Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

October 31, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: LaSalle County Station Units 1 and 2
Preliminary Evaluation of the Service
Water System as a Backup to the Fire
Protection System
NRC Docket Nos. 50-373 and 50-374

Reference (a): License NPF-11, Technical Specification
3.7.5.1, Actions a. and b.1.

Dear Mr. Denton:

Enclosed please find the subject preliminary evaluation. This preliminary evaluation was made at the request of the NRC staff to provide additional justification for our use of the service water system as a backup (not necessarily equivalent) fire suppression water system. We are continuing our review of the adequacy of the fire protection water supply.

To the best of my knowledge and belief the statements contained herein and in the enclousre are true and correct. In some respects these statements are not based on my personal knowledge but upon information furnished by other Commonwealth Edison employees and contractor employees. Such information has been reviewed in accordance with Company practice and I believe it to be reliable.

If there are any further questions regarding this matter, please contact this office.

Very truly yours,

CW Schroeder 10/31/83

C. W. Schroeder
Nuclear Licensing Administrator

8311040130 831031
PDR ADOCK 05000373
F PDR

lm

Enclosure

B002
1/1
DRAWINGS TO REG FILE

cc: J. G. Keppler 1/1
W. Guldemond 1/0

7538N

ENCLOSURE

Preliminary Evaluation of the Service Water System as a Back-Up to the Fire Protection System at LaSalle

The fire protection water distribution system is capable of supplying cooling lake water to the plant fire hydrants, the water sprinkler and deluge systems, and the hose valve stations under all conditions. The system is normally kept pressurized by fire protection jockey pumps. If a system demand occurs, the pressure decreases in the fire protection system, thereby automatically starting a diesel fire pump. A second diesel fire pump is available should the system pressure continue to drop. Each fire pump has a capacity of 2,500 gpm at 315 feet TDH.

By comparison, each of the five service water pumps has a capacity of 16,000 gpm at 215 feet TDH. By backing the service water pumps down their head capacity curve and reducing service water loads, the service water pumps may be used as a back-up should the diesel fire pumps both be inoperable. This report represents an assessment (the calculations were made independent of the original fire pump sizing and design calculations) of the limitations imposed on the current fire protection system when the service water system is used as a back-up supply.

The conclusions are:

1. The service water pumps can provide 750 gmp at 65 psi to the refuel floor at el. 848'6" - Attachment A.
2. The service water pumps cannot provide 1000 gpm (+750 gpm for hose stations) at 75 psi to the Unit 1 cable spreading room at el. 753'6" - Attachment B.
3. Operating the service water pumps at low flow requires reducing service water load to the station and maintaining minimum cooling requirements for service water pumps (2400 gpm).

Attachment A

The attachment discusses the use of the service water pumps to supply 750 gpm at 65 psi to the refuel floor. The following comments apply:

(1) Sensitivity estimates show that the service water system could also provide the two worst hose stations (there are 10 total on the refuel floor) with 100 gpm at approximately 65 psi. In this case, the fire protection system flow would be 200 gpm.

(2) The calculations in the attachments are based on a C of 100. This is conservative. A header flow test (LST 82-177) was conducted in July 1982 at LaSalle and the results of this test were compared against calculations with the following conclusions for three fire pump flows:

Q = 2975 gpm		psi calculated	
Hydrant	psi measured	C = 100	C = 120
507	112	105	110
504	108	101	108
503	106	98	106
501	105	94	103
515	100	91	100
▲P from 507-515 =	12	14	10

Q = 2800 gpm		psi calculated	
Hydrant	psi measured	C = 100	C = 120
507	119	111	116
504	115	108	114
503	113	105	112
501	112	102	110
515	111	99	107
▲P from 507-515 =	8	12	9

Q = 2550 gpm		psi calculated	
Hydrant	psi measured	C = 100	C = 120
507	129	118	122
504	126	116	120
503	124	113	119
501	123	110	117
515	122	108	115
▲P from 507-515 =	7	10	7

These numbers indicate that a C of 100 is conservative by at least 15-20% in the prediction of pressure drops.

Attachment B

This attachment discusses the use of the service water system to supply 1000 gpm at 75 psi to the U1 cable spreading room. It includes a paragraph stating that the fire pumps can meet this demand but the service water pumps cannot. The following comment applies:

(1) The cable spreading room was designed for a spray density of 0.3 gpm/sq.ft. The combustible material in this zone consists of Division 2 control and instrumentation cable insulation. The design basis of fire protection system is to protect the cables in the cable trays. A cable tray spray system was designed to meet the intent of NFPA-15 with spray nozzles located in the trays. There is also a sprinkler system to meet the intent of NFPA-13. LaSalle uses qualified cable, solid bottom cable trays to prevent the propagation of cable fires and is designed such that in the unlikely event of a fire that completely destroyed the cable spreading room there is an alternate path whereby Unit 1 could be brought to a safe shutdown.

The recommended density in Section 4-4.1.4 of NFPA 15 is 0.15 gpm/sq.ft. for extinguishment of fire which originates within the cable. We interpret Section 4-4.3.3(d) to recommend a density of 0.3 gpm/sq.ft. to protect cables from an exposure fire.

A demonstration was conducted in the cable spreading room at LaSalle on March 12, 1982 at which time a spray density of 0.32 gpm/sq.ft. was measured from one nozzle at a pressure of 10 psi.

PRELIMINARY ATTACHMENT A

Evaluation of Service Water System
As Back-Up to Fire Protection System
at the Refueling Floor

1.0 INTRODUCTION

The fire protection water distribution system is capable of supplying cooling lake water to the plant fire hydrants, the water sprinkler and deluge systems, and the hose valve stations under all conditions. The system is normally kept pressurized by one of two fire protection jockey pumps. If a system demand occurs, the pressure decreases in the fire protection system, thereby automatically starting a diesel fire pump. Each fire pump has a capacity of 2,500 gpm @ 315 feet TDH. The sizing basis for the fire pumps was Nuclear Mutual, Limited (NML) Standards.

The diesel fire pumps take suction from the water tunnel in the lake screen house. The tunnel has multiple intakes from the LSCS cooling lake. As a backup to the diesel fire pumps, water can be supplied from the service water system. The service water system is connected to the fire protection system through a 12-inch line at each pump discharge line.

2.0 PURPOSE

The purpose of this calculation/report is to demonstrate that the Service Water System can back-up the Fire Protection

2.0 PURPOSE (continued)

System demand in the event both diesel fire pumps are inoperable by supplying 750 gpm @ 65 psig to the highest fire suppression system. This system consists of fire hose streams on the refuel floor at elevation 848'-6".

3.0 ASSUMPTIONS

We have assumed the pipe to be "old". This implies a Hazen-Williams coefficient of 100. The equivalent length for the butterfly valves was obtained from Crane's TP-410 paper (L/D=40). There are two strainers in the calculation where we assumed conservative pressure drops.

The flow branching off the service water piping is assumed to be 750 gpm. This condition assumes that valves downstream of the branch point will be partially closed (throttled) if such a need arises. We assumed that 375 gpm are diverted to the Unit 2 side of the refueling floor due to symmetry in pipe routings. Each fire hose has been assumed to have a flow of 75 gpm. (Figures 1 and 2 show the ten hose stations on the refueling floor.).

4.0 DESIGN INPUT

The head loss calculations were performed using Sargent & Lundy Standards MES-2.10 and MES-2.16. The pipe routing and calculations are in Appendix A. The pipe routing was developed from the current single line and outdoor piping drawings. The calculations were performed using Form MES-2.16.1.

5.0 REFERENCES

5.1 Goulds Pumps, Inc., Characteristic Curve for Service Water Pumps

1WS01PA - A-19376

1WS01PG - A-19377

0WS01P - A-19375

5.2 NML Standards for Nuclear Generating Stations

5.3 Crane TP No. 410 - Flow of Fluids

5.4 Cameron Hydraulic Data, 14th Edition

5.5 P&ID's

M-68 , Rev. P, Service Water

M-71-01, Rev. AB, Fire Protection

M-72-02, Rev. U, Fire Protection

5.6 Structural Drawings

S-119, Rev. R, Plumbing Underground Piping

S-120, Rev. T, Plumbing Underground Piping

5.0 REFERENCES (continued)

5.7 Mechanical Drawings

M-766-06, Rev. G, Outdoor Piping

M-766-07, Rev. D, Outdoor Piping

M-766-08, Rev. F, Outdoor Piping

M-766-09, Rev. K, Outdoor Piping

M-783 , Rev. K, Lake Screen House Piping

M-785 , Rev. M, Lake Screen House Piping

M-787 , Rev. M, Lake Screen House Piping

M-788 , Rev. J, Lake Screen House Piping

M-814 , Rev. H, Fire Protection Piping-Reactor Building

M-814-02, Rev. G, Fire Protection Piping-Reactor Building

M-814-03, Rev. J, Fire Protection Piping-Reactor Building

M-814-04, Rev. F, Fire Protection Piping-Reactor Building

M-814-05, Rev. G, Fire Protection Piping-Reactor Building

M-814-06, Rev. G, Fire Protection Piping-Reactor Building

M-814-07, Rev. G, Fire Protection Piping-Reactor Building

5.8 Instrument Location Number

M-1312-03, Rev. B

5.9 Piping Design Tables

PDT "002LS" and "100LS"

6.0 SUMMARY

The calculations demonstrate that the head loss due to friction between the WS pumps and the hose stations approximately 23 feet of water. A static head of 161 feet exists between the WS pumps and the hose stations. Section V of the

6.0 SUMMARY (continued)

Nuclear Mutual, Limited Standards require a water supply pressure at the highest hose nozzle location of 150 feet of water. Hence, the discharge head of the WS pumps must equal 334 feet.

The discharge nozzle of the service water pumps are located below the elevation of the cooling lake. The difference in elevation results in a static suction head to the WS pumps of approximately 12.5 feet. Hence, the total developed head for three pumps equals 321.5 feet (assuming negligible suction friction).

At this discharge head three WS pumps provide approximately 10,600 gpm. This flow exceeds the minimum flow requirement specified by the pump vendor in Specification J-2535. Figure 3 presents characteristic curves for the various pump schemes considered and the systems' resistance curve. With one and two pumps in parallel, the combined flows equal approximately 4000 gpm and 7600 gpm, respectively.

The Service Water System is concluded to be adequate to provide the water supply to the Fire Protection System based upon the calculations and Figure 3. A pressure transmitter and indicator on the WS piping can be used to determine when adequate pressure is achieved.

7.0 RECOMMENDATIONS

The WS system can supply 750 gpm at 65 psig to the refueling floor. To accomplish this, WS valves downstream of the fire protection branch must be partially closed. The proper pressure can be obtained by reading pressure indicator 1PI-WS007. With three pumps operating the indicator, located on the discharge nozzle of pump 1WS01PA, must reflect a pressure of approximately 144.6 psig (334 ft. H_2O). In addition to the pressure indicator, a pressure transmitter (1PT-WS009) is also available to detect line pressure. The transmitter must reflect a pressure of 138.2 psig (319 ft. H_2O).

In order to provide adequate water supply to the FP system, the WS pumps must be backed up on their characteristic curve. By doing this, the capacity is sacrificed and as such, will require the operator to shed load. Although one WS pump can provide the necessary flow, it would be prudent to operate with three pumps in parallel. With the three pumps operating, more service water would be available to other heat loads.

APPENDIX A

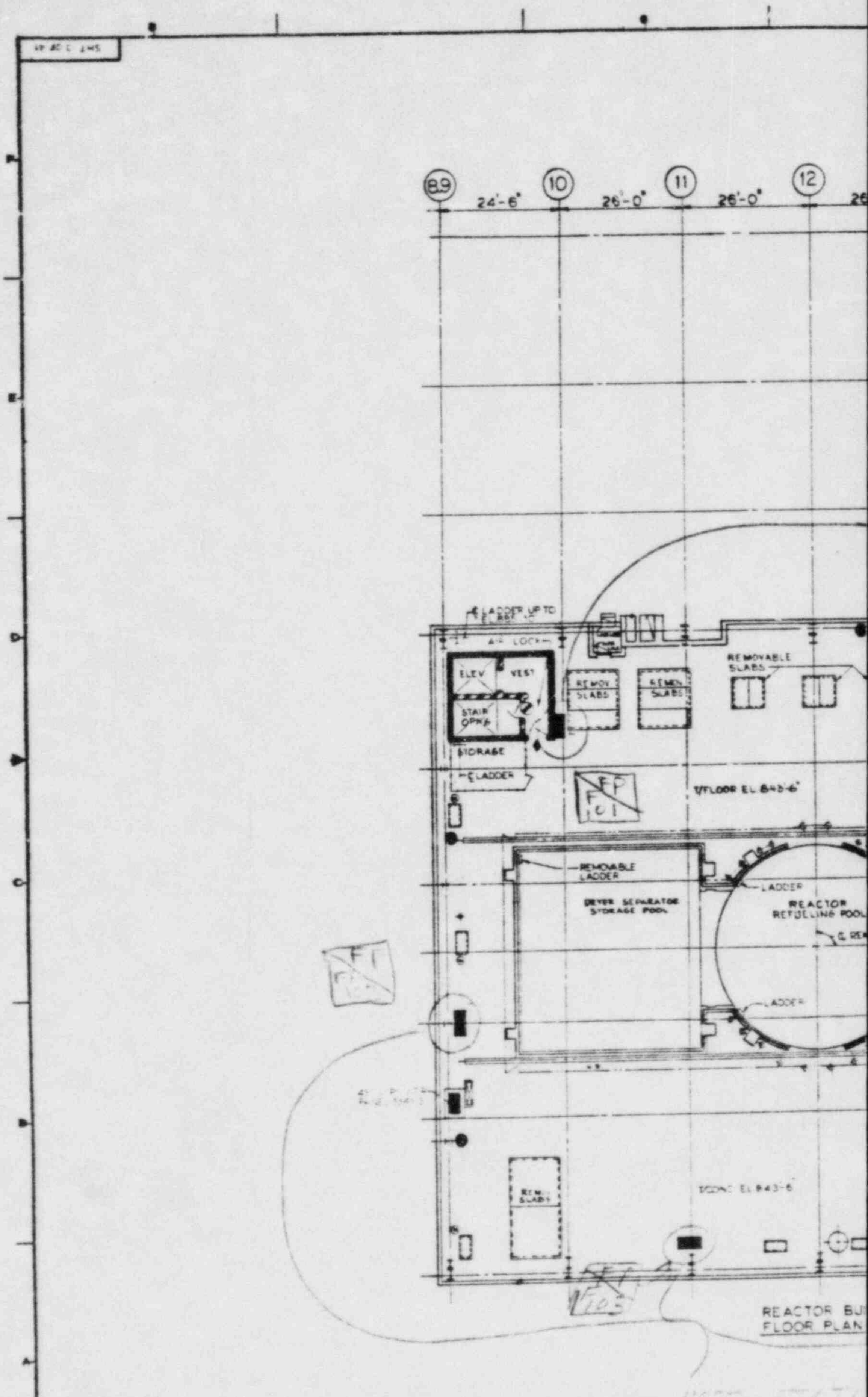
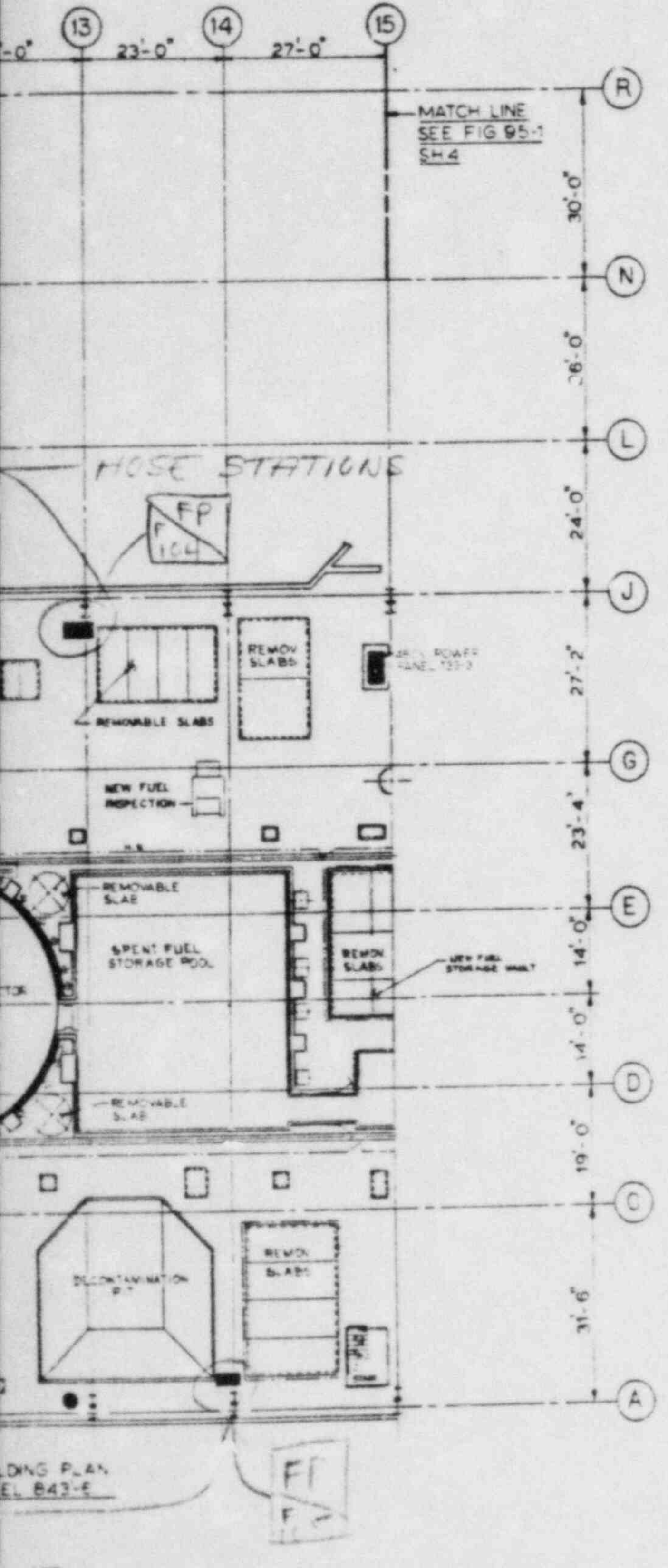

8.9
10
11
12
24'-6"
26'-0"
26'-0"
26
LADDER UP TO EL 88'-0"
AIR LOCK
ELEV
VEST
STAIR OPN'G
STORAGE
LADDER
REMOV SLABS
REMOV SLABS
REMOVABLE SLABS
FP
F 101
T/FLOOR EL 843'-6"
REMOVABLE LADDER
DRYER SEPARATOR STORAGE POOL
LADDER
REACTOR REFUELING POOL
LADDER
FP
F 102
REM SLABS
T/CONC EL 843'-6"
FP
F 103
REACTOR BU
FLOOR PLAN
HOSE STAT

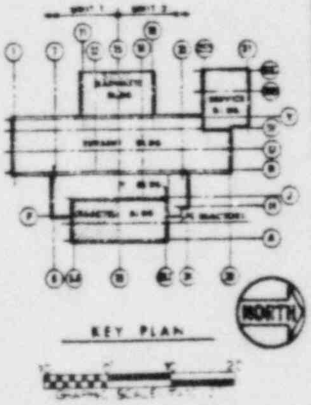
FIGURE 1

AMENDMENT [illegible]
SEPTEMBER 1977



PRC
APERTURE
CARD

Also Available On
Aperture Card



KEY PLAN

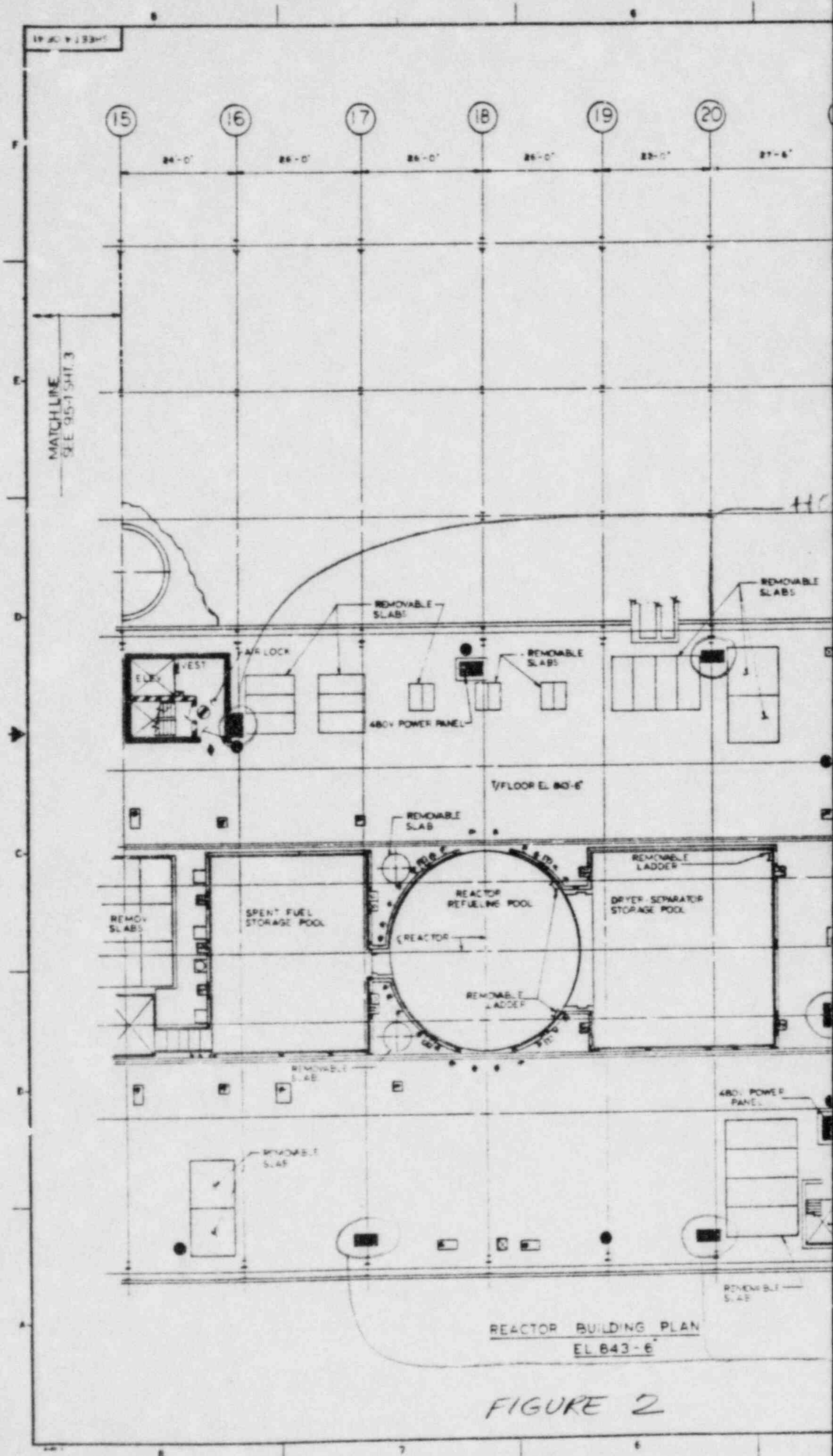
GRAPHIC SCALE

8311040130-01

LA SALLE COUNTY STATION
FINAL SAFETY ANALYSIS REPORT

FIGURE 9.5-1
FIRE PROTECTION SYSTEM
(SHEET 3 OF 4)

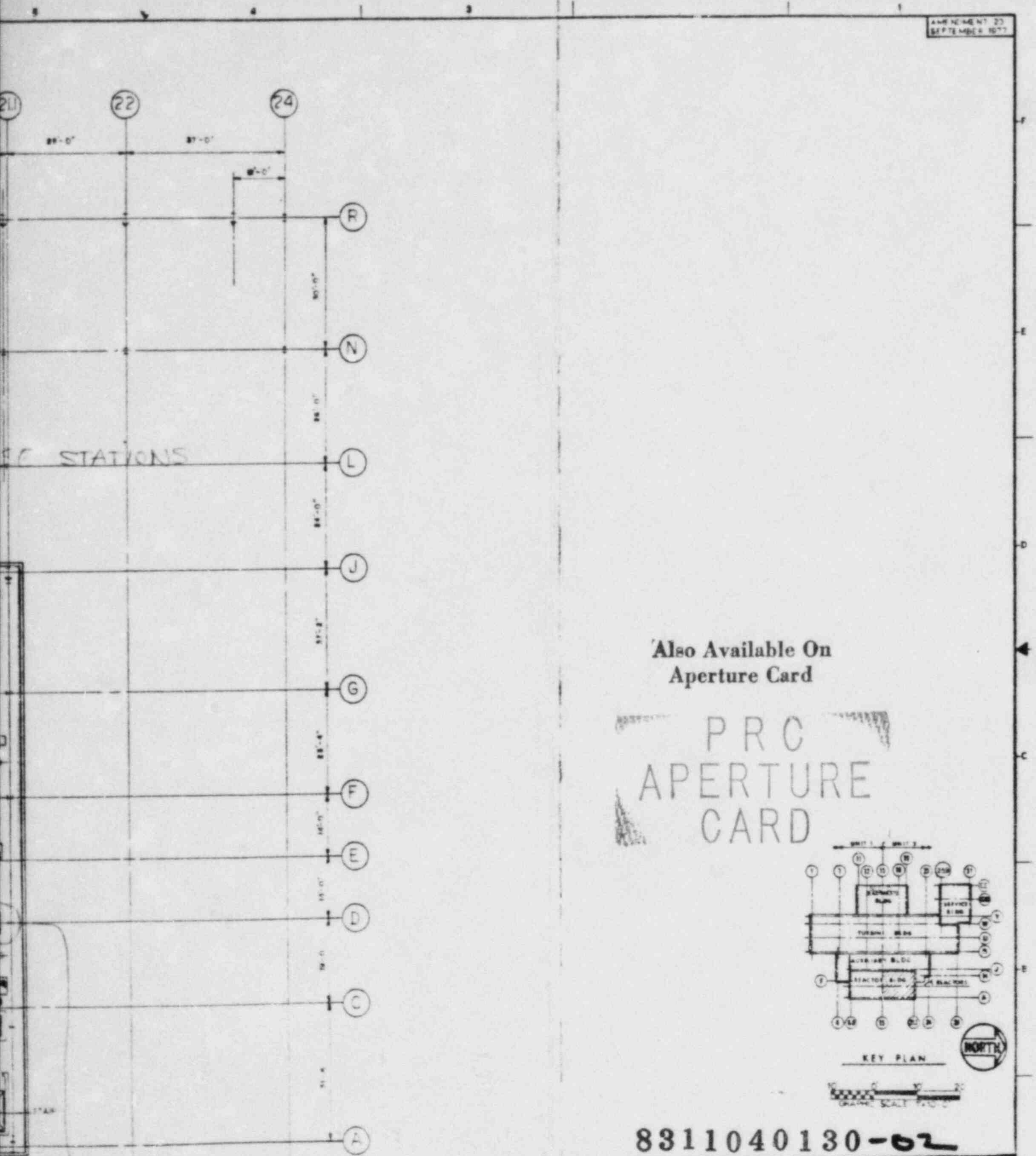
PAGE 8



REACTOR BUILDING PLAN
EL 843'-6"

