 +2	8.0 +4	8.1 +4
GG	8.76 +2	8.0 +4	8.1 +4	3.2 +1	9.1 +2
HH	8.76 +2	9.7 +2	1.8 +3	1.1 +3	2.0 +3
II	1.10 +5	2.7 +5	3.8 +5	2.7 +5	3.8 +5
JJ	8.76 +2	1.1 +3	2.0 +3	9.7 +2	1.8 +3
KK	8.76 +2	5.0 +2	1.4 +3	5.0 +2	1.4 +3
LL	8.76 +2	1.2 +3	2.1 +3	1.2 +3	2.1 +3

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CALCULATION IDENTIFICATION NUMBER				
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Calculation

4. Determination of the most conservative radiation zone of each environmental zone and the total dose.

Environ. zone	Radia. zone (Attached IDC)	Radiation zone / highest total dose		Total dose (rads)
AB-2A	B, C, D, H, I, J	B	{7.01+6 (40 year normal) 4.5+4 (6 month LOCA)	7.1 +6
AB-2B	A, E (penetration areas)	E★	{2.50+6 2.50+6	5.0 +6
AB-2C	F, G (charging pump cubicles)	F★	{2.8 +6 8. +6	1.1 +7
AB-13A	L, M, N, O, P, Q, U, V	Q	{2.66+7 9.3 +5	2.8 +7 *
AB-13B	K, R	R	{1.96+4 3.2 +4	5.2 +4
AB-13C	S, T	S	{1.40+5 2.2 +5	3.6 +5
AB-27	W, X, Y, Z, AA, BB, CC, DD, EE	X	{1.26+8 6.8 +2	1.3 +8 +
AB-45	FF, GG, HH, II, JJ, KK, LL	II	{1.10+5 2.7+5	3.8 +5

* The high dose is from 40 year normal operation, due to primary drain tank and gas stripper inside the primary drain tank cubicle.

\+ Volume control tank contact dose.

★ : Doses in peneration areas (AB-2B) and charging pump cubicles (AB-2C) are based on equipment qualification calc. (ref(3)) Those numbers are in the same order of magnitude as the numbers in p. 5 (E → 2.5×10^6 rads for 40 year & 4.5×10^6 rads for LOCA; F → 3.5×10^6 & 3.9×10^6 rads respectively)

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 11
EZD REFERENCE DESCRIPTION: 12846.38-RP-031-0
ENVIRONMENTAL ZONE(S): CSPH-11, MSVH-11

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	8.8×10^2	27	5.9×10^6	27				

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 11
EZD REFERENCE DESCRIPTION: 12846.38-RP-031-0
ENVIRONMENTAL ZONE(S): CSPH-27

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	8.8×10^2	27	5.3×10^2	27				

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 11
EZD REFERENCE DESCRIPTION: 12846.38-RP-031-0
ENVIRONMENTAL ZONE(S): MSVH-27

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)	8.8×10^2	27	1.7×10^4	27				

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 11
EZD REFERENCE DESCRIPTION: 12846.38-RP-031-0
ENVIRONMENTAL ZONE(S): SB-9B, TB-9, TB-35

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)			<2500	30				

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CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

▲5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF 31
VEPCO SURRY 1 & 2	
CALCULATION TITLE (Indicative of the Objective): NUREG-0578 Shielding Review - Site Dose Rates following a LOCA.	QA CATEGORY (✓) ☑ I - NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ___ OTHER

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J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12846.38	46/48 RP	RP-031-0		

* APPROVALS - SIGNATURE & DATE			REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (✓)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
Wuhung Peng 6/30/81	Shuwan Lin 7/13/81	Shuwan Lin 7/13/81			(Ref. CODE: GAMTRN, QADMOD ACTIVITY2 RADIOISOTOPES)	

DISTRIBUTION *

GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT. FILES (OR FIRE FILE IF NONE)	J. Barnhart (14)	✓			

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I. Objective.

The objective of this calc. is to determine the site dose rates as a function of time up to 6 month after a LOCA. This is part of the shielding review for NUREG-0578 TMI accident short term recommendations. The locations being considered are areas outside the containment and aux. bldg, which may need personnel access after LOCA — including control room, counting lab inside the health physics, machine shops (proposed TSC), Lunch room (proposed OSC), emergency switchgear and relay rooms, heating boiler room, security bldg, office bldg, and information center. The radiation source terms are TID-14844 source terms and no letdown is assumed.

The 6 month LOCA and 40 year normal doses in main steam value house / containment spray pump house and Emergency switch gear & relay room will also be calculated.

II. Method / Approach.

- The approach of this calc. is similar to that of aux. zone map calc. (ref (1)).
- A series of calc. had been performed to determine the site dose rates after a LOCA for North Anna Plant. ref (2). Because of Congruity between North Anna plant and Surry plant, North Anna dose rates are taken for Surry's use with the appropriate adjustment factors taking into consideration of the difference in power level, containment free volume, sump water volume, the distance between the dose point and the source, and the shields in between.

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III References.

(1). Surry calc. 12846.38-RP-026-0, "NUREG 0578 Shielding Review, Auxiliary Bldg Radiation Zone Maps Following LOCA"

(2). North Anna Calc. 13075-UR-022-0, "Radiation Zone Maps For Existing Facilities outside the auxiliary bldg for specific locations, due to Post LOCA sources during the mitigation phase (No letdown) – based on NUREG-0578. 1/6/81.

(3). Surry calc. 12846.54-RP-037-0, "Direct γ dose rates and integrated dose to electrical components in the safeguard area after a LOCA." 9/5/80

(4). Surry Calc. 12846.54-RP-039-0, "6 Month LOCA Doses as a function of distance from the containment direct shine." 9/13/80

(5). North Anna Calc. 12050-RP-84-0, "Generic Calculation of factors of gamma attenuation through various thickness of concrete"

(6) N. A. Calc. 12050-RP-087-0, "Dose rates at different locations and times after LOCA via main steam line penetrations in containment wall" 6/12/80

(7) N. A. Calc. 13075-UR(B)-033-0, "Direct γ-dose rates to the technical support center, due to post LOCA sources based on NUREG-0578"

(8) N. A. Calc. 12050-RP-095-0 "Worst 6 month integrated LOCA γ dose for the MSVH and QSPH for mitigation only (no letdown)".

(9). Shielding Design Summary for Surry power station, VEPCO. 12/1970

IV. Radiation Source Strength and Site Dose Points

1. Identification of site location for which dose rate is to be calculated.

As shown in fig. 1, the dose rate at the following location will be calculated: (

① Control room

② Counting lab in the health physics area

③ Machine shops (proposed technical supporting Center).
④ Lunch room (proposed operation supporting center)
⑤ Emergency switchgear and relay rooms.

⑥ Heating Boiler room.

⑦ Office Bldg.

⑧ Central Area Security Bldg (CAS)

⑨ Secondary Area Security Bldg. (SAS)

⑩ Information Center

2. Radiation sources.

The following radiation sources will be considered:

①. Containment atmosphere shine from the dome (and wall)

②. Containment atmosphere shine through main steam line penetrations.

③ SI/DA lines in yard area (under MSVH and CSPH).

④ Sources inside the aux bldg.

The following sources were considered in North Anna Calc.(ref(2)), but not considered here because their dose rate contribution is small compared to those listed above due to the following reasons.
(continued)

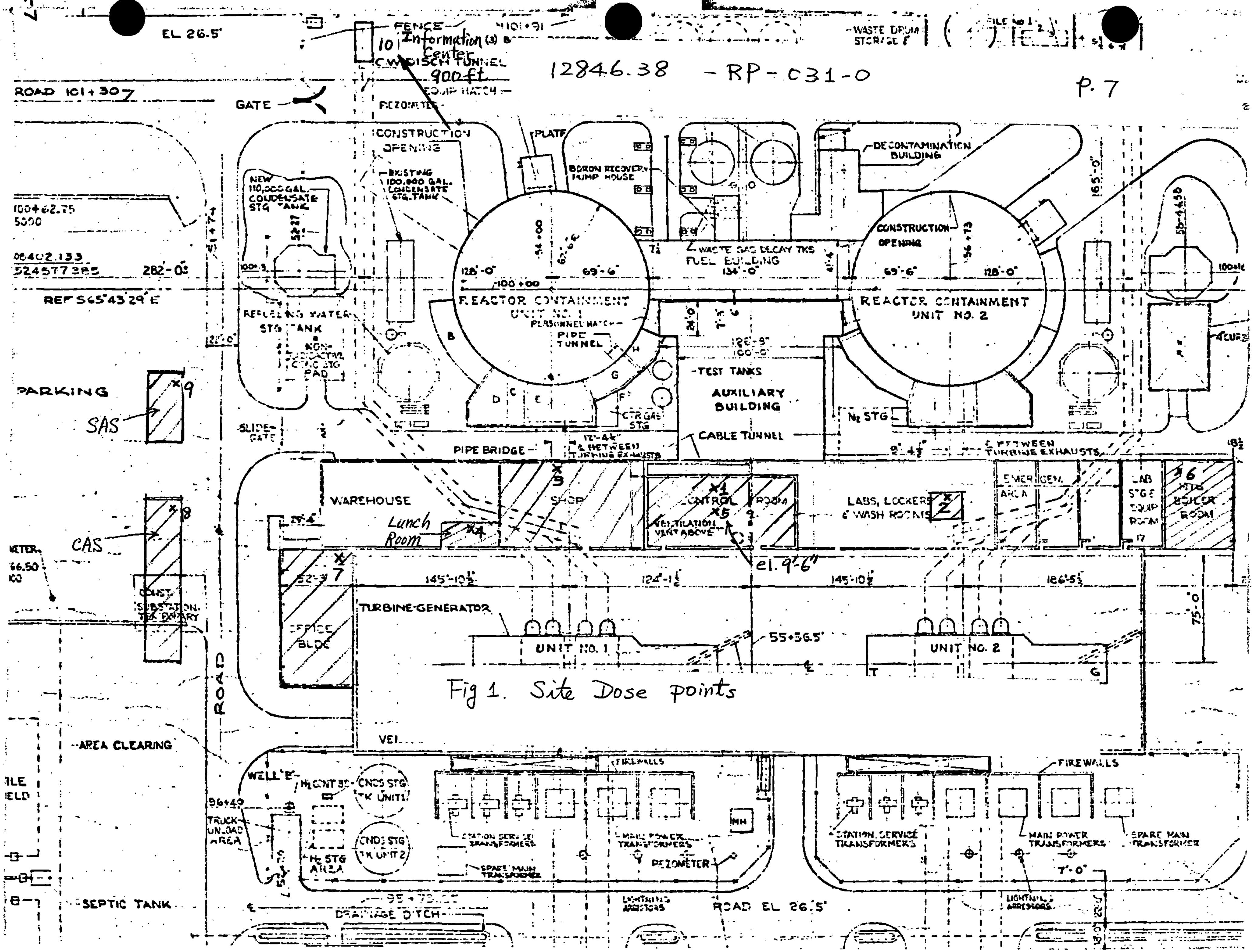

Fig 1. Site Dose points

- Containment dome recirculation spray headers — Those lines are located at an elevation lower than the top of crane wall (and thus lower than the bend line elevation) (see reference (1), § X.19). They are shielded by 2' crane wall and 4.5' concrete wall.
- Containment atmosphere shine through purge air ducts = This is a local source, its contribution to control room is shielded by walls in Motor Control Center (MCC), aux. bldg and control room. The integrated dose in MCC was calculated in ref. (1).
- SI lines in safeguards bldg : They are all below grade and far away from the dose points (ref (3)). Dose contributions are small.
- H_2 recombiner system – It is inside containment for Surry plant.
- SI lines in yard area between safeguards area and MSVH = The lines are at el. 18'-9" (DWG 11548-FP-60F), 8'-9" below the grade elevation (27'-6") and are far away from the dose points.

3. Source terms and specific source strength

Source terms and specific source strength are the same as ref. (1). (see ref (1). § VII)

4. Source strength adjustment factors

- SI & DA lines (containment sump water) $f_1 = 1.1$
- Coolant sampling lines (RCS) $f_2 = 0.89$
- containment atmosphere $f_3 = 0.90$

V Dose Rate Calculation

1. Containment Atmosphere shine from Containment dome (and wall).

• In ref. (4), dose rates are given as a function of distance from the containment wall. The numbers are derived from North Anna calculations. The dose rates are plotted in fig. 2.

Dose point	Description	Distance to unit ① #1 cont. center (ft)	Distance to unit ① #2 cont. center (ft)	shielding Factor
1.	control room	~230	~230	3.0×10^{-3} ②
2.	counting Lab	300	150	3.2×10^{-1} ③
3.	Machine Shops	180	250	1.0
4.	Lunch Room	180	340	3.2×10^{-1} ④
5.	swgr & Relay rooms	240	240	5.6×10^{-2} ⑤
6.	Htg Boiler Room	460	240	1.0
7	office Bldg	240	460	1.0
8.	CAS	300	550	1.0
9	SAS	260	530	1.0
10	Information Center	900	1000	1.0

Notes ① Distances are chosen so that conservative dose rates are represented. (FY-1D)

② Concrete wall is at least 3'. Ceiling is 2' concrete @ el. 45' and 5" slab at el. 58'-6" (DWGs 11448-FC-2P, FC-7E). The dose rate reduction factor is ~3.0×10^{-3}, from ref. (5) for 2'-5" concrete.

③ counting lab has at least 1' concrete walls and 6" concrete slab at el. 42' ceiling (DWG-11448-FC-7D). ⇒ $10^{-6/12} = (3.2)^{-1}$

④ Lunch room has at least 8" concrete walls and 6" concrete slab at el. 42' ceiling (DWG-11448-FC-7D) ⇒ 0.32 for shielding factor

⑤ Swgr & Relay rooms have at least 6" concrete shield at el. 45' (FC-7D & FE27C) & 11548-FE-27A & 9" concrete shield at el. 27' (-FC-2N) ⇒ $10^{-15/12} = 0.056$

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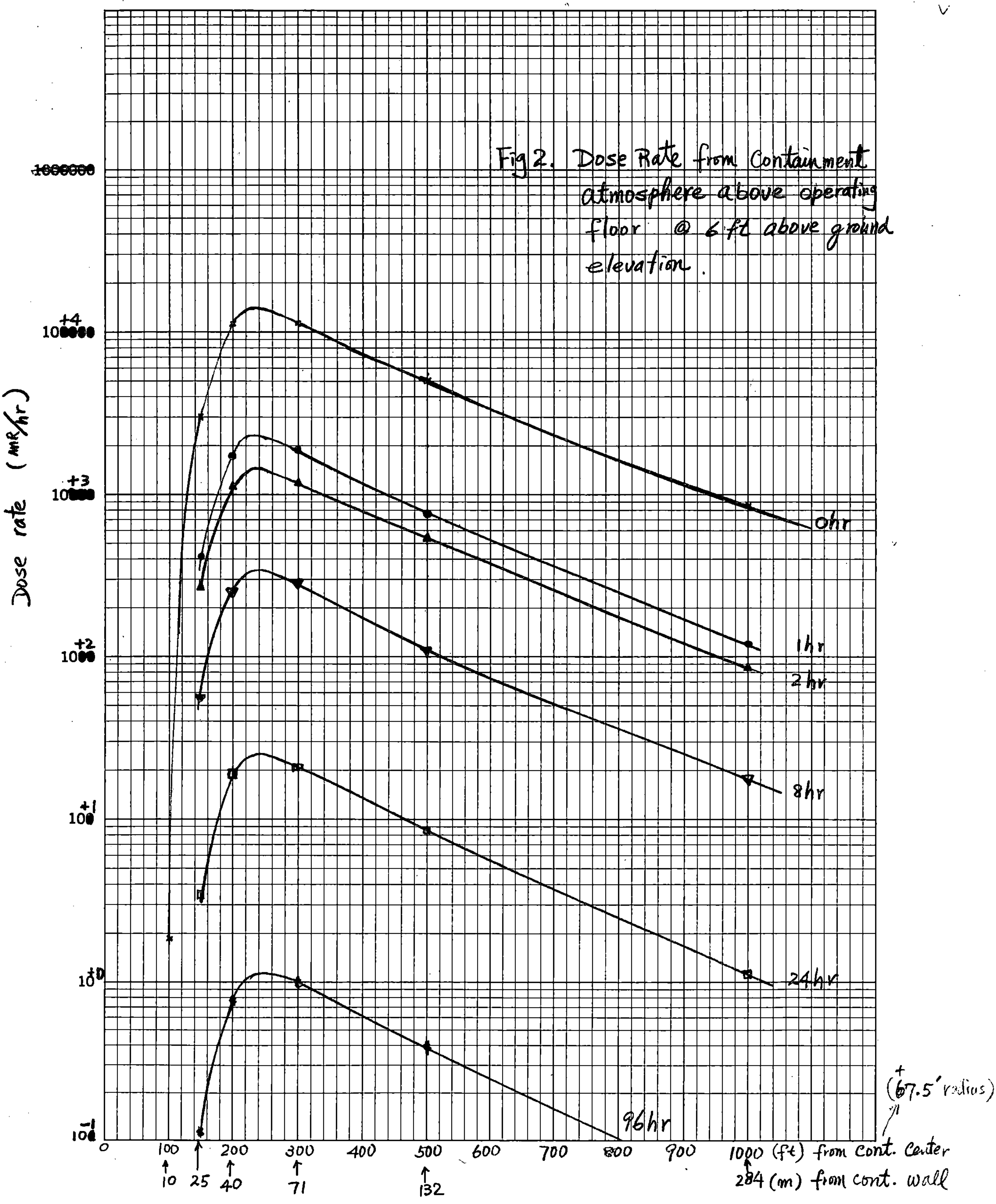

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• Dose · rates

Table 1. Dose rates from Containment atmosphere shine from the dome for unit # 1 accident. (mR/hr)

D. P.	Location	0 hr	1 hr	2 hrs	8 hrs	24 hrs	96 hrs
1	Control room	4.4 +1	6.9+0	5.0 +0	9.9 -1	—	—
2	Counting lab	3.9 +3	6.0 +2	4.2+2	8.9 +1	6.8+0	3.1 -1
3	Machine shops	7.5 +3	1.2+3	7.5+2	1.8+2	1.2 +1	4.4 -1
4	Lunch room	2.4 +3	3.8+2	2.4+2	5.8 +1	3.8 +0	1.4 -1
5	Swgr & relay rooms	8.1 +2	1.3+2	9.0+1	1.9+1	1.5+0	6.7 -2
6	Htg boiler rm	5.8 +3	9.0+2	6.2 +2	1.4+2	1.1+1	4.7 -1
7	Office Bldg	1.5 +4	2.3+3	1.6 +3	3.5 +2	2.7+1	1.2 +0
8	CAS	1.2 +4	1.9 +3	1.3+3	2.8+2	2.1+1	9.7 -1
9	SAS	1.4 +4	2.2 +3	1.5+3	3.4+2	2.5 +1	1.2+0
10	Information center	1.2+3	1.7 +2	1.3 +2	2.6+1	1.7+0	—

All dose points are considered 6' above ground elevation

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Table 2. Dose Rates from containment atmosphere shine from the dome for unit #2 accident

D.P.	Locations	0 hr	1 hr	2 hrs	8 hrs	24 hrs	96 hrs
1	control room	4.4+1	6.9+0	5.0+0	9.9-1	—	—
2	countg lab	9.8+2	1.3+2	9.1+1	1.8+1	1.1+0	3.8-2
3	machine shops	1.4+4	2.3+3	1.6+3	3.5+2	2.6+1	1.2+0
4	Lunch rm	3.0+3	5.4+2	3.2+2	7.4+1	5.8+0	2.6-1
5	swgr & relay rms	8.1+2	1.3+2	9.0+1	1.9+1	1.5+0	6.7-2
6	Htg boiler rm	1.5+4	2.3+3	1.6+3	3.5+2	2.7+1	1.2+0
7	office bldg	5.8+3	9.0+2	6.2+2	1.4+2	1.1+1	4.7-1
8	CAS	4.0+3	6.5+2	4.7+2	9.0+1	7.0+0	3.2-1
9	SAS	4.5+3	7.0+2	4.9+2	9.5+1	7.5+0	3.4-1
10	Information Center	8.6+2	1.2+2	8.6+1	1.8+1	1.2+0	5.0-2

All dose points are considered 6' above the ground elevation.

