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

lm

Enclosure

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

B002
1/1
DRAWINGS TO REG FILE

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.

7538N

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 <u>SUMMARY</u> (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.

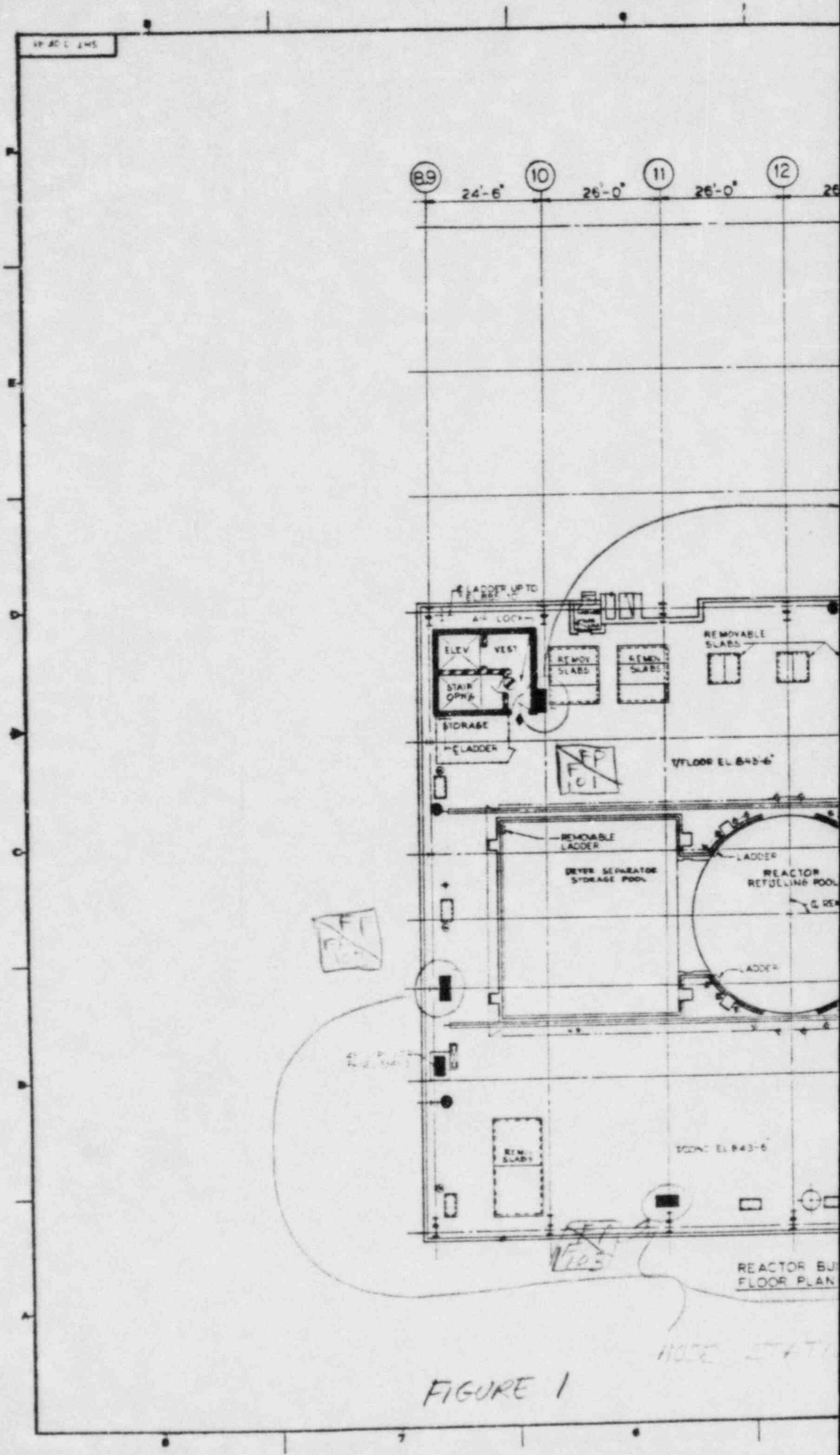
The Service Water System is concluded to be adequate to provide the water supply to the Fire Protection System based upon the calculations and Figure 3. A pressure transmitter and indicator on the WS piping can be used to determine when adequate pressure is achieved.

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).