FIGURE 2

AMENDMENT 23
SEPTEMBER 1977



8311040130-02

LA SALLE COUNTY STATION

FINAL SAFETY ANALYSIS REPORT

FIGURE 9.5-1

FIRE PROTECTION SYSTEM

SHEET 4 OF [illegible]

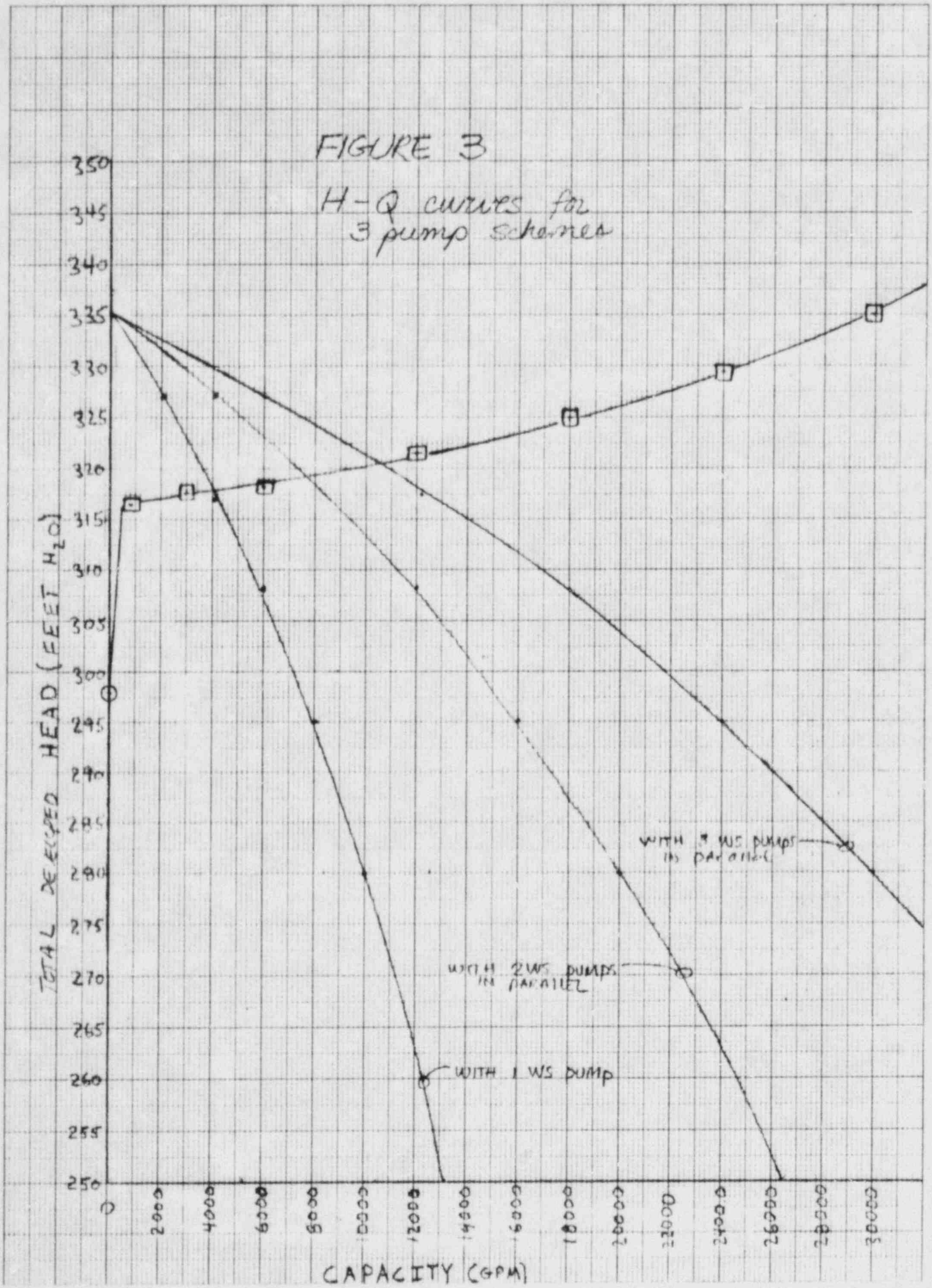
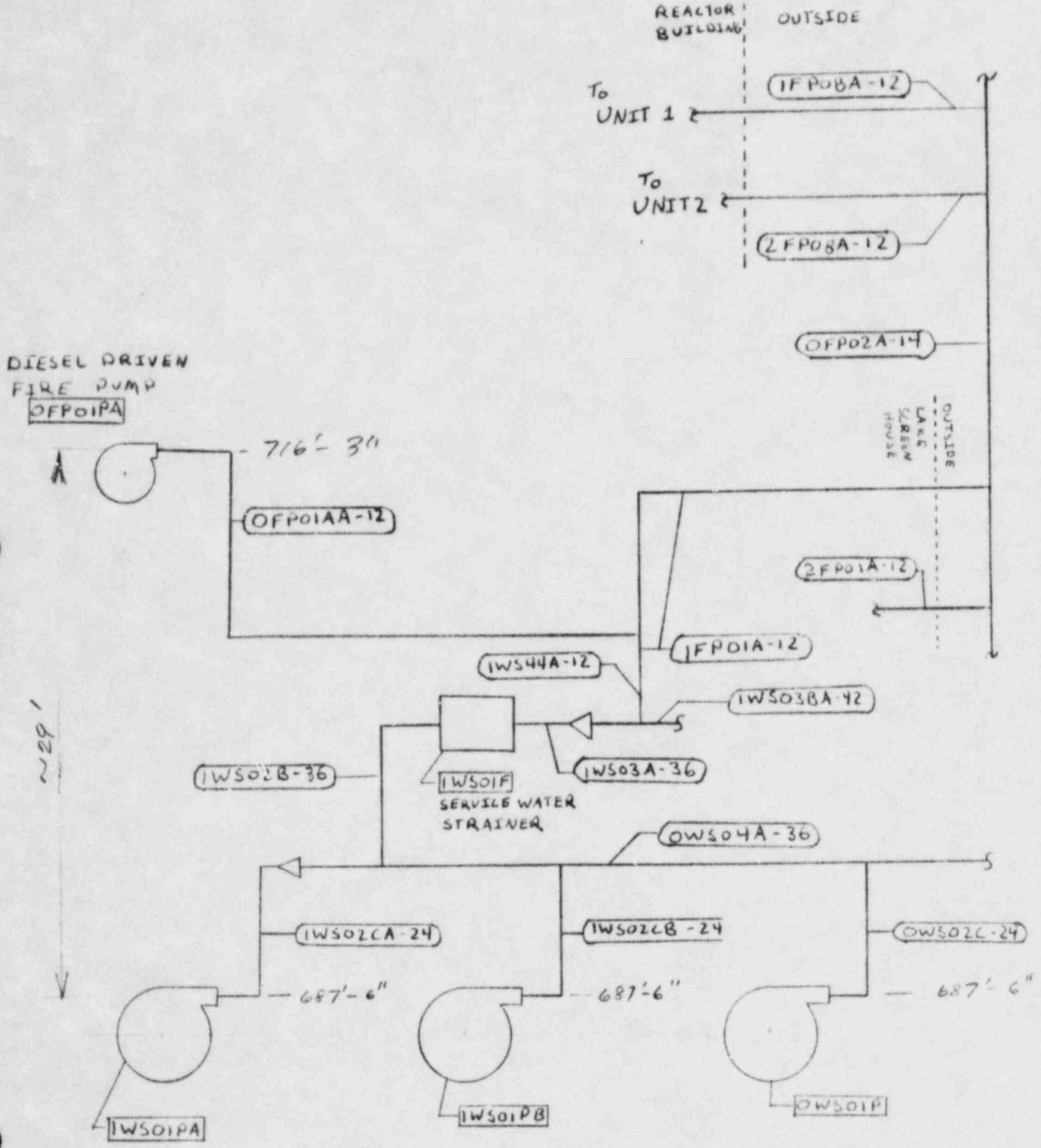


FIGURE 3

H-Q curves for
3 pump schemes



SERVICE WATER PUMPS - UNIT 1

FIGURE 4

SYSTEM ISOMETRIC

1. BASED ON P&ID DRAWING NUMBER M-____________ DATED__________
2. BASED ON PIPING DRAWING NUMBER M-____________ DATED__________

see figure 1
for physicals

⬡ PROCESS FLOW DATA POINT

A. EQUIPMENT (~~HT.~~ EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

ASSUME DROP ACROSS $\overset{}{\wedge}$ 1WS01F = 1 ft H_2O
STRAINER

ΔH_A(FT) = 1.0

B. PIPING

(a) PAGE	ITEM	DE
7	3	90° LO
7	4	45° LO
7	5	STD. T
7	6	STD. T
6	1a	CONV.
6	4a	SWING
6	5a	DISC G
		[illegible]

1. TOTAL
2. D (INS
3. EQUIV.
4. STRAIG
5. TOTAL
6. MARGIN
7. TOTAL
8. FLOW
9. VELOCI
10. Δ H/1
11. TOTAL Δ
12. SIZES
13. LINE N

SUM OF TOTA

REFERENCES:
(a) ME-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES.
(b) ME-2.12, ME-2.13, OR ME-2.14 PIPE SIZE SELECTION
(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

from Cameron Hydraulic Data, pgs 44, 45, 14th Ed pump operation

AND VALVES FROM PUMP 1WS01PA TO POINT A

	(c)	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED				
SCRIPTION (a)	L/D	PUMP A		- PUMP A -		
NG RAD. ELBOW	20	3 60				
NG RAD. ELBOW	12	0			1 12	
EE (BRANCH FLOW)	60	0		1 60	1 60	
EE (RUN FLOW)	20	0				
GLOBE VALVE	340	0				
CHECK VALVE	135	1 135				
ATE VALVE	13	0				
FF410 fully flexible - [illegible]	40	1 40			2 80	
/D		235		60	152	
DE DIAMETER)	(FT)	1.9375		29167	2.9167	
STR. PIPE (1x2)	(FT)	455		175	443.3	
T PIPE	(FT)	49		15	14	
QUIV. LENGTH (3+4)	(FT)	504		190	457	
(0 %)						
	(FT)	505		190	457	
(LB/HR) OR	(GPM)	4000		4000	4000	
Y v_a (b)	(FPS)	3.0226(*)		1.3338(*)	1.3338(*)	
00' (b)	(FT/100 FT)	0.2016(*)		.0291(*)	.0291(*)	
ΔH (5x10)	(FT)	1.0181		.055	.1330	
SELECTED		24		36	36	
MBER		1WS07CA		1WS07B	1WS03A	

L ΔH (ITEM 11) FOR ALL SIZES, ΔH_B(FT) = 1.2

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT) 0

Typically the velocity head is very small and when multiplied by K the result is even smaller. e.g.

$\Delta H = K \frac{v_a^2}{64.4}$ see page 7/8

This fitting has the highest velocity.

D. CONTROL VALVES

Also Available On Aperture Card

PRC APERTURE CARD

ΔH_D (FT) = 0

$\Delta H_F = \Delta H_A + \Delta H_B + \cancel{\Delta H_C} + \cancel{\Delta H_D}$

ΔH_F(FT) = 2.0 ft

FOR OFFICE USE ONLY
NOT TO BE SENT OUTSIDE OF
SARGENT & LUNDY

DESIGN BY:		DATE:	
CHECKED BY:		DATE:	
REVISED BY:		DATE:	

HEAD LOSS IN PIPING SEGMENT: ____

PROJECT ____

CLIENT ____ JOB NO. ____

SARGENT & LUNDY
ENGINEERS
CHICAGO

STANDARD

SYSTEM

SHEET ___ OF 8

SYSTEM ISOMETRIC

1. BASED ON P&ID DRAWING NUMBER M-______________ DATED______________
2. BASED ON PIPING DRAWING NUMBER M-______________ DATED______________

⬡ PROCESS FLOW DATA POINT

A. EQUIPMENT (~~HT~~. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

assume drop across
IWFCIF = 2.0 ft H_2O

ΔH_A(FT) = 2.0

B. PIPING

(a) PAGE / ITEM	D
7 / 3	90° L
7 / 4	45° L
7 / 5	STD. T
7 / 6	STD. T
6 / 1a	CONV.
6 / 4a	SWING
6 / 5a	DISC
8 / 1	34-2
5 / [illegible]	34-2
/	0.a
/	
/	
/	
/	

1. TOTAL
2. D (INS
3. EQUIV.
4. STRAIG
5. TOTAL
6. MARGIN
7. TOTAL
8. FLOW
9. VELOCI
10. △ H/1
11. TOTAL △
12. SIZES
13. LINE N

SUM OF TOTA

REFERENCES:

(a) ME-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES.

(b) ME-2.12, ME-2.13, OR ME-2.14 PIPE SIZE SELECTION

(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

(A) - see page 1/2

3 pumps in parallel

AND VALVES From 1W50177, [illegible] to 1W517A

SCRIPTION (a)	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED				
		Pump A				
NG RAD. ELBOW	20	3 / 60				
ONG RAD. ELBOW	12				1 / 12	
EE (BRANCH FLOW)	60			1 / 60	1 / 60	
EE (RUN FLOW)	20		1 / 20		0	
GLOBE VALVE	340					
CHECK VALVE	135	1 / 135				
ATE VALVE	13					
Flow Thru Branch	50	1 / 50				
Flow Thru Run	40	1 / 40	1 / 40			
Butterfly Valve	40	1 / 40			2 / 80	
/D		325	60	60	152	
IDE DIAMETER) (FT)		1.9375	2.967	2.967	2.9167	
STR. PIPE (1x2) (FT)		630	175	175	443	
HT PIPE (FT)		49	16.83	15	14	
EQUIV. LENGTH (3+4)(FT)		679	192	190	457	
(____%)						
(FT)		679	192	190	457	
(LB/HR) OR (GPM)		4000	8000	12000	12000	
TY v_a (b) (FPS)		3.0266 (*)	2.66 (*)	4.0[illegible] (*)	4.0014 (*)	
00'(b) (FT/100 FT)		0.2016 (*)	.1013 (*)	.2163 (*)	.2163 (*)	
ΔH (5x10) (FT)		1.3689	.1945	.411	.988	
SELECTED		24	36	36	36	
MBER				1W5008	1W503A	

L ΔH (ITEM 11) FOR ALL SIZES, ΔH_B(FT)= ~3.0

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT) 0

$\Delta H = K \frac{v_a^2}{64.4}$ 0

D. CONTROL VALVES

PRO APERTURE CARD

Also Available On Aperture Card

ΔH_D (FT)= 0

$\Delta H_P = \Delta H_A + \Delta H_B + \Delta H_C + \Delta H_D$

ΔH_P(FT)= ~5.0

FOR OFFICE USE ONLY
NOT TO BE SENT OUTSIDE OF
SARGENT & LUNDY

DESIGN BY:		DATE:	
CHECKED BY:		DATE:	
REVISED BY:		DATE:	

HEAD LOSS IN PIPING SEGMENT: ____________

PROJECT ____________

CLIENT ____________ JOB NO. ________

SARGENT & LUNDY
ENGINEERS
CHICAGO

STANDARD

SYSTEM

SHEET 2 OF 8

SYSTEM ISOMETRIC

1. BASED ON P&ID DRAWING NUMBER M-______________ DATED______________
2. BASED ON PIPING DRAWING NUMBER M-______________ DATED______________

SEE Figures 1, 2, 3
for physicals

⬡ PROCESS FLOW DATA POINT

A. EQUIPMENT (~~HT~~. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

1FP04AM - 12" STRAINER - ASSUME (0.1 psi) DROP
Y-TYPE STRAINER

conservatively assumed
since Leslie Catalog Bulletin
70/3.11 indicates a clean
Strainer equals = 0.015 psid

ΔH_A(FT) = .231 ft

B. PIPING

(a) PAGE	ITEM	DE
7	3	90° LO
7	4	45° LO
7	5	STD. T
7	6	STD. T
6	1a	CONV. C
6	4a	SWING C
6	5a	DISC G
8	B	"Fittin SIZ
		(CRAN butter
8	A	12-14 [illegible] lon
8	B	12" [illegible] lon

1.	TOTAL L
2.	D (INSI
3.	EQUIV.
4.	STRAIGH
5.	TOTAL E
6.	MARGIN
7.	TOTAL
8.	FLOW
9.	VELOCIT
10.	Δ H/10
11.	TOTAL Δ
12.	SIZES S
13.	LINE NU
SUM OF TOTA	

REFERENCES:

(a) ME-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES.

(b) ME-~~2.12~~ 2.10.1, ME-~~2.13~~ 2.10.2, OR ~~ME-2.14~~ 2.10.3 PIPE SIZE SELECTION

(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

(*) - from Cameron Hydraulic data, pgs 41 & 42, 13th Ed.

AND VALVES "A" TO "U2" & "U2" TO "E"

	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED				
SCRIPTION (a)	L/D					Btw U2 AND 1FP01A-12
NG RAD. ELBOW	20	1/20	3/60		7/140	
NG RAD. ELBOW	12		6/72	4/48		
EE (BRANCH FLOW)	60					
E (RUN FLOW)	20					
LOBE VALVE	340					
HECK VALVE	135	1/135				
ATE VALVE	13	1/13	1/13		1/13	
GS W/ REDUCED E BRANCHES	39	1/39				
& TP4(B) ly Valves - fully open	40		1/40	2/80	1/40	2/80
duced Size Branch Three Run	54					1/54
ced Size Branch Three Branch	57			1/114		1/114
/D		207	185	242	193	248
DE DIAMETER) (FT)		1.0	1.0	1.104	1.0	1.104
STR. PIPE (1x2) (FT)		207	185	267.2	193	273.8
T PIPE (FT)		8.4	729.2	203	210	123
QUIV. LENGTH (3+4)(FT)		215.4	914.2	470.2	403	396.8
(0 %)						
(FT)		215	914	470	403	397
(LB/HR) OR (GPM)		750	750	375	375	750
Y v_a(b) (FPS)		2.15	2.15	0.93(*)	1.07(*)	1.745(*)
0'(b) (FT/100 FT)		0.25	0.25	.047(*)	.065(*)	.15(*)
H (5x10) (FT)		.54	2.3	.22	.274	.60
ELECTED		12	12	14	12	14
MBER		1WS44A	1FP01A	0FP02A	1FP08A	0FP07A

L ΔH (ITEM 11) FOR ALL SIZES, ΔH_B(FT)= 3.934

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT) 0

ASSUMED NEGLIBIBLE

$$\Delta H = K \frac{v_a^2}{64.4}$$

D. CONTROL VALVES

APERTURE CARD

Also Available On Aperture Card

ΔH_D (FT)= 0

$$\Delta H_F = \Delta H_A + \Delta H_B + \cancel{\Delta H_C} + \cancel{\Delta H_D}$$

ΔH_F(FT)= 4.16 ft

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NOT TO BE SENT OUTSIDE OF
SARGENT & LUNDY

DESIGN BY:		DATE:	
CHECKED BY:		DATE:	
REVISED BY:		DATE:	

HEAD LOSS IN PIPING SEGMENT: ____________

PROJECT ____________

CLIENT ____________ JOB NO. ________

SARGENT & LUNDY
ENGINEERS
CHICAGO

STANDARD

SYSTEM

SHEET 3 OF 8

SYSTEM ISOMETRIC FP/103

1. BASED ON P&ID DRAWING NUMBER M-__________ DATED__________
2. BASED ON PIPING DRAWING NUMBER M-__________ DATED__________

SEE Figures 3 and 6
for physicals

⨀ PROCESS FLOW DATA POINT

A. EQUIPMENT (~~HT~~. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

ΔH_A(FT) = 0

B. PIPING

(a) PAGE	ITEM	DES
7	3	90° LON
7	4	45° LO
7	5	STD. TE
7	6	STD. TE
6	1a	CONV. C
6	4a	SWING C
6	5a	DISC GA
8	E	12-5 F FITTI
8	F	8-6 F Fittin
8	A	6-2½
8	B	6-2½

1. TOTAL L
2. D (INSI
3. EQUIV.
4. STRAIGH
5. TOTAL E
6. MARGIN
7. TOTAL
8. FLOW
9. VELOCIT
10. Δ H/10
11. TOTAL $\angle$
12. SIZES S
13. LINE NU

SUM OF TOTAL

REFERENCES:
(a) ME-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS,
VALVES AND DISCONTINUITIES.
(b) ME-2.12, ME-2.13, OR ME-2.14 PIPE SIZE SELECTION
(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS
(*) from Cameron Hydraulic data, pg 38, 14th Ed.

ND VALVES -103- "

	(c)	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED				
CRIPTION (a)	L/D	B→F	F	→ J		
G RAD. ELBOW	20	1 / 20	0	2 / 40		
NG RAD. ELBOW	12	1 / 12	0	0		
E (BRANCH FLOW)	60	0	0	0		
E (RUN FLOW)	20	0	0	0		
LOBE VALVE	340	0	0	0		
HECK VALVE	135	0	0	0		
ATE VALVE	13	1 / 13	1 / 13	0		
low thru Branch G w/Reduced Brch	50	1 / 50	0			
low Thru Branch w/Reduced Brch	53		1 / 53			
Flow Thru un	24		3 / 73			
Flow Thru Branch	42		1 / 42			
/D		95	181	40		
DE DIAMETER) (FT)		.6651	.5054	.2058		
STR. PIPE (1x2) (FT)		63.18	91.48	8.232		
PIPE (FT)		25.23	117.25	7		
QUIV. LENGTH (3+4)(FT)		88.4	208.73	15.232		
(0 %)						
(FT)		88	209	15.2		
(LB/HR) OR (GPM)		225	75	75		
v_a(b) (FPS)		1.44	.835 (*)	5.03		
' (b) (FT/100 FT)		0.191	.10 (*)	7.55		
H (~~5~~x10) (FT)		.169	.21	1.1476 ✓		
ELECTED		8	6	2½		
MBER		1FP18A	1FP55A	1FP55F		

ΔH (ITEM 11) FOR ALL SIZES, ΔH_B(FT)= 1.32

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT) 0

$$\Delta H = K \frac{v_a^2}{64.4}$$

D. CONTROL VALVES

BRC
APERTURE
CARD

Also Available On
Aperture Card

ΔH_D (FT)= 0

$$\Delta H_F = \cancel{\Delta H_A} + \Delta H_B + \cancel{\Delta H_C} + \cancel{\Delta H_D}$$

ΔH_F(FT)= 1.52 dr

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SARGENT & LUNDY

DESIGN BY:		DATE:	
CHECKED BY:		DATE:	
REVISED BY:		DATE:	

HEAD LOSS IN PIPING SEGMENT: ____________

PROJECT ____________

CLIENT ____________ JOB NO. ______

SARGENT & LUNDY
ENGINEERS
CHICAGO

STANDARD

SYSTEM

SHEET 4 OF 8

SYSTEM ISOMETRIC F/105

1. BASED ON P&ID DRAWING NUMBER M-__________ DATED__________
2. BASED ON PIPING DRAWING NUMBER M-__________ DATED__________

SEE Figures 3 AND 6
for Physicals

⬡ PROCESS FLOW DATA POINT

A. EQUIPMENT (~~HT.~~ EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

ΔH_A(FT) = 0

B. PIPING

(a) PAGE ITEM	DES
7 / 3	90° LO
7 / 4	45° LO
7 / 5	STD. T
7 / 6	STD. T
6 / 1a	CONV. C
6 / 4a	SWING C
6 / 5a	DISC G
8 / A	8-6 reduce
8 / A	8-6 reduc
8 / B	6-2½ Bran
8 / A	8-4 run
8 / A	8-2½
8 / A	6-4 run
8 / A	6-2½
1.	TOTAL L
2.	D (INSI
3.	EQUIV.
4.	STRAIGH
5.	TOTAL E
6.	MARGIN
7.	TOTAL
8.	FLOW
9.	VELOCIT
10.	Δ H/10
11.	TOTAL Δ
12.	SIZES S
13.	LINE NU
SUM OF TOTAL	

REFERENCES:
(a) ME-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS,
VALVES AND DISCONTINUITIES.
(b) ME-2.12, ME-2.13, OR ME-2.14 PIPE SIZE SELECTION
(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

(+) from Cameron Hydr. Data, pgs 38, 39, 14th Ed.