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2. Containment atmosphere shine through main steam Line penetrations

(1) Unit # 1 accident

- Of all the concerned dose point locations listed in p. 6, only machine shops will receive significant dose rate from the γ ray shine through the three 30" steam line penetrations located at el. 39'-6". A detailed calc. for the North Anna plant was performed in ref. (6). These numbers will be adjusted by the source strength adjustment factor $f_3 = 0.9$
- N. A. dose rates at the entrance of personnel doorway of the machine shops are

	0 hr	1 hr	2 hrs	8 hrs	24 hrs	
N. A.	56.2	8.01	— (not available)	1.13	0.07	mR/hr

- Surry's dose rates in machine shops due to unit #1 accident are (mR/hr)

	0 hr	1 hr	2 hrs*	8 hrs	24 hrs
Surry D.P. 3. (machine shops)	5.1+1	7.2+0	5.3+0	1.0+0	6.3-2

* Dose rate at 2 hrs is taken as 73% of that of 1 hr.

$$\text{Ratio} = \frac{2.16\times10^8}{2.95\times10^8} = 0.73$$ based on specific activities. (Ref. 4)

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(2). Unit #2 accident

The dose point location that will receive significant doserate from containment atmosphere shine through main steam line penetrations for the unit #2 accident is the counting lab in the health physics area. The dose point D8 of N. A. Calc. (ref(6)) is a representative point in the counting lab. The lab is shielded by at least one foot of pour concrete.

	0hr	1hr	8hrs	
N.A D8	2.88 +1	4.09 +0	5.8 -1	(mR/hr)

Applying a source strength adjustment factor $f_3 = 0.9$ and a shielding factor = 0.1, we have the following dose rates for Surry.

	0hr	1hr	2hrs	
Surry D.P2 (counting lab)	2.6+0	3.7^{-1}	—	(mR/hr)

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3. SI and DA lines in yard area under MSVH and CSPH.

The two 8" safety injection lines and one 2" drain line carrying containment sump water are passing yard area under main steam valve house and containment spray pump house at el. 23' (BOP). (DWG. 11448-FP-5F). The ground elevation is 26'-6". Those SI and DA lines may contribute significant dose rates to bldgs in the neighborhood. The layout of these lines and the shields are similar to those of N.A. for which a detailed calc. had been performed in ref. (7). Comparison between N.A. model and Surry plant is listed in the following.

		N.A. Model (ref(7))	Surry (11448-FP-5D, 5F, 5G.)
Sources			
2 SI-lines -	D	8"	8"
	L	~65'	~59'
1 DA-line	D	2"	2"
	L	~57'	~61'
Distance to ground elevation		3'-3"	3'-2"
Shields			
Walls of MSVH & CSPH		2' concrete	2' concrete
(south) wall of MSVH		3' concrete	3' concrete
(el. 27'-6") MSVH Floor		1' concrete	1' concrete
(el. 27'-6") CSPH Floor		2' concrete	2' concrete

Comparison indicates that results in ref (7) can be applied to Surry with appropriate source strength adjustment factor, $f_1 = 1.1$, (and appropriate shielding factor if any exists).

(1) unit #1 accident

D.P. & Location	corresponding N.A. Dose Pt	ref(7) N.A.D.R(t=0)	adjustment factor	Surry D.R @ t=0
1. Control room	C2	1.12+1 (mR/hr)	1.1 × 0.01*	1.2 −1 (mR/hr) ✓
3. Machine shops	S1	4.82+2 "	1.1	5.3 +2 " ✓
4. Lunch room	CL2	4.99+1 "	1.1 × 0.22**	1.2 +1 " ✓

Dose rates at other locations are not significant.

* 2′ concrete wall ✓
** 8″ concrete wall ✓ } DWG 11448-FA-1C.

(2) Unit #2 accident.

D.P. & Location	Corresponding N.A. D.P. (ref(7))	N.A.D.R @ t=0	Adjustment factor	Surry D.R. @ t=0
1 Control room	C2	1.12+1 (mR/hr)	1.1 × 0.01*	1.2 −1 (mR/hr) ✓
2. Counting lab	CL2	4.99+1 (mR/hr)	1.1 × 0.1+	5.5 +0 (mR/hr). ✓
6. Htg Boiler rm	B2	7.3−3 (mR/hr)	1.1	8.0 −3 (mR/hr) ✓

Dose rates at other locations are not significant.

\+ 12″ concrete wall — DWG 11448-FA-1C. ✓

Dose rates at t > 0 are determined by the same approach* as ref(7), that is, by ratioing up the Surry Sump water source strength. (ref. (1), page 18)

t ref(1)	0 hr	1 hr	2 hrs	8 hrs	24 hrs	96 hrs	192 hrs	360 hrs	720 hrs	2160/4320
$S_T(t)$	2.2+10	1.3+10	8.9+9	3.6+9	1.5+9	5.2+8	3.5+8	2.2+8	1.1+8	3.6+7/1.5+7 ✓
$\frac{S_T(t)}{S_T(0)}$	1.0	5.9−1	4.0−1	1.6−1	6.8−2	2.4−2	1.6−2	1.0−2	5.0−3	1.6−3/6.8−4 ✓

* This approach will overestimate dose rates for t ≥ 24 hrs because spectrum becoms softer.

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Site dose rates from SI/DA lines in yard area for unit # 1 accident

(mR/hr)

Location	0 hr	1 hr	2 hrs	8 hrs	24 hrs	96 hrs	192 hrs	360 hrs	720 hrs	2160 hrs
control room	1.2-1	—	—	—	—	—	—	—	—	—
machine shops	5.3+2	3.1+2	2.1+2	8.5+1	3.6+1	1.3+1	8.5+0	5.3+0	2.7+0	8.5-1
Lunch room	1.2+1	7.1+0	4.8+0	1.9+0	8.2-1	—	—	—	—	—
others	insignificant									

Site dose rates from SI/DA lines in yard area for unit #2 accident

(mR/hr)

Location	0 hr	1 hr	2 hrs	8 hrs
Control room	1.2 -1	—	—	—
Counting lab	5.5+0	3.2+0	2.2+0	8.8 -1
Htg Boiler rm	8.0 -3	—	—	—
Others	insignificant			

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4. Sources inside the aux bldg

In our effort for the radiation zone mapping of the aux. bldg, the following sources were considered : ref(1)

- SI and CH lines in penetration area and charging pump cubicles
- Aux bldg sump, drain lines, LL WDT or HLDWT
- Reactor coolant sampling lines
- Containment vac. & Leakage monitoring system
- Hydrogen analyzers
- Main Charcoal filter Banks.

(And radiation sources inside the containment).

Of all the site dose points we are concerned, only control room (D.P. 1) and emergency switchgear and relay rooms (D.P.5) are close enough to the aux bldg to receive any significant dose.

(1) Control room dose rates.

Control room is located at el. 27', south of zone EE of aux. bldg. Inspection of the dose rate contributors of that zone indicates that the main potential sources are LL WDT or HLWDT and the associated drain lines (of which WDT contribution is dominant).

Dose rates in zone DD (which is not directly above the HLWDT) of ref. (1) were derived from N.A. calc. It took 18" floor at el. 27'-6" into consideration. The shields from the tank to control room are either (continued)

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- 24" aux bldg south concrete wall (11448-FE-27C)
  (11548-FE-27A)
- 18" shield wall of emergency switchgear room (")
- 9" floor at el. 27' (11448-FC-2N)

(A total of 51" concrete shield)

or

- 18" floor at el. 27'-6" (11448-FM-5A)
- 24" aux bldg south wall (11448-FM-5C)
- 18" shield wall south of "line E" (11448-FC-2N)

(A total of 60" concrete shield)

Therefore, an extra shielding credit for 51" - 18" = 33" should be taken into account, which is 8.5×10^{-4} by ref. (5)

t =	0 hr	1 hr	
Zone DD ref (1)	3.9×10^{3}	1.0×10^{3}	(mR/hr)
Control Room	3.3+0	8.5×10^{-1}	(mR/hr)

The above dose rates apply to both units.

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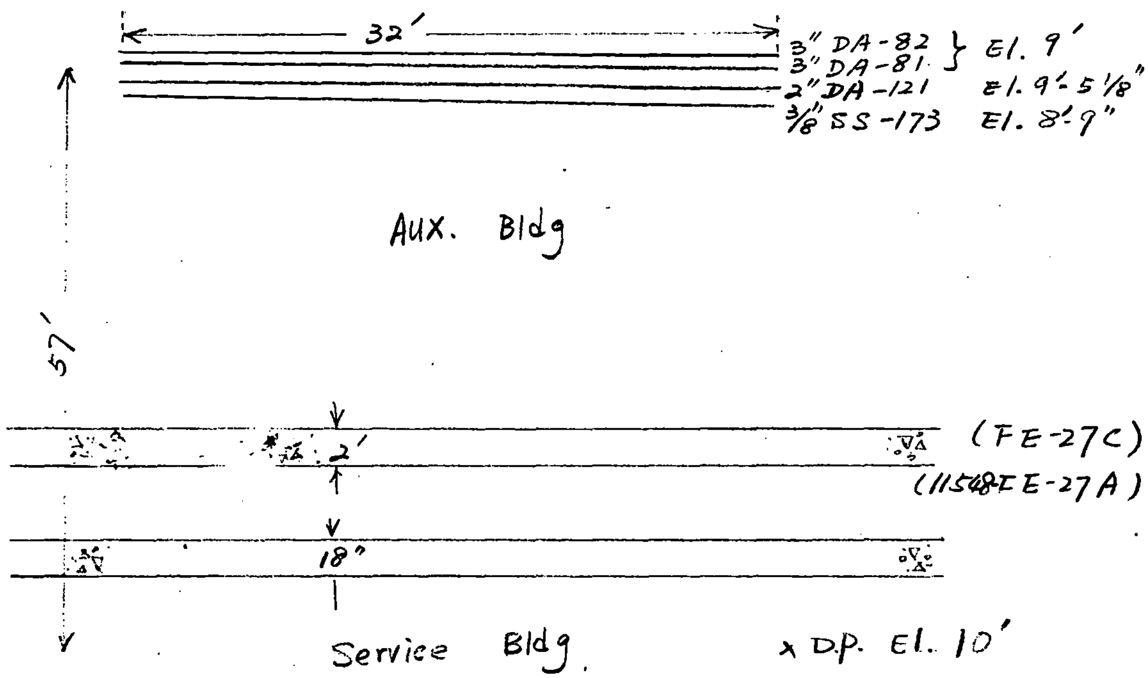
(2) Dose rates in the emergency switchgear and relay room

The emergency switchgear and relay rooms are located at elevation 9'6". The possible significant sources are the lines in penetration area, Drain lines and sampling lines in the pipe tunnel area south of charging pump cubicles, and the drain lines and HLWDT or LLWDT in waste drain tank cubicles.

The lines in penetration area are shielded by many walls of waste drain tank cubicles. Their dose rate contribution will be smaller than that of lines in the pipe tunnel area and LLWDT or HLWDT.

• The line sources in the pipe tunnel south of charging pump cubicles and the shields are identified as: (FP-19C, FP-17B)



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- The following line source equation is used for the dose rate calculation. The parameters are explained in § X.8 of ref. (1).

$$D(mR/hr) = B(\mu t)\, e^{-\mu t}\, \frac{7.2\times10^{-5}\, S_T\, D^2}{R}\, \frac{\theta_1+\theta_2}{\pi}$$

To be conservative and consistant, we assume the average energy of 1.5 MeV. $\mu = 0.1163\ cm^{-1}$. (ref(1) § X.10)

$$t = 2' + 18'' = 107\ cm$$

$$\mu t = 12.41$$

$$B(\mu t) = 1 + 0.925\,\mu t\, e^{+0.037\,\mu t} = 19.2 \quad \text{(ref(1) § X.10)}$$

$$B(\mu t)\, e^{-\mu t} = 7.85\times10^{-5}$$

$$R \approx (57'^2 + (10'-9')^2)^{1/2} = 57$$

$$(\theta_1+\theta_2)/\pi = \tan^{-1}(32'/57')/\pi = 0.163$$

$D^2 = (3.068'')^2 = 9.41\ in^2$ (DA lines) (standard pipe-from Crane 410)

$= (2.067)^2 = 4.27\ in^2$ (D.A line)

$= (0.493'')^2 = 0.243\ in^2$ (SS line)

The total dose rate is

$$D(mR/hr) = 7.85\times10^{-5} \times 0.163 \times \frac{7.2\times10^{-5}}{57}\left[(2\times9.41 + 4.27)\, S_T^{DA} + 0.243\, S_T^{SS}\right]$$

$$= 1.62\times10^{-11}\,(23.1\, S_T^{DA} + 0.243\, S_T^{SS})$$

- Results (These results are applicable to accident of either reactor unit)

Time	0 hr	1 hr	2 hr	8 hr	24 hr	96 hr	192 hr
S_T^{DA} (mev/sec/cm³) ref.(1)	2.2 +10	1.3 +10	8.9 +9	3.6 +9	1.5 +9	5.2 +8	3.5 +8
S_T^{SS} (mev/sec/cm³) ref.(1)	2.1 +11	8.6 +10	6.1 +10	2.3 +10	8.9 +9	3.5 +9	2.2 +9
D (mR/hr)	9.1 +0	5.2 +0	3.6 +0	1.4 +0	6.0 -1	—	—

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• Dose rates from LLWDT/HLWDT.

A similar approach as ref (1), § X.9 can be used to estimate dose rates from LLWDT/HLWDT to emergency switch gear and relay rooms. The dose point is shielded by 2' concrete wall near line E and 18" radiation shield wall. The distance of switch gear room to the tank is ~16' (488 cm).

The dose rates of zone E of ref. (1) are for a point 750 cm away from the tank and 18" concrete in between.

The distance adjustment factor is $\left(\frac{750}{488}\right)^2 = 2.36$.

The shielding adjustment factor is $10^{-\left(\frac{24''+18''-18''}{12''}\right)} = 0.01$

Therefore, the overall adjustment factor is

$$0.01 \times 2.36 = 2.36 \times 10^{-2}$$

Time (hrs)	0	1	2	8	24	96	192	360	720	2160	4320
Zone E ref(1) (mR/hr)	1.8+5	1.1+5	7.5+4	3.0+4	5.6+3	1.9+3	1.3+3	8.2+2	4.1+2	1.3+2	5.6+1
SWTCH GEAR ROOM (mR/hr)	4.2+3	2.6+3	1.8+3	7.1+2	1.3+2	4.5+1	3.1+1	1.9+1	9.7+0	3.1+0	1.3+0

The above dose rates apply to accidents of either unit.

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5. Site dose rate tables

- Site dose rates from each of four listed source due to unit #1 accident are listed in table 3.

- Site dose rates due to unit #2 accident are listed in table 4.

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TABLE 3   SURRY SITE DIRECT γ DOSE RATES (mR/hr) FROM VARIOUS SOURCES DUE TO A LOCA (TID-14844 SOURCE TERMS) AT REACTOR UNIT # 1

SITE: CONTROL ROOM — TIME (HR)	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL
0	4.4+1	—	1.2-1	3.3+0	4.7+1
1	6.9+0	—	—	8.5-1	7.8+0
2	5.0+0	—	—	—	5.0+0
8	9.9-1	—	—	—	9.9-1
24	—	—	—	—	—
96	—	—	—	—	—
192	—	—	—	—	—
360	—	—	—	—	—
720	—	—	—	—	—
2160	—	—	—	—	—
4320	—	—	—	—	—

SITE: COUNTING LAB INSIDE THE HP — TIME (HR)	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL
0	3.9+3	—	—	—	3.9+3
1	6.0+2	—	—	—	6.0+2
2	4.2+2	—	—	—	4.2+2
8	8.9+1	—	—	—	8.9+1
24	6.8+0	—	—	—	6.8+0
96	3.1-1	—	—	—	3.1-1
192	—	—	—	—	—
360	—	—	—	—	—
720	—	—	—	—	—
2160	—	—	—	—	—
4320	—	—	—	—	—

SITE: MACHINE SHOPS — TIME (HR)	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL
0	7.5+3	5.1+1	5.3+2	—	8.1+3
1	1.2+3	7.2+0	3.1+2	—	1.5+3
2	7.5+2	5.3+0	2.1+2	—	9.7+2
8	1.8+2	1.0+0	8.5+1	—	2.7+2
24	1.2+1	6.3-2	3.6+1	—	4.8+1
96	4.4-1	—	1.3+1	—	1.3+1
192	—	—	8.5+0	—	8.5+0
360	—	—	5.3+0	—	5.3+0
720	—	—	2.7+0	—	2.7+0
2160	—	—	8.5-1	—	8.5-1
4320	—	—	—	—	—

SITE: LUNCH ROOM — TIME (HR)	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL
0	2.4+3	—	1.2+1	—	2.4+3
1	3.8+2	—	7.0+0	—	3.9+2
2	2.4+2	—	4.8+0	—	2.4+2
8	5.8+1	—	1.9+0	—	6.0+1
24	3.8+0	—	8.2-1	—	4.6+0
96	1.4-1	—	—	—	1.4-1
192	—	—	—	—	—
360	—	—	—	—	—
720	—	—	—	—	—
2160	—	—	—	—	—
4320	—	—	—	—	—

SITE: EMERG. SWGR & RELAY ROOMS — TIME (HR)	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES (1)	TOTAL
0	8.1+2	—	—	4.2+3	5.0+3
1	1.3+2	—	—	2.6+3	2.7+3
2	9.0+1	—	—	1.8+3	1.9+3
8	1.9+1	—	—	7.1+2	7.3+2
24	1.5+0	—	—	1.3+2	1.3+2
96	6.7-2	—	—	4.5+1	4.5+1
192	—	—	—	3.1+1	3.1+1
360	—	—	—	1.9+1	1.9+1
720	—	—	—	9.7+0	9.7+0
2160	—	—	—	3.1+0	3.1+0
4320	—	—	—	1.3+0	1.3+0

SITE: HEATING BOILER ROOM — TIME (HRS)	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL
0	5.8+3	—	—	—	5.8+3
1	9.0+2	—	—	—	9.0+2
2	6.2+2	—	—	—	6.2+2
8	1.4+2	—	—	—	1.4+2
24	1.1+1	—	—	—	1.1+1
96	4.7-1	—	—	—	4.7-1
192	—	—	—	—	—
360	—	—	—	—	—
720	—	—	—	—	—
2160	—	—	—	—	—
4320	—	—	—	—	—

SITE: OFFICE BLDG — TIME (HRS)	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL
0	1.5+4	—	—	—	1.5+4
1	2.3+3	—	—	—	2.3+3
2	1.6+3	—	—	—	1.6+3
8	3.5+2	—	—	—	3.5+2
24	2.7+1	—	—	—	2.7+1
96	1.2+0	—	—	—	1.2+0
192	—	—	—	—	—
360	—	—	—	—	—
720	—	—	—	—	—
2160	—	—	—	—	—
4320	—	—	—	—	—

SITE: CAS — TIME (HRS)	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL
0	1.2+4	—	—	—	1.2+4
1	1.9+3	—	—	—	1.9+3
2	1.3+3	—	—	—	1.3+3
8	2.8+2	—	—	—	2.8+2
24	2.1+1	—	—	—	2.1+1
96	9.7-1	—	—	—	9.7-1
192	—	—	—	—	—
360	—	—	—	—	—
720	—	—	—	—	—
2160	—	—	—	—	—
4320	—	—	—	—	—

SITE: SAS — TIME (HRS)	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOUCES	TOTAL
0	1.4+4	—	—	—	1.4+4
1	2.2+3	—	—	—	2.2+3
2	1.5+3	—	—	—	1.5+3
8	3.4+2	—	—	—	3.4+2
24	2.5+1	—	—	—	2.5+1
96	1.2+0	—	—	—	1.2+0
192	—	—	—	—	—
360	—	—	—	—	—
720	—	—	—	—	—
2160	—	—	—	—	—
4320	—	—	—	—	—

SITE: INFORMATION CENTER — TIME (HRS)	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL
0	1.2+3	—	—	—	1.2+3
1	1.7+2	—	—	—	1.7+2
2	1.3+2	—	—	—	1.3+2
8	2.6+1	—	—	—	2.6+1
24	1.7+0	—	—	—	1.7+0
96	7.0-2	—	—	—	7.0-2
192	—	—	—	—	—
360	—	—	—	—	—
720	—	—	—	—	—
2160	—	—	—	—	—
4320	—	—	—	—	—

(1) Aux bldg sources include one full tank of LLWDT filled with undiluted containment sump water.