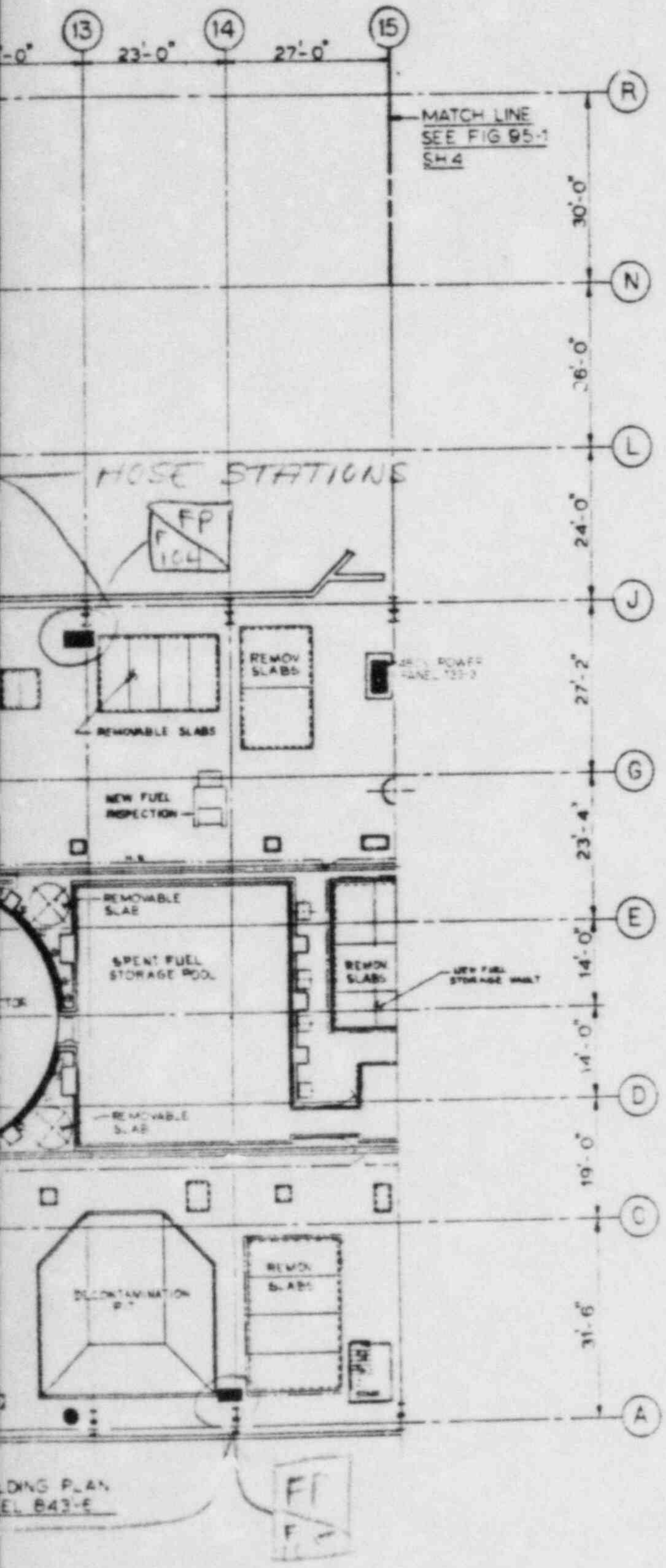
In order to provide adequate water supply to the FP system, the WS pumps must be backed up on their characteristic curve. By doing this, the capacity is sacrificed and as such, will require the operator to shed load. Although one WS pump can provide the necessary flow, it would be prudent to operate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

APPENDIX A



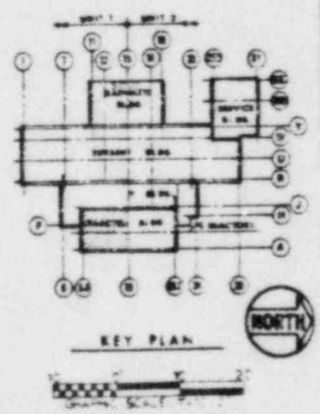
8.9
10
11
12
24'-6"
26'-0"
26'-0"
LADDER UP TO
AIR LOCK
ELEV
VEST
STAIR OPNG
STORAGE
REMOV SLABS
REMOVABLE SLABS
T/FLOOR EL 843'-6"
REMOVABLE LADDER
DRYER SEPARATOR STORAGE POOL
LADDER
REACTOR REFUELING POOL
REACTOR BU
FLOOR PLAN