(* SHORT RADIUS ELBOW L/D = 1.5 L/D REGULAR RADIUS E

-105-

ND VALVES

SCRIPTION (a)	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED F → G	G → I			
G RAD. ELBOW	20	1 / 20	6 / 120	8.5** / 170		
NG RAD. ELBOW	12	4 / 48	2 / 24	2 / 24		
E (BRANCH FLOW)	60	0	0	0		
E (RUN FLOW)	20	0	0	1 / 20		
LOBE VALVE	340	0	0	0		
HECK VALVE	135	0	0	0		
ATE VALVE	13	0	1 / 13	0		
Flow thru run fitting w/ Branc	46	1 / 46	0	0		
Flow thru Branc fitting w/Branch	53	0	1 / 53	0		
flow thru ch	42	0	1 / 42	0		
low thru	30	3 / 90	0	0		
flow thru	20	1 / 20	0	0		
low thru	40		1 / 40	0		
flow thru run	25		2 / 50	0		
/D		224	342	214		
DE DIAMETER)	(FT)	.6651	.5054	.2058		
STR. PIPE (1x2)	(FT)	149	172.8	44.0		
T PIPE	(FT)	107.7	93.2	128.0		
QUIV. LENGTH (3+4)	(FT)	257	266.0	172		
(____%)						
	(FT)	257	266	172		
	(LB/HR) OR (GPM)	150	75	75		
Y v_a(b)	(FPS)	.96(*)	.835(*)	5.03		
' (b)	(FT/100 FT)	.091(*)	.10(*)	7.55		
H (5x10)	(FT)	.23	.27	13.0		
ELECTED		8	6	2½		
MBER		1FP18A	1FP10A	1FP90B		

ΔH (ITEM 11) FOR ALL SIZES, ΔH_B(FT)= 13.67

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT) 0

$$\Delta H = K \frac{v_e^2}{64.4}$$

D. CONTROL VALVES

ΔH_D (FT)= 0

$$\Delta H_F = \overset{0}{\cancel{\Delta H_A}} + \Delta H_B + \cancel{\Delta H_C} + \cancel{\Delta H_D}$$

ΔH_F(FT)= 13.7 ck

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SARGENT & LUNDY

HEAD LOSS IN PIPING SEGMENT: ________

PROJECT ________

CLIENT ________ JOB NO. ________

DESIGN BY:		DATE:	
CHECKED BY:		DATE:	
REVISED BY:		DATE:	

SARGENT & LUNDY
ENGINEERS
CHICAGO

STANDARD

SYSTEM

SHEET 5 OF 8

LBOW

SYSTEM ISOMETRIC

Ff/104

1. BASED ON P&ID DRAWING NUMBER M-__________ DATED__________
2. BASED ON PIPING DRAWING NUMBER M-__________ DATED__________

SEE Figures 3 and 7
for physicals

⬡ PROCESS FLOW DATA POINT

A. EQUIPMENT (HT. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

ΔH_A(FT) = 0

B. PIPING A

(a) PAGE / ITEM	DES
7 / 3	90° LON
7 / 4	45° LON
7 / 5	STD. TE
7 / 6	STD. TE
6 / 1a	CONV. G
6 / 4a	SWING CH
6 / 5a	DISC GA
8 / A	Flow 8-6
8 / A	flow T 8-4
8 / B	flow T 8-2
8 / B	flow Th 8-
8 / A	flow T 6-2½

1. TOTAL L/
2. D (INSID
3. EQUIV. S
4. STRAIGHT
5. TOTAL EQ
6. MARGIN
7. TOTAL
8. FLOW
9. VELOCITY
10. Δ H/100
11. TOTAL Δ
12. SIZES SE
13. LINE NUM

SUM OF TOTAL

(†) assumed $\Delta H = 0$

REFERENCES:

(a) ME-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES.

(b) ME-2.12, ME-2.13, OR ME-2.14 PIPE SIZE SELECTION

(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

(*) From Cameron Hydr. Data, 13th Ed., Page 3?, 74

ND VALVES

-104-

CRIPTION (a)	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED G		→ H		
RAD. ELBOW	20	2 / 40	8 / 160	3 / 60	4 / 80	
G RAD. ELBOW	12	0	2 / 24	2 / 24	0	
(BRANCH FLOW)	60	0	1 / 60	0	0	
(RUN FLOW)	20	1 / 20	0	0	0	
LOBE VALVE	340	0	0	0	0	
ECK VALVE	135	0	0	0	0	
TE VALVE	13	2 / 26	1 / 13	0	0	
thru run	46	1 / 46	0	0	0	
hru run	30	1 / 30	0	0	0	
ru run	20	0	2 / 40	0	0	
u branch	53	0	0	1 / 53	0	
ru run	25	0	0	2 / 50	0	
D		162	297	187	80	
E DIAMETER) (FT)		.6651	.6651	.5054	.2058	
TR. PIPE (1x2) (FT)		107.8	197.5	94.5	16.5	
PIPE (FT)		82.4	132.5	44.5	49.25	
UIV. LENGTH (3+4) (FT)		190.2	330.0	139.0	65.75	
(0 %)						
(FT)		190	330	139	66	
(LB/HR) OR (GPM)		75	75	75	75	
v_a (b) (FPS)		0.015	0.015	.835(*)	5.03	
'(b) (FT/100 FT)		0022	0.022	.10(*)	7.55	
H (5x10) (FT)		0.04	0.08	.139	4.98	
LECTED		8	8	6	2½	
BER		1FP18A	1FP92A	1FP[illegible]	F007H	

ΔH (ITEM 11) FOR ALL SIZES, ΔH_B(FT)= 5.24

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT) 0

$$\Delta H = K \frac{v_a^2}{64.4}$$

D. CONTROL VALVES

ΔH_D (FT)= 0

$$\Delta H_F = \cancel{\Delta H_A} + \Delta H_B + \overset{0}{\cancel{\Delta H_C}} + \cancel{\Delta H_D}\ 0$$

ΔH_F(FT)= 5.24 ok

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SARGENT & LUNDY

DESIGN BY:		DATE:	
CHECKED BY:		DATE:	
REVISED BY:		DATE:	

HEAD LOSS IN PIPING SEGMENT: ______

PROJECT ______

CLIENT ______ JOB NO. ______

SARGENT & LUNDY
ENGINEERS
CHICAGO

STANDARD

SYSTEM

SHEET 6 OF 8

FP 102

SYSTEM ISOMETRIC

1. BASED ON P&ID DRAWING NUMBER M-__________ DATED__________
2. BASED ON PIPING DRAWING NUMBER M-__________ DATED__________

SEE figure 4 and 8
for Physicals

⬡ PROCESS FLOW DATA POINT

A. EQUIPMENT (HT. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

ΔH_A(FT) = 0

B. PIPING A

(a) PAGE / ITEM	DES
7 / 3	90° LON
7 / 4	45° LON
7 / 5	STD. TE
7 / 6	STD. TE
6 / 1a	CONV. G
6 / 4a	SWING C
6 / 5a	DISC GA
8 / 1	8-4 fl
8 / 1	8-6 fl
8 / 1	8-6 fl
8 / 1	6-2½

1. TOTAL L/
2. D (INSID
3. EQUIV. S
4. STRAIGHT
5. TOTAL E
6. MARGIN
7. TOTAL
8. FLOW
9. VELOCITY
10. △ H/10
11. TOTAL △
12. SIZES S
13. LINE NU

SUM OF TOTAL

REFERENCES:

(a) ME-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES.

(b) ME-2.12, ME-2.13, OR ME-2.14 PIPE SIZE SELECTION

(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

(+) Cameron Hydraulic Data, pp 33-39, 14th Ed.

ND VALVES

-107-

	(c)	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED				
CRIPTION (a)	L/D	B-C	C ——	> E		
G RAD. ELBOW	20	3 / 60	3 / 60	1 / 20		
G RAD. ELBOW	12	5 / 60	3 / 36	4 / 48		
E (BRANCH FLOW)	60	0	0	0		
E (RUN FLOW)	20	1 / 20	0	0	1 / 20	
LOBE VALVE	340	0	0	0		
HECK VALVE	135	0	0	0		
TE VALVE	13	1 / 13	1 / 13	0		
ow thru run	30	3 / 90	0	0		
w thru run	46	1 / 46	0	0		
ow thru Branch	53	1 / 53	0	0		
flow thru run	25		4 / 100	0		
D		342	209	68	20	
E DIAMETER)	(FT)	.6651	.5054	.2058	1.0	
TR. PIPE (1x2)	(FT)	227.5	105.6	14.0	20	
PIPE	(FT)	142.7	118	64	5.0	
UIV. LENGTH (3+4)	(FT)	370.2	223.6	78	25	
(0 %)						
	(FT)	370	224	78	25	
(LB/HR) OR	(GPM)	150	75	75	150	
v_a(b)	(FPS)	0.96	0.84	5.03	0.43	
'(b)	(FT/100 FT)	.091(+)	10(+)	7.55	0.011	
H (5x10)	(FT)	.34	.22	5.89	~0.002	
ELECTED		8	6	2½	12	
BER		1FF08B	1FF79A	1FF71B	1FP08A	

ΔH (ITEM 11) FOR ALL SIZES, ΔH_B(FT)= 6.45

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT) 0.3

6x2½ reducer

"K" assumed to equal .75

$$\Delta H = K \frac{v_a^2}{64.4} = 0.75\left(\frac{5.03^2}{64.4}\right) = 0.3$$

This is worst case all other cases are inconsequential.

D. CONTROL VALVES

PRC APERTURE CARD

Also Available On Aperture Card

ΔH_D (FT)= 0

$\Delta H_F = \Delta H_A + \Delta H_B + \Delta H_C + \Delta H_D$

ΔH_F(FT)= ~6.8

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SARGENT & LUNDY

HEAD LOSS IN PIPING SEGMENT: ________

PROJECT ________

CLIENT ________ JOB NO. ________

DESIGN BY:		DATE:	
CHECKED BY:		DATE:	
REVISED BY:		DATE:	

SARGENT & LUNDY
ENGINEERS
CHICAGO

STANDARD

SYSTEM

SHEET 7 OF 8

SYSTEM ISOMETRIC F P 101

1. BASED ON P&ID DRAWING NUMBER M-________ DATED________
2. BASED ON PIPING DRAWING NUMBER M-________ DATED________

see figures 4 and 8
for physicals

⬡ PROCESS FLOW DATA POINT

A. EQUIPMENT (HT. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

ΔH_A(FT) = 0

B. PIPING A

(a) PAGE / ITEM	DES
7 / 3	90° LON
7 / 4	45° LO
7 / 5	STD. TE
7 / 6	STD. TE
6 / 1a	CONV. C
6 / 4a	SWING C
6 / 5a	DISC G
8 / A	8-6
8 / F	6-2'
8 / B	6-2'
1.	TOTAL
2.	D (INS
3.	EQUIV.
4.	STRAIG
5.	TOTAL
6.	MARGIN
7.	TOTAL
8.	FLOW
9.	VELOCI
10.	△ H/
11.	TOTAL
12.	SIZES
13.	LINE
SUM OF TO	

REFERENCES: (F) see page 7/a

(a) ME-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES.

(b) ME-2.12, ME-2.13, OR ME-2.14 PIPE SIZE SELECTION

(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

(*) from Cameron Hydr Data, pg 3-8 39, 8th Ed.

ND VALVES — 101 —

	(c)	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED				
CRIPTION (A)	L/D	C			→ D	
G RAD. ELBOW	20	5 / 100	1 / 20	2 / 40	2 / 40	
G RAD. ELBOW	12	1 / 12	2 / 24	2 / 24	0	
E (BRANCH FLOW)	60	1 / 60	0	0	0	
E (RUN FLOW)	20	1 / 20	1 / 20	0	0	
LOBE VALVE	340	0	0	0	0	
HECK VALVE	135	0	0	0	0	
ATE VALVE	13	2 / 26	1 / 13	0	0	
flow thru run	46	1 / 46	0	0	0	
flow thru run	25	0	0	2 / 50	0	
flow thru branch	42	0	0		1 / 42	
L/D		264	77	114	82	
IDE DIAMETER) (FT)		.6651	.6651	.5054	.2058	
STR. PIPE (1x2) (FT)		175.6	51	57.6	16.88	
HT PIPE (FT)		71.7	84.2	64.6	25.5	
EQUIV. LENGTH (3+4)(FT)		247.3	135.2	122.2	42.38	
(____ %)						
(FT)		247	135	122	42.4	
(LB/HR) OR (GPM)		75	75	75	75	
TY v_a (b) (FPS)		0.48	0.48	0.84	5.03	
100'(b) (FT/100 FT)		0.022	0.022	.10	7.55	
ΔH (5x10) (FT)		0.06	0.03	.012	3.2	
SELECTED		8	8	6	2½	
NUMBER		1FP08B	1FP77A	1FP77B	1FP77C	

AL ΔH (ITEM 11) FOR ALL SIZES, ΔH_B(FT)= 3.3

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT) 0

PRC
APERTURE
CARD

$$\Delta H = K \frac{v_a^2}{64.4}$$

D. CONTROL VALVES

ΔH_D (FT)= 0

$$\Delta H_F = \Delta H_A + \Delta H_B + \Delta H_C + \Delta H_D$$

ΔH_F(FT)= 3.3 ok

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SARGENT & LUNDY

DESIGN BY:		DATE:	
CHECKED BY:		DATE:	
REVISED BY:		DATE:	

HEAD LOSS IN PIPING SEGMENT: ____________

PROJECT ____________

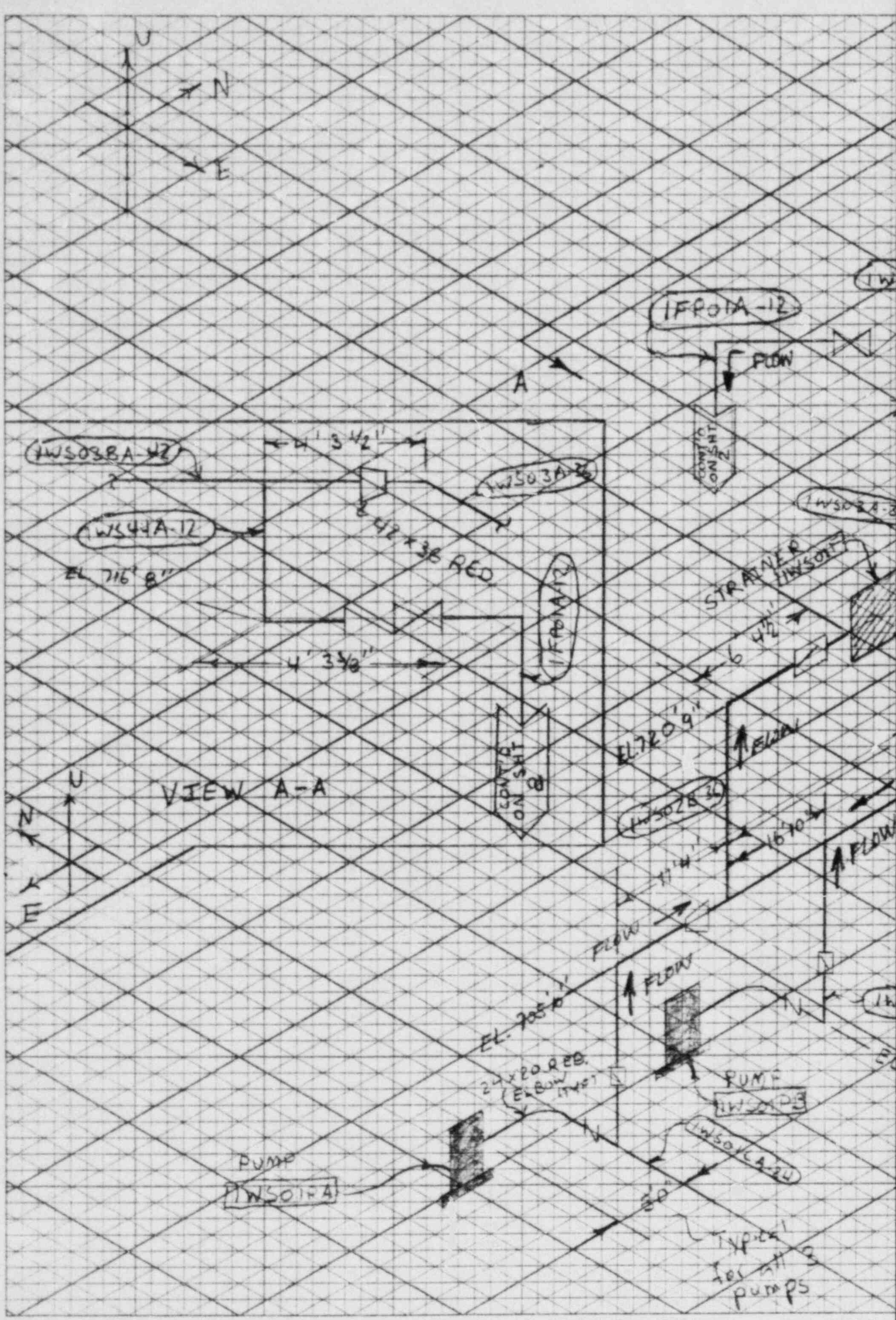
CLIENT ____________ JOB NO. ________

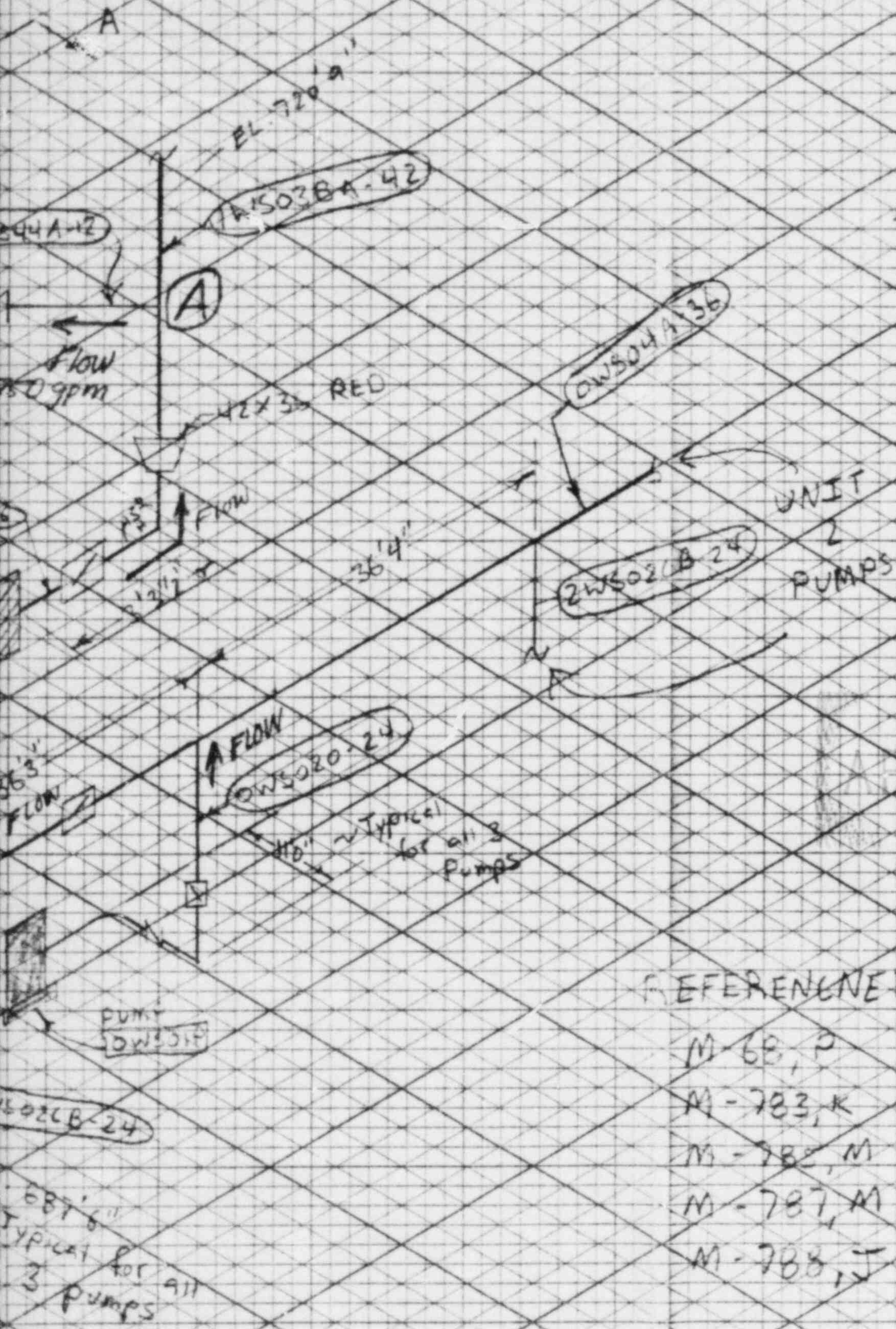
SARGENT & LUNDY
ENGINEERS
CHICAGO

STANDARD

SYSTEM

SHEET 8 OF 8

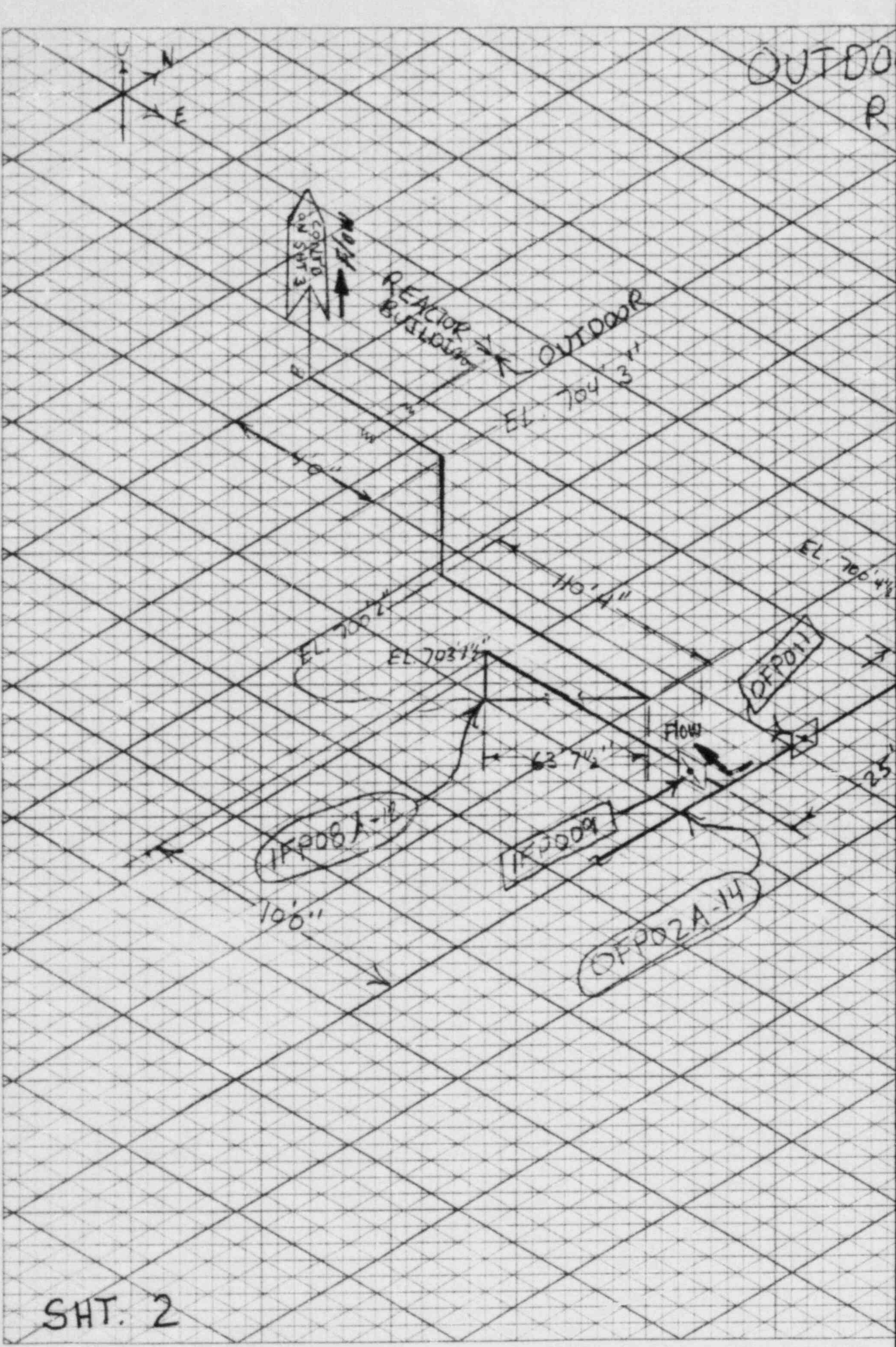

U
N
E
A
1FP01A-12
FLOW
CONT'D ON SHT 2
1WS03BA-42
4' 3 1/2"
1WS03A-36
1WS44A-12
42 x 36 RED
EL 716' 8"
1FP01A-12
STRAINER
1WS01
1WS02A-3
6' 4 1/2"
4' 3 3/8"
CONT'D ON SHT 8
EL 720' 9"
FLOW
VIEW A-A
U
N
E
1WS02B-36
16' 10"
11' 4"
FLOW
FLOW
FLOW
EL. 705' 0"
24 x 20 RED. ELBOW 1 THRT
PUMP
1WS01PB
PUMP
1WS01PA
1WS01CA-24
20"
Typical for all 3 pumps
1W