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TABLE 4 SURRY SITE DIRECT γ DOSE RATES (mR/hr) FROM VARIOUS SOURCES DUE TO A LOCA (TID-14844 SOURCE TERMS) AT REACTOR UNIT # 2

SITE	CONTROL ROOM					COUNTING LAB INSIDE THE HP					MACHINE SHOPS					LUNCH ROOM					EMERG. SWGR & RELAY ROOMS				
SOURCE / TIME (HR)	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES (1)	TOTAL
0	4.4+1	—	1.2-1	3.3+0	4.7+1	9.8+2	2.6+0	5.5+0	—	9.9+2	1.4+4	—	—	—	1.4+4	3.0+3	—	—	—	3.0+3	8.1+2	—	—	4.2+3	5.0+3
1	6.9+0	—	—	8.5-1	7.8+0	1.3+2	3.7-1	3.2+0	—	1.3+2	2.3+3	—	—	—	2.3+3	5.4+2	—	—	—	5.4+2	1.3+2	—	—	2.6+3	2.7+3
2	5.0+0	—	—	—	5.0+0	9.1+1	—	2.2+0	—	9.3+1	1.6+3	—	—	—	1.6+3	3.2+2	—	—	—	3.2+2	9.0+1	—	—	1.8+3	1.9+3
8	9.9-1	—	—	—	9.9-1	1.8+1	—	8.8-1	—	1.9+1	3.5+2	—	—	—	3.5+2	7.4+1	—	—	—	7.4+1	1.9+1	—	—	7.1+2	7.3+2
24	—	—	—	—	—	1.1+0	—	—	—	1.1+0	2.6+1	—	—	—	2.6+1	5.8+0	—	—	—	5.8+0	1.5+0	—	—	1.3+2	1.3+2
96	—	—	—	—	—	3.8-2	—	—	—	3.8-2	1.2+0	—	—	—	1.2+0	2.6-1	—	—	—	2.6-1	6.7-2	—	—	4.5+1	4.5+1
192	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.1+1	3.1+1
360	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.9+1	1.9+1
720	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9.7+0	9.7+0
2160	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.1+0	3.1+0
4320	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.3+0	1.3+0

SITE	HEATING BOILER ROOM					OFFICE BLDG					CAS					SAS					INFORMATION CENTER				
SOURCE / TIME (HRS)	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOUCES	TOTAL	CONTMNT DOME SHINE	CONTMNT SHINE THRU MAIN STM LINE PENE.	SI/DA LINES IN YARD AREA	AUX BLDG SOURCES	TOTAL
0	1.5+4	—	8.0-3	—	1.5+4	5.8+3	—	—	—	5.8+3	4.0+3	—	—	—	4.0+3	4.5+3	—	—	—	4.5+3	8.6+2	—	—	—	8.6+2
1	2.3+3	—	—	—	2.3+3	9.0+2	—	—	—	9.0+2	6.5+2	—	—	—	6.5+2	7.0+2	—	—	—	7.0+2	1.2+2	—	—	—	1.2+2
2	1.6+3	—	—	—	1.6+3	6.2+2	—	—	—	6.2+2	4.7+2	—	—	—	4.7+2	4.9+2	—	—	—	4.9+2	8.6+1	—	—	—	8.6+1
8	3.5+2	—	—	—	3.5+2	1.4+2	—	—	—	1.4+2	9.0+1	—	—	—	9.0+1	9.5+1	—	—	—	9.5+1	1.8+1	—	—	—	1.8+1
24	2.7+1	—	—	—	2.7+1	1.1+1	—	—	—	1.1+1	7.0+0	—	—	—	7.0+0	7.5+0	—	—	—	7.5+0	1.2+0	—	—	—	1.2+0
96	1.2+0	—	—	—	1.2+0	4.7-1	—	—	—	4.7-1	3.2-1	—	—	—	3.2-1	3.4-1	—	—	—	3.4-1	5.0-2	—	—	—	5.0-2
192	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
360	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
720	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2160	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4320	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

(1) Aux bldg sources include one fuel tank of LLWDT filled with undiluted containment sump water.

VI. Integrated Doses in same specific Areas

1. 40 year normal and 6 month LOCA dose in MSVH/CSPH.

- Here we are interested in 40 year normal and 6 month LOCA dose for equipment qualification for main steam valve house and containment spray pump house, both above and under the grade evelvation (el. 27'-6").
- The main LOCA sources are the safety Injection lines and drain lines at el. 23' (BOP) and containment atmosphere shine through the main steam line penetrations at el. 39'-6".
- A detailed calc. had been performed to determine the 6 month LOCA doses in these areas for North Anna plant.[ref.(8)] The results are listed in the following:

	North Anna 1 & 2
MSVH below grade elevation	— 5.4×10^6 rads (SI/DA lines)
MSVH above grade elevation	— 1.5×10^4 rads (92% from SI/DA lines, 8% from MS line penetrations)
QSPH below grade elevation	— 5.4×10^6 rads (SI/DA lines)
QSPH above grade elevation	— 4.8×10^2 rads (SI/DA lines)

- From the comparison between N. A and Surry plants in p. 15, the layout of the sources and shields is similar and we can use above doses for Surry with a proper source strength adjustment factor. Since majority of the doses are from SI/DA lines,

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the source strength adjustment factor is $f_1 = 1.1$.

• 40 year normal operation dose.

During normal operation, there is no radioactive source in these areas. The main steam line penetrations will provide streaming path for radiation inside the containment. Since the areas are outside the containment wall, it is safe to designate the area as radiation zone II, with maximum dose rate 2.5 mR/hr.

The 40 year normal dose is therefore $2.5 \times 24 \times 365 \times 40 = 8.8 \times 10^5$ mR $= 8.8 \times 10^2$ rads

• Total dose

Surry 1 & 2

	6 Month LOCA (rads)	40 year normal (rads)	Total (rads)
MSVH below el. 27'-6"	5.9×10^6	880	5.9×10^6
MSVH above el. 27'-6"	1.7×10^4	880	1.8×10^4
CSPH below el. 27'-6"	5.9×10^6	880	5.9×10^6
CSPH above el. 27'-6"	5.3×10^2	880	1.4×10^3

2. 40 year normal and 6 month LOCA dose in emergency switch gear and relay rooms.

- 6 month LOCA dose.

In § V of this calc, the 6 month dose rates from containment dome shine and radioactive sources inside the aux. bldg have been calculated. Those numbers are for zone mapping effort. They will be furthere fine-tuned here for equipment qualification.

* For the drain system as it is now, the drain from SI/CH lines during mitigation phase will eventually be pumped to LLWDT/HLWDT. If we assume one LLWDT is filled with the undiluted sump water, this will provide a very significant source to equipment inside the switch gear room. As described in p. 22, the switch gear room is shielded by 2' concrete wall near line E and 18" shield wall 8' south of line E. However, a radiation shield door of the 18" wall is located in such a way that an important equipment (MOV-1869B switch gear) will have direct shine from LLWDT. Therefore, this 18" shield wall will not be taken into credit for equipment qualification. The distance of this equipment to LLWDT is ~ 31' (945 cm) (From DWG 11448-FE-27C)

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Following the same procedure as described in p.22, we can estimate the dose rates by refering to the dose rates of zone E of ref.(1).

The distance adjustment factor $= \left(\frac{750}{945}\right)^2 = 0.63$

The shielding adjustment factor $= 10^{-\left(\frac{24'-18''}{12''}\right)} = 0.32$

The total adjustment factor is therefore $0.63 \times 0.32 = 0.20$

Time (Hr)	0	1	2	8	24	96	192	360	720	2160	4320
Zone E ref(1) (mR/hr)	1.8+5	1.1+5	7.5+4	3.0+4	5.6+3	1.9+3	1.3+3	8.2+2	4.1+2	1.3+2	5.6+1
swtchgr room (mR/hr)	3.6+4	2.2+4	1.5+4	6.0+3	1.1+3	3.8+2	2.6+2	1.6+2	8.2+1	2.6+1	1.1+1

The six month integrated dose by linear integration is, therefore, 450 rads

Time (hr)	LLWDT (mR/hr)	DA etc. lines (P.21) (mR/hr)	Dome shine (table 1) (mR/hr)	Total (mR/hr)	Aver. D.R (mR/hr)	Integ. Dose (mR)
0	3.6+4	9.1+0	8.1+2	3.7+4	2.95+4	2.95+4
1	2.2+4	5.2+0	1.3+2	2.2+4	1.85+4	1.85+4
2	1.5+4	3.6+0	9.0+1	1.5+4	1.05+4	6.30+4
8	6.0+3	1.4+0	1.9+1	6.0+3	3.55+3	5.68+4
24	1.1+3	6.0-1	1.5+0	1.1+3	7.4+2	5.33+4
96	3.8+2	—	6.7-2	3.8+2	3.2+2	3.07+4
192	2.6+2	—	—	2.6+2	2.1+2	3.53+4
360	1.6+2	—	—	1.6+2	1.21+2	4.36+4
720	8.2+1	—	—	8.2+1	5.4+1	7.78+4
2160	2.6+1	—	—	2.6+1	1.85+1	4.00+4
4320	1.1+1	—	—	1.1+1		

+)

4.5×10^5 mR

= 450 rads.

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* In the future, the system will be revised so that the highly contaminated undiluted sump water will be returned to the containment instead of being returned to LLWDT/HLWDT. In this case, we have the following 6 month LOCA dose.

Time (Hr)	Total D.R. (mR/hr)	Ave. D.R (mR/hr)	Integ. Dose (mR)
0	8.2+2	4.8+2	4.8+2
1	1.4+2	1.2+2	1.2+2
2	9.4+1	5.7+1	3.4+2
8	2.0+1	1.1+1	1.8+2
24	2.1+0	1.1+0	7.9+1
96	6.7-2		

+)

$= 1.2 \times 10^3$ mR = 1.2 rads.

- 40 year normal operation dose

According to N.A. FSAR, Part B, Supplement Volume III, the service bldg is designated as radiation zone I. The maximum dose rate for Surry zone I is 0.75 mR/hr (Shielding design summary for Surry power station) ref(9)

(From ref. (9), dose rates outside the waste drain tank cubicle is ≤ 15 mR/hr. Additional shields (24"-15") and distance (31 ft relative to ~ 6ft) will reduce that dose rate to less than 0.75 mR/hr)

Therefore, the 40 year normal operation dose

$= 0.75 \times 10^{-3} \times 40 \times 365 \times 24 = 260$ rads. *

* This 40 year normal dose is also applicable to other areas of the service bldg. (N.A. FSAR, above,) and to the turbine bldg (ref. (9)).

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 31
12846.38	46/48 RP	RP-031-0		

- Results

	6 Mo LOCA Dose	40 year normal Dose	Total
– with LLWDT	450 rads	260 rads	~710 rads
– without LLWDT	1.2 rads	260 rads	~260 rads

1-L-31

FORWARD WHITE AND PINK COPIES. RETAIN PINK COPY FOR FILE.

INTEROFFICE CORRESPONDENCE

TO: Mike O'MEARA — LOCATION 14

FROM: Wu PENG — LOCATION 9

SUBJECT / REFERENCE / J.O. NO. 12846.38 40 year and 6 month LOCA doses to

MESSAGE: — Ref. Calc. 12846.38-RP-031-0, "NUREG 0578 Shielding Review - Site dose rates following a LOCA". dated 7/13/81.

<1>. The referenced calc. has been finalized and checked. The following are 40 year normal dose and 6 month LOCA dose for some areas considered in this calc: (all units in rads)

	6 month LOCA ~~40 year normal~~	40 year normal ~~6 Month LOCA~~	Total
MSVH below el. 27'-6"	5.9×10^{6}	880	5.9×10^{6}
MSVH above el. 27'-6"	1.7×10^{4}	880	1.8×10^{4}
CSPH below el. 27'-6"	5.9×10^{6}	880	5.9×10^{6}
CSPH above el. 27'-6"	5.3×10^{2}	880	1.4×10^{3}
Emerg. switch gear & relay rm (el. 9'-6")	260 *	450	710

DATE SIGNATURE TELEPHONE

REPLY:

* This 40 year normal dose (based on radiation zone I with maximum dose rate 0.75 mR/hr) is also applicable to other general areas of service bldg and to the turbine bldg.

C.C. R. Westfahl
J. Barnhart.

7/14/81

Wuhung Peng X 0104

NOTED JUL 17 1981 S. Ingenieri

DATE SIGNATURE TELEPHONE

▲ 040.13B

1-L-32

SENDER DETACH AND RETAIN THIS COPY

SENDER — RETAIN YELLOW COPY.
FORWARD WHITE AND PINK COPIES.

REPLIER — RETURN WHITE COPY.
RETAIN PINK COPY FOR FILE.

INTEROFFICE CORRESPONDENCE

TO: Mike OMEARA	LOCATION 14	SUBJECT / REFERENCE / J.O. NO. 12846.38 NUREG 0578 Shielding Review - Site dose rates following a LOCA
FROM: Wu PENG	LOCATION 9	

MESSAGE: —

Ref. S&W calc. 12846.38-RP-031-0, "NUREG 0578 Shielding Review - site dose rates following a LOCA" dated 7/13/81

<1> The referenced calc. had been checked, and the attached site dose rate tables (3 copies) are considered final.

<2>. The source terms and approach used for the site dose rate calculation are the same as those for aux. bldg. radiation zone map calc. (RP-026). They were described in the previous IOC associated with that calc.

cc. R. Westfahl

7/14/81 — Wuhung peng — X0104

NOTED JUL 17 1981 S.Ingeneri

DATE — SIGNATURE — TELEPHONE

REPLY:

DATE — SIGNATURE — TELEPHONE

A 040.13D

1-L-33

USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 12
EZD REFERENCE DESCRIPTION: 12846.44-PE-044-0
ENVIRONMENTAL ZONE(S): MSVH-27

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
TEMPERATURE (°F)							300, 0-1 hr.	2, 34
PRESSURE (psia)							16.5, 0-10 sec 16.2, 10 sec-1 hr	*
RELATIVE HUMIDITY (%)							100	**
CHEMICAL SPRAY								

REMARKS: * Profile is based on results of the referenced calculation by estimating a transient which conservatively bounds the calculated transient. Note that no HELB is specified for the region between el 11'6" and 27'6" since it is separated from the remainder of the MSVH, and there are no high energy lines located in the region.

** Relative humidity bounds are results of computer runs.

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CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

▲5010.64 (FRONT)

CLIENT & PROJECT VEPCO Surry 1 & 2	PAGE 1 OF 33
CALCULATION TITLE (Indicative of the Objective): Pipe Break Analysis – Main Steam Valve House	QA CATEGORY (✓) ☑ I – NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ____ OTHER

CALCULATION IDENTIFICATION NUMBER				
J. O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12846.44	PE (B)	PE-044-0	00004	

* APPROVALS – SIGNATURE & DATE			REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (✓)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE (S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
R. [signature] 9/4/80	W. [signature] 10/24/80 NOTED	W. [signature] 10/24/80 NOV 20 1980 R.F.MILLER RFM	0			✓

DISTRIBUTION *

GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT. FILES (OR FIRE FILE IF NONE)	M Cliffe 245/14	2			
Project	J. Barnhart	1			

1-M-1

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STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 2
Preliminary Item PE-044-0

Client VEPCO Location SURRY 1 & 2 Est. No. J.O. No. 12846.44
Subject PIPE BREAK – MSVH Date By R. GALLAGHER
Checked By
Based on Revised By

PROBLEM:

TO DETERMINE PRESSURE AND TEMPERATURE CONDITIONS IN MSVH FOLLOWING PIPE BREAK IN 6" LINE THAT CONNECTS A RELIEF VALVE TO RELIEF VALVE HEADER AS PER REF. 35

MODEL

SURRY UNIT #1 AND UNIT #2 MAIN STEAM VALVE HOUSES (MSVH) WERE MODELED INTO 6 NODES FROM LEVEL 27'6" TO 67'5". VENT TO ATMOSPHERE IS ONLY THROUGH ROOF OPENINGS. NO HEAT SINKS WILL BE USED. BREAK IS IN 6" LINE FROM HEADER TO RELIEF VALVES.

RESULTS:

BASED ON THREED COMPUTER RUN (NU-92) 3800004 THE PEAK TEMPERATURE OF 294.07 °F IS REACHED AT 589.0 SEC.

THE MAX PRESSURE DIFFERENTIAL OCCURS BETWEEN NODE 6 AND ATMOSPHERE – 1.17 PSID AT .850 SEC.

TEMPERATURE IN BOTTOM OF BUILDING NEXT AUX. FEED PUMPS HAS A MAX. TEMP OF 244.91 °F

*NOTE: NO PAGE # 11.

1-M-2

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 3
Preliminary
Item PE-044-0

Client VEPCO	Location SURRY 1 & 2	Est. No.	J.O. No. 12846.44
Subject PIPE BREAK - MSVH		Date	By R. GALLAGHER
		Checked	By
Based on		Revised	By

ASSUMPTIONS:

1) DOOR BETWEEN CONTAINMENT SPRAY PUMP AREA AND MAIN STEAM VALVE HOUSE AT LEVEL 27'6" IS A DOUBLE SLIDING DOOR AND THEREFORE WILL NOT BE CONSIDERED AS A VENT PATH. ALSO STEAM PIPES GOING THROUGH WALL ARE PACKED WITH INSULATION AND NOT CONSIDERED A VENT PATH.

2) UNLESS OTHERWISE NOTED ALL PIPING IS ASSUMED TO HAVE 4" INSULATION PER SIDE.

3) A GRATING FACTOR OF .9 WILL BE USED TO ACCOUNT FOR AREA OF GRATING AND SUPPORT PIECES

4) THIS CALCULATION IS EQUALLY VALID FOR UNIT'S #1 AND #2 SINCE DRAWING FOR BOTH UNITS WERE COMPARED AND DIMENSIONS ARE COMPARABLE. ALSO FLOOR HATCHES IN UNIT #1 FLOOR MUST BE IN PLACE DURING OPERATION.

5) ASSUMED THAT OPERATOR ACTION TAKEN SO AS TO SHUT OFF AUX. FEED FLOW SUCH THAT GENERATOR WOULD BE DRY AND THEREFORE NO BLOWDOWN AT 1800 SEC.

1-M-3

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 4

Preliminary Item PE-044-0

Client VEPCO — Location Surry 1&2 — Est. No. — J.O. No. 12846.44

Subject Pipe Break MSVH — Date — By R. Gallagher

Checked — By

Based on — Revised — By

REFERENCES:

1) S+W DRG. 11548-FP-1B-9

2) S+W DRG. 11548-FP-2C-4

3) S+W DRG. 11548-FP-2J-5

4) S+W DRG. 11548-FP-2K-2

5) S+W DRG. 11548-FP-2L-1

6) DRG # V-46 HMTA 86X4-A

7) DRG. # V-38 HMTA 86X4

8) S+W DRG. 11448-FS-19A-3

9) S+W DRG. 11448-FS-19B-4

10) S+W DRG. 11548-FS-19B-2

11) S+W DRG 11548-FS-19A-2

12) S+W DRG. 11448-FC-19B-7

13) S+W DRG. 11448-FC-19C-4

14) S+W DRG. 11448-FP-5F-6

15) S+W DRG. 11548-FC-19B 4

16) S+W DRG. 11548-FC-19C-3

17) S+W DRG. 11548-FB-40B-3

18) S+W DRG. 11548-FB-43A-3

19) S+W DRG. 11548-FM-14A-7

20) S+W DRG 11548-FP-5F-5

21) S+W DRG. 11448-FP-2C-4

1-M-4

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CALCULATION SHEET

Page No. 5

Preliminary

Item FE-044-0

Client VEPCO Location SURRY 1 & 2 Est. No. J.O. No. 12846.44

Subject Date By R. GALLAGHER

Checked By

Based on Revised By

(REFERENCES CONT.)