FIGURE 1



PRC APERTURE CARD

Also Available On Aperture Card



8311040130-01

LA SALLE COUNTY STATION

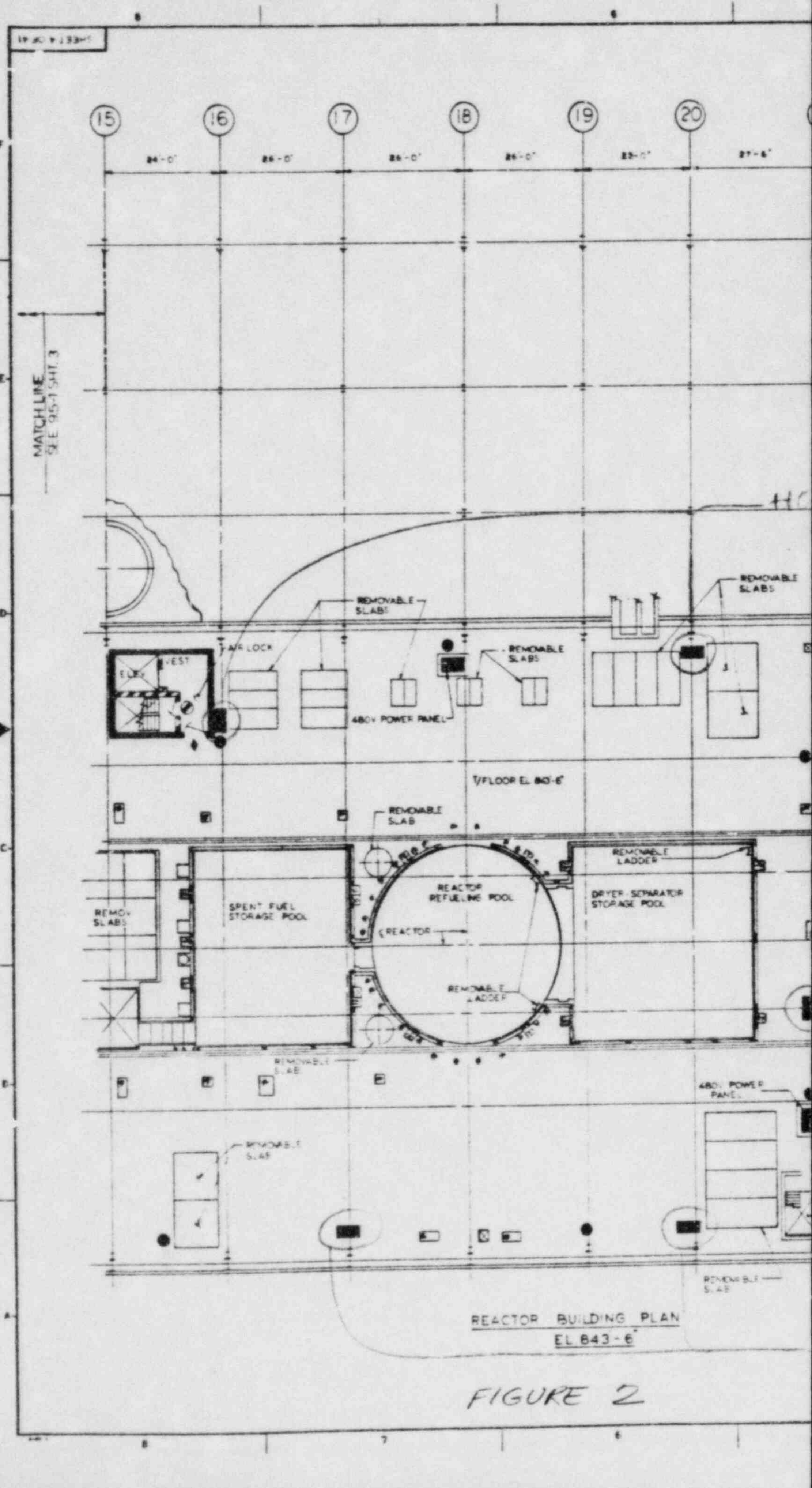
FINAL SAFETY ANALYSIS REPORT

FIGURE 9.5-1

FIRE PROTECTION SYSTEM

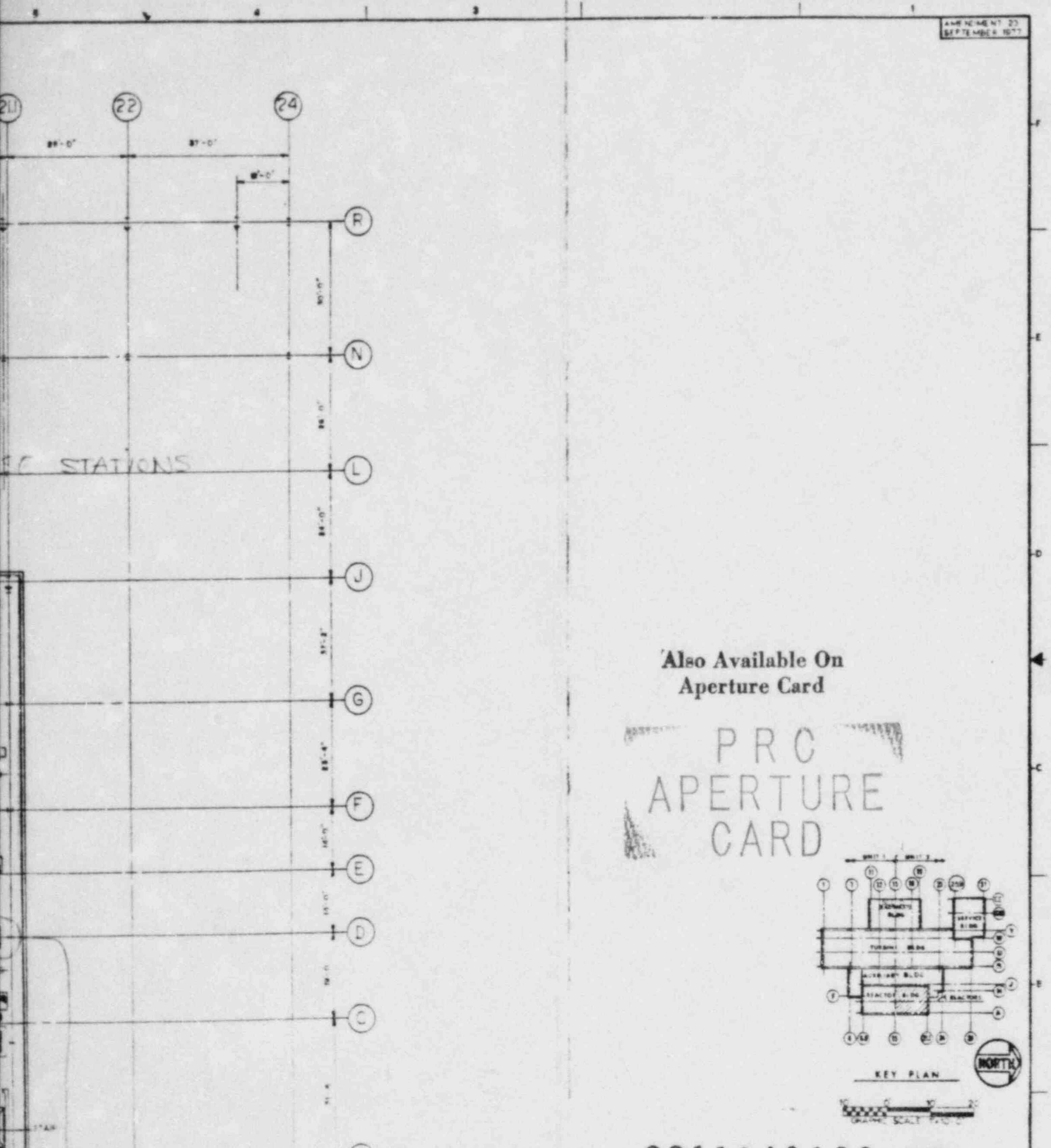
(SHEET 3 OF 4)