REFERENCNE DRAWINGS

M-68, P
M-783, K
M-782, M
M-787, M
M-788, J

SHT 1/8

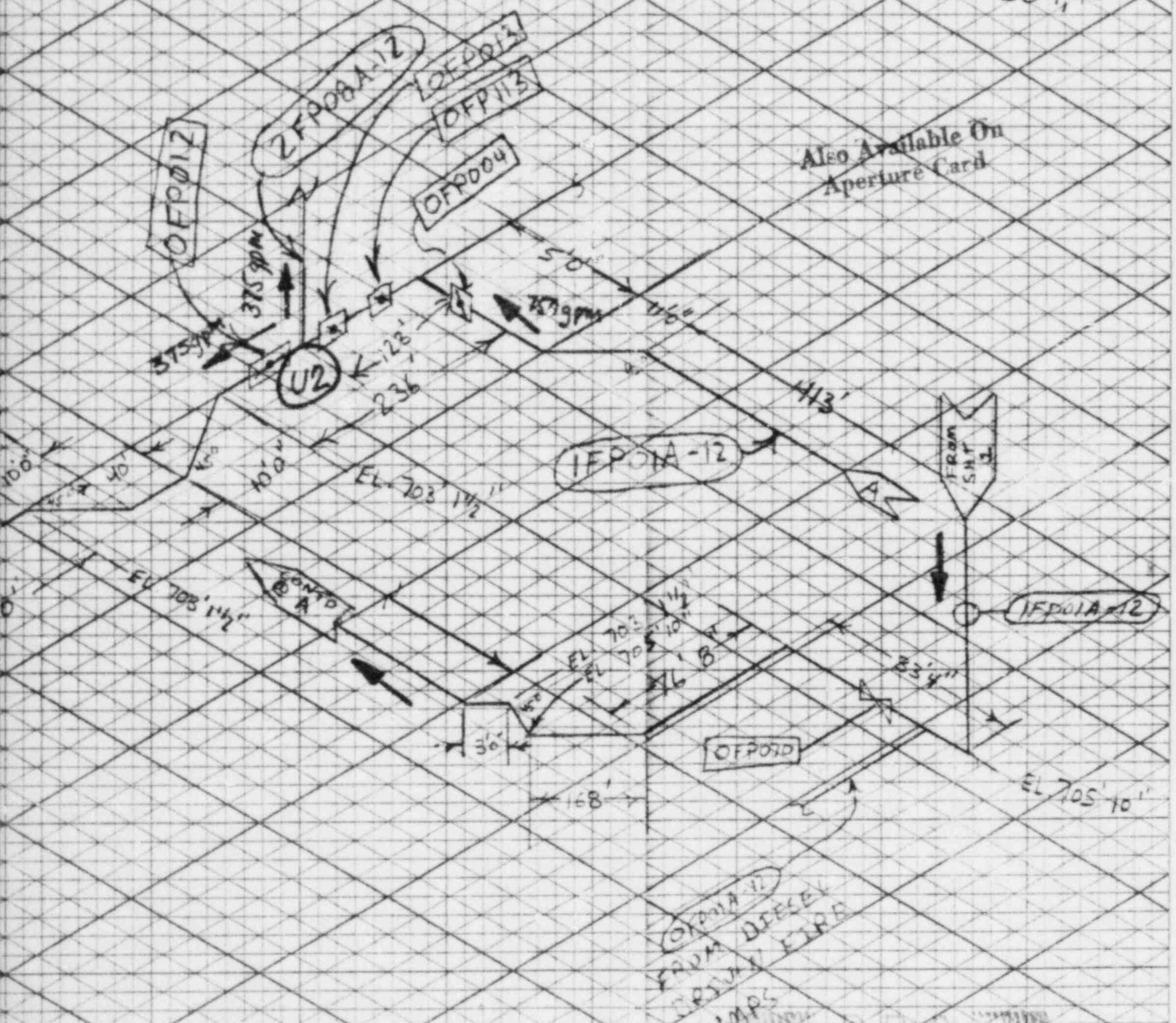

OUTDOO
R
U
N
E
CONT'D ON SHT 3
FLOW
REACTOR BUILDING
OUTDOOR
EL. 704' 3"
3"
3"
5'0"
10'4"
EL. 700'4½
EL. 702'
EL. 703'1½"
OFP011
Flow
63'7½"
25'
1FP008A-12
1FP009
10'0"
OFP02A-14

SHT. 2

OR PIPING

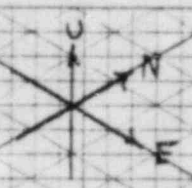
EFERENCE DRAWINGS

M-71-01, AB S-120, T S-119, R M-766-06, G
-07, D
-08, F
-09, K



NO SCALE

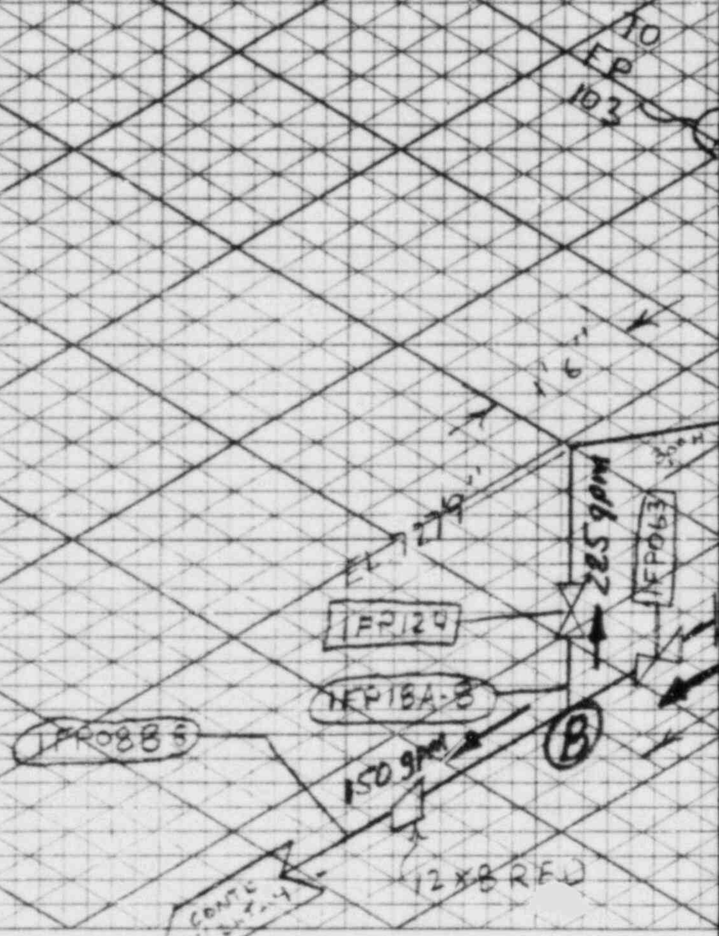
Figure 2/8



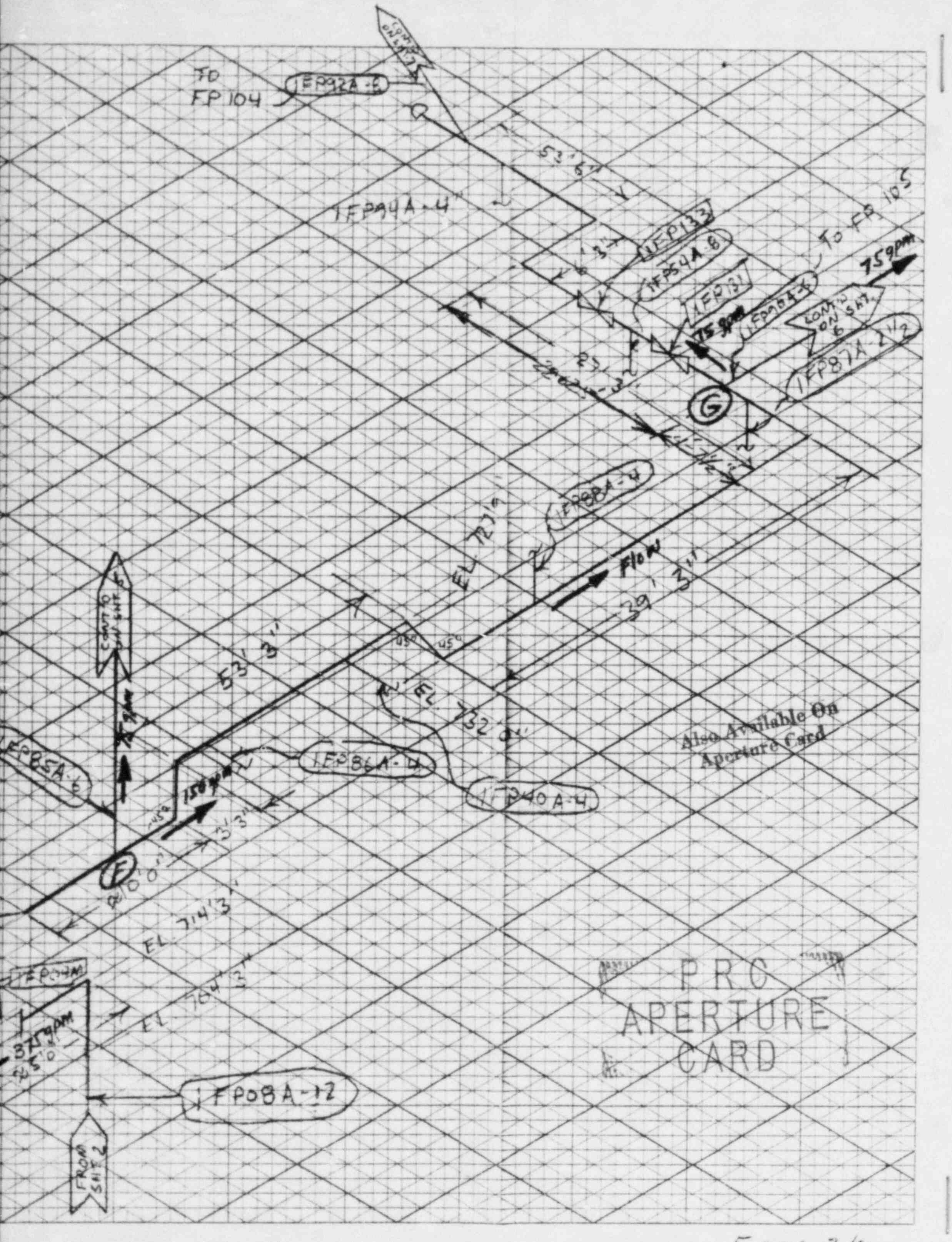
REACTOR BUILDING
Fuel Handling floor
Fire Protection Supply
Line

NO SCALE

REFERENCE DRAWINGS
M-72-02, U
M-814-01, H
-03, J
-06, G
-07, G



SHT. 3



Also Available On Aperture Card

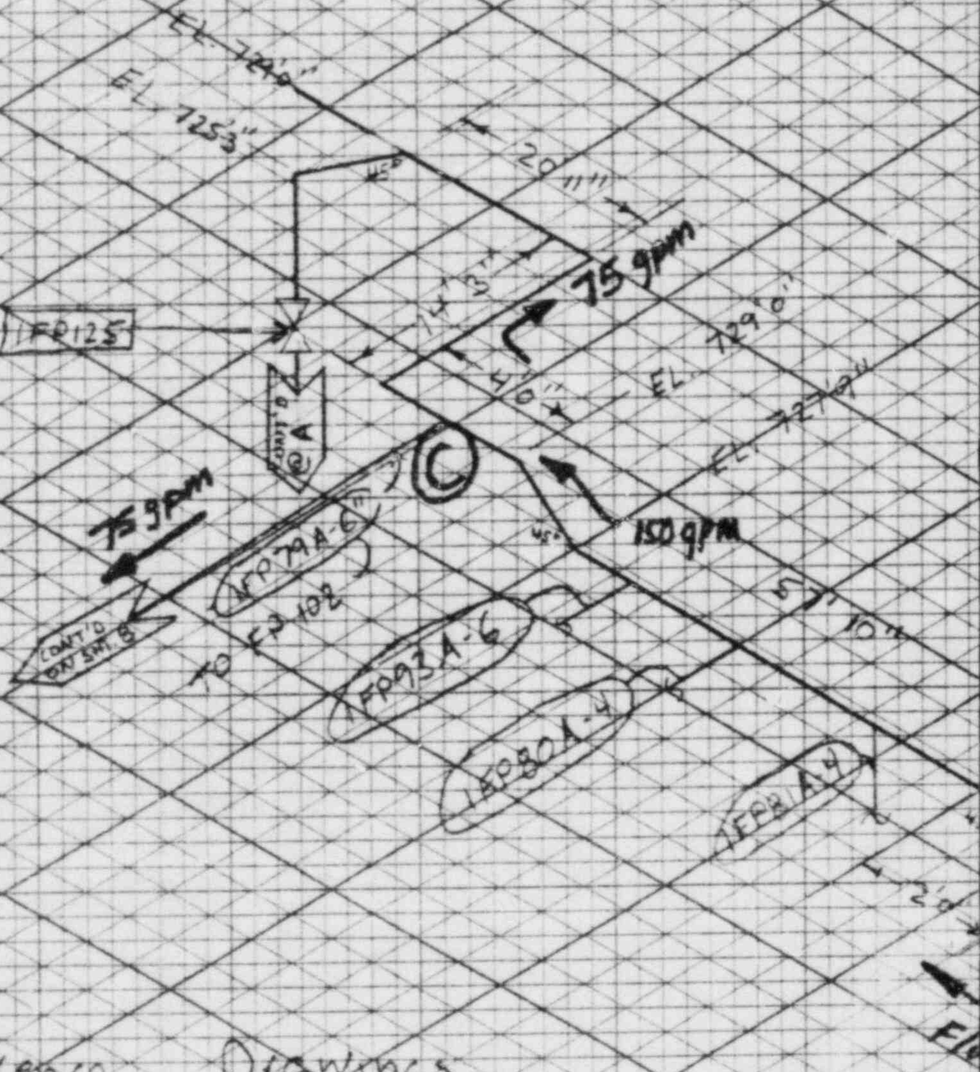
PRC APERTURE CARD

8311040130-13

Figure 3/8

Reactor Building
Fuel Handling Floor
Fire Protection Supply Pipe

NO SCALE



Reference Drawings

M-72-02, U

M-814-01, H

M-814-04, F

M-814-05, G

M-814-06, G

SHT. 4

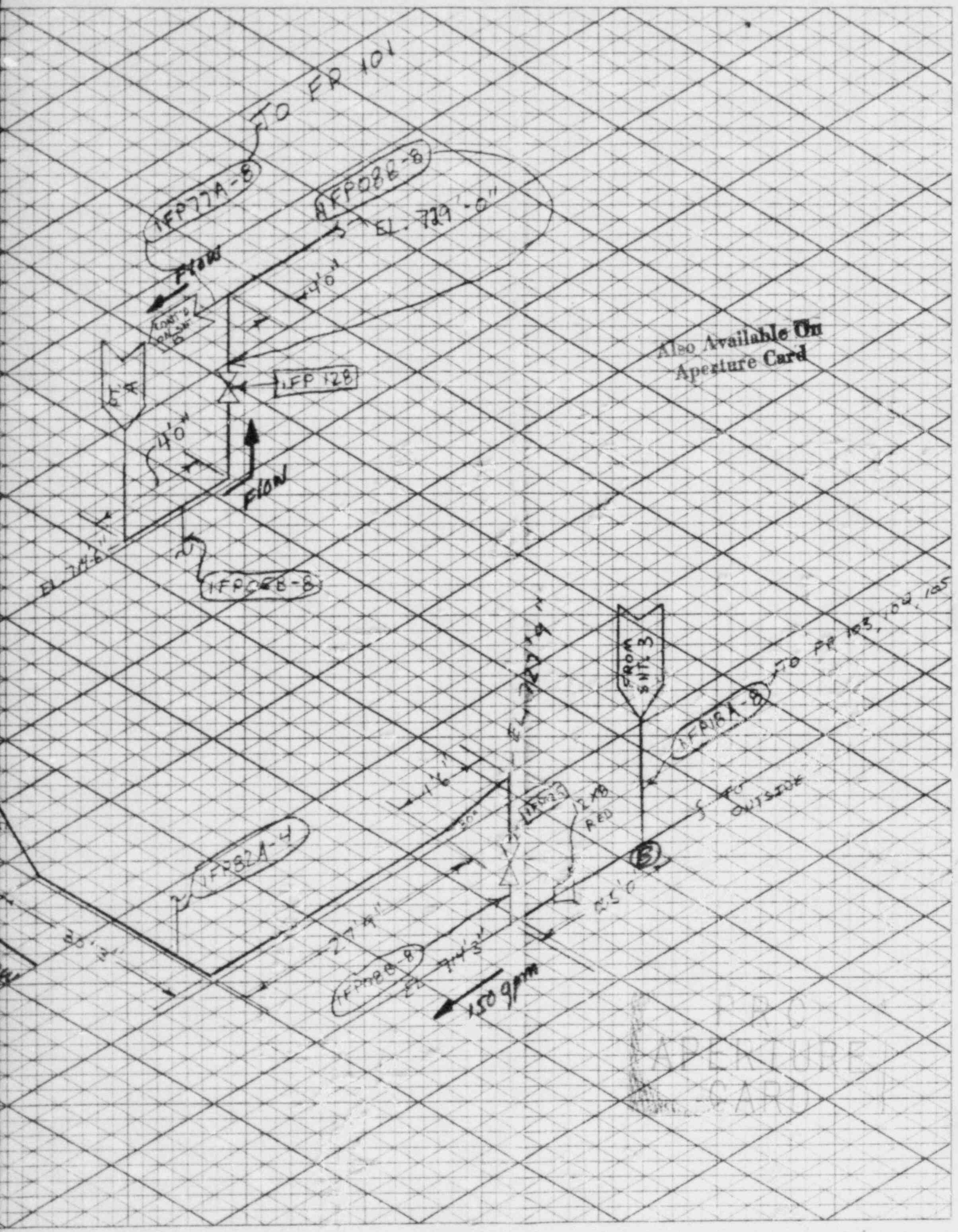

TO FP 101
1FP77A-8
1FP08B-8
EL. 729'-0"
Flow
4'0"
CONT'D ON DWG B
FROM A
1FP128
4'0"
FLOW
EL 714'-6"
1FP08B-8
FROM SNTC 3
TO FP 103, 104, 105
1FP118A-8
TO OUTSIDE
EL 722'-9"
1'6"
12x8 RED
1FP123
B
1FP82A-4
2'5'0"
27'4"
30'3"
1FP08B-8
EL 714'-3"
150 gpm