22) S+W DRG 11448-FP-2E-6

23) S+W DRG. 11448-FP-2J-7

24) S+W DRG 11448-FP-2K-3

25) S+W DRG 11448-FP 2L-2

26) S+W DRG. 11448-FM-14A-12

27) S+W DRG 11448-FP-5C-6

28) S+W DRG. 11448-FP-1B-11

29) CRANE TECH. PAPER No. 410 © 1979

30) IDEL'CHIK (HANDBOOK OF HYDRAULIC RESISTANCE) © 1966

31) THREED VER 12 LEVEL 1 RUN# 38000Q4. SUMMARY (ATTACHMENT #1)

32) SURRY 1 & 2 F.S.A.R., PART B VOL 3 p. 10.3.1-1

33) MOODY CRITICAL FLOW RATES TABLE 6B-2

34) ASME STEAM TABLES © 1967 p. 91

35) IOC W. KNAPP TO R. F. MILLER (ATTACHMENT # 2)

36) S+W DRG. - 11448-FP-42A

37) S+W DRG. - 11448-FP-2P-2

38) 1978 STRUCTURAL SHAPES (BETHLEHEM STEEL) CATALOG 3277

39) PIPING SPECIFICATION SURRY POWER STATION 1972

1-m-5

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

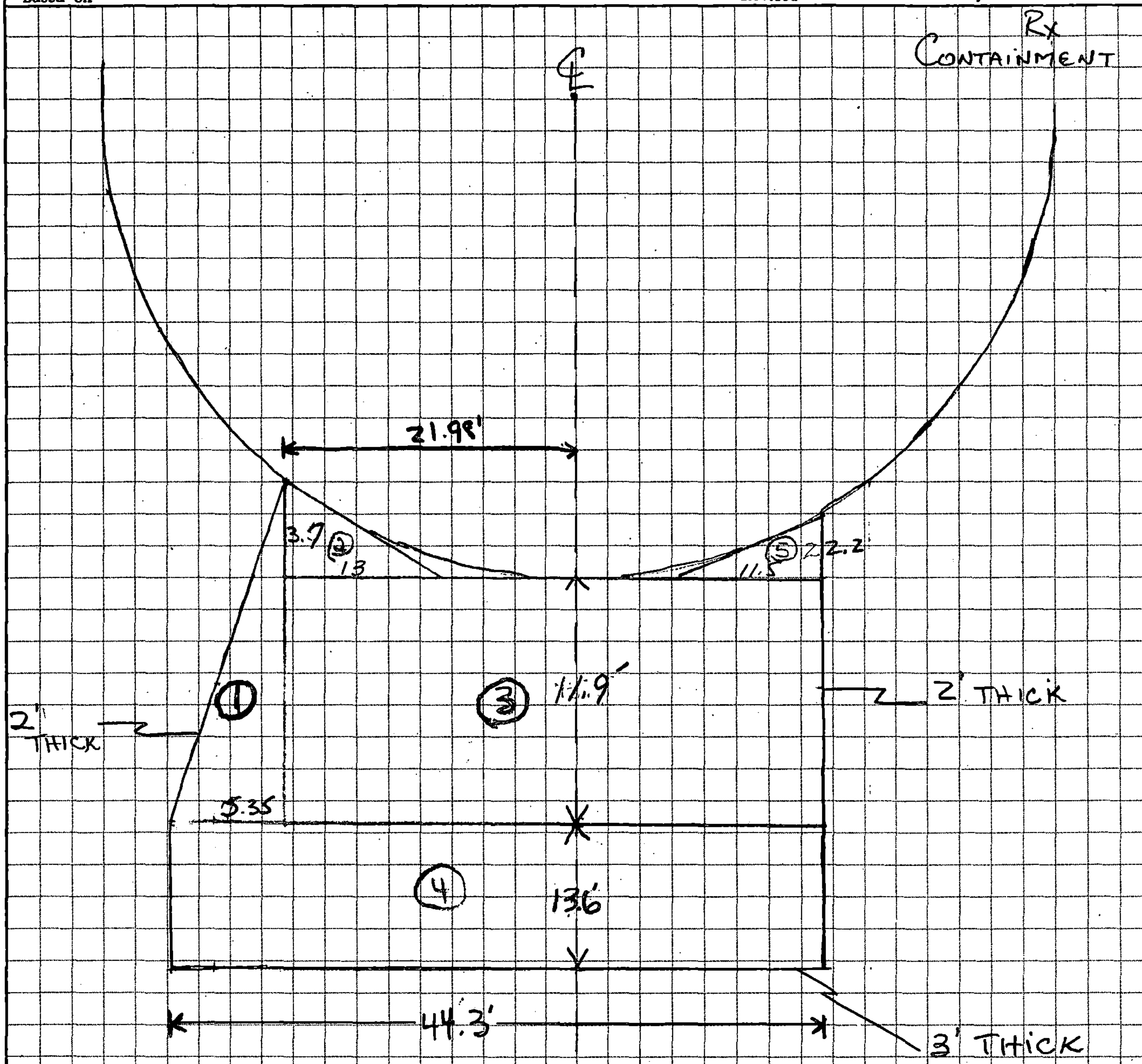
Page No. 6
Preliminary
Item PE-044-0

Client VEPCO — Location SURRY 1&2 — Est. No. — J.O. No. 12846.44

Subject — Date — By R. GALLAGHER

Checked — By

Based on — Revised — By



AREA OF BASE FROM 11548-FC-19B-4 DIVIDED IN RED AS SHOWN FOR CALCULATION OF AREA.

DRAWN FOR UNIT #2 – UNIT #1 IS IDENTICAL IN SIZE – ORIENTED OPPOSITE TO UNIT #2.

1-M-6

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

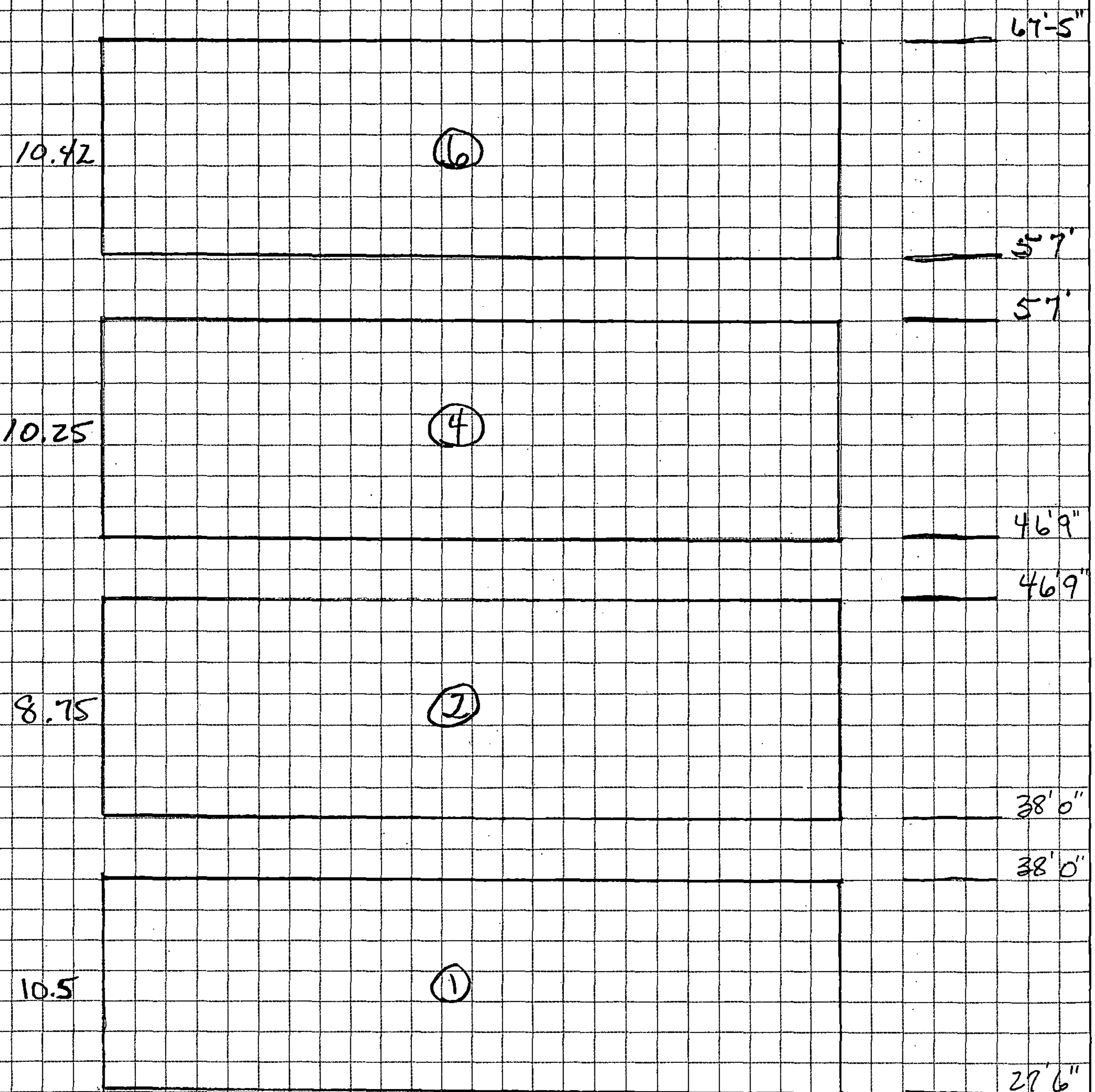
Page No. 7
Preliminary
Item PE-044-0

Client VEPCO Location SURRY 1 & 2 Est. No. J.O. No. 12846.44

Subject Date By R. GALLAGHER

Checked By

Based on Revised By



1-M-7

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 8

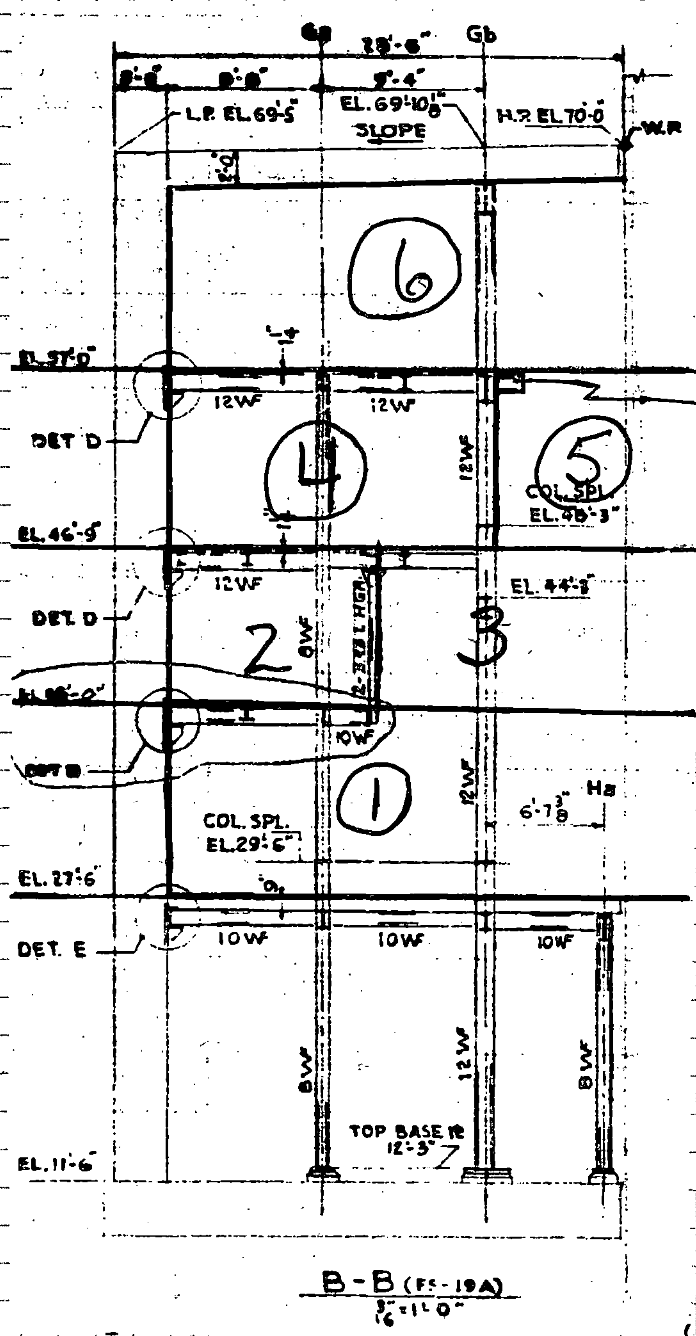
Preliminary Item PE-044-0

Client VEPCO Location SURRY 1 & 2 Est. No. J.O. No. 12846.44

Subject Date By R. GALLAGHER

Checked By

Based on Revised By



SIDE VIEW OF NODALIZATION MODEL.

NODES AS OUTLINED AND NUMBERED IN RED.

REF. 11548-FS-19B-2

1-M-8

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

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Item PE-044-0

Client VEPCO Location SURRY 1&2 Est. No. J.O. No. 12846.44
Subject Date By R. GALLAGHER
Checked By
Based on Revised By

AREA OF BASE

AREA DIVIDED AS SHOWN OF PAGE 6.

① TRIANGLE UPPER LEFT –

.5 (5.35) (11.9 + 3.7) = 41.73

② TRIANGLE

.5 (3.7) (13) = 24.05

③ RECTANGLE

(11.9) (38.95) = 463.5

④ RECTANGLE

(13.6) (44.3) = 602.48

⑤ TRIANGLE

.5 (2.2) (11.5) = 12.65

TOTAL = 41.73 + 24.05 + 463.5 + 602.48 + 12.65 =

= 1144.4 FT^2

1-m-9

Client VEPCO Location SURRY 1&2 Est. No. J.O. No. 12846.44

Subject Date By R. GALLAGHER

Checked By

Based on Revised By

GROSS VOLUMES

NODE 1

HEIGHT = 38' - 27.5' = 10.5 FT

AREA OF BASE = 1144.4 FT^2

TOTAL VOLUME = 12016.2 FT^3

NODE 2

HEIGHT = 46.75 - 38 = 8.75 FT

AREA OF BASE = (W) x L = 11.42 x 44.33 = 506.25

TOTAL VOLUME = 4429.69 FT^3

NODE 3

HEIGHT - SAME AS NODE 2 = 8.75 FT

AREA OF BASE = 1144.4 - 506.25 = 638.2 FT^2

TOTAL VOLUME = 5584.25 FT^3

NODE 4 AND 5 HEIGHT = 57 - 46.75 = 10.25 FT

NODE 4

BASE AREA = 18 x 44.3 = 797.4

TOTAL VOLUME = 8173.35 FT^3

NODE 5

BASE AREA = 1144.4 - 797.4 = 347

TOTAL VOLUME = 3556.75 FT^3

NODE 6

HEIGHT = 67'5" - 57' = 10.42 FT

AREA OF BASE = 1144.4 FT^2

TOTAL VOLUME = 11924.65 FT^3

NODE 7

ATMOSPHERE = 1.0 E 20 FT^3

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 12

Preliminary Item PE-044-0

Client VEPCO   Location Surry 1 & 2   Est. No.   J.O. No. 12846.44

Subject   Date   By R. GALLAGHER

Checked   By

Based on   Revised   By

MINUS VOLUMES –

NODE 1 – 14.67 FT OF 14" FEEDWATER PIPE 4" INSULATION

14.67 x 3 = 44.0'

$44.0 \times \pi/4 (22/12)^2 = 116.2\ FT^3$

WAPD + WCMU LINES – NO INSULATION

45.25 FT OF 4" PIPE

$45.25 \times \pi/4 (4/12)^2 = 3.95\ FT^3$

21.5 FT OF 2" PIPE

$21.5 \times \pi/4 (2/12)^2 = .47\ FT^3$

11.0 FT OF 1" PIPE

$11 \times \pi/4 (1/12)^2 = .06\ FT^3$

179.63 FT OF 6" PIPE

$179.63 \times \pi/4 (6/12)^2 = 35.27\ FT^3$

TOTAL WAPD – WCMU PIPING – $39.75\ FT^3$

AUX. FEED PUMPS – (3)

(2) 46.5' x 12.33' x 62" = 246.86 @

(1) 34.5 x 8.5' x 52 3/8" = 106.66 @

TOTAL PUMPS = $600.38\ FT^3$

MISC. STEEL, PIPES AND HANGERS

5% OF GROSS VOL = $573.2\ FT^3$

STEEL =

2 (8WF) @ 10.5 = 21 x 35 ÷ 489 = 1.51

2 (12WF) @ 10.5 = 21 x 96 ÷ 489 = 4.12

$5.63\ FT^3$

1-m-11

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 13
Preliminary
Item PE 044-0

Client VEPCO Location SURRY 1 & 2 Est. No. J.O. No. 12846.44

Subject Date By R. GALLAGHER

Checked By

Based on Revised By

SHPD AND SHP PIPING — 2 1/2 INSULATION

3"	— 68 FT	$68 \times \pi/4\,(8/12)^2$ =	23.74 FT^3
6"	— 35.0 FT	$35 \times \pi/4\,(11/12)^2$ =	23.10 FT^3
1"	— 36.5 FT	$36.5 \times \pi/4\,(6/12)^2$ =	7.17 FT^3
1 1/2"	— 83.5 FT	$83.5 \times \pi/4\,(4.5/12)^2$ =	19.24 FT^3
		TOTAL SHPD =	73.25
(CC LINES) 3"	— 89 FT (NO INSULATION)	$89 \times \pi/4\,(3/12)^2$ =	4.37
(CC LINES) 1 1/2"	— 30 FT	$30 \times \pi/4\,(1.5/12)^2$ =	.37
			4.74

TOTAL MINUS = 176.2 + 39.75 + 600.38 + 573.2 +
5.63 + 73.25 + 4.74 = 1413.2 FT^3

NODE 2

9.42 FT / LINE 3 LINES = 28.26 FT OF 20" STM PIPE

4" OF INSULATION —

$28.26 \times \pi/4\,(38/12)^2 = 222.57\ FT^3$

9.8 FT OF 14" MN. FEED PIPE

$9.8 \times \pi/4\,(22/12)^2 = 25.87\ FT^3$

SHP + SHPD PIPING — 2 1/2" INSULATION

1 1/2"	= 6.85 FT	$6.85 \times \pi/4\,(6.5/12)^2$ =	1.58
3/4"	= 2 FT	$2 \times \pi/4\,(5.75/12)^2$ =	.36
		TOTAL =	1.94 FT^3

STEEL —

2 (12 WF) @ 9.5 FT = 19 × 96 ÷ 489 = 3.72

2 (8 WF) @ 8.75 FT = 17.5 × 35 ÷ 489 = 1.26

2 (3×3) HGR. = .75 × 8.75 = 6.56 × 2 = 13.13

TOTAL 18.11 FT^3

1-m-12

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 14

Preliminary Item PE-044-0

Client VEPCO Location SURRY 1&2 Est. No. J.O. No. 12846.411

Subject Date By R. GALLAGHER

Checked By

Based on Revised By

MISC. PIPES, HANGERS, STEEL -

5% GROSS VOL. = 182.9 FT^3

TOTAL MINUS = 182.9 + 18.11 + 1.94 + 25.87 + 222.57 = 451.39 FT^3

NODE 3

21.92 FT / LINE 3 LINES 65.76 FT
OF 30" STM LINE 4" INSULATION

$65.76 \times \pi/4 \left(\frac{38}{12}\right)^2 = 517.91$ FT^3

PIPE SUPPORTS, MISC STEEL AND SMALL PIPES

5% GROSS VOL. = 294.8 FT^3

14" MN. FEED PIPE = 11.7 FT × 3 = 35.1

$35.1 \times \pi/4 \left(\frac{22}{12}\right)^2 = 92.66$ FT^3

STEEL

2 (12 WF) @ 9.25 FT ea = 18.5 × 96 ÷ 489 = 3.63

2 (12 WF) @ 8.75 FT ea = 17.5 × 96 ÷ 489 = 3.43

TOTAL 7.06

3 VALVES

2 × 1.5 × 2 = 6 FT^3 / VALVE = 18 FT^3

6" MN. STM. LINE 4" INSULATION

5 FT / LINE 3 LINES = 15 FT

$15 \times \pi/4 \left(\frac{14}{12}\right)^2 = 16.04$ FT^3

1-M-13

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 15
Preliminary Item PE-044-0

Client VEPCO Location Surry 1 & 2 Est. No. J.O. No. 12846.44
Subject Date By R. Gallagher
Checked By
Based on Revised By

SHP LINES — 4" INSULATION

46 FT

$46 \times \pi/4 \left(\frac{12}{12}\right)^2 = 36.13\ FT^3$

SUB. TOTAL MINUS = 517.91 + 92.66 + 7.06 + 18 + 16.04 + 36.13 + 294.8 = 982.60 FT^3

SHPD + SHP LINES — 2 1/2" INSULATION

1 1/2"	$18.8 \times \pi/4 (6.5/12)^2$	=	4.33
1"	$11 \times \pi/4 (6/12)^2$	=	2.16
3/4"	$30.25 \times \pi/4 (5.75/12)^2$	=	5.45
4"	$21.5 \times \pi/4 (9/12)^2$	=	9.50
3"	$49.0 \times \pi/4 (8/12)^2$	=	17.1
			38.54 FT^3

TOTAL MINUS —

982.60 + 38.54 = 1021.14 FT^3

NODE 4

30" MN STM. LINE — 4" INSULATION

10.71 FT/LINE 3 LINES 32.13 FT

$32.13 \times \pi/4 \left(38/12\right)^2 = 253.05\ FT^3$

STEEL

2 (12 WF) @ 18.75 FT LG	= 37.5 × 96 ÷ 489	=	7.35
2 (12 WF) @ 10.25 FT LG	= 20.5 × 96 ÷ 489	=	4.02
2 (8 WF) @ 10.25 FT LG	= 20.5 × 35 ÷ 489	=	1.48
	TOTAL		12.85 FT^3

1-M-14

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 16

Preliminary Item PE-044-0

Client VEPCO | Location SURRY 1&2 | Est. No. | J.O. No. 12846.44

Subject | Date | By R. GALLAGHER

Checked | By

Based on | Revised | By

MN. STM. VALVE OPERATOR

RECTANGLE

$5.75 \times 2.5 \times 3.0 = 43.13\ FT^3$

6" MN. STM. PIPE — 4" INSULATION.

30.75 FT/LINE 3 LINES 92.25 FT

$92.25 \times \pi/4\,(14/12)^2 = 98.62\ FT^3$

PIPE SUPPORTS, MISC PIPES,

5% GROSS VOL. — $412.15\ FT^3$

TOTAL MINUS = 253.05 + 12.85 + 43.13 + 98.62 + 412.15 = $819.80\ FT^3$

NODE 5

30" MN. STM. PIPE 4" INSULATION.