PAGE 8



REACTOR BUILDING PLAN
EL 843'-6"

FIGURE 2



Also Available On
Aperture Card

8311040130-02

LA SALLE COUNTY STATION

FINAL SAFETY ANALYSIS REPORT

FIGURE 9.5-1

FIRE PROTECTION SYSTEM

SHEET 4 OF 11

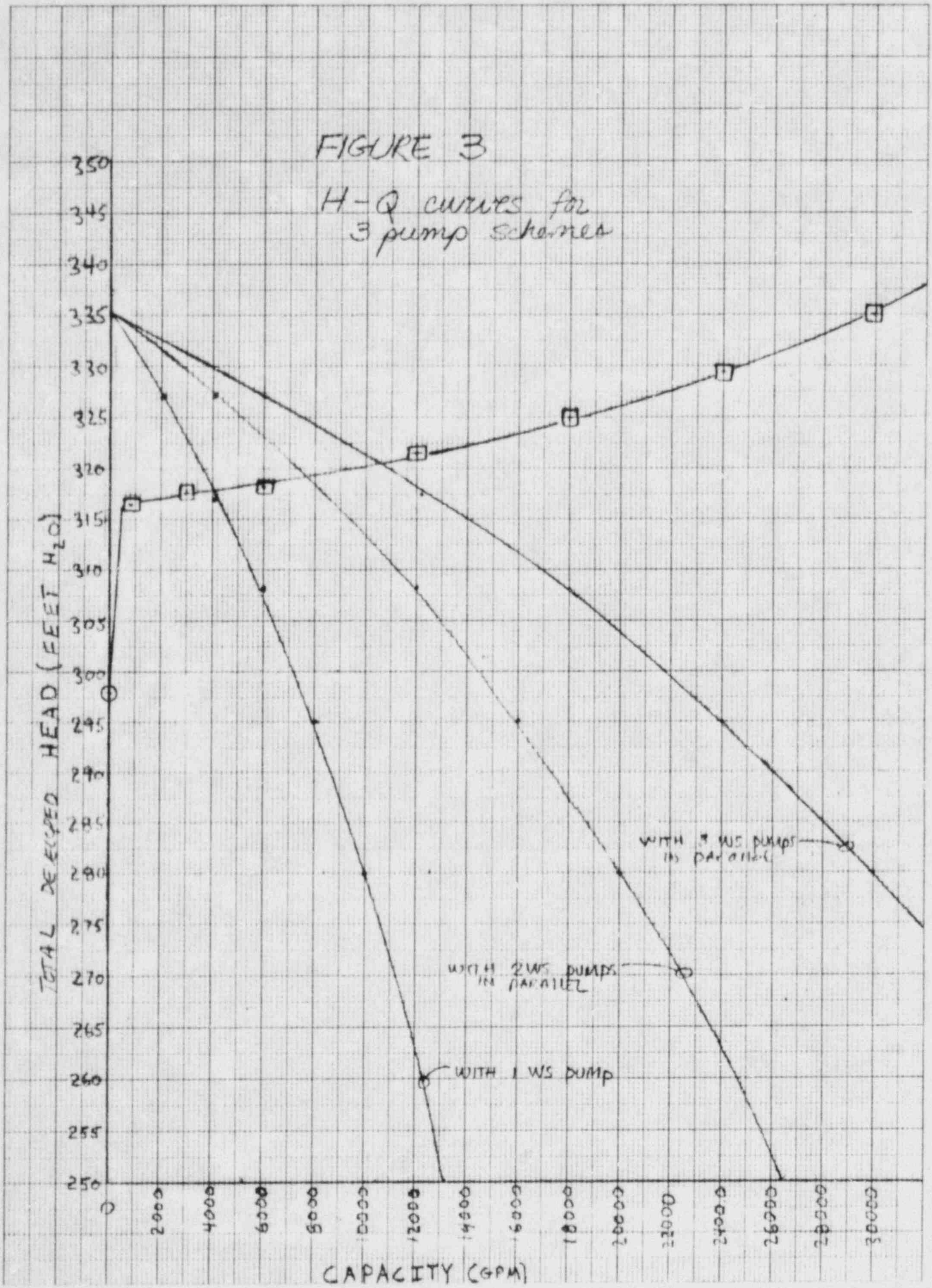
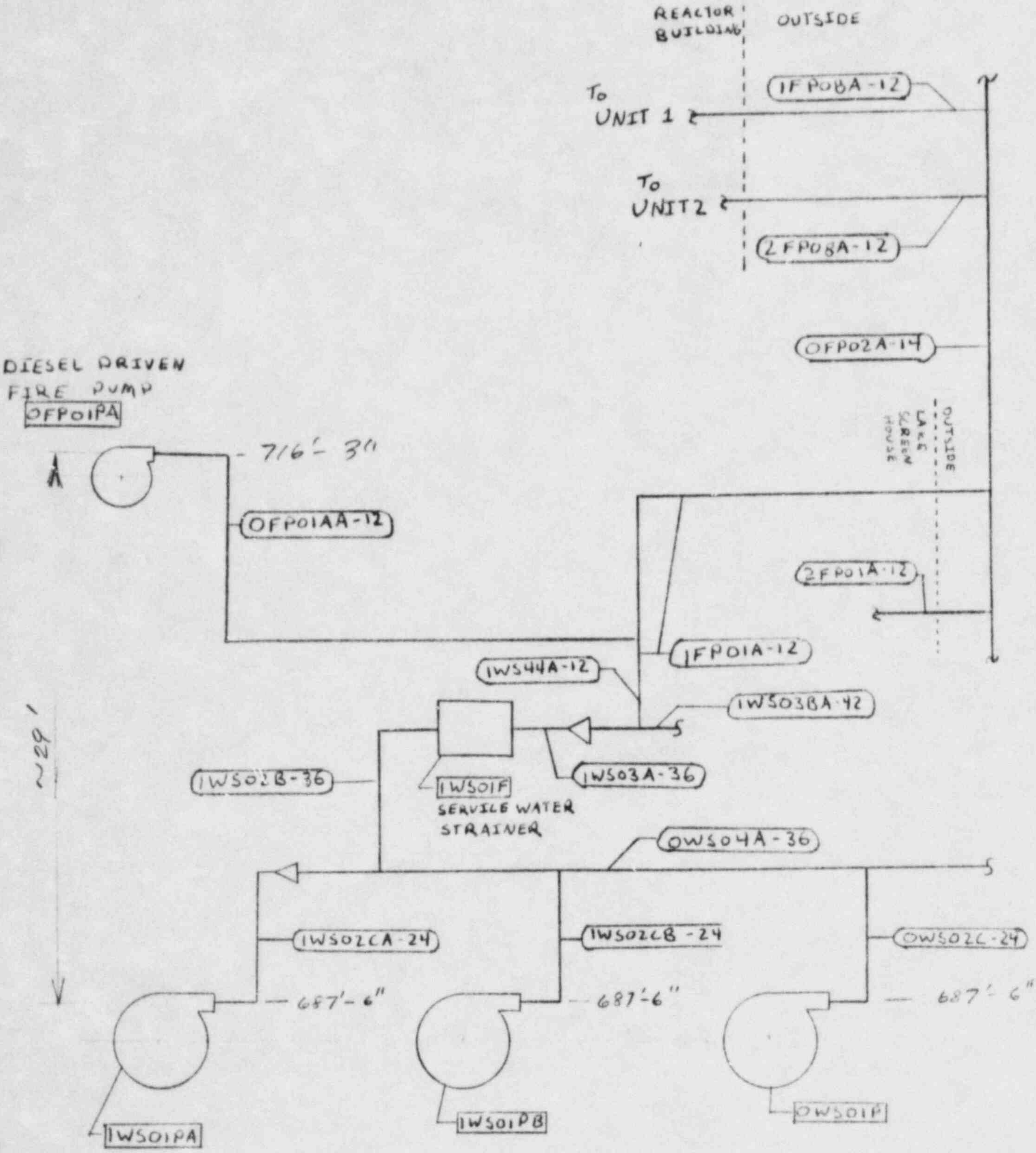