Figure 4/8

FIRE STATION

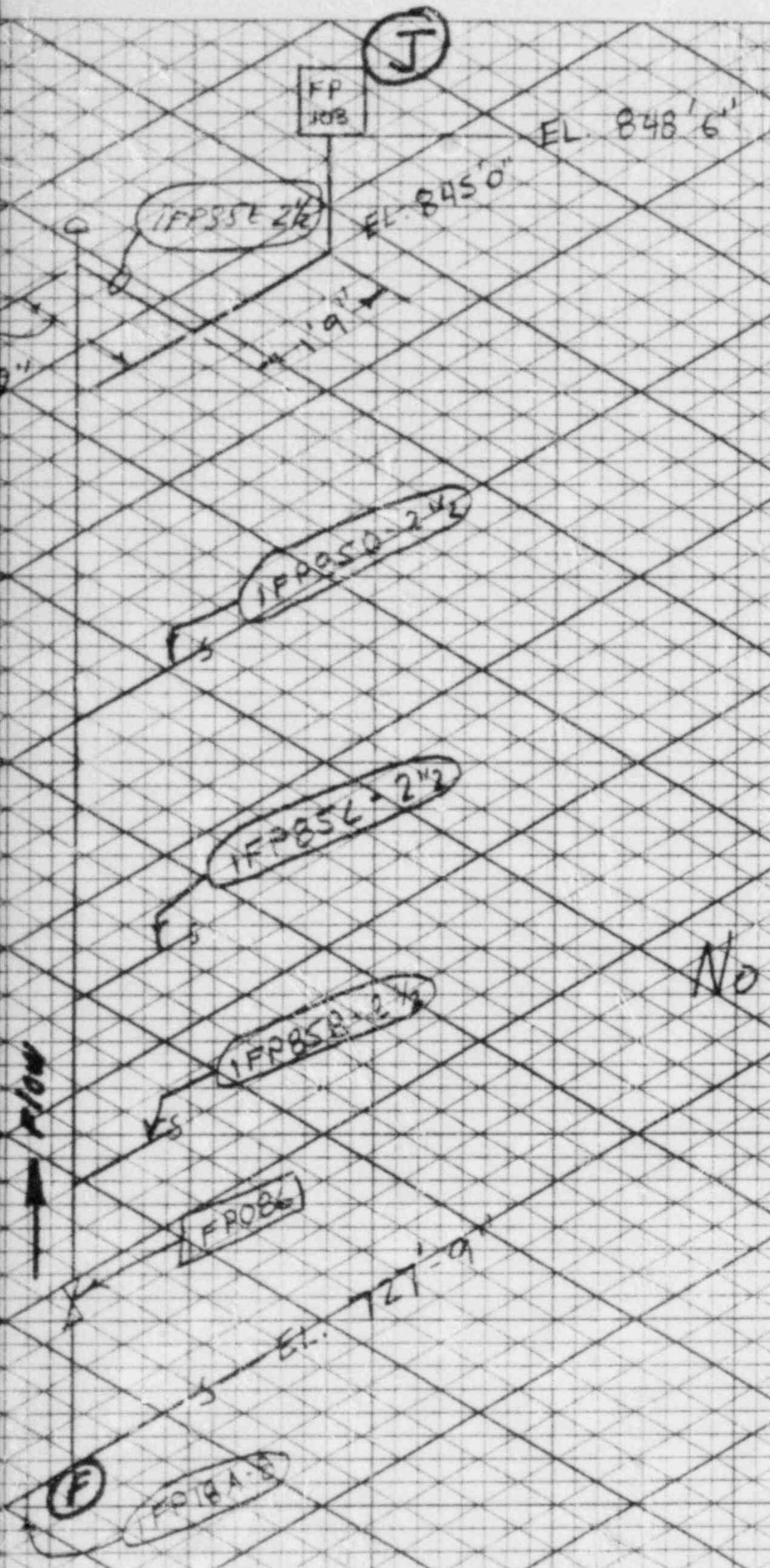
FP 153

Reference Drawings

M-72-02, V
M-814-01, H
-03, J
-06, G

FROM SHT. 5

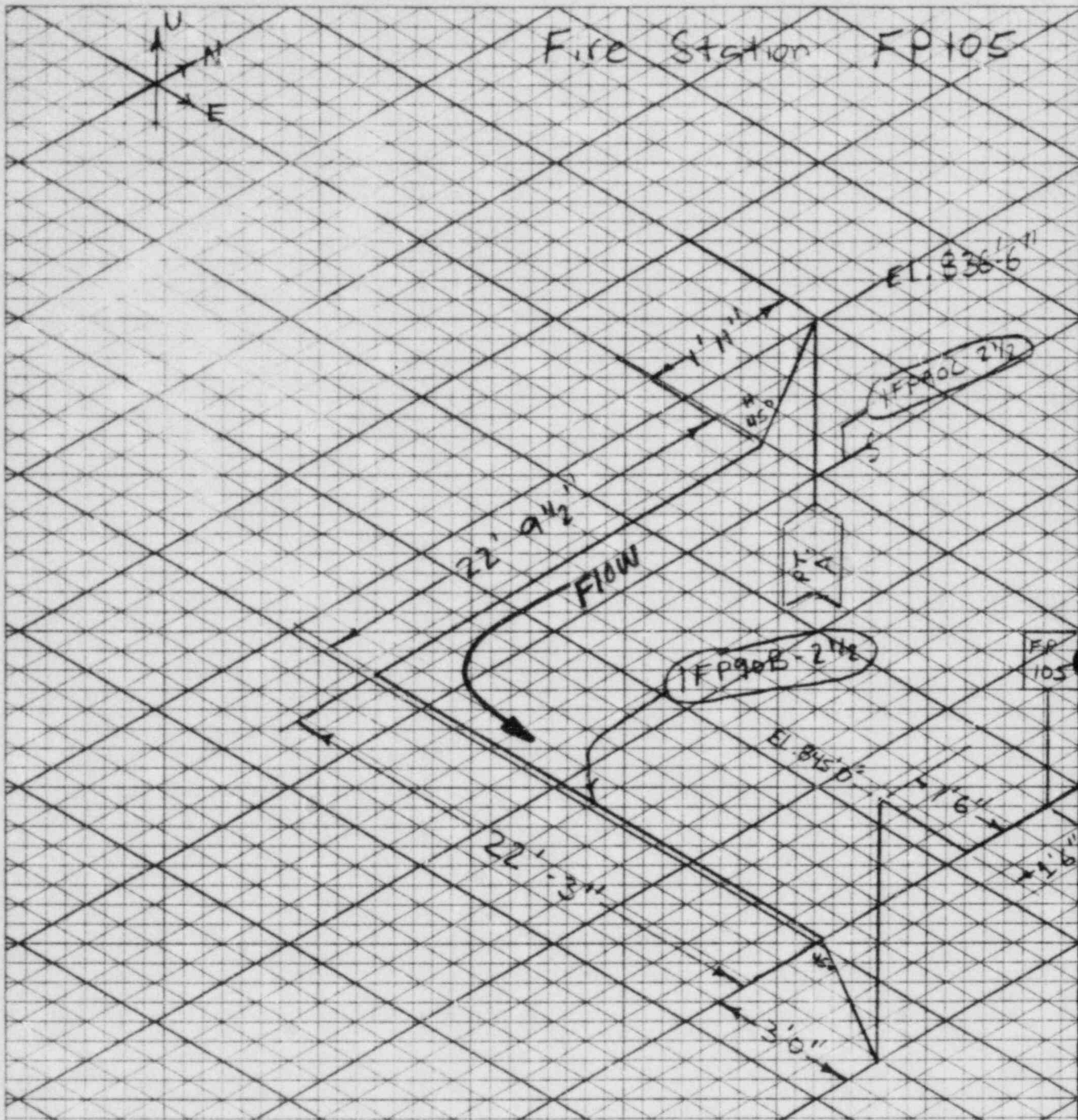
SHT. 5



No Scale

Figure 5/8

Fire Station FP105



Reference Drawing

M-72-02, U

M-814-01, H

-03, J

-07, G

SHT. 6

MEC A-14

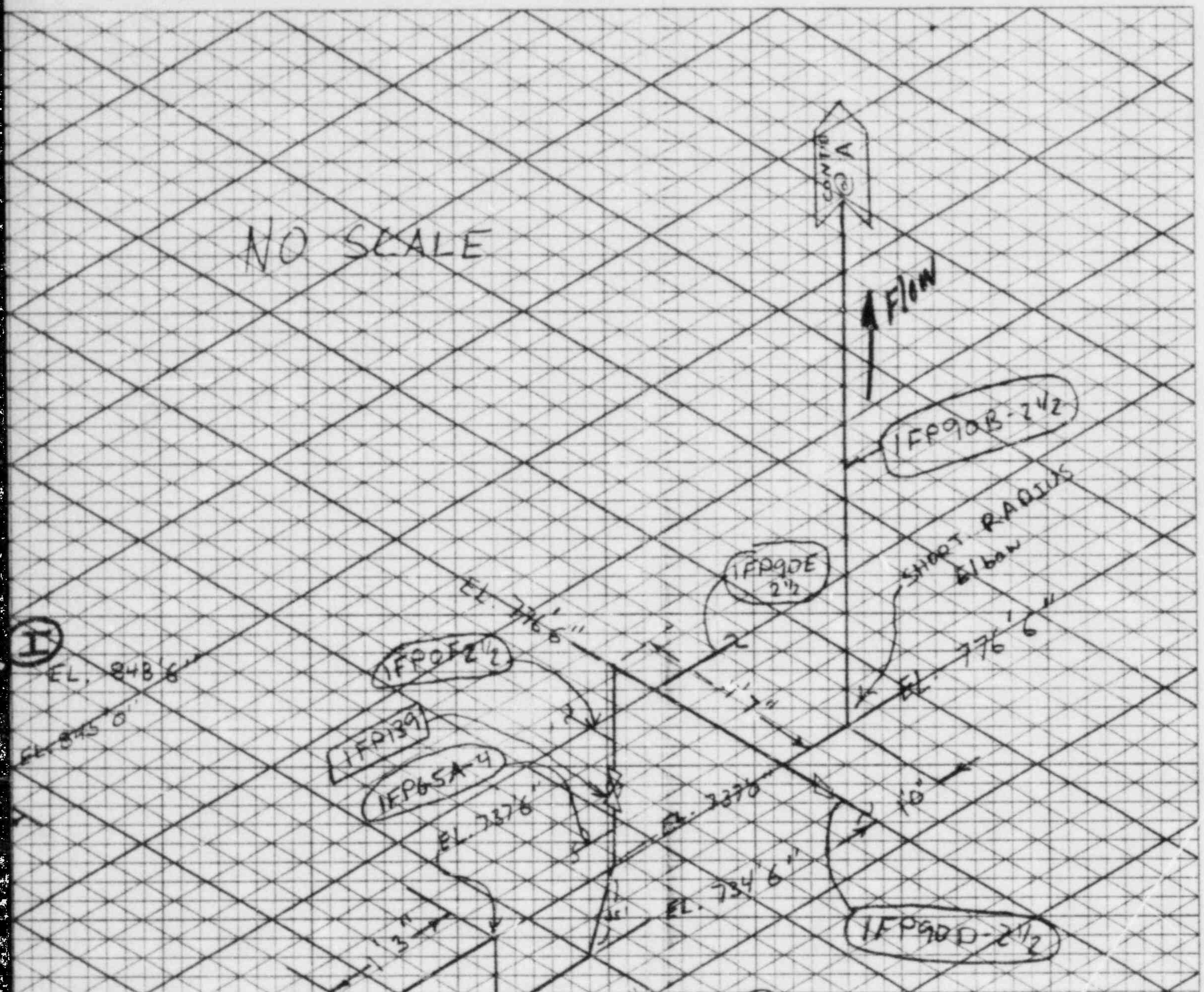
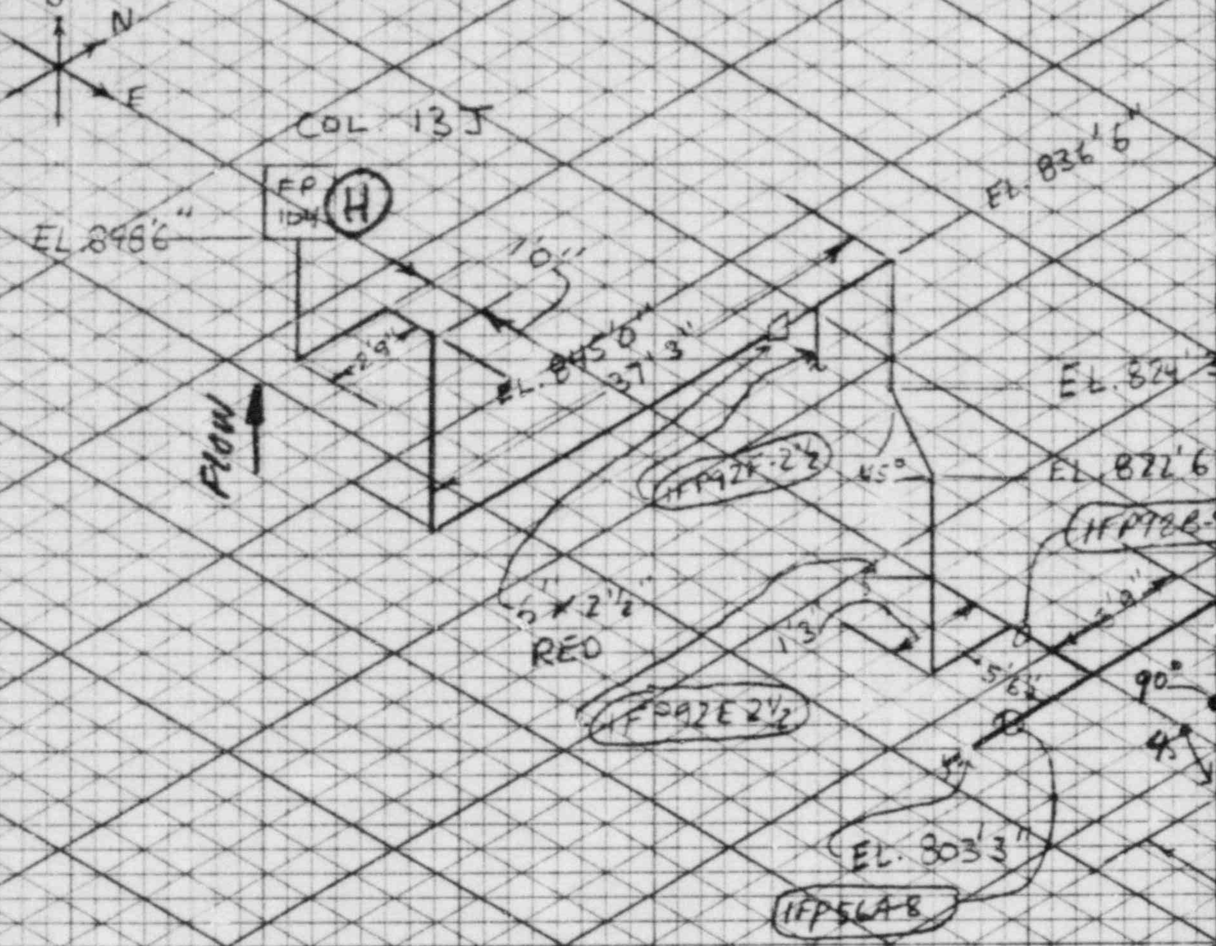

NO SCALE
CONT'D
A
FLOW
1FP90B-2½
SHORT RADIUS Elbow
1FP90E 2½
EL. 776'6"
EL. 776'6"
1'7"
10"
1FP90F 2½
1FP139
1FP65A-4
EL. 737'6"
EL. 737'0
EL. 734'6"
1FP90D-2½
1'3"
2'2"
1FP90A-6
EL. 737'6
33'
7½"
36'6"
EL. 732'0"
FLOW
H
EL. 848'6"
EL. 845'0
G
2'6"
1FP18A-8
FROM SHT. 3

Figure 6/8



SHT. 7

PAGE A-15

REALTOR BUILDING FP 104
Fuel Handling Floor E 843'6"

References M-72-02, U
M-814-01, H
-03, J
-06, G

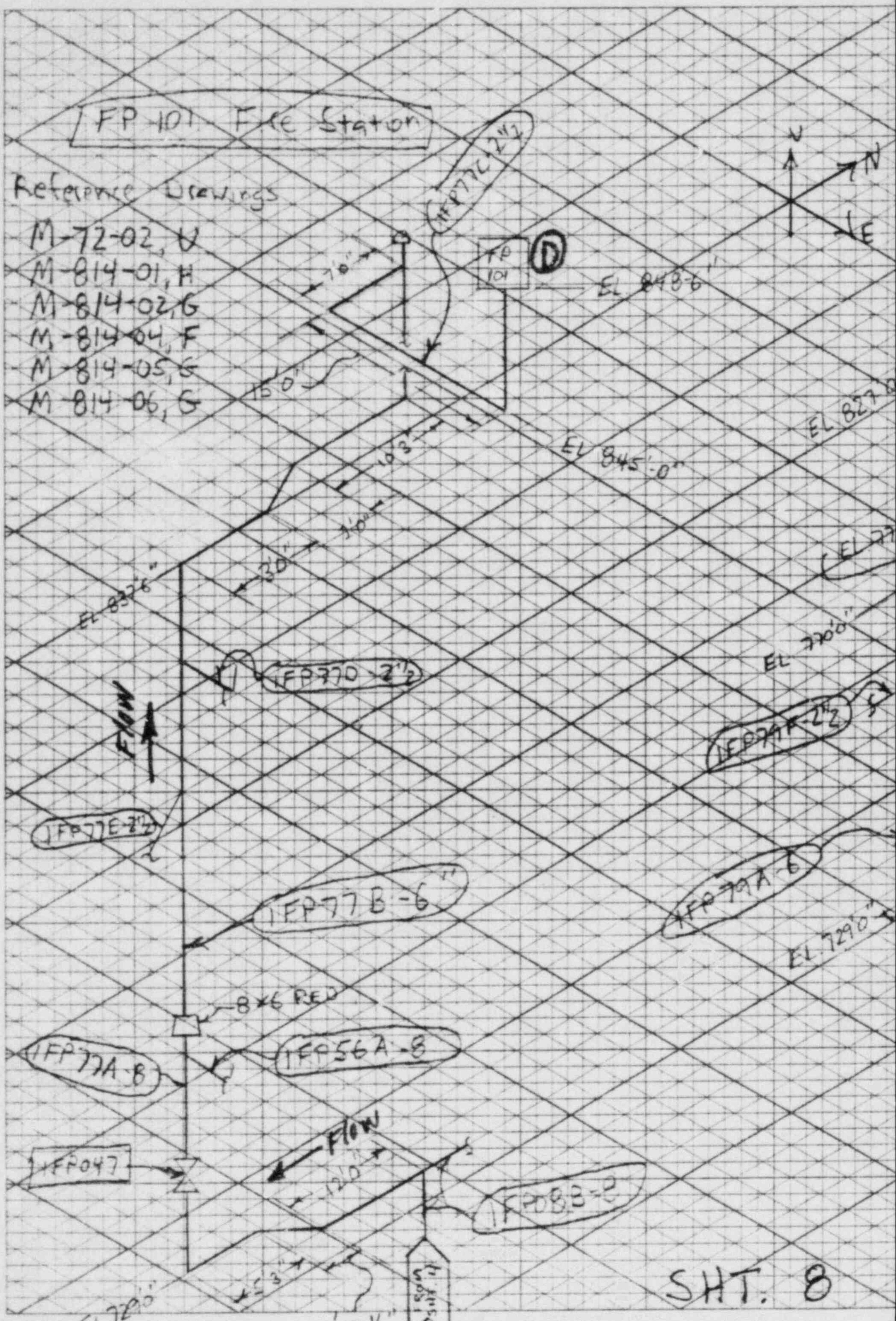
NO SCALE

Figure 7/8

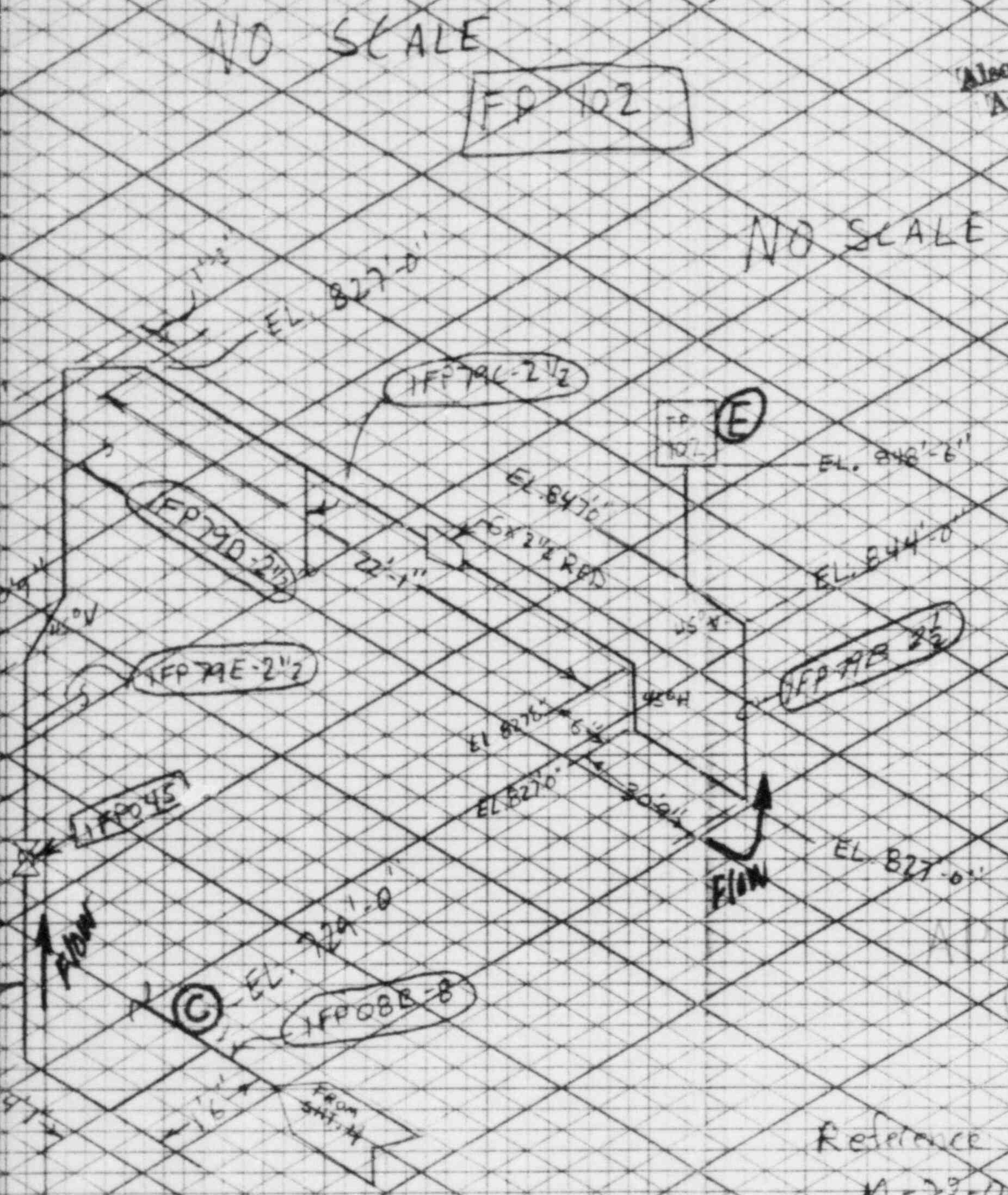
1FP-101 Fire Station

Reference Drawings

M-72-02, V
M-814-01, H
M-814-02, G
M-814-04, F
M-814-05, G
M-814-06, G



PAGE A-16



Reference Drawing

M-22-02, V

M-814-01, H

M-814-02, G

M-814-04, F

M-814-05, G

Figure 5/8

ATTACHMENT B

PRELIMINARY

EVALUATION OF SERVICE WATER SYSTEM
AS BACK-UP TO FIRE PROTECTION SYSTEM
AT THE CABLE SPREADING ROOM
FOR THE
LASALLE COUNTY STATION - UNIT 1

1.0 INTRODUCTION

The fire protection water distribution system is capable of supplying cooling lake water,to the plant fire hydrants, the water sprinkler and deluge systems, and the hose valve stations under all conditions. The diesel fire pumps take suction from the water tunnel in the lake screen house. As a backup to the diesel fire pumps, water can be supplied from the service water system. The service water system is not an equivalent or redundant fire protection system. The service water system is connected to the fire protection system through a 12-inch line at each pump discharge line.

2.0 PURPOSE

The purpose of this calculation/report is to demonstrate that the Service Water System can back up the Fire Protection System demand at the Unit 1 Cable Spreading Room in the event both diesel fire pumps are inoperable. The LaSalle Safety Evaluation Report (SER) states that the

2.0 PURPOSE (continued)

greatest water demand for areas containing or exposing safety-related equipment is 1000 gpm. An additional 750 gpm is required for hose streams, totals a water demand of 1750 gpm. This water flow requirement corresponds to the Cable Spreading Room.

This report will also demonstrate as a corollary that the Fire Protection System can supply a water demand of 1750 gpm to the Cable Spreading Room.

3.0 ASSUMPTIONS

We have assumed the pipe to be "old". This implies a Hazen-Williams coefficient of 100. The equivalent length for the butterfly valves was obtained from Crane's paper TP-410 (L/D=40). We assumed conservative pressure drops for the strainers. The reducers were assumed to have negligible effect to the head loss because velocity magnitudes are very small.

The 750 gpm dedicated for the hose streams was divided amongst four outlets. Two hose stations were assumed to have 125 gpm each. The remaining 500 gpm was divided equally between two fire hydrants.

4.0 DESIGN INPUT

The head loss calculations were performed using Sargent & Lundy Standards MES-2.10 and MES-2.16. The pipe routings and calculations are in Appendix A. The pipe routing was developed from the current single line and outdoor piping drawings. The calculations were performed using Form MES-2.16.1

5.0 REFERENCES

5.1 Goulds Pumps, Inc. Characteristic Curve for Service Water Pumps

1WS01PA 0WS01P A-19377
1WS01PB A-19376 A-19375

5.2 Peerless Pump Division, FMC Corporation Characteristic Curve for Fire Protection Pump

0FP01PA C14645B
0FP01PB C14645B (Identical pumps)

5.3 Nuclear Mutual, Limited (NML) Standards for Nuclear Generating Stations

5.4 Crane Paper TP-410 - Flow of Fluids

5.5 Cameron Hydraulic Data, 14th Edition

5.6 P&ID's

M-68 , Rev. P , Service Water
M-71-01, Rev. AB, Fire Protection
M-72-01, Rev. T , Fire Protection

5.0 REFERENCES (continued)

5.7 Structural Drawings

S-117, Rev. M, Plumbing Underground Piping

S-118, Rev. Z, Plumbing Underground Piping

S-119, Rev. R, Plumbing Underground Piping

S-120, Rev. T, Plumbing Underground Piping

S-102, Rev. U, Plumbing Underground Piping

5.8 Mechanical Drawings

M-766-06, Rev. G, Outdoor Piping

M-766-07, Rev. E, Outdoor Piping

M-766-08, Rev. F, Outdoor Piping

M-766-09, Rev. K, Outdoor Piping

M-783 , Rev. K, Lake Screen House Piping

M-784 , Rev. F, Lake Screen House Piping

M-785 , Rev. M, Lake Screen House Piping

M-786 , Rev. G, Lake Screen House Piping

M-787 , Rev. M, Lake Screen House Piping

M-788 , Rev. J, Lake Screen House Piping

M-814-08, Rev. L, Fire Protection Piping-Turbine & Auxiliary Building

M-814-09, Rev. R, Fire Protection Piping-Turbine & Auxiliary Building

M-814-10, Rev. H, Fire Protection Piping-Turbine & Auxiliary Building

5.8 Mechanical Drawings (continued)

M-814-11, Rev. K, Fire Protection Piping-Turbine & Auxiliary Building

M-814-12, Rev. K, Fire Protection Piping-Turbine & Auxiliary Building

M-814-13, Rev. K, Fire Protection Piping-Turbine & Auxiliary Building

M-814-15, Rev. N, Fire Protection Piping-Turbine & Auxiliary Building

5.9 Instrument Location Drawing

M-1312-04, Rev. A

5.10 Piping Design Tables

PDT "002LS" and "100LS"

6.0 SUMMARY

The calculations demonstrate that the head loss due to friction between the WS pumps and the cable spreading room approximately equals 148 feet of water (64 psi). A static head of 66 feet exists between the WS pumps and the cable spreading room. The residual pressure at the isolation valve (1FP147) is 74.9 psi (173 ft. H_2O). Hence, the discharge head of the WS pumps must equal 387 feet.

The discharge nozzle of the Service Water pumps is located below the elevation of the cooling lake (700'-0"). The

6.0 SUMMARY (continued)

difference in elevations results in a static suction head of approximately 12.5 feet. Hence, the total developed head for the WS pumps approximately equals 374.5 feet (assuming negligible suction friction).

The service water pumps cannot provide the cable spreading room with 1000 gpm @ 74.9 psi, since the shutoff head to the pumps equals 335 feet. The service water pumps can provide the cable spreading room with 1000 gpm @ 55 psi (127 ft. H_2O).

The fire protection system was designed to provide the cable spreading room demand of 1000 gpm @ 740 psi (173 feet). The head loss due to friction between the FP pump and the cable spreading room approximately equals 147 feet of H_2O (64 psi). The static head between the two points approximately equals 37 feet. Hence, the discharge head of the FP pump must be approximately 357 feet.

The discharge nozzle of the FP pumps is located above the elevation of the cooling lake (700'-0"). The difference in elevation results in a suction lift of approximately 16 feet. Hence, the total developed head for the FP pump

6.0 SUMMARY (continued)

approximately equals 373 feet (162 psi). At this discharge head, the FP pump provides a flow of approximately 1750 gpm. Hence, the fire protection system is concluded to be adequate.

A pressure indicator and transmitter on the piping can be used to determine when adequate pressure is achieved by the WS pumps.

7.0 RECOMMENDATIONS

The WS system can supply 1000 gpm to the fire protection system at 55 psi. To accomplish this, the service water valves downstream of the fire protection branch must be closed. The proper pressure can be obtained by reading pressure indicator 2PI-WS007. The indicator is located on the discharge nozzle of pump 2WS01PA, it must reflect a pressure of approximately 147.6 psig (341 ft. H_2O). In addition to the pressure indicator, a pressure transmitter (2PT-WS009) is also available to detect line pressure. The transmitter must reflect a pressure of 139.6 psig (323 ft. H_2O).

In order to provide adequate water supply to the FP system, the WS pumps must be backed up on their characteristic CURVE.