10.25 FT/LINE 3 LINES 30.75 FT

$30.75 \times \pi/4\,(38/12)^2 = 242.18\ FT^3$

SHP - 37, 38, 39 5 FT ea.

$15\ FT \times \pi/4\,(12/12)^2 = 11.78\ FT^3$

1-m-15

Client VEPCO | Location SURRY 1&2 | Est. No. | J.O. No. 12846.44
Subject | Date | By R. GALLAGHER
Checked | By
Based on | Revised | By

PIPE SUPPORTS, MISC PIPES

5% GROSS VOLUME 147.37 FT^3

TOTAL MINUS - 242.18 + 11.78 + 147.37
= 401.33 FT^3

NODE 6

30" MN. STM. LINE

10.33 FT/LINE 3 LINES 30.99 FT

$30.99 \times \pi/4 \left(\frac{38}{12}\right)^2 = 244.07 \ FT^3$

MN. STM. VALVE OPERATOR - 3 RECTANGLES -

1.75 X 2.5 X 3 = 13.13

1 X 3 X 6.5 = 19.5

3 X 6.5 X 2.5 = 48.75

TOTAL = 81.38 FT^3

SHP 37, 38, 39 4" LINE 16 FT
4" INSULATION

$48 FT \times \pi/4 (12/12)^2 = 37.7 \ FT^3$

4.5 FT OF 16" MN. STM. PIPE / RELIEF VALVE
15 RELIEF VALVES. 67.5 FT.

$67.5 \times \pi/4 (24/12)^2 = 212.06 \ FT^3$

STEEL
2 (12WF) - 10.42 FT @ = 2084 X 96 ÷ 489 = 4.08
(16WF45) - 10 FT = 10 X 45 ÷ 489 = .92
24WF110 - 24.5 FT = 24.5 X 110 ÷ 489 = 5.51

10.51 FT^3

1-m-16

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 18

Preliminary Item PE-044-0

Client VEPCO | Location Surry 1 & 2 | Est. No. | J.O. No. 12846.44

Subject | Date | By R. Gallagher

Checked | By

Based on | Revised | By

RELIEF VALVES – (15)

$10.94\ FT^3/VALVE \times 15 = 164.1\ FT^3$

$+ 1 \times \pi/4\,(10/12)^2 = .55 \times 15 = 8.18$

TOTAL $= 172.28\ FT^3$

MISC STEEL + PIPING SUPPORTS –

5% GROSS VOLUME $568.8\ FT^3$

TOTAL MINUS $= 244.07 + 81.38 + 37.7 + 212.06$

$+ 10.51 + 172.28 + 568.8$

$= 1326.8\ FT^3$

1-m-17

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 19
Preliminary
Item PE-044-0

Client VEPCO | Location Surry 1&2 | Est. No. | J.O. No. 12846.44

Subject | Date | By R. Gallagher

Checked | By

Based on | Revised | By

Net Volume

	Gross Volume	Total Minus Volume	Net (FT³) Volume
Node 1	12016.2	1913.20	10603.0
Node 2	4429.69	451.39	3978.3
Node 3	5584.25	1021.14	4563.11
Node 4	8173.35	819.80	7353.55
Node 5	3556.75	401.33	3155.42
Node 6	11924.65	1326.8	10597.85

1-m-18

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 20
Preliminary Item OE-044-0

Client VEPCO Location SURRY 1 & 2 Est. No. J.O. No. 12846.44

Subject Date By R. GALLAGHER

Checked By

Based on Revised By

JUNCTION AREAS

JUNC. #	FROM NODE	TO NODE		JUNC AREA FT²
1	1	2	.7* (506.25)	354.38
2	1	3	Base Are of Node 3	638.2
3	2	4	.7 (506.25)	354.38
4	3	4	(638.2 − 347.0)	291.20
5	3	5	Base Ara of Node 5	347.0
6	4	6	.7 (797.4)	558.2
7	5	6	Base of Node 5	347.0
8	2	3	(8.75 x 44.3)	387.63
9	4	5	(10.25 x 44.3)	454.08
10	6	7	(.17 x 6) x 18 *	18.36
11	6	7	.17 x 6 x 18 *	18.36
12	6	7	.17 x 6 x 18 *	18.36

* From page 27 each opening is 2" wide or .17' by 6' and there are 18 openings

** p. 3 Assumption #3

1-M-19

Client VEPCO Location SURRY 1&2 Est. No. J.O. No. 12846.44

Subject Date By R. GALLAGHER

Checked By

Based on Revised By

INERTIA

JUNC. #	$\frac{C_1}{A_1}$ +	$\frac{C_2}{A_2}$ +	$\frac{L_I}{A_i}$	I
1	$\frac{5.25}{1144.4}$ +	$\frac{4.375}{506.25}$ +	0	.014
2	$\frac{5.25}{1144.4}$ +	$\frac{4.375}{638.2}$ +	0	.012
3	$\frac{4.375}{506.25}$ +	$\frac{5.125}{797.4}$ +	0	.015
4	$\frac{4.375}{638.2}$ +	$\frac{5.125}{797.4}$ +	0	.013
5	$\frac{4.375}{638.2}$ +	$\frac{5.125}{347.0}$ +	0	.022
6	$\frac{5.125}{797.4}$ +	$\frac{5.21}{1144.4}$ +	0	.012
7	$\frac{5.125}{347.0}$ +	$\frac{5.21}{1144.4}$ +	0	.021
8	$\frac{5.71}{(8.75)(44.3)}$ +	$\frac{7.04}{(8.75)(44.3)}$ +	0	.033
9	$\frac{9.0}{(10.25)(44.3)}$ +	$\frac{3.75}{(10.25)(44.3)}$ +	0	.028
10	$\frac{5.21}{1144.4}$ +	~~ATMOS.~~ +	$\frac{2}{18.36}$ REF. 12 ([illegible])	.114
11	$\frac{5.21}{1144.4}$ +	~~ATMOS.~~ +	$\frac{2}{18.36}$ REF. 12 ([illegible])	.114
12	$\frac{5.21}{1144.4}$ +	~~ATMOS.~~ +	$\frac{2}{18.36}$ REF. 12 ([illegible])	.114

1-m-20

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 22

Preliminary Item (circled) IE-044-0

Client VEPCO. Location SURRY 1 & 2 Est. No. J.O. No. 12846.44

Subject Date By R. GALLAGHER

Checked By

Based on Revised By

CONTRACTION COEFFICIENT ↗ ESG-19

JUNC. #	FROM NODE	TO NODE		.5 (1 − A_J/A_1)	K_C
1	1	2	*	.5 (1 − 506.25 / 1144.4)	.279
1	2	1	*	.5 (1 − 506.25 / 506.25)	0
2	1	3		.5 (1 − 638.2 / 1144.4)	.221
2	3	1		.5 (1 − 638.2 / 638.2)	0
3	2	4	*	.5 (1 − 506.25 / 506.25)	0
3	4	2	*	.5 (1 − 506.25 / 797.4)	.183
4	3	4		.5 (1 − 291.2 / 638.4)	.272
4	4	3		.5 (1 − 291.2 / 797.4)	.317
5	3	5		.5 (1 − 347.0 / 638.4)	.228
5	5	3		.5 (1 − 347.0 / 347.0)	0
6	4	6	*	.5 (1 − 797.4 / 797.4)	0
6	6	4	*	.5 (1 − 797.4 / 1144.4)	.152
7	5	6		.5 (1 − 347.0 / 347.0)	0
7	6	5		.5 (1 − 347.0 / 1144.4)	.348
8	2	3		.5 (1 − 387.63 / 387.63)	0
8	3	2		.5 (1 − 387.63 / 387.63)	0
9	4	5		.5 (1 − 454.08 / 454.08)	0
9	5	4		.5 (1 − 454.08 / 454.08)	0

*NOTE:
FOR JUNC. 1, 3, 6 FOR CONTRACTION TERM. A_J IS JUNC AREA ON p. 20 WITHOUT .7 AREA CORRECTION

1-M-21

▲ 5010.1D

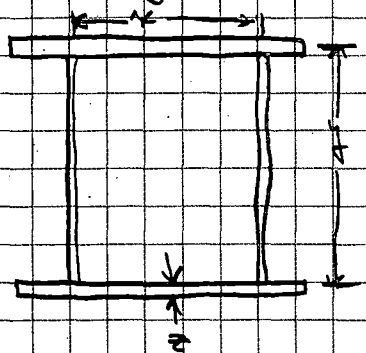
STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 23
Preliminary
Item CE-044-0

Client VEPCO | Location Surry 1&2 | Est. No. | J.O. No. 12846.44
Subject | Date | By R. GALLAGHER
| Checked | By
Based on | Revised | By

GRATING FACTOR – REF. CALC. 13075.49-ES-224-0 p.5



x = 1.1875"

y = 4.0" THICKNESS = 1.25"

z = .1875"

$$F = \frac{(x-z)(y-z)}{xy} = .80263$$

$$D_H = \frac{4(F \times y)}{2[(4-.1875)+(1)]} = 1.334$$

9.625

$$\frac{L}{D_H} = \frac{1.25}{1.334} = .937$$

using .7 OF p.325 TABLE OF REF. 30
→ ASSUMPTION #3

K = .61

$$.61(F)^2 = .298$$

FOR CONSERVATISM A K FACTOR FOR GRATING OF .3 IS USED.

1-m-22

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 24
Preliminary
Item PE-044-0

Client VEPCO Location SURRY 1&2 Est. No. J.O. No. 12846.44
Subject Date By R. GALLAGHER
Checked By
Based on Revised By

EXPANSION COEFFICIENT

[FORMULA (ESG-19)]

JUNC #	FROM NODE	TO NODE		$(1 - A_J/A_2)^2$	K_E
1	1	2	*	$(1 - 506.25/506.25)^2$	.0
1	2	1	*	$(1 - 506.25/1144.4)^2$	.311
2	1	3		$(1 - 638.2/638.2)^2$	0
2	3	1		$(1 - 638.2/1144.4)^2$	.196
3	2	4	*	$(1 - 506.25/797.4)^2$	.133
3	4	2	*	$(1 - 506.25/506.25)^2$	0
4	3	4		$(1 - 291.2/797.4)^2$	.403
4	4	3		$(1 - 291.2/638.2)^2$	.296
5	3	5		$(1 - 347.0/347.0)^2$	0
5	5	3		$(1 - 347.0/638.2)^2$	.208
6	4	6	*	$(1 - 797.4/1144.4)^2$	.092
6	6	4	*	$(1 - 797.4/797.4)^2$	0
7	5	6		$(1 - 347.0/1144.4)^2$	.486
7	6	5		$(1 - 347.0/347.0)^2$	0
8	2	3		$(1 - 387.63/387.63)^2$	0
8	3	2		$(1 - 387.63/387.63)^2$	0
9	4	5		$(1 - 454.08/454.08)^2$	0
9	5	4		$(1 - 454.08/454.08)^2$	0

* SEE NOTE PAGE 22.

1-m-23

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 25
Preliminary
Item EE-044-0

Client VEPCO | Location SURRY | Est. No. | J.O. No. 12846.44
Subject | Date | By R. GALLAGHER
Checked | By
Based on | Revised | By

MOMENTUM FLUX – K'

$$K' = \left(\frac{A_J}{A_2}\right)^2 - \left(\frac{A_J}{A_1}\right)^2$$ (FORMULA ESG-19)

JUNC. #	① FROM NODE	② TO NODE	$(A_J/A_2)^2$	–	$(A_J/A_1)^2$	K'
1	1	2	$(354.38/506.25)^2$	–	$(354.38/1144.4)^2$	.394
1	2	1	$(354.38/1144.4)^2$	–	$(354.38/506.25)^2$	-.394
2	1	3	$(638.2/638.2)^2$	–	$(638.2/1144.4)^2$	-.687
2	3	1	$(638.2/1144.4)^2$	–	$(638.2/638.2)^2$	-.687
3	2	4	$(354.38/797.4)^2$	–	$(354.38/506.25)^2$	-.294
3	4	2	$(354.38/506.25)^2$	–	$(354.38/797.4)^2$	.294
4	3	4	$(291.2/797.4)^2$	–	$(291.2/638.2)^2$	-.075
4	4	3	$(291.2/638.2)^2$	–	$(291.2/797.4)^2$	.075
5	3	5	$(347.0/347)^2$	–	$(347.0/638.2)^2$	-.704
5	5	3	$(347.0/638.2)^2$	–	$(347.0/347)^2$	-.704
6	4	6	$(558.2/1144.4)^2$	–	$(558.2/797.4)^2$	-.252
6	6	4	$(558.2/797.4)^2$	–	$(558.2/1144.4)^2$	.252
7	5	6	$(347.0/1144.4)^2$	–	$(347.0/347.0)^2$	-.908
7	6	5	$(347.0/347.0)^2$	–	$(347.0/1144.4)^2$	-.908
8	2	3	$(387.63/387.63)^2$	–	$(387.63/387.63)^2$	0
8	3	2	$(387.63/387.63)^2$	–	$(387.63/387.63)^2$	0
9	4	5	$(454.08/454.08)^2$	–	$(454.08/454.08)^2$	0
9	5	4	$(454.08/454.08)^2$	–	$(454.08/454.08)^2$	0
10	6	7	$(18.36/\text{ATMOS.})^2$	–	$(18.36/1144.4)^2$	-.0003
10	7	6	$(18.36/1144.4)^2$	–	$(18.36/\text{ATMOS.})^2$	.0003
11	6	7	$(18.36/\text{ATMOS.})^2$	–	$(18.36/1144.4)^2$	-.0003
11	7	6	$(18.36/1144.4)^2$	–	$(18.36/\text{ATMOS.})^2$	.0003
12	6	7	$(18.36/\text{ATMOS.})^2$	–	$(18.36/1144.4)^2$	-.0003
12	7	6	$(18.36/1144.4)^2$	–	$(18.36/\text{ATMOS.})^2$	.0003

1-m-24

Client VEPCO | Location Surry 1 & 2 | Est. No. | J.O. No. 12846.44

Subject | Date | By R. Gallagher

Checked | By

Based on | Revised | By

FRICTION COEFFICIENT – K_F

FRICTION WILL BE DETERMINED ON ONE NODE AND ASSUMED TO BE CONSTANT FOR ALL NODES.

REF. 30.

$$D_H = \frac{(4)\,506.25}{2(11.42+44.3)} = 18.17$$

$$\bar{\Delta} = \frac{.25\,(.03937)}{18.17 \times 12} = .00045$$

$$\lambda = \frac{1}{\left(2 \log \frac{3.7}{.00045}\right)^2} = .016$$

$$\frac{.016 \times 4.375}{18.17} = .004$$

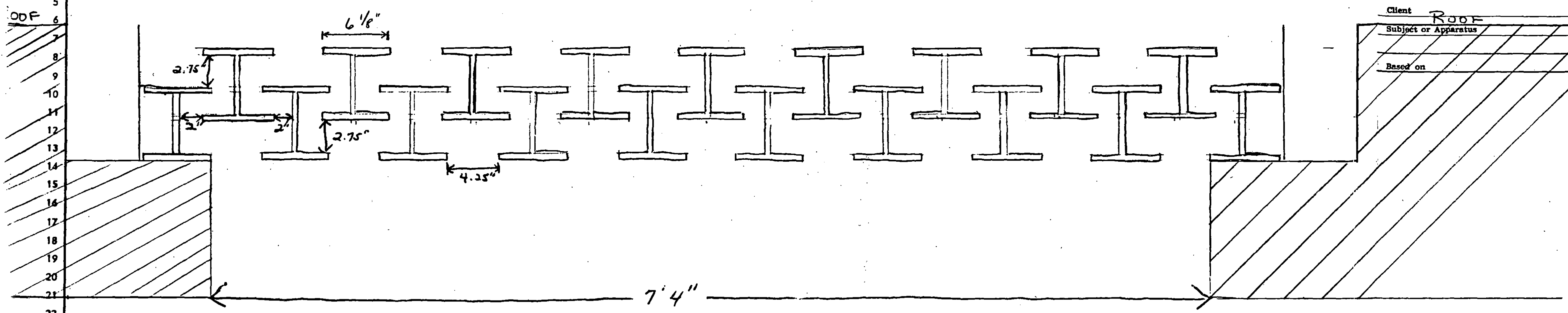
$$= .004 \times 2 = .008$$

WILL USE $K_F = .01$

1-m-25

Client ROOF	Location	Est. No.	J.O. No. page 27
Subject or Apparatus		Date	By R. CALLAGHER
		Checked	By
Based on		Revised	By

PS-044-0

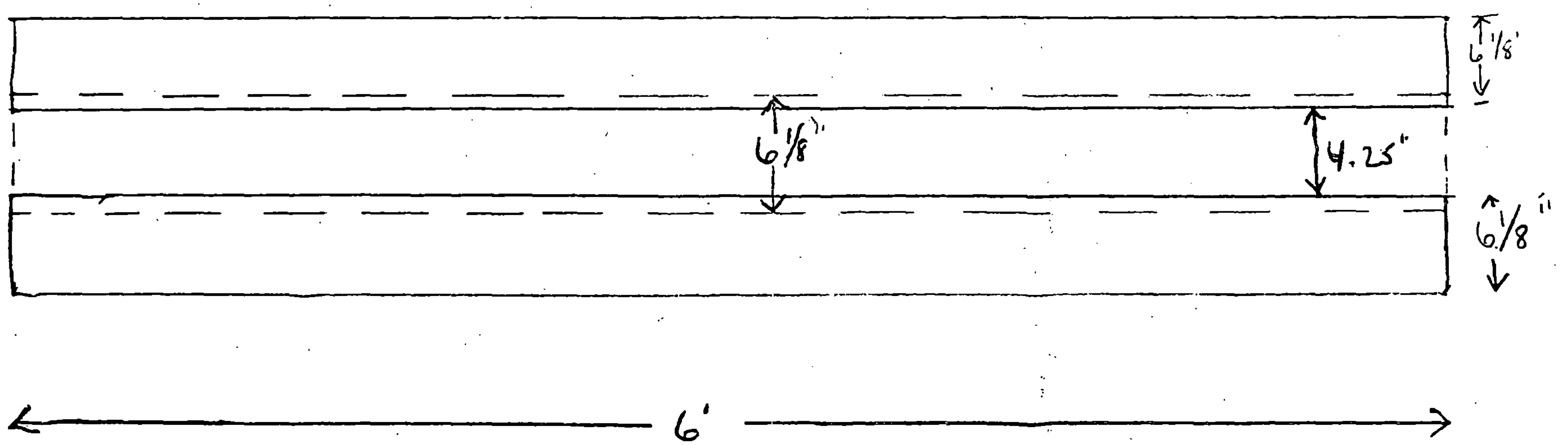


ALL DIMENSION SHOWN ARE TYP. TO DISTANCES BETWEEN ALL 6 WF25 I BEAMS.

OVERALL OPENING =

6 × 7'4" = 43.98 FT

NOTE: DIMENSIONS AS STATED ON THIS SKETCH ARE FROM A FIELD INSPECTION ON 7/8/80. THIS IS ALSO SHOWN ON REF. 12, SECT. C-C, EXCEPT THAT THE END BEAMS ARE SPACED OUT AS SHOWN AT LEFT. (MEASURED DIMENSIONS CAN BE CONFIRMED BY CALCULATION)



TYP. OVER 7'4" LENGTH

I-M-26

Client VEPCO Location SURRY 1&2 Est. No. J.O. No. 12846.44
Subject Date By R. GALLAGHER
Checked By
Based on Revised By

ROOF OPENINGS

(AS SHOWN ON ATTACHED DRAWING.) p.27

ROOF OPENINGS WERE MODELED AS A CONTRACTION FROM NODE 6 TO JUST INSIDE I BEAM. FROM THERE AS A 180° TO ANOTHER 180°, THEN TO AN EXPANSION.

ROOF OPENING 7'4" X 6' BEFORE I BEAMS.