FIGURE 3
H-Q curves for
3 pump schemes
TOTAL DEVELOPED HEAD (FEET H_2O)
350
345
340
335
330
325
320
315
310
305
300
295
290
285
280
275
270
265
260
255
250
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
24000
26000
28000
30000
CAPACITY (GPM)
WITH 3 WS PUMPS IN PARALLEL
WITH 2 WS PUMPS IN PARALLEL
WITH 1 WS PUMP



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 ^STRAINER 1WS01F = 1 ft H_2O

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] But
1.	TOTAL
2.	D (INSI
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 1USC14A TO POINT A

(a) DESCRIPTION	(c) L/D	QUANTITY PUMP A	L/D x QUANTITY OF FITTINGS FOR SIZES LISTED	– 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				
…LOBE VALVE	340	0				
…HECK VALVE	135	1/135				
…ATE VALVE	13	0				
…full …flex…	40	1/40			2/80	
…/D		235		60	152	
…DE DIAMETER) (FT)		1.9375		2.9167	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: .291

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

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

ΔH_F(FT)= 2.0 ft

FOR OFFICE USE ONLY
NOT TO BE SENT OUTSIDE OF
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 ___ OF 8

8311040130-03

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
RWFCIF = 2.0 ft H_2O

ΔH_A(FT) = 2.0

B. PIPING

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

A) - [illegible] 1/2

3 pumps in parallel

AND VALVES From [illegible], [illegible] to [illegible]

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		1	
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	2.967	
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)	3.0[illegible] (*)	1.6[illegible] (*)	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				[illegible]	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

8311040130-04

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
70/3.1.1 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. ...
6 / 4a	SWING ...
6 / 5a	DISC G...
8 / B	"Fittin... SIZ...
	(CRAN... Butter...
8 / A	12-14 ... Lon...
8 / B	12" ... 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~~, ~~ME-2.13~~, OR ~~ME-2.14~~ PIPE SIZE SELECTION (ME-2.10.1, 2.10.2, 2.10.3)
(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"

SCRIPTION (a)	(c) L/D	QUANTITY	L/D x QUANTITY OF FITTINGS FOR SIZES LISTED			FITTING 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) fly Valves - fully open	40		1 / 40	2 / 80	1 / 40	2 / 80
duced Size Branch Three Run	54					1 / 54
duced 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 (*)	.068 (*)	.15 (*)
ΔH (5x10)	(FT)	.54	2.3	.22	.274	.60
ELECTED		12	12	14	12	14
MBER		1WS44A	1FP01A	0FP02A	1FP01A	0FP02A

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

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

ΔH_F(FT)= 4.16 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 3 OF 8

8311040130-05

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 / B	12-8 F Fitti
8 / B	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 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, 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 3-8, 14th Ed.

-103- "

ND VALVES						
	(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 Br	50	1 / 50	0			
low thru Branch w/Reduced Br	53		1 / 53			
Flow thru Run	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		
T 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		
D'(b) (FT/100 FT)		0.191	.10 (*)	7.55		
H (~~5~~x10) (FT)		.169	.21	1.1476		
ELECTED		8	6	2 1/2		
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

ΔH_D (FT)= 0

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

ΔH_F(FT)= 1.52

FOR OFFICE USE ONLY
NOT TO BE SENT OUTSIDE OF
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 4 OF 8

8311040130-06

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 / B	8-6 reduc
8 / B	6-2 1/2 bran
8 / A	8-4 run
8 / A	8-2 1/2
8 / A	6-4 redu
8 / A	6-2 1/2
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

AND VALVES

DESCRIPTION (a)	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED: F → G	G → I			
...NG 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/ Branch	46	1 / 46	0	0		
Flow thru Branch fitting w/Branch	53	0	1 / 53	0		
...flow thru ...ch	42	0	1 / 42	0		
...flow thru	30	3 / 90	0	0		
... flow thru ...	20	1 / 20	0	0		
...flow thru	40		1 / 40	0		
... flow thru run	25		2 / 50	0		
...L/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		
...D'(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

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

D. CONTROL VALVES

ΔH_D (FT)= 0

$\Delta H_F = \Delta H_A + \Delta H_B + \Delta H_C + \Delta H_D$ (with ΔH_A marked 0, and ΔH_C, ΔH_D struck out)

ΔH_F(FT)= 13.7 ck

FOR OFFICE USE ONLY
NOT TO BE SENT OUTSIDE OF
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

FA/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. GI
6 / 4a	SWING CH
6 / 5a	DISC GA
8 / A	Flow 8-6
8 / A	Flow T 8-4
8 / E	flow T 8-2
8 / E	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 ΔH = 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 38, 39

ME-2.29 5-72

ND VALVES

-104-

CRIPTION (a)	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED				
		G		→ H		
G RAD. ELBOW	20	2 / 40	8 / 160	3 / 60	4 / 80	
G RAD. ELBOW	12	0	2 / 24	2 / 24	0	
E (BRANCH FLOW)	60	0	1 / 60	0	0	
E (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	
thru run	30	1 / 30	0	0	0	
thru run	20	0	2 / 40	0	0	
thru branch	53	0	0	1 / 53	0	
thru 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)	0.022	0.022	.10(*)	7.55	
H (5x10)	(FT)	0.04	0.08	.139	4.98	
LECTED		8	8	6	2½	
BER		1FP?A	1FP92A	1FP??	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