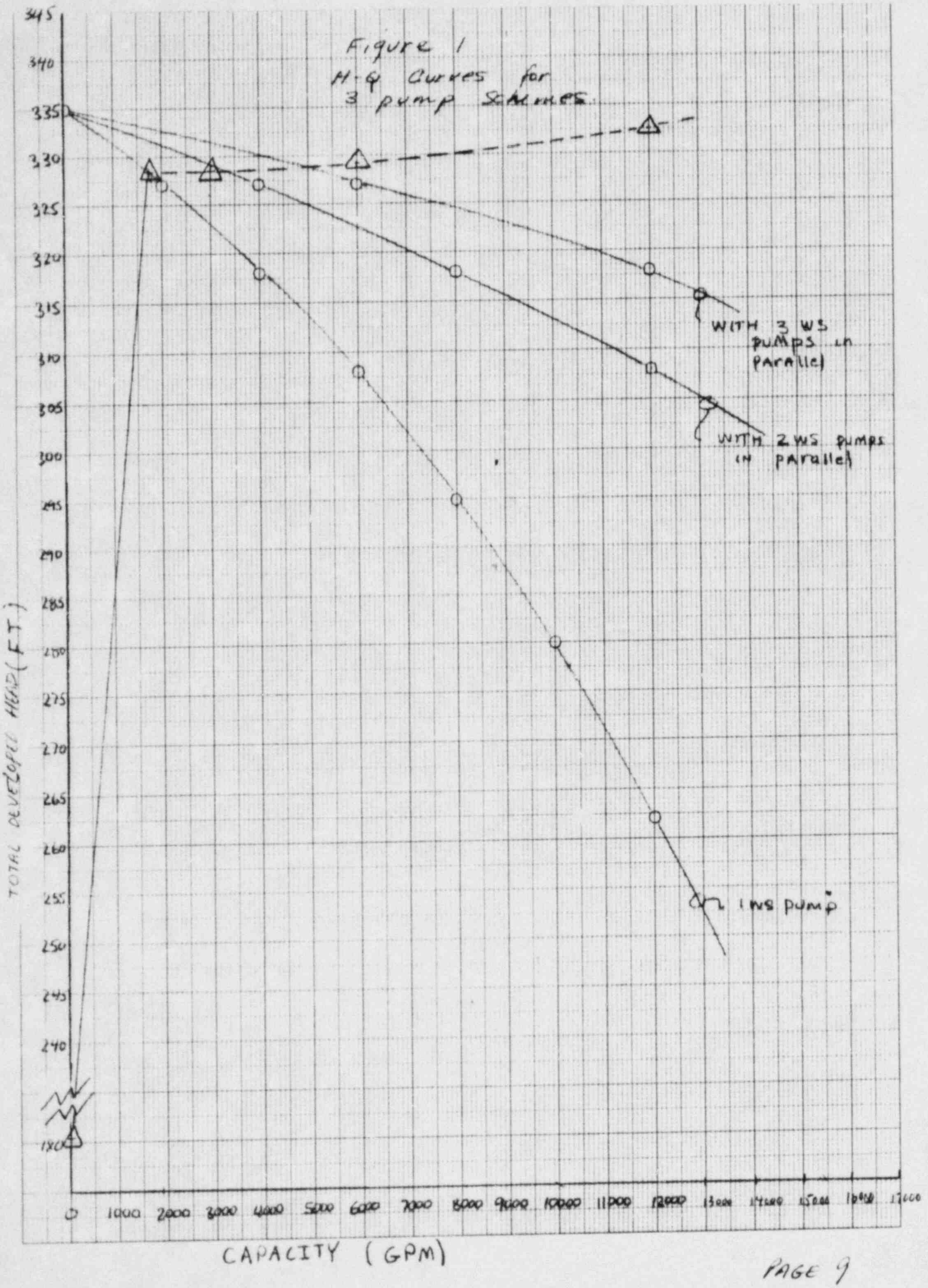
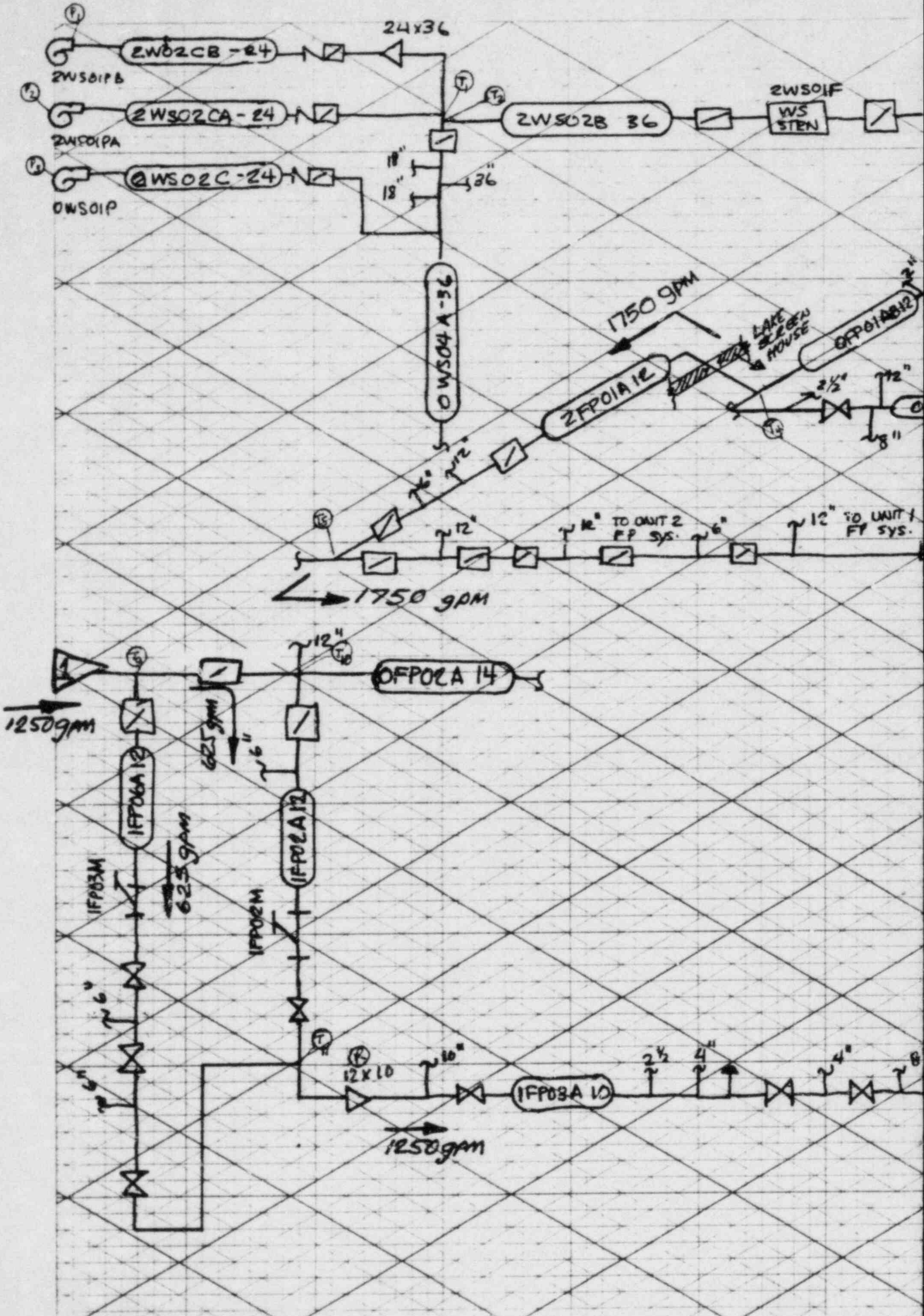


Figure 1
H-Q Curves for
3 pump Schemes

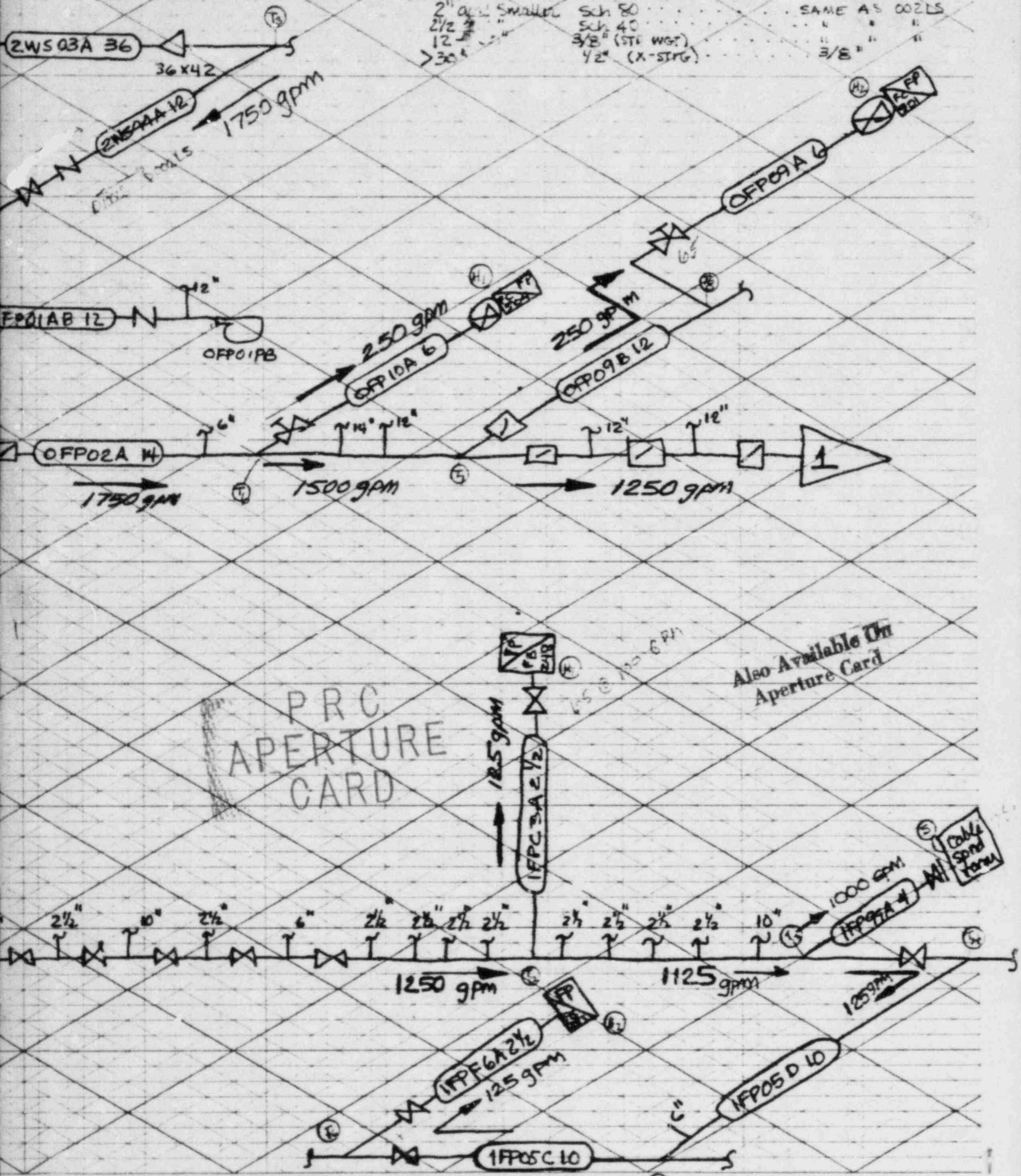
46 1512

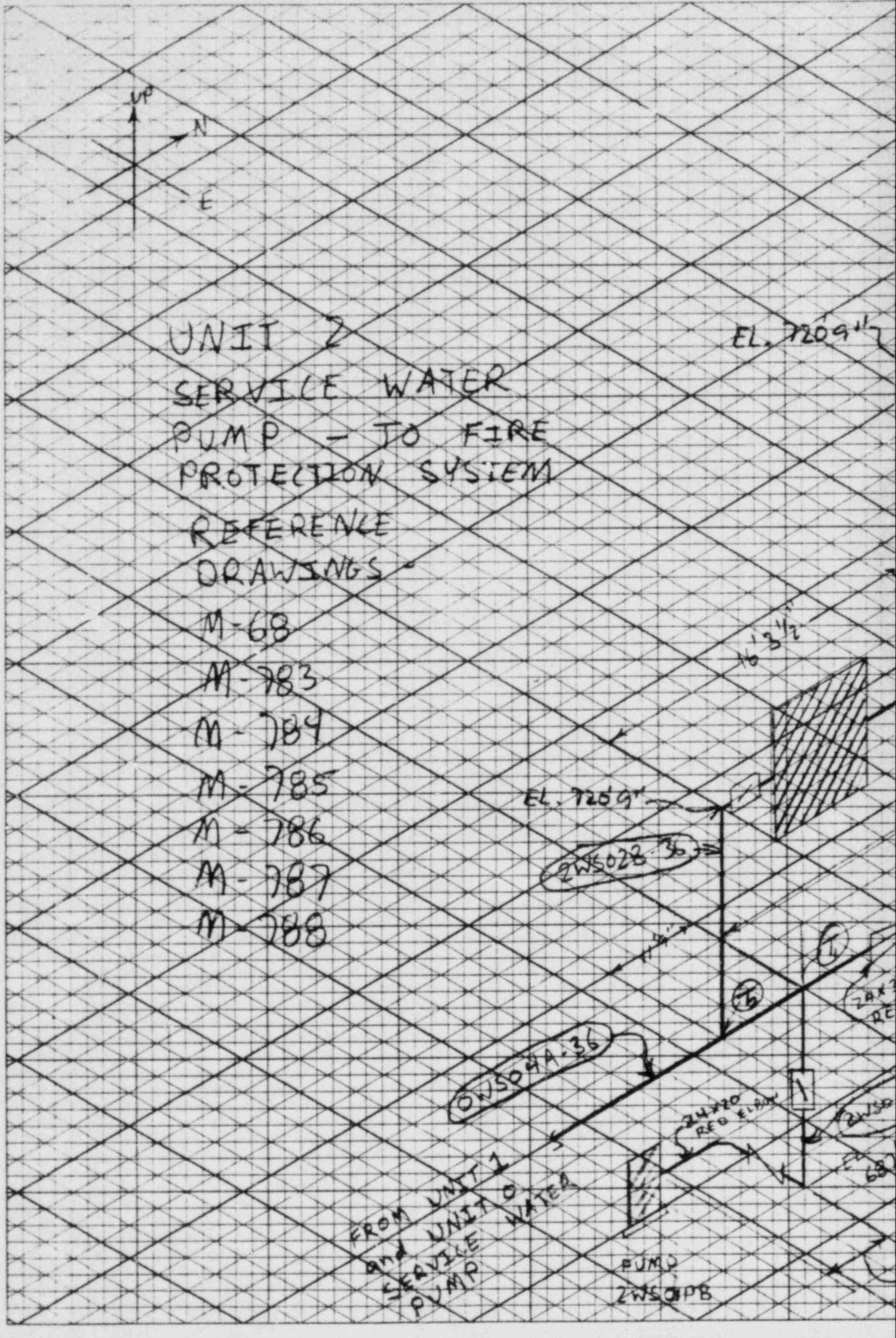
APPENDIX A



P1
2W02CB-24
2WS01PB
24x36
P2
2WS02CA-24
2WS01PA
P3
0WS02C-24
0WS01P
T1
T2
2WS02B 36
2WS01F
WS STRN
18"
18"
36"
0WS04A-36
1750 gPM
LAKE SCREEN HOUSE
2FP01A 12
0FP01AB12
2½"
12"
8"
12"
T4
6"
12"
T3
12"
12" TO UNIT 2 FP SYS.
6"
12" TO UNIT 1 FP SYS.
1750 gpm
12"
T5
T10
0FP02A 14
1250gpm
625 gpm
6"
1FP06A 12
1FP02A 12
1FP03M
625 gpm
1FP02M
6"
6"
T11
R
12X10
10"
1FP03A 10
2½
4"
4"
8
1250gpm

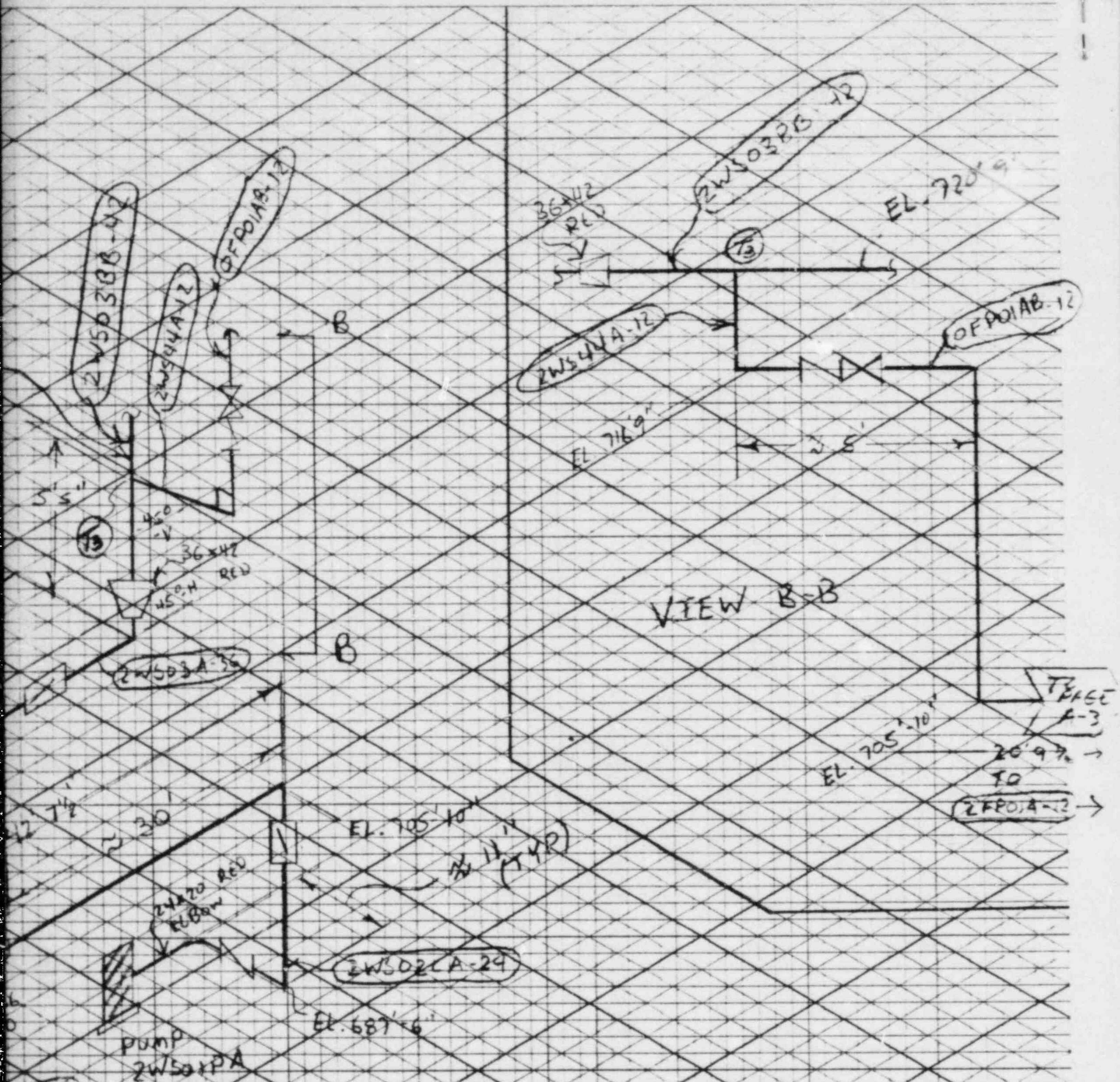
	PER PDT 002LS	PER PDT 100LS
2" and Smaller	Sch 80	SAME AS 002LS
2½ " "	Sch 40	" " "
12 " "	3/8" (STD WGT)	" " "
>30"	1/2" (X-STRG)	3/8"