CONTRACTION —

$$.5\left(1 - \frac{(18)\,1.02}{1091.75}\right) = .492 \quad \left(\text{WILL USE } .5\right)$$

EXPANSION —

$$\left(1 - \frac{18(1.02)}{\text{ATMOSPHERE}}\right)^2 = 1$$

180° (REF 30 p.2-30)

$$D_H = \frac{4\,(1.374)}{2\,(6 + .229)} = \frac{5.496}{12.458} = .441$$

FROM REF. 30 A ROUGHNESS OF .15 WILL BE USED.

$$\frac{.15\,(.03937)}{.441 \times 12} = .00112$$

$$\frac{1}{\left(2 \log \frac{3.7}{.00112}\right)^2} = .020 = \lambda$$

1-m-27

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 29

Preliminary

Item QE-044-0

Client VEPCO Location SURRY 1 & 2 Est. No. J.O. No. 12846.44

Subject Date By R GALLAGHER

Checked By

Based on Revised By

FLOW AREA = 1.02 FT²

b_o = 2.75" = .229 FT

l_o = .438" = .036 FT REF. 38 p.35 t_f (W6x25)

b_1 = 2.75" = .229 FT

a_o = 6'

b_{CH} = 2" = .17 FT

$$\frac{l_o}{b_o} = \frac{.036}{.229} = .157 \qquad \frac{b_{CH}}{b_o} = \frac{.17}{.229} = .742$$

USING GRAPH A AND THE .73 CURVE ζ_1 = 3.9

$$\frac{a_o}{b_o} = \frac{6'}{.229} = 26.2$$

ASSUME GRAPH B FLATTENS OUT, SO THAT A .7 VALUE OF C_1 WILL BE USED.

$$I_{FR} = \lambda\left(1 + \frac{l_o}{b_o}\right)$$

$$= .020\,(1 + .157)$$

$$= .023$$

$$K = C_1\zeta_1 + I_{FR}$$

$$= .7\,(3.9) + .023 = 2.753$$

$$2.753\left(\frac{1.02}{1.374}\right)^2 = 1.517$$

$$K'_{FWD} = \left(\frac{18.36}{\text{ATMOS}}\right)^2 - \left(\frac{18.36}{1144.4}\right)^2 = -.0003$$

$$K'_{REV} = \left(\frac{18.36}{1144.4}\right)^2 - \left(\frac{18.36}{\text{ATMOSPHERE}}\right)^2 = .0003$$

1-m-28

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Page No. 30 bz-W-1
Preliminary / Item: [illegible]
J.O. No. 12846.44
By R. Gallagher
By
By
Est. No.
Date
Checked
Revised
Location Surry 1&2
Client VEPCO
Subject
Based on

JUNC. #	FROM NODE	TO NODE	K_C	K_E	K_g	K_F	K'	$K_{180(1)}$	$K_{180(2)}$	K_T
1	1	2	.299	0	.3	.01	.394	—	—	.983
1	2	1	0	.311	.3	.01	-.394	—	—	.227
2	1	3	.221	0	—	.01	.687	—	—	.918
2	3	1	0	.196	—	.01	-.687	—	—	-.481
3	2	4	0	.133	.3	.01	-.294	—	—	.149
3	4	2	.183	0	.3	.01	.294	—	—	.787
4	3	4	.272	.403	—	.01	-.075	—	—	.610
4	4	3	.317	.296	—	.01	.075	—	—	.698
5	3	5	.228	0	—	.01	.704	—	—	.942
5	5	3	0	.208	—	.01	-.704	—	—	-.486
6	4	6	0	.092	.3	.01	-.252	—	—	.150
6	6	4	.152	0	.3	.01	.252	—	—	.714
7	5	6	0	.486	—	.01	-.908	—	—	-.412
7	6	5	.348	0	—	.01	.908	—	—	1.266
8	2	3	0	0	—	.01	0	—	—	.01
8	3	2	0	0	—	.01	0	—	—	.01
9	4	5	0	0	—	.01	0	—	—	.01
9	5	4	0	0	—	.01	0	—	—	.01
10	6	7	.5	1.0	—	.01	-.0003	1.517	1.517	4.54
10	7	6	.5	1.0	—	.01	.0003	1.517	1.517	4.54

(CONT.)

5010.1D

▲ 5010.1D

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

Client VEPCO

Subject

Based on

Location Surry 1&2 Est. No.

Date

Checked

Revised

Page No. 31 QE-W-1

Preliminary PE 0440

Item

J.O. No. 12846.44

By R. Callaghan

By

By

Junc. #	From Node	To Node	K_c	K_E	K_g	K_F	K'	$K_{180(1)}$	$K_{180(2)}$	K_T
11	6	7	.5	1.0	—	.01	-.0003	1.517	1.517	4.54
11	7	6	.5	1.0	—	.01	.0003	1.517	1.517	4.54
12	6	7	.5	1.0	—	.01	-.0003	1.517	1.517	4.54
12	7	6	.5	1.0	—	.01	.0003	1.517	1.517	4.54

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 32
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
12846.44		PE-044-0	00004	

BLOWDOWN

SATURATED STEAM AT 1,085 psig AT 600°F

FROM REF. 32 BREAK IS A 6" RELIEF VALVE LINE TO STM. RELIEF HEADER. (Piping XS FROM REF. 39)

1085 psig
+ 14.7
= 1099.7 psia

AREA OF OPENING =

6" PIPE – XS SCH 80 ID = .1810 FT² (REF. 29)

FROM REF. 33 using [illegible] 1100 psia AND 1.0 QUALITY A VALUE OF 2.35 $\left(\frac{10^3\ lb}{sec - FT^2}\right)$ WAS DETERMINED.

$$\frac{2.35 \quad 10^3\ lb \quad .181\ FT^2}{sec - FT^2}$$

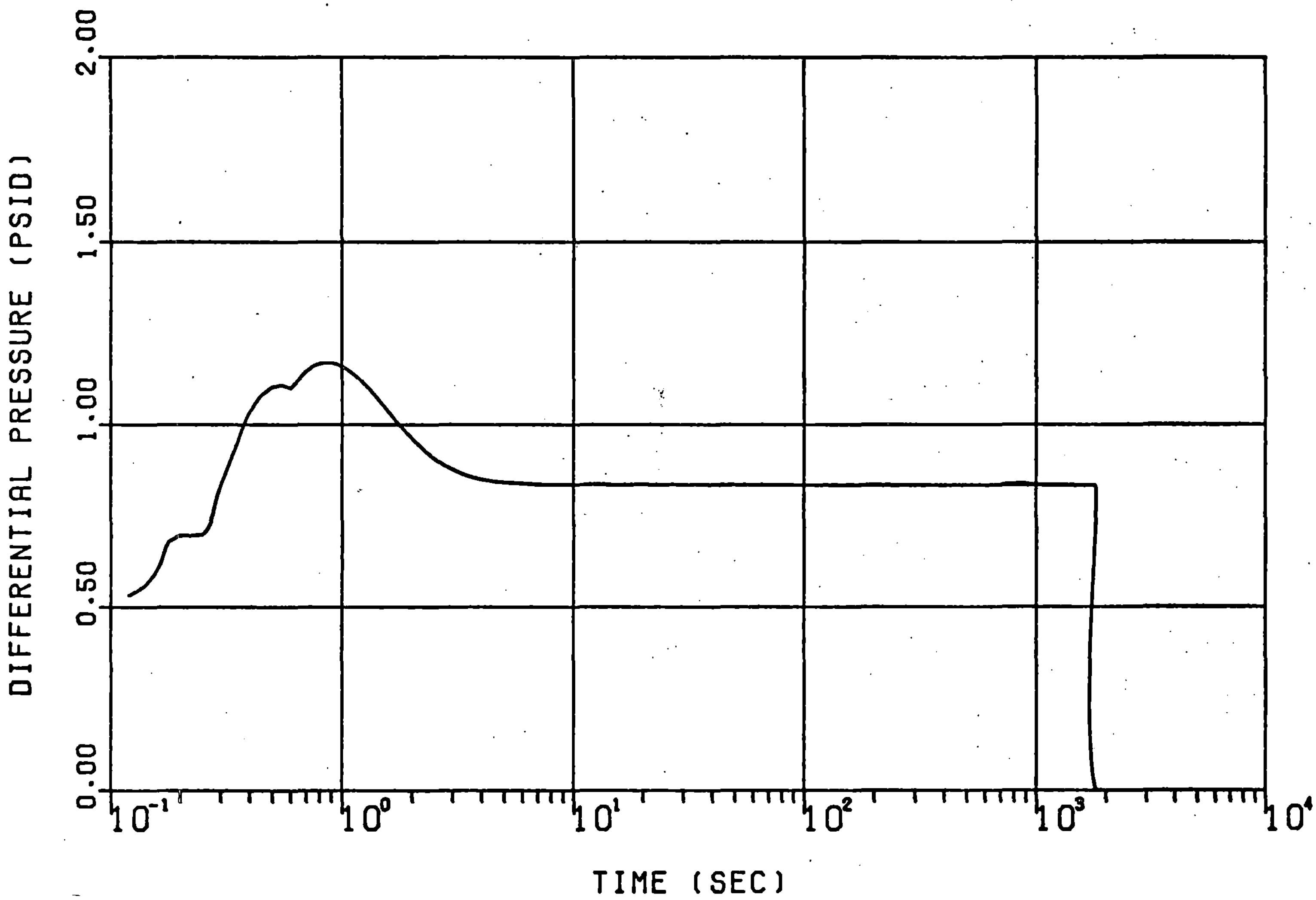
$$= .425\ \frac{10^3\ lb}{sec} = 425\ \frac{lb}{sec}$$

FROM REF. 34 – SATURATED STEAM TABLE AN ENTHALPY (hg) OF 1189.5 WAS USED.

$$425 \times 1189.5 = 505537.5\ BTU/sec.$$

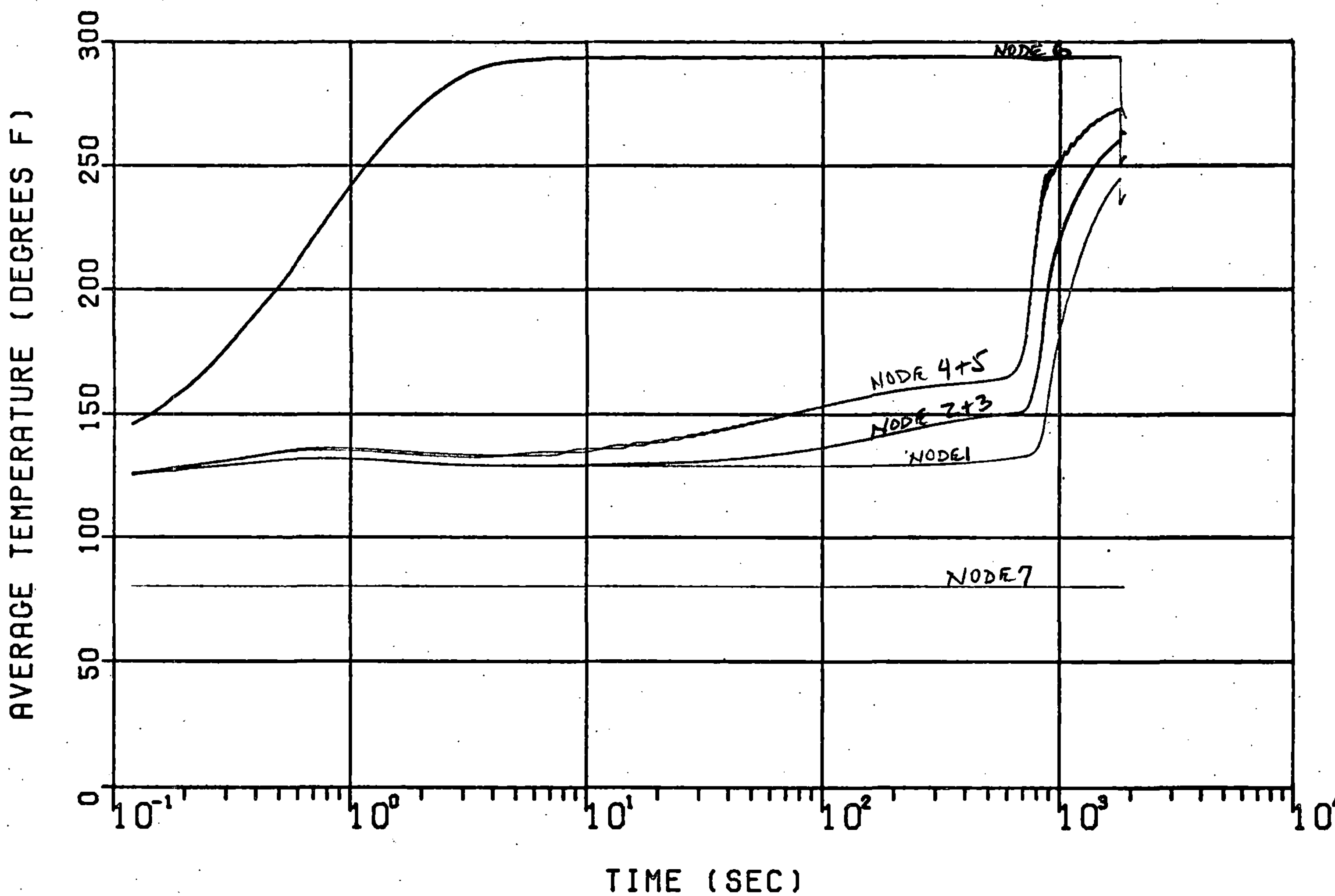
$$= 5.06 \times 10^5$$

I-M-31



SURRY 1-2 7 NODE MSVH
DIFFERENTIAL PRESSURE VERSUS TIME
MN. STM. LINE RUPTURE IN NODE 06
RUN # 3600004 NODES 6-7

1-m-33



SURRY 1-2 7 NODE MSVH
AVERAGE TEMPERATURE VERSUS TIME
MN. STM. LINE RUPTURE IN NODE 6
RUN = 3600004

PE-84-D

```
UNIT 55 (SEQ  1) INPUT ECHO         1         2         3         4         5         6         7         8
                           12345678901234567890123456789012345678901234567890123456789012345678901234567890

SURRY 1-2 MSVH HIGH ENERGY LINE BREAK CASE 4
*
*
*PROBLEM DIMENSION DATA CARDS
*
*
 1   4  2   7 13  1  0  0  0  0
*
*
*IMPLICIT/EXPLICIT COEFICIENT CARD
*
*
1.0
*
*
*TIME STEP CONTROL DATA CARDS
*
*
20  5  0  0  0.001    0.0001         .2
1  10  0  0  0.05     0.001        20.0
10  5  0  0  0.1      0.001       300.0
2   5  0  0  0.5      0.001      2000.0
*
*
*TRIP CONTROL DATA CARDS
*
*
1  0    0 1900.0   0.00
1  0    0    0.0   0.0
*
*
*NODAL DATA CARDS
*
*
14.7    120.  1.0    10603.00   0.0  10.5    0.0  0
14.7    120.  1.0     3978.30  10.5   8.75   0.0  0
14.7    120.  1.0     4563.11  10.5   8.75   0.0  0
14.7    120.  1.0     7353.55  19.25 10.25   0.0  0
14.7    120.  1.0     3155.42  19.25 10.25   0.0  0
14.7    120.  1.0    10597.85  29.50 10.42   0.0  0
14.7     80.  0.01    1.0E20    0.0  39.92   0.0  0
*
*
*JUNCTION DATA CARDS
*
*
1   2   0  0  354.38  .014   0.983  0.227  2 1.0 0  0.0  10.50 1.0
1   3   0  0  638.20  .012   0.918 -0.481  2 1.0 0  0.0  10.50 1.0
2   4   0  0  354.38  .015   0.149  0.787  2 1.0 0  0.0  19.25 1.0
3   4   0  0  203.84  .013   0.610  0.698  2 1.0 0  0.0  19.25 1.0

12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

```
UNIT 55 (SEQ  1) INPUT ECHO          1         2         3         4         5         6         7         8
                            12345678901234567890123456789012345678901234567890123456789012345678901234567890

                            3    5    0   0  347.00   .022    0.942 -0.486  2 1.0 0   0.0   19.25 1.0
                            4    6    0   0  558.20   .012    0.150  0.714  2 1.0 0   0.0   29.50 1.0
                            5    6    0   0  347.00   .021   -0.412  1.266  2 1.0 0   0.0   29.50 1.0
                            2    3    0   0  387.63   .033    0.01   0.01   2 1.0 0   0.0   10.50 1.0
                            4    5    0   0  454.08   .028    0.01   0.01   2 1.0 0   0.0   19.25 1.0
                            6    7    0   0   18.36   .114    4.54   4.54   2 1.0 0   0.0   39.92 1.0
                            6    7    0   0   18.36   .114    4.54   4.54   2 1.0 0   0.0   39.92 1.0
                            6    7    0   0   18.36   .114    4.54   4.54   2 1.0 0   0.0   39.92 1.0
                            0  6      1   0    1.0  0.0       0.0    0.0    0 1.0 0   0.0   32.50 1.0
                            *
                            *
                            *FILL TABLE DATA CARDS
                            *
                            *
                             4  2
                               0.0     425.0  505537.5
                            1800.0     425.0  505537.5
                            1800.001     0.0       0.0
                            2000.0       0.0       0.0