PRC APERTURE CARD

Also Available On Aperture Card

ΔH_D (FT)= 0

$\Delta H_P = \Delta H_A + \Delta H_B + \Delta H_C + \Delta H_D$ (0, 0, 0)

ΔH_P(FT)= 5.24 ok

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 6 OF 8

8311040130-08

PAGE A-6

SYSTEM ISOMETRIC

FP 102

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 EQ
6.	MARGIN
7.	TOTAL
8.	FLOW
9.	VELOCITY
10.	Δ H/100
11.	TOTAL Δ
12.	SIZES S
13.	LINE NUM
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, pgs 3-39, 14th Ed.

-107-

ND VALVES

CRIPTION (a)	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED: B-C	C-D?	→ E		
G RAD. ELBOW	20	3 60	3 60	20		
G RAD. ELBOW	12	5 60	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		
flow thru run	30	3 90	0	0		
flow thru run	46	1 46	0	0		
flow 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		1FP08B	1FP79A	1FP71B	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

6 x 2½ 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

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

(0) (6.45) (0.3) (0)

ΔH_F(FT) = ~6.8

FOR OFFICE USE ONLY NOT TO BE SENT OUTSIDE OF 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

8311040130-09

PAGE A-7

SYSTEM ISOMETRIC FP101

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 / A	6-2½
8 / B	6-2½
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	
SUM OF TOT	

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 39, 8th Ed.

ND VALVES

—101—

CRIPTION (A)	(c) L/D	QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED: C			>D	
G RAD. ELBOW	20	5 / 100	1 / 20	2 / 40	2 / 40	
NG 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

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)= 3.3 ok

HEAD LOSS IN PIPING SEGMENT: ____

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

PROJECT ____
CLIENT ____ JOB NO. ____

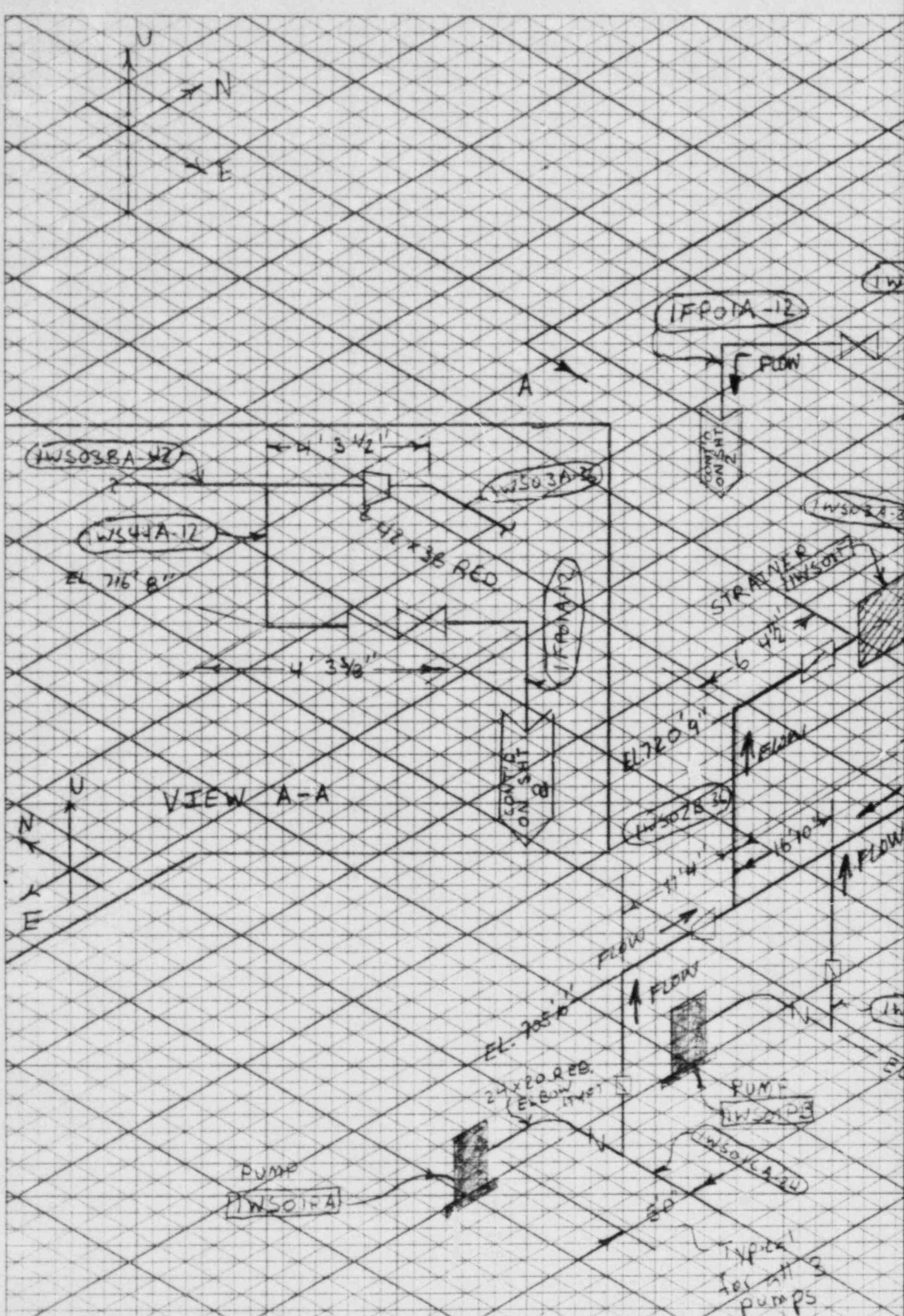
DESIGN BY:		DATE:	
CHECKED BY:		DATE:	
REVISED BY:		DATE:	