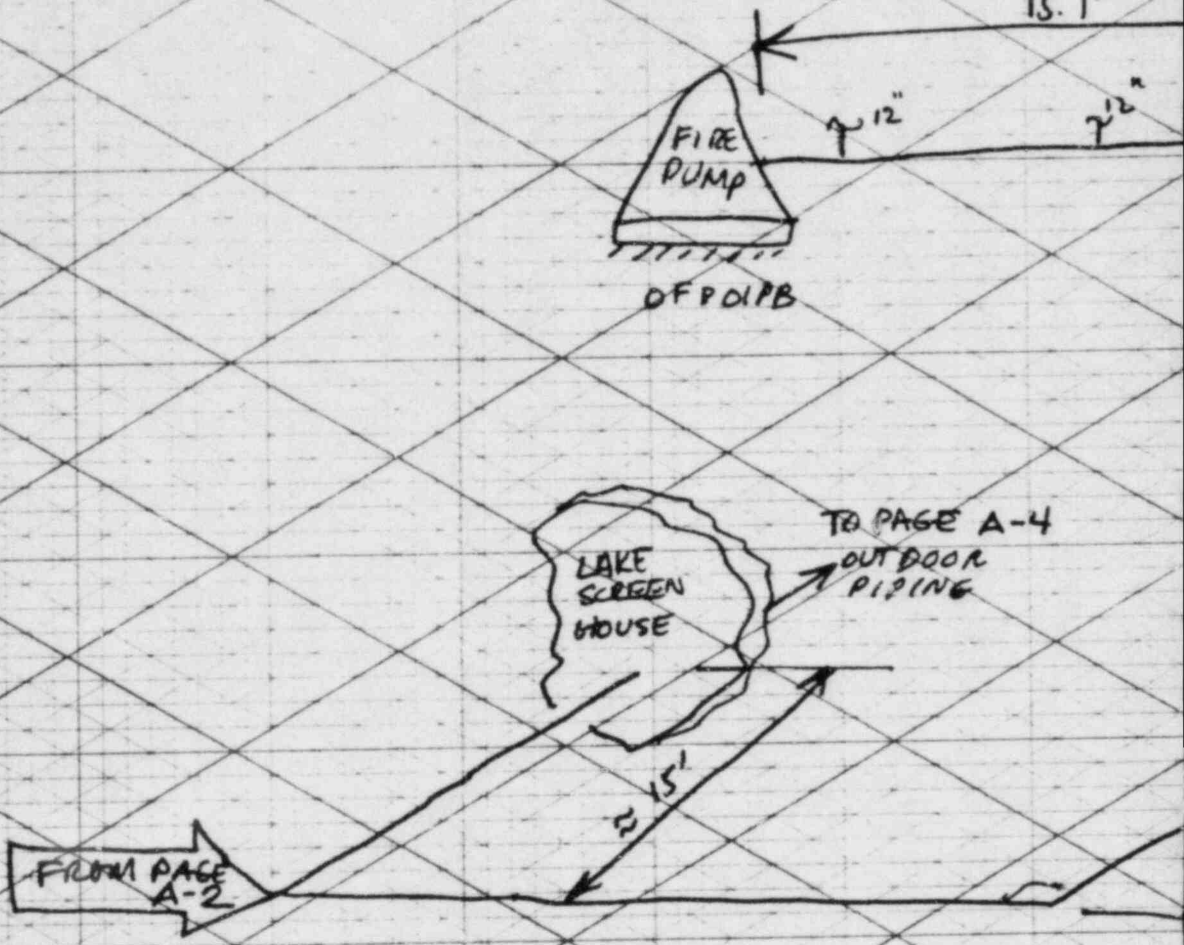


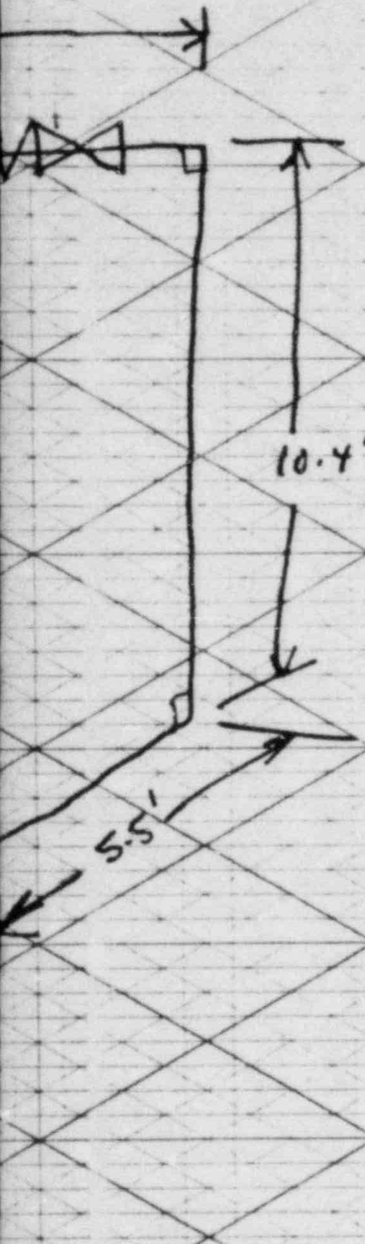


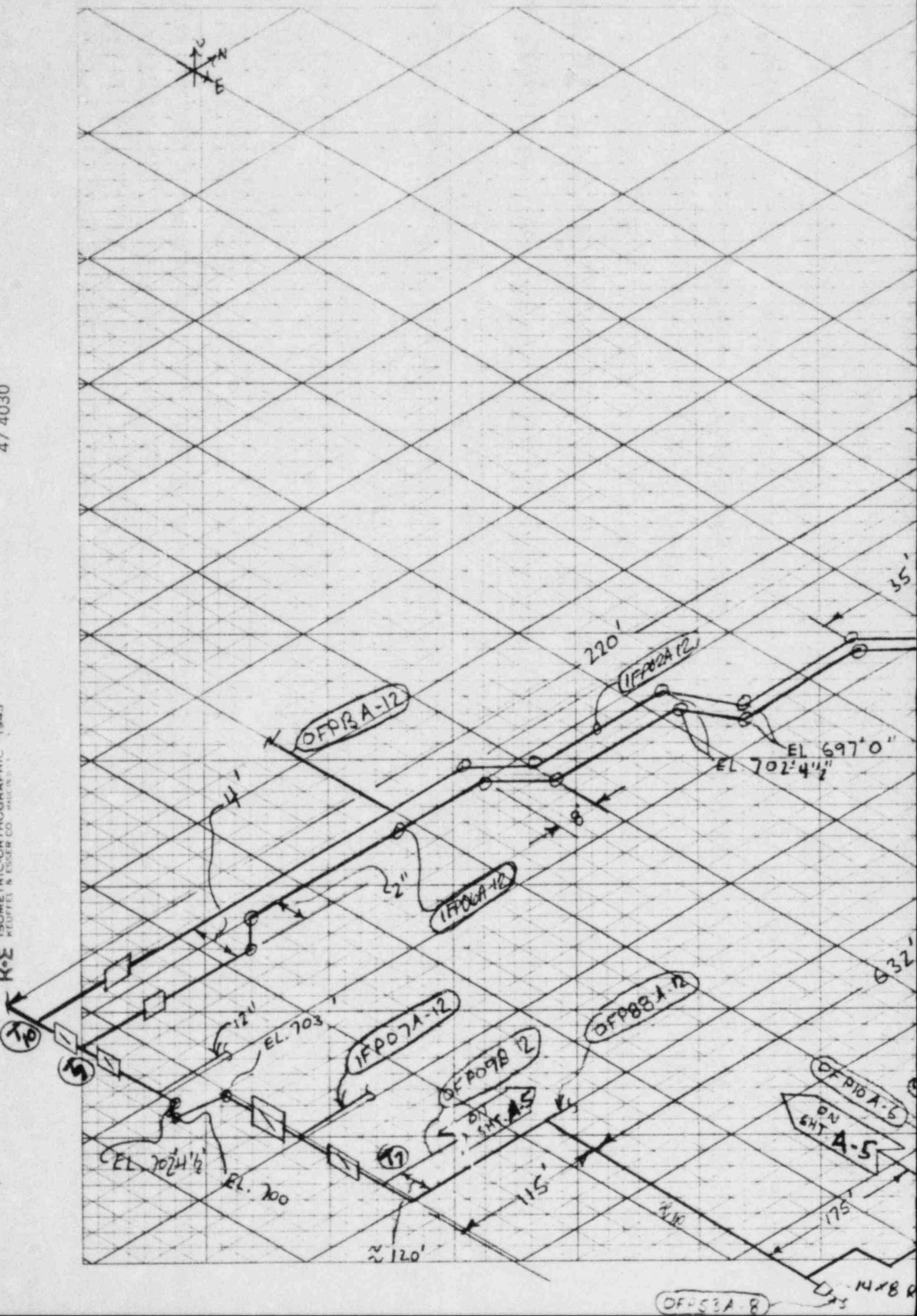
UNIT 2
SERVICE WATER
PUMP - TO FIRE
PROTECTION SYSTEM

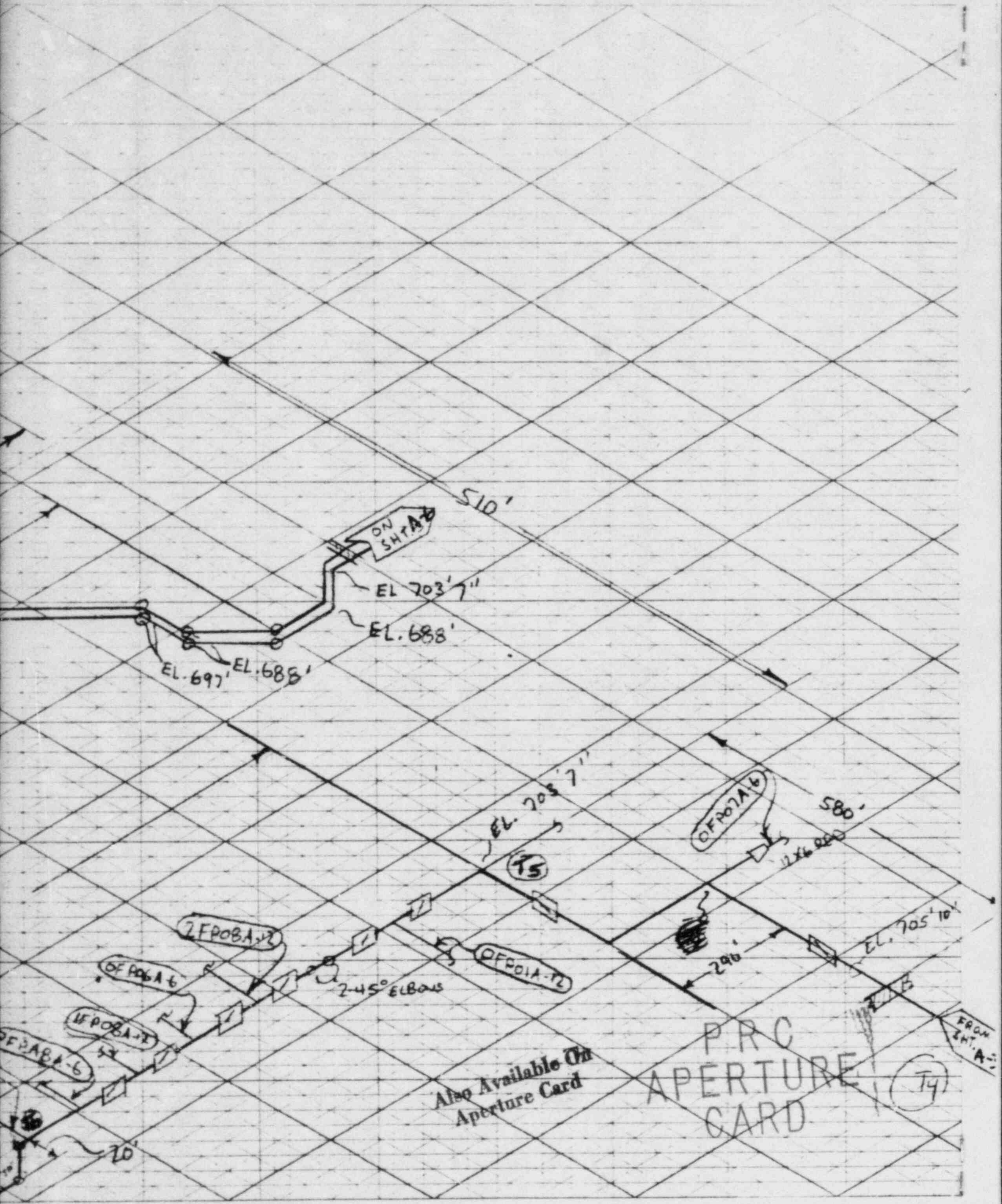
REFERENCE
DRAWINGS -
M-68
M-783
M-784
M-785
M-786
M-787
M-788

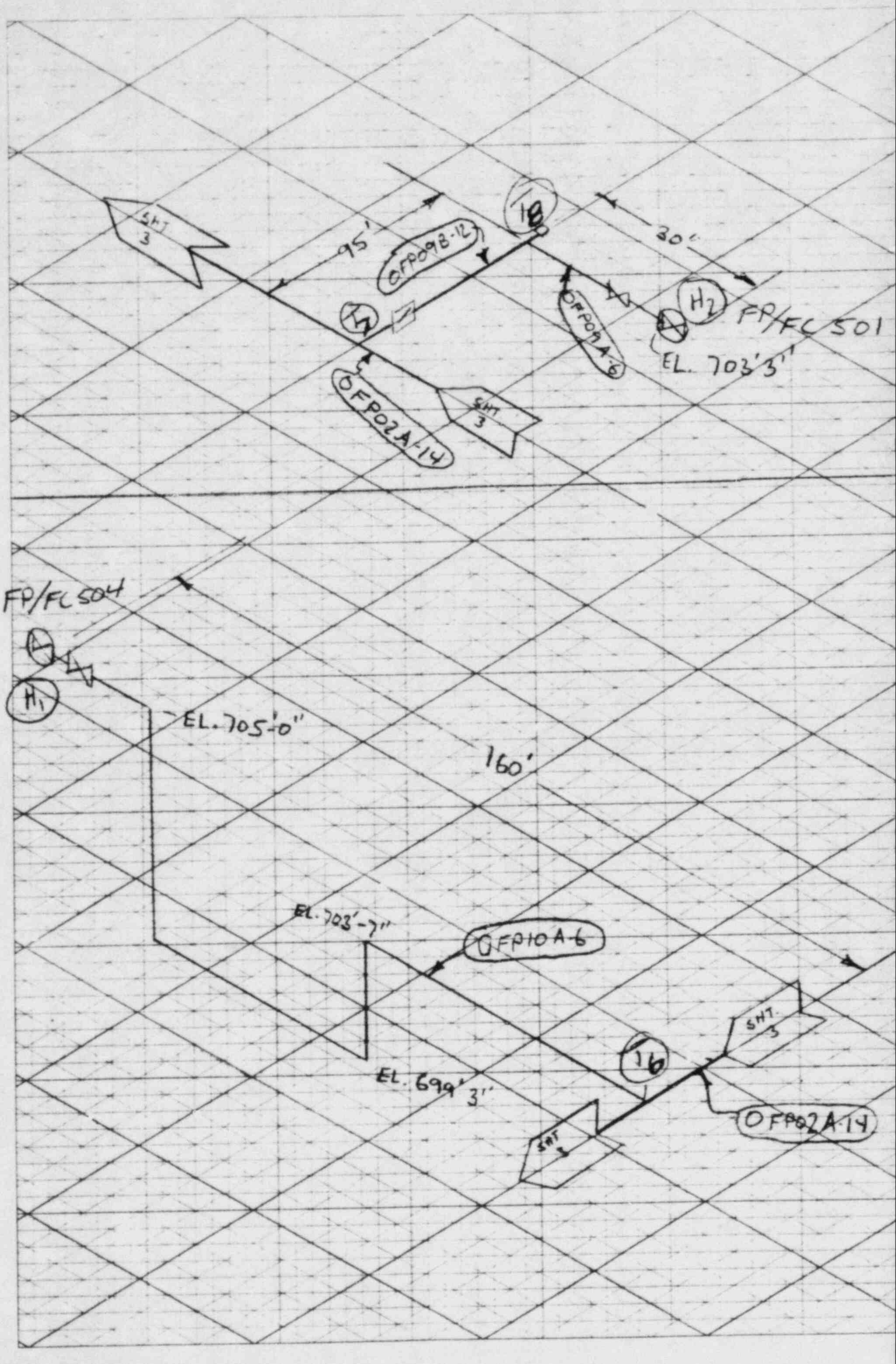

2WS03BB-42
2WS44A-12
0FP01AB-12
B
B
5'-5"
T3
45° -V
36×42 RED
45° EH
2WS03A-36
1'1/2"
42
3'-0"
EL. 705'-10"
11" (TYP)
24×20 RED ELBOW
2WS02CA-24
EL. 687'-6"
PUMP 2WS01PA
CB-24
6"
5' (TYP)
36×42 RED
2WS03RB-42
EL. 720'-9"
T3
2WS44A-12
0FP01AB-12
EL. 716'-9"
2'-8"
VIEW B-B
TO PAGE A-3
EL. 705'-10"
20'-9 1/2"
TO
2FP01A-12

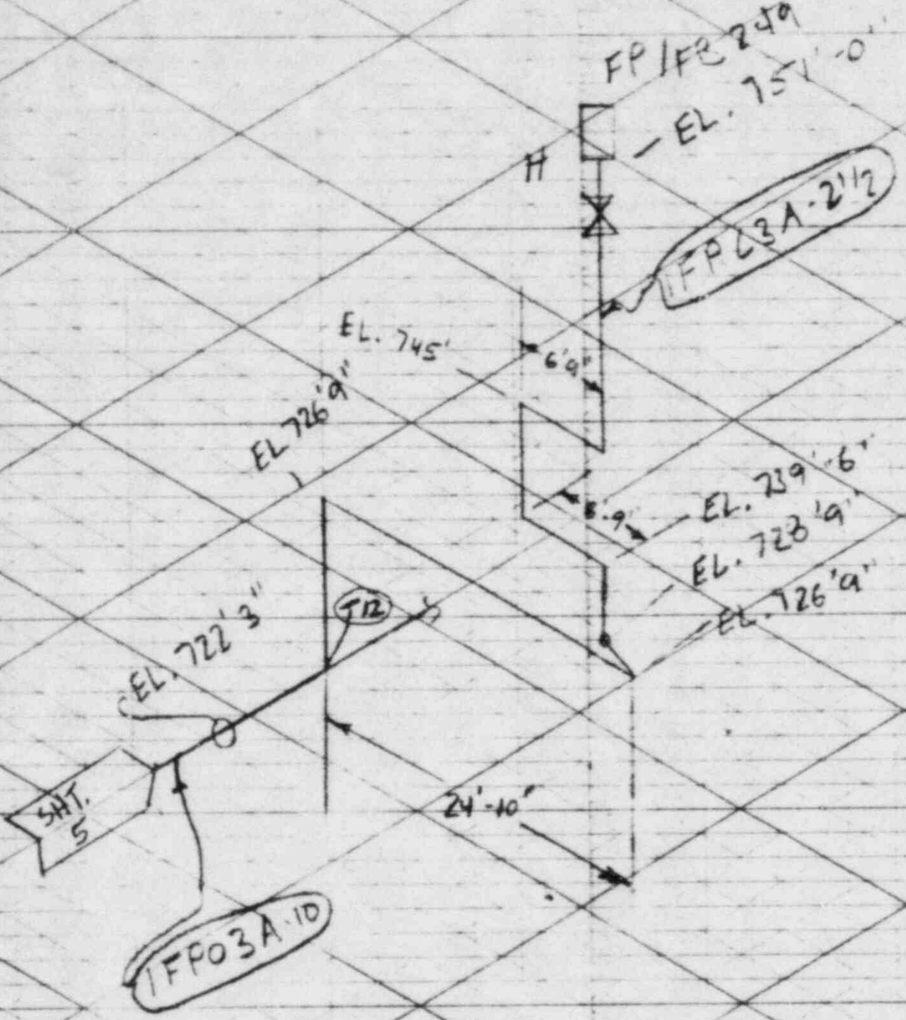

15.1'
12"
12"
FIRE PUMP
OFP01PB
LAKE SCREEN HOUSE
TO PAGE A-4 OUTDOOR PIPING
15'
FROM PAGE A-2


10.4'
5.5'

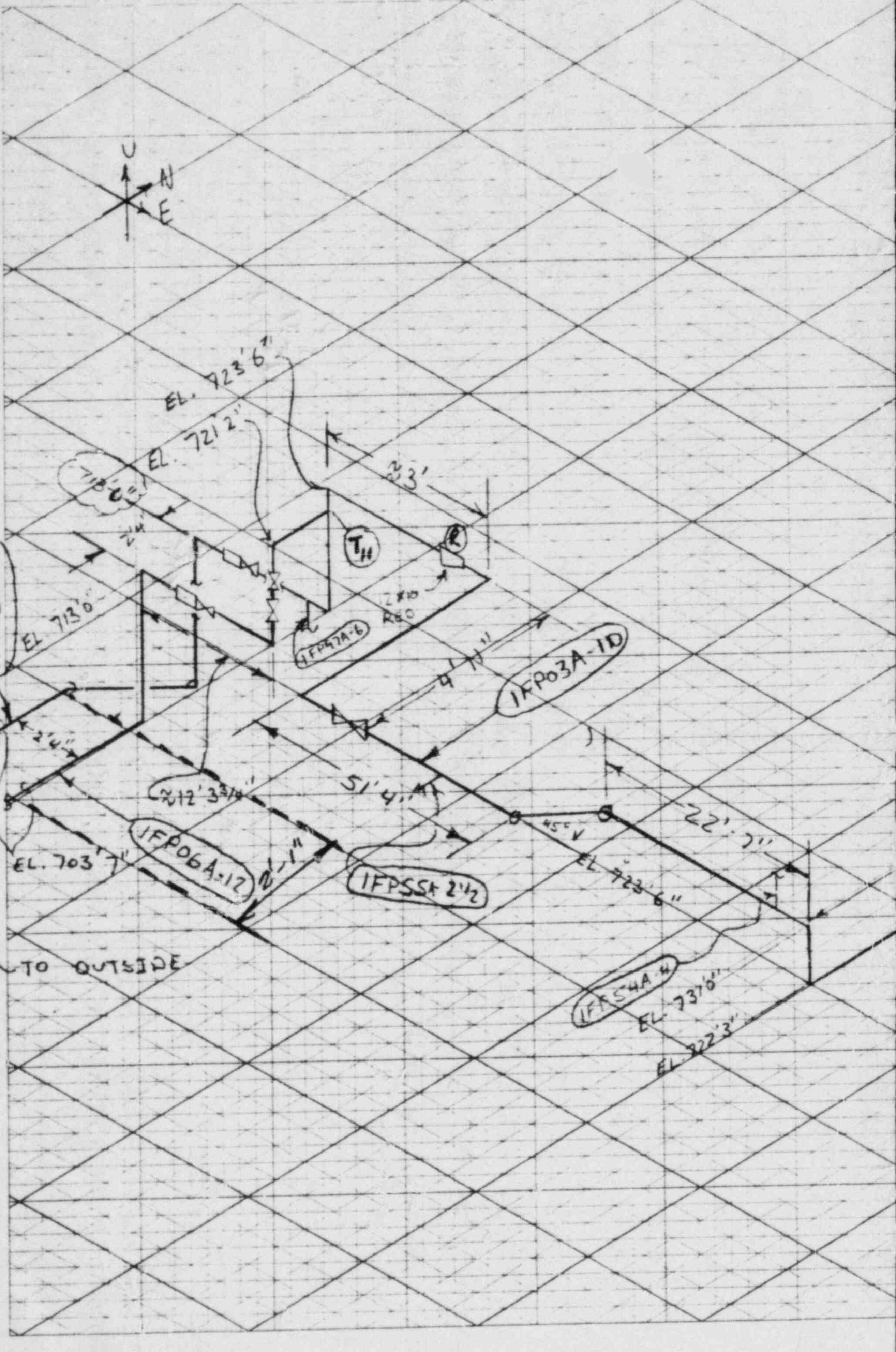

U
N
E
35'
220'
1FP02A-12
EL 697'0"
EL 702'4½"
0FP13A-12
4'
8
2"
1FP06A-12
632'
T10
T9
12"
EL. 703'
1FP07A-12
0FP88A-12
0FP09B-12
ON SHT. A-5
0FP10A-6
ON SHT. A-5
EL. 702'4½"
EL. 700
T7
115'
≈10
≈120'
175'
14×8 R
0FP53A-8

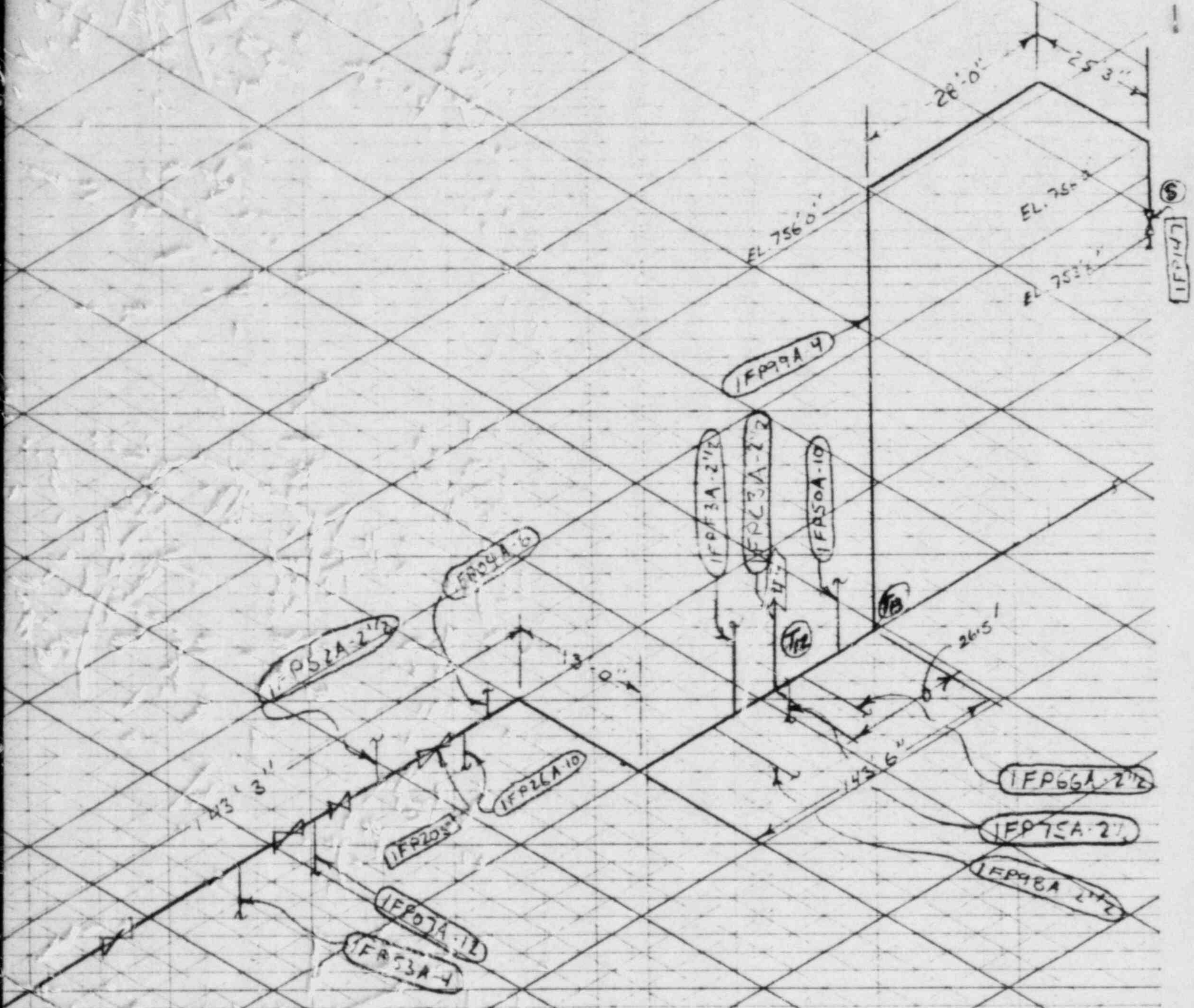

510'
ON SHT A-6
EL 703' 7"
EL. 688'
EL. 697'
EL. 688'
EL. 703' 7"
T5
OFP07A-6
580'
12x6 RED
2FP08A-T2
OFP08A-6
2-45° ELBOWS
OFP01A-T2
1FP08A-T2
OFP08A-6
[redacted]
290'
EL. 705' 10"
B
FROM SHT. A-3
T6
20'
T4


SHT 3
95'
OFP09B-12
18
30"
OFP09A-6
H2
FP/FC 501
EL. 703'3"
17
OFP02A-14
SHT 3
FP/FC504
H1
EL. 705'-0"
160'
EL. 703'-7"
OFP10A-6
EL. 699'3"
16
SHT. 3
OFP02A-14
SHT 3



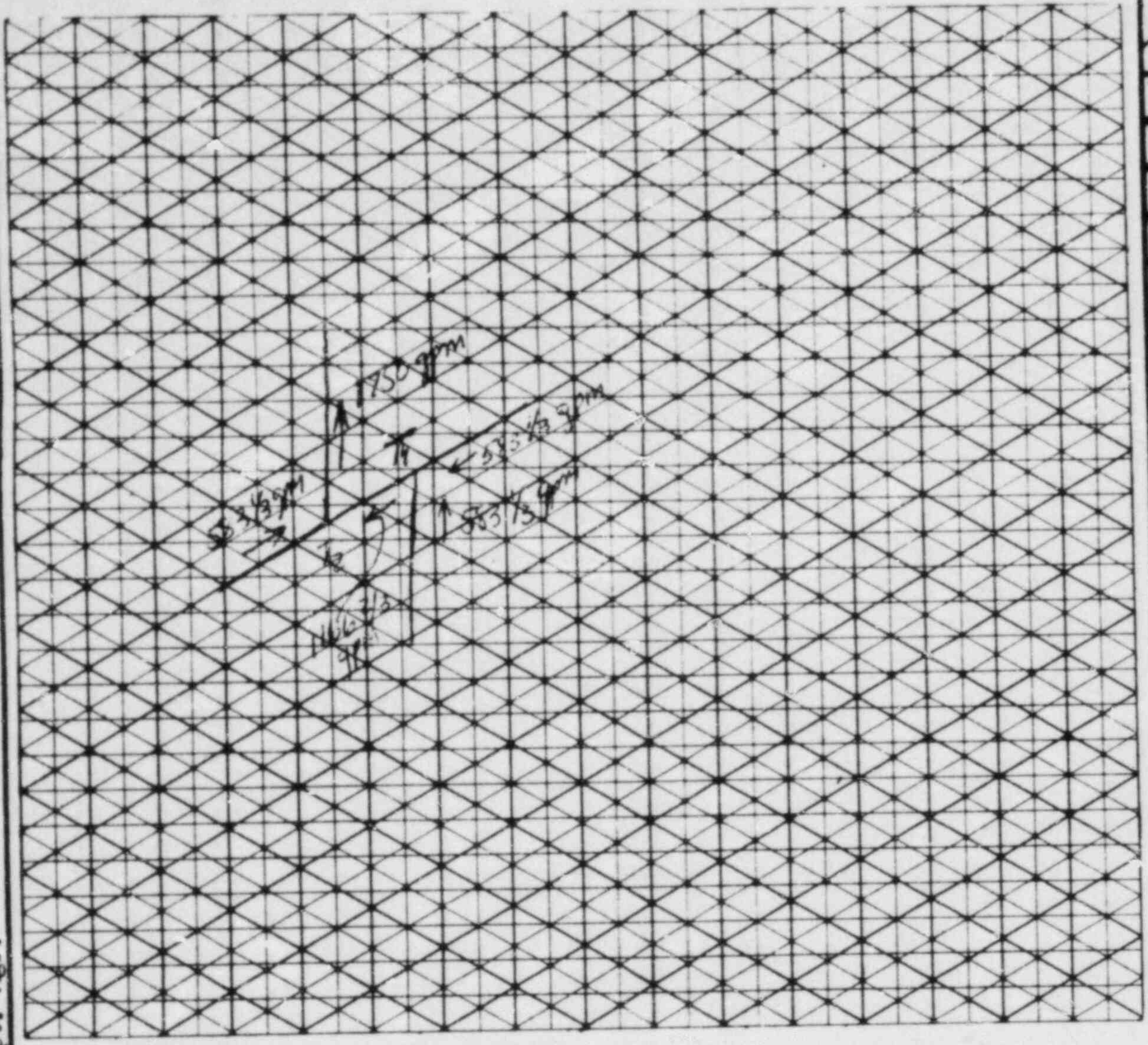
HOSE STATIONS FOR
CABLE SPREADING AREA


U
N
E
EL. 723'6"
EL. 721'2"
713'0"
3'
TH
R
12x10 RED
1FP02A-12
EL. 713'0"
1FP47A-6
4'11"
1FP03A-10
2'4"
%12'3 3/4"
51'4"
45° V
22'7"
EL. 703'7"
1FP06A-12
2'1"
1FP55A 2½
EL. 723'6"
1FP54A-4
EL. 737'0"
EL. 722'3"
TO OUTSIDE


28'-0"
25'3"
EL. 756'0"
EL. 75-3
EL. 753'3"
1FP147
1FP99A-4
1FP73A-2½
1FP63A-2½
4"
1FP50A-10
T12
T13
26'-5'
1FP94A-6
1FP52A-2½
13'-0"
143'-3"
1FP26A-10
1FP205
1FP07A-12
1FP53A-4
143'-6"
1FP66A-2½
1FP75A-2½
1FP98A-2½

SYSTEM ISOMETRIC

1. BASED ON P&ID DRAWING NUMBER M- ______________ DATED ________
2. BASED ON PIPING DRAWING NUMBER M- ______________ DATED ________



⬡ PROCESS FLOW DATA POINT

A. EQUIPMENT (HT. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

ΔH_A(FT)=

B. PIPI

(a) PAGE	ITEM	
7	3	90°
7	4	45°
7	5	STI
7	6	STI
6	1a	CON
6	4a	SWI
6	5a	DIS
		L/

1. TOTA
2. D (I
3. EQUI
4. STRA
5. TOTA
6. MARG
7. TOTA
8. FLOW
9. VELO
10. Δ H
11. TOTA
12. SIZE
13. LINE

SUM OF T

REFERENCES:
(a) MES-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES
(b) MES-2.10.1, MES-2.10.2 OR MES-2.10.3 PIPE SIZE SELECTION
(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

SYSTEM: ________

☐ SAFETY-RELATED
☐ NON-SAFETY-RELATED

PREPARED BY	
REVIEWED BY	
APPROVED BY	

Form MES-2.16.1 Approved by H A Wagner Dept. Mgr.
Rev. Orig. (2-1-73)

NG AND VALVES

DESCRIPTION (a)	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED				
LONG RAD. ELBOW	20	2/40				
LONG RAD. ELBOW	12					
. TEE (BRANCH FLOW)	60			1/60		
. TEE (RUN FLOW)	20					
V. GLOBE VALVE	340					
NG CHECK VALVE	135	1/135				
C GATE VALVE	13					
tterfly valves	40	1/40				
educer	0	1/0				
36 24 36 FLOW THRU BRANCH	50			1/50		
24 36 flow thru Run	13		1/13	1/13		
L L/D		215	13	123		
NSIDE DIAMETER) (FT)		1.9375	2.9167	2.9167		
V. STR. PIPE (1x2) (FT)		416.6	37.9	358.8		
IGHT PIPE (FT)		63.4	24.4	0		
L EQUIV. LENGTH (3+4) (FT)		480	62.3	358.8		
IN (______%)						
L (FT)		480	62	360		
(LB/HR) OR (GPM)		583.33	1166.67	583.33		
CITY v_a(b) (FPS)		.4405	.389	.195		
/100'(b) (FT/100 FT)		.005	.003	.001		
L ΔH (7x10) (FT)		.022	.002	.004		
S SELECTED		24	36	36		
NUMBER		2WS02BA	1WS04A	1WS04A		

OTAL ΔH (ITEM 11) FOR ALL SIZES, ΔH_B (FT)= 0.028

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT)

Reducer has negligible effect due very small velocities. 0

$$\Delta H = K \frac{v_a^2}{64.4}$$

D. CONTROL VALVES

PRC APERTURE CARD

Also Available On Aperture Card

ΔH_D (FT)=

$\Delta H_F = \Delta H_A + \Delta H_B + \Delta H_C + \Delta H_D$

ΔH_F(FT)= 0

PROJECT:________

CLIENT:________ JOB NO.________

CALC. NO.