                            12345678901234567890123456789012345678901234567890123456789012345678901234567890  <EOF>  COPIED TO UNIT  5
                                                                                                                              W/O CMTS
```

RUN SUMMARY SHEET

MISCELLANEOUS PROBLEM CONTROL DATA:

OUTPUT FLAG................. 1
NUMBER OF TIME STEP CARDS... 4
NUMBER OF TRIP CONTROLS..... 2
NUMBER OF VOLUMES........... 7
NUMBER OF JUNCTIONS......... 13
NUMBER OF FILL TABLES....... 1
NUMBER OF FAN TABLES........ 0
NUMBER OF HT SOURCE CURVES.. 0
IMPLICIT/EXPLICIT COEFF..... 1.000

TOTAL TIME OF RUN..........................1900.500 SEC
NUMBER OF STANDARD TIME STEPS.............. 6597
NUMBER OF ACTUAL TIME STEPS................ 6607
NUMBER OF TIMES GAUSSIAN ELIMINATION USED.. 6607
NUMBER OF TIMES GAUSS-SEIDEL USED.......... 0
NUMBER OF TRANSIENTS STORED FOR PLOTEMUP... 27
NUMBER OF SELECTED NODAL DIFF. PRESS....... 0
NUMBER OF HEAT SINKS....................... 0
NUMBER OF INTERNAL JUNCTIONS............... 12

STEAM TABLES USED (FT15) VOLUME SERIAL NO. = SHARE0 DATA SET NAME = HEATBAL.ME190.STH20G.OUTPUT1

OUTPUT: TRANSIENTS TAPE (FT08) = 016308 FILE NUMBER = 19 DATA SET NAME = FE.GUARDS.PLOTTER
TRANSMITTAL FILE (FT09) WAS NOT USED

PEAK PRESSURE DIFFERENTIAL

JUNCTION NUMBER	CONNECTING VOLUMES	PRESSURE PSID	TIME SEC
1	1 TO 2	0.06	0.040
2	1 TO 3	0.08	0.039
3	2 TO 4	-0.07	0.016
4	3 TO 4	-0.05	0.015
5	3 TO 5	-0.07	0.016
6	4 TO 6	-0.12	0.009
7	5 TO 6	-0.11	0.400
8	2 TO 3	0.03	862.500
9	4 TO 5	-0.04	867.000
10	6 TO 7	1.17	0.850
11	6 TO 7	1.17	0.850
12	6 TO 7	1.17	0.850

PEAK PRESSURES AND TEMPERATURES

NODE NUMBER	PRESSURE (PSIA)	TIME (SEC)	TEMPERATURE (DEG F)	TIME (SEC)
1	15.83	0.800	244.91	1799.500
2	15.83	0.800	260.76	1798.500
3	15.83	0.800	260.73	1792.000
4	15.83	0.800	273.38	1799.500
5	15.83	0.800	273.13	1790.000
6	15.86	0.800	294.07	589.000
7	14.70	1900.500	80.00	1900.500

ATTACHMENT 2
1 OF 1
PE-044-0

INTEROFFICE CORRESPONDENCE

TO:	LOCATION	SUBJECT / REFERENCE / J.O. NO. 12846.44
~~WF Emerson~~ LJ Kwall	14	79-01B - Main Steam Valve House Surry 1&2
FROM: RF Miller	LOCATION 9	

MESSAGE:— We need to establish a criteria for pipe breaks in the MSVH. Appendix D states an extensive NDT program was to be initiated for Main Steam Line and Main Feedwater Line break points in the MSVH. This program would preclude large breaks, so only smaller steam line breaks would need to be considered.

However App. D included a pressure transient for a large MSLB in the MSVH, anyway (Fig. D.5-1).

We would like the following questions answered:

1. Has the Inspection Program (Sect. D.5.1.6 and D.5.2.5) been implemented?
2. The pressure plot in Fig D.5-1 is not correct, mainly because much of the vent area assumed in that analysis is not available. If the analysis of a large steam break in the MSVH were done today with the proper input, very high pressures would be calculated.

DATE SIGNATURE TELEPHONE

~~REPLY~~: Do we need to do anything about this?

3. Despite the statement that smaller steam line breaks need to be considered, and despite there being many smaller steam lines in the MSVH, none are listed in Table D.3-1, High Energy Lines "Sources". (except for the 3" lines which went to the CSP turbine drives and have been since blanked off.) What are the lines and break locations which must be considered?

Reply
1) Yes
2) based upon the answer to #1 ~~[illegible]~~ it is felt no new runs are necessary
3) Break points are points 220, 307 and 520 as shown on MSK-103A2, [illegible] 8550

8/1/80

cc: C. Wilson
P. Reilly

7/31/80 DATE — RF Miller SIGNATURE — 6816 TELEPHONE

▲ 040.13B

1-M-38

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 13
EZD REFERENCE DESCRIPTION: 12846.54-RP-039-0
ENVIRONMENTAL ZONE(S): SB-9B, TB-9, TB-35

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
RADIATION (rads)			<2500	17				

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CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF
VEPCO SURRY 1 & 2	18

CALCULATION TITLE (indicative of the Objective): 6 Month LOCA Doses As A Function of Distance From the Containment Direct Shine

QA CATEGORY (✓): ☒ I – NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ______ OTHER

CALCULATION IDENTIFICATION NUMBER

J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
12846.54	Power / RP	RP-039-0		

*APPROVALS – SIGNATURE & DATE

PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)	REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (✓) YES	NO
Shuwan Lin 9-17-80	[signature] 9/18/80	[signature] 9/18/80			Ref. (QADMOD) (Activity) (Radioisotope)	✓

DISTRIBUTION*

GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT. FILES (OR FIRE FILE IF NONE) Project	M. OMEARA (14)	✓			
	J. Barnhart (14)	✓			

1-N-1

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CALCULATION SHEET

▲5010.65

CALCULATION IDENTIFICATION NUMBER				PAGE 2
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
12846.54	Power RP	RP-039-0		

TABLE OF CONTENTS

LIST OF TABLES & FIGURE

PROBLEM:

To determine 6-month integrated doses as a function of distance from the reactor building containment following a LOCA. (Direct shine only).

METHOD & APPROACH: *

(1) • This calculation utilizes the result of Calc.# 12050-RP-098-0 "Dose rates from containment building (direct γ) after a LOCA" performed for North Anna 1 & 2 plants.

(1) • The North Anna calculation was based on the following data.

Source Term: @ $t \geq 0.0$ 100 % Noble Gases
@ $t = 0.0$ 50 % Halogens (TID 14844)
@ $t > 0.0$ 25 % Halogens (Reg. Guide 1.4)

Sepecific Activities: From North Anna Calc. # 12050-RP-073-0

Containment Volume: 5.21×10^{10} cm^3

Power Level: 2900 MWt

• Due to the congruence between the Noth Anna and Surry plants, the North Anna dose rates are taken to apply to the Surry plants with the following adjustment factor.

	Surry	NA (ref. 1)
(2) Power level:	2546 MWt	2900 MWt
Containment volume:	1.80×10^6 ft^3	1.84×10^6 ft^3 (5.21×10^{10} cm^3)

$$\text{Adjustment Factor} = \frac{2546}{2900} \times \frac{1.84 \times 10^6}{1.80 \times 10^6} = 0.90$$

* Only atmosphere inside the containment is considered as the radioactive source. Dose rate from R.S. headers is small as can be seen from cal. #12846-RP-027-0.

W.P.

1-N-3

CALCULATION IDENTIFICATION NUMBER				PAGE 4
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
12846.54	power RP	RP-039-0		

METHOD & APPROACH (cont'd)

- In North Anna Ref. (1) calculation part Ⓑ, the dose rates were determined at two different elevations (operating floor and ground level) for various distances outside the containment structure.

- At the operating floor elevation, only those dose rates obtained with crane wall opening in Ref. (1) calculation were used and adjusted by a factor of 0.90 for Surry. The dose rates were taken from Ref. (1) calculation Tables 2 thru 6 for dose points 10~20 corresponding to 0~100 meters; and from Table 7 for dose points 3~7 corresponding to 132~589 meters from the containment wall.
- At the ground level, dose rates were taken from Ref. (1) Table 7, dose points 8~13 which correspond to 10~284 meters from the containment wall.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 5
12846.54	power RP	RP-039-0		

REFERENCES :

(1) North Anna 1 & 2 calculation # 12050-RP-098-0
" Dose Rates From Containment Building (direct γ) after a LOCA (REG. GUIDE 1.4 sources)" dated 1-14-80

(2) Surry 1 & 2 calculation # 12846.38-RP-026
" NUREG-0578 Shielding Review - Aux Bldg Rad. Zone Maps Following a LOCA"

(3) North Anna 1 & 2 calculation # 13075-PR(6)-018-0
" 6 mo. Integrated LOCA Dose & Dose Rates After LOCA Due to Containment Shine via Electrical Penetration Area" dated 8-29-80

1-N-5

CALCULATIONS :

The dose rates taken from the North Anna calculation are multiplied by 0.90 adjustment factor and are tabulated in Tables 1 and 2 for elevations at the operating floor and ground level respectively.

It should be noticed that, at the operating floor level, the dose rates were not available from the North Anna calculation for 0 to 100 meters at t = 2 hr after LOCA. These dose rates were calculated from dose rates at t = 1 hr by multiplying the ratio of total source strength (i.e. specific activities). The ratio is determined as follows :

Ref. (3)

	Specific Activity (Mev/cc-sec)							Total Sp. Act.
	.4 Mev	.8 Mev	1.3 Mev	1.7 Mev	2.2 Mev	2.5 Mev	3.5 Mev	
t = 1 hr	2.52+7	9.36+7	3.79+7	3.32+7	4.11+7	6.37+7	7.07+5	2.95+8
t = 2 hr	2.42+7	6.45+7	2.92+7	2.58+7	2.75+7	4.45+7	1.91+5	2.16+8

$$\text{Ratio} = \frac{2.16 \times 10^8}{2.95 \times 10^8} = 0.73$$

IT IS USED IN THE NEXT PAGE

1-N-7

TABLE 1

Distance from Containment (meters)	LOCA Dose Rates (mrem/hr) at Operating Floor Elevation										
	0 hr	1 hr	2 hr	8 hr	24 hr	96 hr	192 hr	360 hr	720 hr	2160 hr	4320 hr
		→ *0.73 ↘									
0 (contact)	7.50+3	7.80+2	5.70+2	1.01+2	4.57+0	1.29-1	4.75-2	1.12-2	2.21-8	1.27-12	Not Significant ↓
10	2.39+3	2.50+2	1.83+2	3.27+1	1.50+0	4.24-2	1.57-2	3.70-3	6.74-7	6.32-10	
20	5.99+3	7.78+2	5.69+2	1.08+2	6.32+0	2.17-1	8.07-2	2.31-2	2.99-3	1.42-5	
30	1.69+4	2.53+3	1.85+3	3.68+2	2.58+1	1.07+0	4.11-1	1.36-1	2.33-2	1.18-4	
40	2.27+4	3.50+3	2.56+3	5.19+2	3.86+1	1.74+0	6.71-1	2.31-1	4.19-2	2.14-4	
50	2.14+4	3.35+3	2.45+3	5.00+2	3.81+1	1.76+0	6.85-1	2.39-1	4.45-2	2.28-4	
60	1.82+4	2.85+3	2.08+3	4.26+2	3.26+1	1.52+0	5.93-1	2.09-1	3.88-2	1.99-4	
70	1.54+4	2.40+3	1.75+3	3.59+2	2.75+1	1.29+0	5.03-1	1.76-1	3.30-2	1.69-4	
80	1.30+4	2.03+3	1.48+3	3.03+2	2.32+1	1.08+0	4.24-1	1.49-1	2.78-2	1.43-4	
90	1.10+4	1.71+3	1.25+3	2.55+2	1.95+1	9.09-1	3.56-1	1.25-1	2.32-2	1.19-4	
100	9.36+3	1.47+3	1.07+3	2.19+2	1.67+1	7.75-1	3.02-1	1.06-1	1.97-2	1.01-4	
132	5.64+3	8.72+2	6.06+2	1.29+2	9.72+0	4.46-1	1.73-1	6.00-2	1.10-2	5.64-5	
193	2.50+3	3.77+2	2.62+2	5.53+1	4.05+0	1.76-1	6.80-2	2.30-2	4.09-3	2.08-5	
284	8.90+2	1.29+2	8.87+1	1.85+1	1.28+0	5.19-2	1.91-2	6.37-3	1.06-3	5.31-6	
406	3.04+2	4.12+1	2.84+1	5.83+0	3.75-1	1.41-2	5.29-3	1.60-3	2.39-4	1.17-6	
589	7.51+1	9.18+0	6.31+0	1.27+0	7.40-2	2.54-3	9.45-2	2.62-4	3.22-5	1.46-7	↓

TABLE 2

Distance from Containment (meters)	LOCA Dose Rates (mrem/hr) at Ground Level										
	0 hr	1 hr	2 hr	8 hr	24 hr	96 hr	192 hr	360 hr	720 hr	2160 hr	4320 hr
10	1.91+0	7.55-2	4.94-2	8.31-3	2.37-4	5.12-6	2.03-6	4.50-7	1.82-8	8.02-13	3.32-16
25	3.06+3	4.13+2	2.84+2	5.72+1	3.46+0	1.20-1	4.46-2	1.29-2	1.74-3	8.19-6	3.89-9
40	1.17+4	1.77+3	1.22+3	2.57+2	1.85+1	7.79-1	2.98-1	9.90-2	1.72-2	8.73-5	4.41-8
71	1.21+4	1.87+3	1.31+3	2.77+2	2.11+1	9.72-1	3.74-1	1.31-1	2.39-2	1.22-4	6.36-8
132	5.04+3	7.76+2	5.39+2	1.14+2	8.60+0	3.89-1	1.50-1	5.19-2	9.45-3	4.84-5	2.50-8
284	8.59+2	1.24+2	8.56+1	1.78+1	1.23+0	5.00-2	1.90-2	6.11-3	1.02-3	5.09-6	2.52-9

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

CALCULATION IDENTIFICATION NUMBER

J.O. OR W.O. NO. 12846.54

DIVISION & GROUP Power RP

CALCULATION NO. RP-039-0

OPTIONAL TASK CODE

5010.65

CALCULATIONS : (Cont'd)

The 6-month integrated doses are calculated by using exponential interpolation as follows:

$$D(t) = \alpha e^{-\beta t} \quad \text{where}$$

$$\alpha = D(t_1) e^{\beta t_1}, \quad \beta = \frac{\ln \frac{D(t_1)}{D(t_2)}}{t_2 - t_1} \qquad D(t) = \text{dose rate at time '}t\text{'}$$

$$\Delta D = \int_{t_1}^{t_2} D(t)\,dt = \frac{\alpha}{\beta}\left[e^{-\beta t_1} - e^{-\beta t_2}\right]$$

(dose integration between t_1 and t_2)

$$= \frac{D(t_1)e^{\beta t_1}}{\beta}\left[e^{-\beta t_1} - e^{-\beta t_2}\right]$$

$$= \frac{D(t_1)}{\beta}\left[1 - e^{-\beta (t_2 - t_1)}\right]$$

$$= \frac{D(t_1)}{\beta}\left[1 - \frac{D(t_2)}{D(t_1)}\right]$$

Therefore,

$$\text{Integrated Dose} = \sum_{i=1}^{n} \Delta D_i \quad \text{where } n = \text{no. of time intervals}$$

The integrated doses are tabulated in Tables 3 and 4 for operating floor and ground level elevations respectively.

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

▲ 5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 10
12846.54	Power RP	RP-039-0		

Table 3 Integrated Doses @ Operating Floor Elevation

0 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	7.50E+03	0.0	0.0	0.0	0.0
1.0	7.80E+02	7.50E+03	2.26E+00	2.97E+00	2.97E+00
2.0	5.70E+02	1.07E+03	3.14E-01	6.70E-01	3.64E+00
8.0	1.01E+02	1.01E+03	2.88E-01	1.63E+00	5.26E+00
24.0	4.57E+00	4.75E+02	1.93E-01	4.98E-01	5.76E+00
96.0	1.29E-01	1.50E+01	4.95E-02	8.96E-02	5.85E+00
192.0	4.75E-02	3.50E-01	1.04E-02	7.83E-03	5.86E+00
360.0	1.12E-02	2.48E-01	8.60E-03	4.22E-03	5.86E+00
720.0	2.21E-08	5.68E+03	3.65E-02	3.07E-04	5.87E+00
2160.0	1.27E-12	2.92E-06	6.78E-03	3.26E-09	5.87E+00

*

10 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	2.39E+03	0.0	0.0	0.0	0.0
1.0	2.50E+02	2.39E+03	2.26E+00	9.48E-01	9.48E-01
2.0	1.83E+02	3.42E+02	3.12E-01	2.15E-01	1.16E+00
8.0	3.27E+01	3.25E+02	2.87E-01	5.24E-01	1.69E+00
24.0	1.50E+00	1.53E+02	1.93E-01	1.62E-01	1.85E+00
96.0	4.24E-02	4.92E+00	4.95E-02	2.94E-02	1.88E+00
192.0	1.57E-02	1.15E-01	1.03E-02	2.58E-03	1.88E+00
360.0	3.70E-03	8.19E-02	8.60E-03	1.39E-03	1.88E+00
720.0	6.74E-07	2.03E+01	2.39E-02	1.55E-04	1.88E+00
2160.0	6.32E-10	2.20E-05	4.84E-03	1.39E-07	1.88E+00

20 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	5.99E+03	0.0	0.0	0.0	0.0
1.0	7.78E+02	5.99E+03	2.04E+00	2.55E+00	2.55E+00
2.0	5.69E+02	1.06E+03	3.13E-01	6.68E-01	3.22E+00
8.0	1.08E+02	9.90E+02	2.77E-01	1.66E+00	4.89E+00
24.0	6.32E+00	4.46E+02	1.77E-01	5.73E-01	5.46E+00
96.0	2.17E-01	1.94E+01	4.68E-02	1.30E-01	5.59E+00
192.0	8.07E-02	5.84E-01	1.03E-02	1.32E-02	5.60E+00
360.0	2.31E-02	3.37E-01	7.45E-03	7.74E-03	5.61E+00
720.0	2.99E-03	1.78E-01	5.68E-03	3.54E-03	5.61E+00
2160.0	1.42E-05	4.34E-02	3.72E-03	8.01E-04	5.61E+00

* Dose rates at t = 4320 hr are comparatively small, therefore, do not contribute significantly to the integrated dose.

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CALCULATION IDENTIFICATION NUMBER				PAGE 11
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12846.54	power RP	RP-039-0		

Table 3 Cont'd

30 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	1.69E+04	0.0	0.0	0.0	0.0
1.0	2.53E+03	1.69E+04	1.90E+00	7.57E+00	7.57E+00
2.0	1.85E+03	3.46E+03	3.13E-01	2.17E+00	9.74E+00
8.0	3.68E+02	3.17E+03	2.69E-01	5.51E+00	1.52E+01
24.0	2.58E+01	1.39E+03	1.66E-01	2.06E+00	1.73E+01
96.0	1.07E+00	7.45E+01	4.42E-02	5.59E-01	1.79E+01
192.0	4.11E-01	2.79E+00	9.97E-03	6.61E-02	1.79E+01
360.0	1.36E-01	1.45E+00	6.58E-03	4.18E-02	1.80E+01
720.0	2.33E-02	7.94E-01	4.90E-03	2.30E-02	1.80E+01
2160.0	1.18E-04	3.27E-01	3.67E-03	6.32E-03	1.80E+01

40 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	2.27E+04	0.0	0.0	0.0	0.0
1.0	3.50E+03	2.27E+04	1.87E+00	1.03E+01	1.03E+01
2.0	2.56E+03	4.79E+03	3.13E-01	3.01E+00	1.33E+01
8.0	5.19E+02	4.36E+03	2.66E-01	7.67E+00	2.09E+01
24.0	3.86E+01	1.90E+03	1.62E-01	2.96E+00	2.39E+01
96.0	1.74E+00	1.08E+02	4.30E-02	8.56E-01	2.48E+01
192.0	6.71E-01	4.51E+00	9.93E-03	1.08E-01	2.49E+01
360.0	2.31E-01	2.27E+00	6.35E-03	6.93E-02	2.49E+01
720.0	4.19E-02	1.27E+00	4.74E-03	3.99E-02	2.50E+01
2160.0	2.14E-04	5.86E-01	3.66E-03	1.14E-02	2.50E+01

50 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	2.14E+04	0.0	0.0	0.0	0.0
1.0	3.35E+03	2.14E+04	1.85E+00	9.73E+00	9.73E+00
2.0	2.45E+03	4.58E+03	3.13E-01	2.88E+00	1.26E+01
8.0	5.00E+02	4.16E+03	2.65E-01	7.36E+00	2.00E+01
24.0	3.81E+01	1.81E+03	1.61E-01	2.87E+00	2.28E+01
96.0	1.76E+00	1.06E+02	4.27E-02	8.51E-01	2.37E+01
192.0	6.85E-01	4.52E+00	9.83E-03	1.09E-01	2.38E+01
360.0	2.39E-01	2.28E+00	6.27E-03	7.12E-02	2.39E+01
720.0	4.45E-02	1.28E+00	4.67E-03	4.17E-02	2.39E+01
2160.0	2.28E-04	6.22E-01	3.66E-03	1.21E-02	2.39E+01

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Table 3. Cont'd

60 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	1.82E+04	0.0	0.0	0.0	0.0
1.0	2.85E+03	1.82E+04	1.85E+00	8.28E+00	8.28E+00
2.0	2.08E+03	3.91E+03	3.15E-01	2.44E+00	1.07E+01
8.0	4.26E+02	3.53E+03	2.64E-01	6.26E+00	1.70E+01
24.0	3.26E+01	1.54E+03	1.61E-01	2.45E+00	1.94E+01
96.0	1.52E+00	9.06E+01	4.26E-02	7.30E-01	2.02E+01
192.0	5.93E-01	3.90E+00	9.80E-03	9.45E-02	2.03E+01
360.0	2.09E-01	1.95E+00	6.21E-03	6.19E-02	2.03E+01
720.0	3.88E-02	1.13E+00	4.68E-03	3.64E-02	2.04E+01
2160.0	1.99E-04	5.42E-01	3.66E-03	1.05E-02	2.04E+01

70 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	1.54E+04	0.0	0.0	0.0	0.0
1.0	2.40E+03	1.54E+04	1.86E+00	6.99E+00	6.99E+00
2.0	1.75E+03	3.29E+03	3.16E-01	2.06E+00	9.05E+00
8.0	3.59E+02	2.97E+03	2.64E-01	5.27E+00	1.43E+01
24.0	2.75E+01	1.30E+03	1.61E-01	2.06E+00	1.64E+01
96.0	1.29E+00	7.63E+01	4.25E-02	6.17E-01	1.70E+01
192.0	5.03E-01	3.31E+00	9.81E-03	8.02E-02	1.71E+01
360.0	1.76E-01	1.67E+00	6.25E-03	5.23E-02	1.71E+01
720.0	3.30E-02	9.39E-01	4.65E-03	3.08E-02	1.72E+01
2160.0	1.69E-04	4.61E-01	3.66E-03	8.96E-03	1.72E+01

80 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	1.30E+04	0.0	0.0	0.0	0.0
1.0	2.03E+03	1.30E+04	1.86E+00	5.91E+00	5.91E+00
2.0	1.48E+03	2.78E+03	3.16E-01	1.74E+00	7.65E+00
8.0	3.03E+02	2.51E+03	2.64E-01	4.45E+00	1.21E+01
24.0	2.32E+01	1.10E+03	1.61E-01	1.74E+00	1.38E+01
96.0	1.08E+00	6.45E+01	4.26E-02	5.19E-01	1.44E+01
192.0	4.24E-01	2.75E+00	9.74E-03	6.74E-02	1.44E+01
360.0	1.49E-01	1.40E+00	6.22E-03	4.42E-02	1.45E+01
720.0	2.78E-02	7.99E-01	4.66E-03	2.60E-02	1.45E+01
2160.0	1.43E-04	3.88E-01	3.66E-03	7.56E-03	1.45E+01

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Table 3 cont'd

90 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	1.10E+04	0.0	0.0	0.0	0.0
1.0	1.71E+03	1.10E+04	1.86E+00	4.99E+00	4.99E+00
2.0	1.25E+03	2.34E+03	3.13E-01	1.47E+00	6.46E+00
8.0	2.55E+02	2.12E+03	2.65E-01	3.76E+00	1.02E+01
24.0	1.95E+01	9.22E+02	1.61E-01	1.47E+00	1.17E+01
96.0	9.09E-01	5.42E+01	4.26E-02	4.37E-01	1.21E+01
192.0	3.56E-01	2.32E+00	9.76E-03	5.66E-02	1.22E+01
360.0	1.25E-01	1.18E+00	6.23E-03	3.71E-02	1.22E+01
720.0	2.32E-02	6.73E-01	4.68E-03	2.18E-02	1.22E+01
2160.0	1.19E-04	3.24E-01	3.66E-03	6.30E-03	1.22E+01

100 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	9.36E+03	0.0	0.0	0.0	0.0
1.0	1.47E+03	9.36E+03	1.85E+00	4.26E+00	4.26E+00
2.0	1.07E+03	2.02E+03	3.18E-01	1.26E+00	5.52E+00
8.0	2.19E+02	1.82E+03	2.64E-01	3.22E+00	8.74E+00
24.0	1.67E+01	7.93E+02	1.61E-01	1.26E+00	1.00E+01
96.0	7.75E-01	4.65E+01	4.26E-02	3.73E-01	1.04E+01
192.0	3.02E-01	1.99E+00	9.82E-03	4.82E-02	1.04E+01
360.0	1.06E-01	9.99E-01	6.23E-03	3.15E-02	1.05E+01
720.0	1.97E-02	5.70E-01	4.67E-03	1.85E-02	1.05E+01
2160.0	1.01E-04	2.75E-01	3.66E-03	5.35E-03	1.05E+01

132 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	5.64E+03	0.0	0.0	0.0	0.0
1.0	8.72E+02	5.64E+03	1.87E+00	2.55E+00	2.55E+00
2.0	6.06E+02	1.25E+03	3.64E-01	7.31E-01	3.28E+00
8.0	1.29E+02	1.01E+03	2.58E-01	1.85E+00	5.13E+00
24.0	9.72E+00	4.70E+02	1.62E-01	7.38E-01	5.87E+00
96.0	4.46E-01	2.72E+01	4.28E-02	2.17E-01	6.09E+00
192.0	1.73E-01	1.15E+00	9.86E-03	2.77E-02	6.12E+00
360.0	6.00E-02	5.80E-01	6.30E-03	1.79E-02	6.14E+00
720.0	1.10E-02	3.27E-01	4.71E-03	1.04E-02	6.15E+00
2160.0	5.64E-05	1.54E-01	3.66E-03	2.99E-03	6.15E+00

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Table 3 cont'd

193 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	2.50E+03	0.0	0.0	0.0	0.0
1.0	3.77E+02	2.50E+03	1.89E+00	1.12E+00	1.12E+00
2.0	2.62E+02	5.42E+02	3.64E-01	3.16E-01	1.44E+00
8.0	5.53E+01	4.40E+02	2.59E-01	7.97E-01	2.24E+00
24.0	4.05E+00	2.04E+02	1.63E-01	3.14E-01	2.55E+00
96.0	1.76E-01	1.15E+01	4.36E-02	8.89E-02	2.64E+00
192.0	6.80E-02	4.56E-01	9.91E-03	1.09E-02	2.65E+00
360.0	2.30E-02	2.35E-01	6.45E-03	6.97E-03	2.66E+00
720.0	4.09E-03	1.29E-01	4.80E-03	3.94E-03	2.66E+00
2160.0	2.08E-05	5.74E-02	3.67E-03	1.11E-03	2.66E+00

284 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	8.90E+02	0.0	0.0	0.0	0.0
1.0	1.29E+02	8.90E+02	1.93E+00	3.94E-01	3.94E-01
2.0	8.87E+01	1.88E+02	3.75E-01	1.08E-01	5.02E-01
8.0	1.85E+01	1.50E+02	2.61E-01	2.69E-01	7.70E-01
24.0	1.28E+00	7.03E+01	1.67E-01	1.03E-01	8.73E-01
96.0	5.19E-02	3.73E+00	4.45E-02	2.76E-02	9.01E-01
192.0	1.91E-02	1.41E-01	1.04E-02	3.15E-03	9.04E-01
360.0	6.37E-03	6.70E-02	6.54E-03	1.95E-03	9.06E-01
720.0	1.06E-03	3.83E-02	4.98E-03	1.07E-03	9.07E-01
2160.0	5.31E-06	1.50E-02	3.68E-03	2.87E-04	9.08E-01

406 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	3.04E+02	0.0	0.0	0.0	0.0
1.0	4.12E+01	3.04E+02	2.00E+00	1.31E-01	1.31E-01
2.0	2.84E+01	5.98E+01	3.72E-01	3.44E-02	1.66E-01
8.0	5.83E+00	4.81E+01	2.64E-01	8.55E-02	2.51E-01
24.0	3.75E-01	2.30E+01	1.71E-01	3.18E-02	2.83E-01
96.0	1.41E-02	1.12E+00	4.56E-02	7.92E-03	2.91E-01
192.0	5.29E-03	3.76E-02	1.02E-02	8.63E-04	2.92E-01
360.0	1.60E-03	2.07E-02	7.12E-03	5.18E-04	2.93E-01
720.0	2.39E-04	1.07E-02	5.28E-03	2.58E-04	2.93E-01
2160.0	1.17E-06	3.42E-03	3.69E-03	6.44E-05	2.93E-01

589 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	7.51E+01	0.0	0.0	0.0	0.0
1.0	9.18E+00	7.51E+01	2.10E+00	3.14E-02	3.14E-02
2.0	6.31E+00	1.34E+01	3.75E-01	7.66E-03	3.90E-02
8.0	1.27E+00	1.08E+01	2.67E-01	1.89E-02	5.79E-02
24.0	7.40E-02	5.26E+00	1.78E-01	6.73E-03	6.46E-02
96.0	2.54E-03	2.28E-01	4.68E-02	1.53E-03	6.61E-02
192.0	9.45E-02	6.83E-05	-3.77E-02	2.44E-03	6.86E-02
360.0	2.62E-04	7.90E+01	3.50E-02	2.69E-03	7.13E-02
720.0	3.22E-05	2.13E-03	5.82E-03	3.95E-05	7.13E-02
2160.0	1.46E-07	4.78E-04	3.75E-03	8.55E-06	7.13E-02

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Table 4 Integrated Doses @ Ground Level

10 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	1.91E+00	0.0	0.0	0.0	0.0
1.0	7.55E-02	1.91E+00	3.23E+00	5.68E-04	5.68E-04
2.0	4.94E-02	1.15E-01	4.24E-01	6.15E-05	6.29E-04
8.0	8.31E-03	8.95E-02	2.97E-01	1.38E-04	7.68E-04
24.0	2.37E-04	4.92E-02	2.22E-01	3.63E-05	8.04E-04
96.0	5.12E-06	8.51E-04	5.33E-02	4.35E-06	8.08E-04
192.0	2.03E-06	1.29E-05	9.64E-03	3.21E-07	8.09E-04
360.0	4.50E-07	1.14E-05	8.97E-03	1.76E-07	8.09E-04
720.0	1.82E-08	1.11E-05	8.91E-03	4.85E-08	8.09E-04
2160.0	8.02E-13	2.74E-06	6.97E-03	2.61E-09	8.09E-04
4320.0	3.32E-16	1.94E-09	3.61E-03	2.22E-13	8.09E-04

25 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	3.06E+03	0.0	0.0	0.0	0.0
1.0	4.13E+02	3.06E+03	2.00E+00	1.32E+00	1.32E+00
2.0	2.84E+02	6.01E+02	3.74E-01	3.44E-01	1.67E+00
8.0	5.72E+01	4.84E+02	2.67E-01	8.49E-01	2.52E+00
24.0	3.46E+00	2.33E+02	1.75E-01	3.07E-01	2.82E+00
96.0	1.20E-01	1.06E+01	4.67E-02	7.15E-02	2.89E+00
192.0	4.46E-02	3.23E-01	1.03E-02	7.31E-03	2.90E+00
360.0	1.29E-02	1.84E-01	7.38E-03	4.29E-03	2.91E+00
720.0	1.74E-03	9.56E-02	5.56E-03	2.01E-03	2.91E+00
2160.0	8.19E-06	2.54E-02	3.72E-03	4.65E-04	2.91E+00
4320.0	3.89E-09	1.72E-02	3.54E-03	2.31E-06	2.91E+00

40 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	1.17E+04	0.0	0.0	0.0	0.0
1.0	1.77E+03	1.17E+04	1.89E+00	5.26E+00	5.26E+00
2.0	1.22E+03	2.57E+03	3.72E-01	1.48E+00	6.74E+00
8.0	2.57E+02	2.05E+03	2.60E-01	3.71E+00	1.04E+01
24.0	1.85E+01	9.58E+02	1.64E-01	1.45E+00	1.19E+01
96.0	7.79E-01	5.32E+01	4.40E-02	4.03E-01	1.23E+01
192.0	2.98E-01	2.04E+00	1.00E-02	4.81E-02	1.23E+01
360.0	9.90E-02	1.05E+00	6.56E-03	3.03E-02	1.24E+01
720.0	1.72E-02	5.70E-01	4.86E-03	1.68E-02	1.24E+01
2160.0	8.73E-05	2.41E-01	3.67E-03	4.66E-03	1.24E+01
4320.0	4.41E-08	1.73E-01	3.51E-03	2.48E-05	1.24E+01

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Table 4 Cont'd

71 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	1.21E+04	0.0	0.0	0.0	0.0
1.0	1.87E+03	1.21E+04	1.87E+00	5.48E+00	5.48E+00
2.0	1.31E+03	2.67E+03	3.56E-01	1.57E+00	7.05E+00
8.0	2.77E+02	2.20E+03	2.59E-01	3.99E+00	1.10E+01
24.0	2.11E+01	1.00E+03	1.61E-01	1.59E+00	1.26E+01
96.0	9.72E-01	5.89E+01	4.27E-02	4.71E-01	1.31E+01
192.0	3.74E-01	2.53E+00	9.95E-03	6.01E-02	1.32E+01
360.0	1.31E-01	1.24E+00	6.24E-03	3.89E-02	1.32E+01
720.0	2.39E-02	7.18E-01	4.73E-03	2.27E-02	1.32E+01
2160.0	1.22E-04	3.35E-01	3.67E-03	6.49E-03	1.32E+01
4320.0	6.36E-08	2.34E-01	3.50E-03	3.48E-05	1.32E+01

132 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	5.04E+03	0.0	0.0	0.0	0.0
1.0	7.76E+02	5.04E+03	1.87E+00	2.28E+00	2.28E+00
2.0	5.39E+02	1.12E+03	3.64E-01	6.50E-01	2.93E+00
8.0	1.14E+02	9.05E+02	2.59E-01	1.64E+00	4.57E+00
24.0	8.60E+00	4.15E+02	1.62E-01	6.53E-01	5.22E+00
96.0	3.89E-01	2.41E+01	4.30E-02	1.91E-01	5.41E+00
192.0	1.50E-01	1.01E+00	9.93E-03	2.41E-02	5.44E+00
360.0	5.19E-02	5.04E-01	6.32E-03	1.55E-02	5.45E+00
720.0	9.45E-03	2.85E-01	4.73E-03	8.97E-03	5.46E+00
2160.0	4.84E-05	1.32E-01	3.66E-03	2.57E-03	5.47E+00
4320.0	2.50E-08	9.37E-02	3.50E-03	1.38E-05	5.47E+00

284 METERS

TIME (HOUR)	DOSE RATE (MR/HR)	EXPONENTIAL FIT ALPHA	EXPONENTIAL FIT BETA	DELTA D (RADS)	INTEGRATED DOSE (RADS)
0.0	8.59E+02	0.0	0.0	0.0	0.0
1.0	1.24E+02	8.59E+02	1.94E+00	3.80E-01	3.80E-01
2.0	8.56E+01	1.80E+02	3.71E-01	1.04E-01	4.83E-01
8.0	1.78E+01	1.44E+02	2.62E-01	2.59E-01	7.42E-01
24.0	1.23E+00	6.77E+01	1.67E-01	9.92E-02	8.42E-01
96.0	5.00E-02	3.58E+00	4.45E-02	2.65E-02	8.68E-01
192.0	1.90E-02	1.32E-01	1.01E-02	3.08E-03	8.71E-01
360.0	6.11E-03	6.95E-02	6.75E-03	1.91E-03	8.73E-01
720.0	1.02E-03	3.66E-02	4.97E-03	1.02E-03	8.74E-01
2160.0	5.09E-06	1.44E-02	3.68E-03	2.76E-04	8.74E-01
4320.0	2.52E-09	1.03E-02	3.52E-03	1.44E-06	8.74E-01

1-N-16

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 17
12846.54	Power RP	RP-039-0		

CONCLUSION:

TABLE 5

6-Month Integrated Dose at Operating Floor Elevation

Distance from Containment Wall	Integrated Dose (Rads)
0 meters	5.87+0
10	1.88+0
20	5.61+0
30	1.80+1
40	2.50+1
50	2.39+1
60	2.04+1
70	1.72+1
80	1.45+1
90	1.22+1
100	1.05+1
132	6.15+0
193	2.66+0
284	9.08-1
406	2.93-1
589	7.13-2

TABLE 6

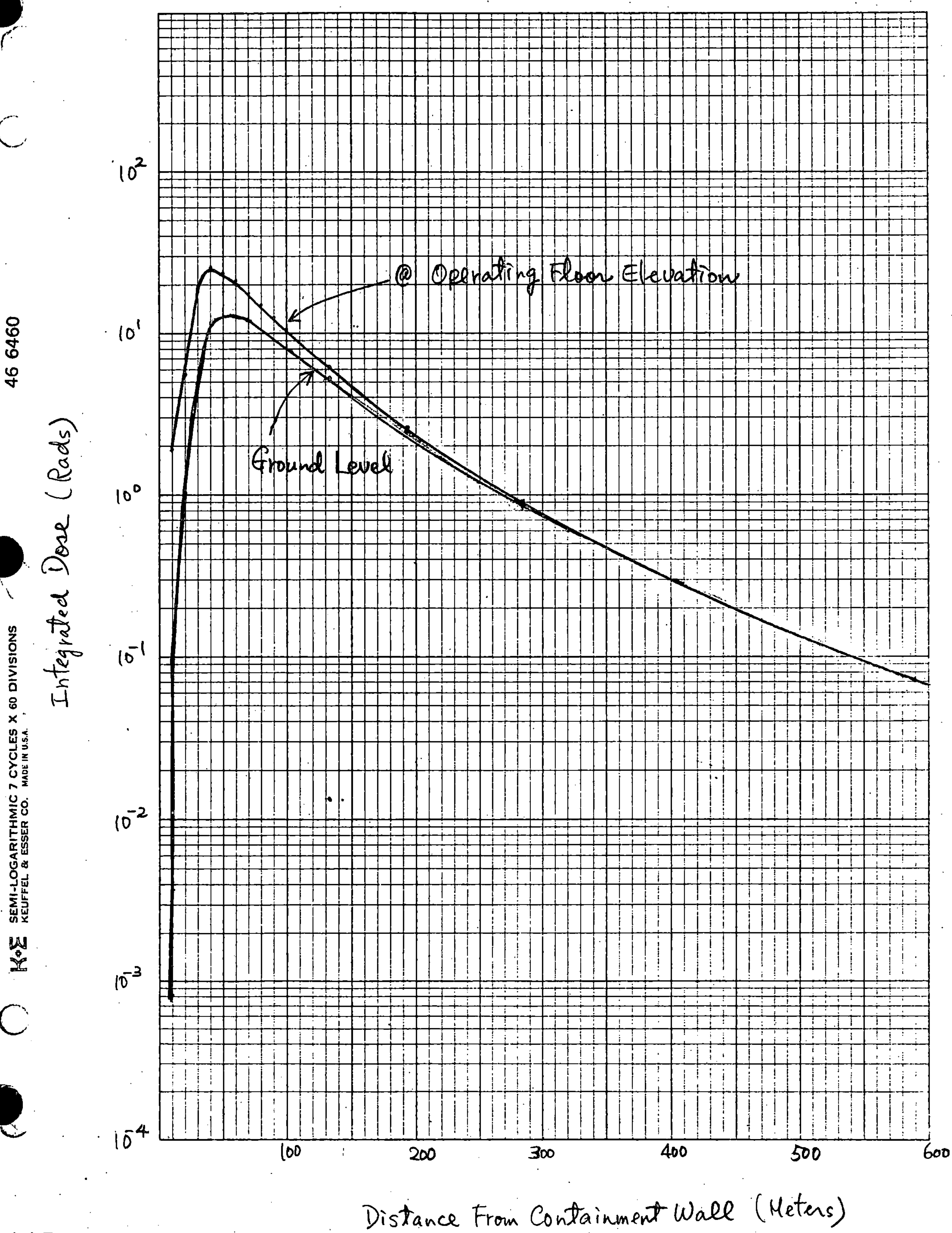
6-Month Integrated Dose at Ground Level

Distance from Containment Wall	Integrated Dose (Rads)
10 meters	8.09-4
25	2.91+0
40	1.24+1
71	1.32+1
132	5.47+0
284	8.74-1

Fig. 1

6-Month Integrated Dose vs. Distance Curve

12846.54 RP-039-0



1-N-18

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 14
EZD REFERENCE DESCRIPTION: FSAR SECTION 9.13.2 (Page 9.13.2-1) Surry Power Station Units 1 & 2, December 1, 1969.
ENVIRONMENTAL ZONE(S): AB-2B, AB-13A, AB-27, AB-45, CSPH-27, SB-9B, SFGD-1, TB-9, TB-35

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
TEMPERATURE (°F)	Occupied spaces 100 Normally unoccupied machinery spaces 120	9.13.2-1						
PRESSURE (psia)								
RELATIVE HUMIDITY (%)								
CHEMICAL SPRAY								

USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 14
EZD REFERENCE DESCRIPTION: FSAR Section 9.13.2 (page 9.13.2-1) Surry Power Station Units 1 & 2, December 1, 1969.
ENVIRONMENTAL ZONE (S): AB-2C, AB-13B, MSVH-11, MSVH-27

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
TEMPERATURE (°F)	Normally unoccupied machinery spaces 120	9.13.2-1						
PRESSURE (psia)								
RELATIVE HUMIDITY (%)								
CHEMICAL SPRAY								

9.13.2 DESIGN BASIS

Outside ambient conditions used for design purposes are 93° F summer dry bulb, 78° F summer wet bulb, 73° F summer dew point, 10° F winter dry bulb, 58° F all year ground temperature, and 15 mph all year wind velocity.

Ventilation is based on limiting the temperature in occupied spaces to 100° F, limiting the temperature in normally unoccupied machinery spaces to 120° F, or providing 10 air changers per hour. Provisions are also made, by dual fans installed in parallel or two speed fan motors, to reduce air quantities in mild weather and during the heating season.

Ventilation for nuclear auxiliary systems is designed on a once-through basis. Supply air is introduced to areas least likely to be contaminated and exhausted directly from those with the greatest contamination potential.

Filter banks for radioactive contamination are designed to remove 99.97 percent of solid particles down to 0.3 micron in size and 99.9 percent of any methyl iodide or iodine vapor entrained in the ventilation exhaust. Filter assemblies consist of roughing, particulate and charcoal filters in series.

The Main Control Room and computer room air conditioning is designed to maintain 75° F dry bulb and 50 percent relative humidity during either normal or emergency conditions. The relay rooms are designed for 80° F dry bulb and 40 percent relative humidity during normal conditions, and 87° F dry bulb and 35 percent relative humidity during emergency operations.

USER'S GUIDE TO EZD REFERENCES

Facility: VEPCO, SURRY
Units: 1 and 2
Dockets: 50-280 and 50-281

EZD REFERENCE NO. 15
EZD REFERENCE DESCRIPTION: FSAR Section 5.3 (Page 5.3-1) Surry Power Station Units 1 & 2, December 1, 1969.
ENVIRONMENTAL ZONE(S): RC-3A, RC-3B, RC-18B, RC-27A, RC-27B, RC-47A, RC-47B

PARAMETER	NORMAL ENVIRONMENT	PAGE	LOCA ENVIRONMENT	PAGE	MSLB ENVIRONMENT	PAGE	HELB ENVIRONMENT	PAGE
TEMPERATURE	105 (Design)	5.3-1						
PRESSURE								
RELATIVE HUMIDITY (%)								
CHEMICAL SPRAY								

5.3.1 VENTILATION SYSTEM

5.3.1.1 General Description

Containment ventilation consists of an Air Cooling Recirculation System, an Air Cooling Control Rod Drive Mechanism System, a Filter System and a Purge System. They are shown on the composite Fig. 5.3.1-1. The reactor main coolant pump motors, Section 4.3.3, are cooled with an integral component cooling water system. The Recirculation System, Control Rod Drive Mechanism System and reactor pump motor coolers provide the total cooling required to limit the bulk air temperature to 105^{o} F during normal summer operations. The minimum temperature during winter operations is about 80^{o} F. The relative humidity, during both summer and winter operations, is about 40 percent.

5.3.1.2 Design Basis

The ventilation systems are designed to limit the containment bulk air temperature to 105^{o} F when three of the recirculating fans are running, two of the three CRDM cooling systems are running, and the cooling systems for the main coolant pump motors are functioning.

The recirculation fan and cooling coil systems are designed to remove their portion of the heat load, under subatmospheric operating conditions, when supplied with 720 gpm of 70^{o} F water.

1-P-1