MECHANICAL DEPARTMENT STANDARD

HEAD LOSS IN PIPING SEGMENT: ________

DATE

DATE

DATE

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SARGENT & LUNDY

REV. DATE

Page of

SYSTEM ISOMETRIC

1. BASED ON P&ID DRAWING NUMBER M-____________ DATED________
2. BASED ON PIPING DRAWING NUMBER M-____________ DATED________

PROCESS FLOW DATA POINT

A. EQUIPMENT (HT. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

STRAINER

≈ΔH= 1.0 ft

STRAINER
2W501F
conservative assumed
value of ΔHa.

ΔH_A(FT)= 1.0

B. PIPIN

(a) PAGE / ITEM	D
7 / 3	90°
7 / 4	45°
7 / 5	STD.
7 / 6	STD.
6 / 1a	CONV
6 / 4a	SWIN
6 / 5a	DISC
	8
	3
	Δ
	-

1. TOTAL
2. D (IN
3. EQUIV
4. STRAI
5. TOTAL
6. MARGI
7. TOTAL
8. FLOW
9. VELOC
10. Δ H/
11. TOTAL
12. SIZES
13. LINE

SUM OF TO

REFERENCES:
(a) MES-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES
(b) MES-2.10.1, MES-2.10.2 OR MES-2.10.3 PIPE SIZE SELECTION
(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

SYSTEM:________

☐ SAFETY-RELATED
☐ NON-SAFETY-RELATED

PREPARED BY	
REVIEWED BY	
APPROVED BY	

Form MES-2.16.1 Approved by H A Wagner Dept. Mgr.
Rev. Orig. (2-1-73)

G AND VALVES

ESCRIPTION (a)	(c) L/D	QUANTITY	L/D x QUANTITY OF FITTINGS FOR SIZES LISTED			
			T_2-T_3	[illegible]	T_2-T_3	T_3-T_4
LONG RAD. ELBOW	20		1 20			3 60
LONG RAD. ELBOW	12			1 12		
TEE (BRANCH FLOW)	60		1 60			1 60
TEE (RUN FLOW)	20					
. GLOBE VALVE	340					
G CHECK VALVE	135					1 135
GATE VALVE	13					1 13
terfly Valve	40		1 40	1 40		
x42 'RED				1 3		
12 42 Flowthru Branch	39					1 39
[illegible] 42	6				1 6	
L/D			120	52	6	307
SIDE DIAMETER) (FT)			2.917	2.917	3.42	1.0
. STR. PIPE (1x2) (FT)			350	151.7	20.52	307
GHT PIPE (FT)			26.25'	8	5.5	54.5
EQUIV. LENGTH (3+4) (FT)			376.3	159.7	26.0	361.5
N (______%)						
(FT)			376	160	26.0	362
(~~LB/HR~~) OR (GPM)			1750	1750	1750	1750
ITY v_a(b) (FPS)			.584	.584	.4252	4.964
100'(b) (FT/100 FT)			.006	.006	.073	1.1607
ΔH (7x10) (FT)			.023	.010	0	4.2
SELECTED			36"	36	42	12"
NUMBER			2WS02B	2WS03?	2WS03B	2WS44A OFP01A

TAL ΔH (ITEM 11) FOR ALL SIZES, ΔH_B (FT)= 4.233

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT)

36x42 RED ΔH=0
Due to small velocity

$$\Delta H = K \frac{v_a^2}{64.4}$$

D. CONTROL VALVES

ΔH_D (FT)=

$\Delta H_F = \Delta H_A + \Delta H_B + \Delta H_C + \Delta H_D$

1

ΔH_F(FT)≈ 5.2 ft

PROJECT:
CLIENT:________ JOB NO.________
CALC. NO.

DATE
DATE
DATE

FOR OFFICE USE ONLY - NOT TO BE SENT OUTSIDE OF SARGENT & LUNDY

MECHANICAL DEPARTMENT STANDARD

HEAD LOSS IN PIPING SEGMENT: ________

SARGENT & LUNDY
ENGINEERS

REV. | DATE

Page 1 of 1

SYSTEM ISOMETRIC

1. BASED ON P&ID DRAWING NUMBER M- ____________________ DATED __________
2. BASED ON PIPING DRAWING NUMBER M- ____________________ DATED __________

⬡ PROCESS FLOW DATA POINT

A. EQUIPMENT (HT. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

ΔH_A(FT)=

B. PIPING

(a) PAGE / ITEM	D
7 / 3	90° I
7 / 4	45° I
7 / 5	STD.
7 / 6	STD.
6 / 1a	CONV.
6 / 4a	SWIN
6 / 5a	DISC
	1 Bu
	1
	1
	J

1. TOTAL
2. D (INS
3. EQUIV.
4. STRAIG
5. TOTAL
6. MARGIN
7. TOTAL
8. FLOW
9. VELOCI
10. Δ H/1
11. TOTAL
12. SIZES
13. LINE N

SUM OF TOT

REFERENCES:
(a) MES-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES
(b) MES-2.10.1, MES-2.10.2 OR MES-2.10.3 PIPE SIZE SELECTION
(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

SYSTEM: ______________

☐ SAFETY-RELATED
☐ NON-SAFETY-RELATED

PREPARED BY		DA
REVIEWED BY		DA
APPROVED BY		DA

Form MES-2.16.1 Approved by H A Wagner Dept. Mgr.
Rev. Orig. (2-1-73)

AND VALVES

SCRIPTION (a)	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED $T_7 - T_9$	$T_6 - T_7$	$T_5 - T_6$	$T_4 - T_5$	
ONG RAD. ELBOW	20		3 / 60		1 / 20	
ONG RAD. ELBOW	12	4 / 48	2 / 24	2 / 24		
TEE (BRANCH FLOW)	60		1 / 60		1 / 60	
TEE (RUN FLOW)	20					
GLOBE VALVE	340					
CHECK VALVE	135					
GATE VALVE	13					
erfly Valve	40	3 / 120		6 / 240	2 / 80	
14 flow thru Run	18	4 / 72	2 / 36	4 / 72		
14 Flow thru Run	9		1 / 9	3 / 27		
14 Flow thru Branch	57				1 / 57	
/D		240	189	363	237	
IDE DIAMETER) (FT)		1.1042	1.1042	1.1042	1.0	
STR. PIPE (1x2) (FT)		265	208.7	400.8	237	
HT PIPE (FT)		123	528	457	870	
EQUIV. LENGTH (3+4) (FT)		388	736.7	857.8	1107	
(_______%)						
(FT)		388	737	858	1107	
~~(LB/HR)~~ OR [✓ (GPM)]		1250	1500	1750	1750	
TY v_a(b) (FPS)		2.91	3.49	4.07	4.9641	
00'(b) (FT/100 FT)		.385	.542	.723	1.160	
ΔH (7x10) (FT)		1.49	3.99	6.20	12.85	
SELECTED		14"	14"	14"	12"	
UMBER		OFP02A	OFP02A	OFP02A	2FP02A	

AL ΔH (ITEM 11) FOR ALL SIZES, ΔH_B (FT)= 24.5

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT)

$$\Delta H = K \frac{v_a^2}{64.4}$$

D. CONTROL VALVES

ΔH_D (FT)=

$$\Delta H_F = \underset{0}{\Delta H_A} + \Delta H_B + \underset{0}{\Delta H_C} + \underset{0}{\Delta H_D}$$

ΔH_F(FT)= 24.5 Ft.

PROJECT:
CLIENT: ________ JOB NO. ________
CALC. NO.

MECHANICAL DEPARTMENT STANDARD
HEAD LOSS IN PIPING SEGMENT: ________

TE
TE
TE

FOR OFFICE USE ONLY - NOT TO BE SENT OUTSIDE OF SARGENT & LUNDY

SARGENT & LUNDY ENGINEERS

REV. DATE

Page of

PAGE A-9

SYSTEM ISOMETRIC

1. BASED ON P&ID DRAWING NUMBER M- ____________ DATED ________
2. BASED ON PIPING DRAWING NUMBER M- ____________ DATED ________

⬡ PROCESS FLOW DATA POINT

A. EQUIPMENT (HT. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

2 STRAINERS "Y" TYPE
ASSUME PRESSURE DROP = 2 (.5) ft

ΔH_A(FT) = 1.0

B. PIPIN

(a) PAGE / ITEM	I
7 / 3	90°
7 / 4	45°
7 / 5	STD.
7 / 6	STD.
6 / 1a	CONV
6 / 4a	SWIN
6 / 5a	DISC

1. TOTAL
2. D (IN
3. EQUIV
4. STRAI
5. TOTAL
6. MARGI
7. TOTAL
8. FLOW
9. VELOC
10. Δ H/
11. TOTAL
12. SIZES
13. LINE
SUM OF TO

REFERENCES:
(a) MES-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES
(b) MES-2.10.1, MES-2.10.2 OR MES-2.10.3 PIPE SIZE SELECTION
(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

SYSTEM: ________
☐ SAFETY-RELATED
☐ NON-SAFETY-RELATED

PREPARED BY		D
REVIEWED BY		D
APPROVED BY		D

G AND VALVES

ESCRIPTION (a)	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED $T_{10} \to T_{11}$	$T_7 \to T_{11}$	$T_9 \to T$.		
LONG RAD. ELBOW	20	5 / 100	6 / 120'			
LONG RAD. ELBOW	12	9 / 108	10 / 120'			
TEE (BRANCH FLOW)	60		1 / 60'			
TEE (RUN FLOW)	20	1 / 20'				
. GLOBE VALVE	340					
G CHECK VALVE	135					
GATE VALVE	13	1 / 13'	3 / 39'			
12 flow thru run	10	1 / 10'	2 / 20'			
butterfly valve	40	1 / 40'	1 / 40	1 / [illegible]		
12 → 14 flow thru branch	57	1 / 57'	1 / 57			
12 → 14 flow thru run	18			2 / 36		

L/D	348'	456	76'		
SIDE DIAMETER) (FT)	1.0'	1.0'	1.1642		
. STR. PIPE (1x2) (FT)	348	456'	88.9'		
GHT PIPE (FT)	278'	273.6	4.1		
EQUIV. LENGTH (3+4) (FT)	626'	729.6	88'		
N (______%)					
(FT)	626	730'	88'		
(LB/HR) OR (GPM)	625	625'	625		
ITY v_a(b) (FPS)	1.7729	1.7729	1.45		
100'(b) (FT/100 FT)	.173	.173	.107		
ΔH (7x10) (FT)	1.08	1.26	.094		
SELECTED	12	12	14		
NUMBER	1FP07A	1FP06A	[illegible]		

TAL ΔH (ITEM 11) FOR ALL SIZES, ΔH_B (FT)= $\frac{1.08+1.26}{2}$. 0.94 + 1.26

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT)

$$\Delta H = K \frac{v_a^2}{64.4}$$

D. CONTROL VALVES

PRC APERTURE CARD

Also Available On Aperture Card

ΔH_D (FT)=

$\Delta H_F = \Delta H_A + \Delta H_B + \Delta H_C + \Delta H_D$

[illegible] 1.26

ΔH_F(FT) ≅ 2.3

	PROJECT:
	CLIENT: ________ JOB NO. ______
	CALC. NO.
ATE	FOR OFFICE USE ONLY - NOT TO BE SENT OUTSIDE OF SARGENT & LUNDY
ATE	
ATE	

MECHANICAL DEPARTMENT STANDARD

HEAD LOSS IN PIPING SEGMENT: ________

SARGENT & LUNDY ENGINEERS

REV. DATE

Page of

SYSTEM ISOMETRIC

1. BASED ON P&ID DRAWING NUMBER M- ____________ DATED ________
2. BASED ON PIPING DRAWING NUMBER M- ____________ DATED ________

⬡ PROCESS FLOW DATA POINT

A. EQUIPMENT (HT. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

ΔH_A(FT)=

B. PIPIN

(a) PAGE / ITEM	D
7 / 3	90°
7 / 4	45°
7 / 5	STD.
7 / 6	STD.
6 / 1a	CONV
6 / 4a	SWIN
6 / 5a	DISC

1. TOTAL
2. D (INS
3. EQUIV.
4. STRAIG
5. TOTAL(
6. MARGIN
7. TOTAL
8. FLOW
9. VELOCI
10. Δ H/
11. TOTAL
12. SIZES
13. LINE N

SUM OF TOT

REFERENCES:
(a) MES-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES
(b) MES-2.10.1, MES-2.10.2 OR MES-2.10.3 PIPE SIZE SELECTION
(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

SYSTEM: ____________

☐ SAFETY-RELATED
☐ NON-SAFETY-RELATED

PREPARED BY		DA
REVIEWED BY		DA
APPROVED BY		DA

Form MES-2.16.1 Approved by ________ Dept. Mgr.
Rev. Orig. (2-1-73)

G AND VALVES

		QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED				
ESCRIPTION (a)	(c) L/D	T_{12} - H_1	T_6 - H_1	T_7 - T_8	T_8 - H_2	
LONG RAD. ELBOW	20	5 100	4 80			
LONG RAD. ELBOW	12	1 12				
TEE (BRANCH FLOW)	60					
TEE (RUN FLOW)	20					
. GLOBE VALVE	340					
G CHECK VALVE	135					
GATE VALVE	13	1 13	1 13		1 13	
10 Flow thru Branch	37.5	1 37.5				
16 14 Flow thru Branch	44		1 44			
12 Flow thru Branch	45				1 45	
erfly Valve	40			1 40		
12 14 Flow thru Branch	56			1 56		
L/D		162.5	137	96	58	
IDE DIAMETER)	(FT)	.194	.5054	1.0	.5054	
STR. PIPE (1x2)	(FT)	31.5	69.2	96	29.3	
HT PIPE	(FT)	68	170	95	30	
EQUIV. LENGTH (3+4)	(FT)	100	239.2	191	79.3	
(______%)						
	(FT)	100	239.2	191	79.3	
(~~LB/HR~~) OR [✓ (GPM)]		125	125	125	125	
TY v_a(b)	(FPS)	9.5	1.40	<.57	140	
00'(b)	(FT/100 FT)	26.5	.24	<.021	.24	
ΔH (7x10)	(FT)	26.5	.574	<.04	.19	
SELECTED		2½"	6"	12"	6"	
UMBER		1FF63A	OFP10A	OFP09B	OFP07A	

AL ΔH (ITEM 11) FOR ALL SIZES, ΔH_B (FT)=

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT)

PRC APERTURE CARD

$$\Delta H = K \frac{v_a^2}{64.4}$$

D. CONTROL VALVES

ΔH_D (FT)=

$\Delta H_F = \Delta H_A + \Delta H_B + \Delta H_C + \Delta H_D$

ΔH_F(FT)=

PROJECT:__________

CLIENT:__________ JOB NO.__________

CALC. NO.

MECHANICAL DEPARTMENT STANDARD

HEAD LOSS IN PIPING SEGMENT: __________

TE

TE

TE

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SARGENT & LUNDY
ENGINEERS

REV. DATE

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Form MES-2.16.1 Approved by ______ Dept. Mgr.
Rev. Orig. (2-1-73)

SYSTEM ISOMETRIC

1. BASED ON P&ID DRAWING NUMBER M- ____________________ DATED __________
2. BASED ON PIPING DRAWING NUMBER M- ____________________ DATED __________

PROCESS FLOW DATA POINT

A. EQUIPMENT (HT. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

ΔH_A(FT)=

B. PIPIN

(a) PAGE / ITEM	I
7 / 3	90°
7 / 4	45°
7 / 5	STD.
7 / 6	STD.
6 / 1a	CONV
6 / 4a	SWIN
6 / 5a	DISC
	FLO 10=
	FLO
	F
	FL
	FO
	Flo
	Ri

1. TOTAL
2. D (IN
3. EQUIV
4. STRAI
5. TOTAL
6. MARGI
7. TOTAL
8. FLOW
9. VELOC
10. Δ H/
11. TOTAL
12. SIZES
13. LINE
SUM OF TO

REFERENCES:
(a) MES-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES
(b) MES-2.10.1, MES-2.10.2 OR MES-2.10.3 PIPE SIZE SELECTION
(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

SYSTEM: ______

☐ SAFETY-RELATED
☐ NON-SAFETY-RELATED

PREPARED BY	
REVIEWED BY	
APPROVED BY	

G AND VALVES

ESCRIPTION (a)	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED: T3→S	T12→T3	R→T2	T4→1	
LONG RAD. ELBOW	20	3 / 60		6 / 120	1 / 20	
LONG RAD. ELBOW	12	0		2 / 24		
TEE (BRANCH FLOW)	60	0				
TEE (RUN FLOW)	20	0	1 / 20	2 / 40	1 / 20	
. GLOBE VALVE	340	0		0		
G CHECK VALVE	135	0		0		
GATE VALVE	13			8 / 104		
thru branch 14 — 10	42	1 / 42				
thru run 10	12		1 / 12			
10 3½ thru run 10	5		3 / 15	8 / 40		
thru run 10 14 10	8			2 / 16		
thru run 20 10	16			1 / 16		
thru run 10	12			1 / 12		
ducer	0				1 / 0	
L/D		102	47	372	40	
SIDE DIAMETER) (FT)		.3350	.8350	.835	1.0	
. STR. PIPE (1x2) (FT)		34.2	39.24	310.6	40	
GHT PIPE (FT)		89.5	26.5	371.5	5.33	
EQUIV. LENGTH (3+4) (FT)		123.7	65.74	682.1	45.3	
N (_______%)						
(FT)		124	66	682	45	
(LB/HR) OR (GPM)		1000	1125	1250	1250	
ITY v_a(b) (FPS)		35.2	4.58	5.09	3.55	
/100'(b) (FT/100 FT)		84.3	1.1223	1.5	.623	
ΔH (7x10) (FT)		104.53	.741	10.23	.28	
SELECTED		4	10	10	12	
NUMBER		1FP04	1FP03A	1FP03A	1FP02A	

TAL ΔH (ITEM 11) FOR ALL SIZES, ΔH_B (FT)= 115.8

C. ENTRANCE/EXIT LOSSES AND CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT) 0

12x10 reducer has negligible ΔH due to small velocity

$$\Delta H = K \frac{v_a^2}{64.4}$$

D. CONTROL VALVES

ΔH_D (FT)= 0

$$\Delta H_F = \cancel{\Delta H_A} + \Delta H_B + \cancel{\Delta H_C} + \Delta H_D$$

ΔH_F(FT)= 116 ft

PROJECT:

CLIENT: JOB NO.

CALC. NO.

MECHANICAL DEPARTMENT STANDARD

HEAD LOSS IN PIPING SEGMENT:

DATE

DATE

DATE

FOR OFFICE USE ONLY - NOT TO BE SENT OUTSIDE OF SARGENT & LUNDY

SARGENT & LUNDY
ENGINEERS

REV. DATE

Page of

SYSTEM ISOMETRIC

1. BASED ON P&ID DRAWING NUMBER M- ____________ DATED ____________
2. BASED ON PIPING DRAWING NUMBER M- ____________ DATED ____________

⬡ PROCESS FLOW DATA POINT

A. EQUIPMENT (HT. EXCH., FILTERS, STRAINERS, FLOW NOZZLES, ETC.)

ΔH_A(FT)= 0

B. PIPIN

(a) PAGE / ITEM	
7 / 3	90°
7 / 4	45°
7 / 5	STD
7 / 6	STD
6 / 1a	CON
6 / 4a	SWI
6 / 5a	DIS

1. TOTA
2. D (I
3. EQUI
4. STRA
5. TOTA
6. MARG
7. TOTA
8. FLOW
9. VELO
10. Δ H
11. TOTA
12. SIZE
13. LINE

SUM OF T

REFERENCES:
(a) MES-2.16 PIPING - PRESSURE DROP THROUGH FITTINGS, VALVES AND DISCONTINUITIES
(b) MES-2.10.1, MES-2.10.2 OR MES-2.10.3 PIPE SIZE SELECTION
(c) IF BACKING RINGS ARE OMITTED L/D CAN BE REDUCED BY 20% FOR ELBOWS

SYSTEM: ____________
☐ SAFETY-RELATED
☐ NON-SAFETY-RELATED

PREPARED BY	
REVIEWED BY	
APPROVED BY	

Form MES-2.16.1 Approved by Dept. Mgr.
Rev. Orig. (2-1-73)

G AND VALVES FROM FIRE Pump To T4

ESCRIPTION (a)	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED				
LONG RAD. ELBOW	20	3 / 60				
LONG RAD. ELBOW	12					
TEE (BRANCH FLOW)	60	1 / 60				
TEE (RUN FLOW)	20	2 / 40				
V. GLOBE VALVE	340					
NG CHECK VALVE	135	1 / 135				
C GATE VALVE	13	1 / 13				

L L/D	308				
NSIDE DIAMETER) (FT)	1.0				
V. STR. PIPE (1x2) (FT)	308				
IGHT PIPE (FT)	42.1				
L EQUIV. LENGTH (3+4) (FT)	350				
IN (________%)					
L (FT)	350				
(LB/HR) OR (GPM)	1750				
CITY v_a(b) (FPS)					
/100'(b) (FT/100 FT)	1.16				
L ΔH (7x10) (FT)	4.1				
S SELECTED	12				
NUMBER	OFP01AC				

OTAL ΔH (ITEM 11) FOR ALL SIZES, ΔH_B (FT)= 4.1

C. ENTRANCE/EXIT LOSSES AN
CHANGES IN PIPE SECTION

(a) PAGE	DESCRIPTION	LINE SIZE	K	v_a^2 (FPS)	ΔH (FT.)

ΔH_C (FT) 0

$$\Delta H = K \frac{v_a^2}{64.4}$$

D. CONTROL VALVES

0

ΔH_D (FT)=

$$\Delta H_F = \cancel{\Delta H_A} + \Delta H_B + \cancel{\Delta H_C} + \cancel{\Delta H_D}$$

ΔH_F(FT)= 4.1

MECHANICAL DEPARTMENT STANDARD

HEAD LOSS IN PIPING SEGMENT: ____________

PROJECT: ____________
CLIENT: ____________ JOB NO. ____________
CALC. NO.

DATE
DATE
DATE

FOR OFFICE USE ONLY - NOT TO BE SENT OUTSIDE OF SARGENT & LUNDY

SARGENT & LUNDY ENGINEERS

REV. DATE

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