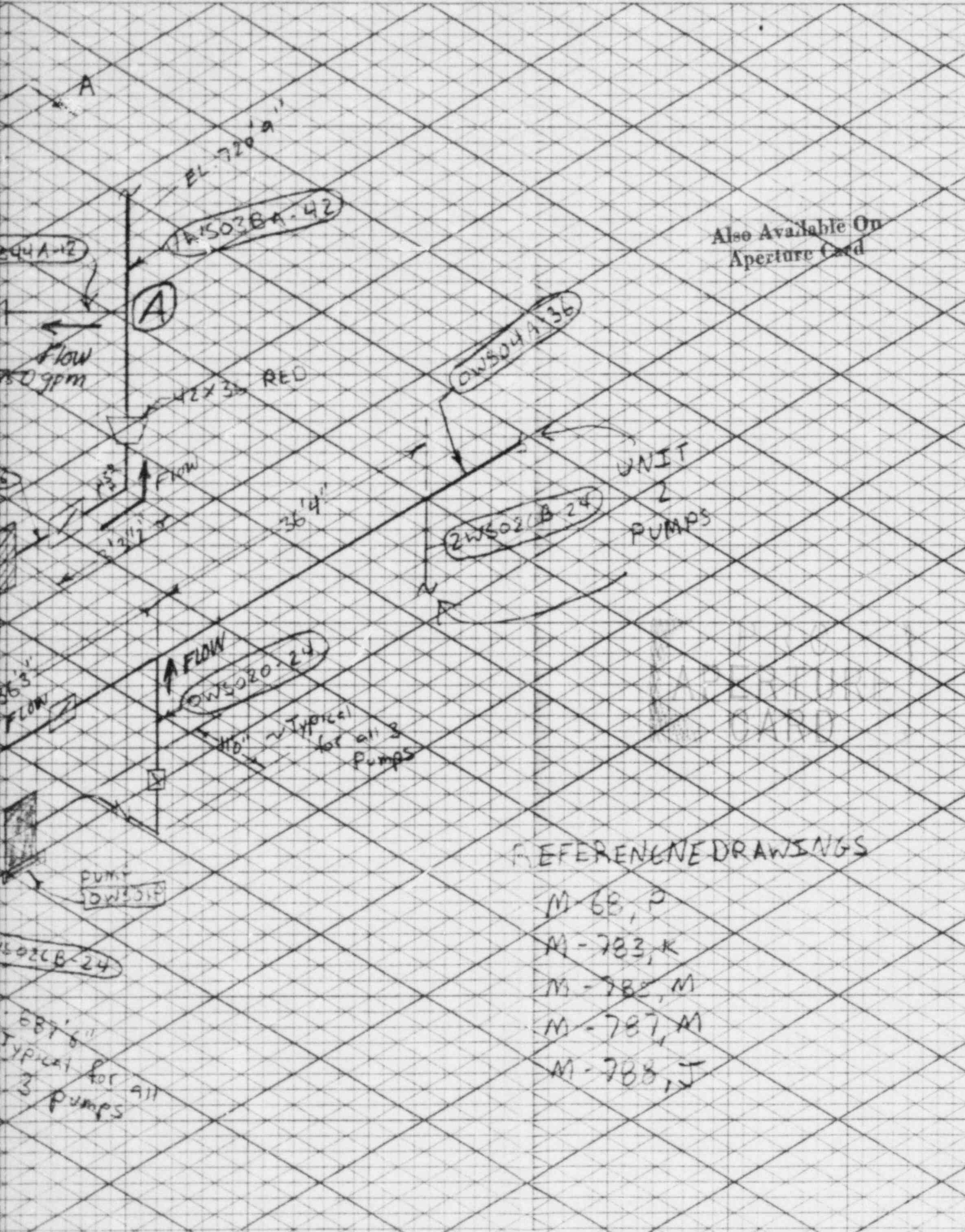
SARGENT & LUNDY ENGINEERS CHICAGO

STANDARD

SYSTEM | SHEET 8 OF 8

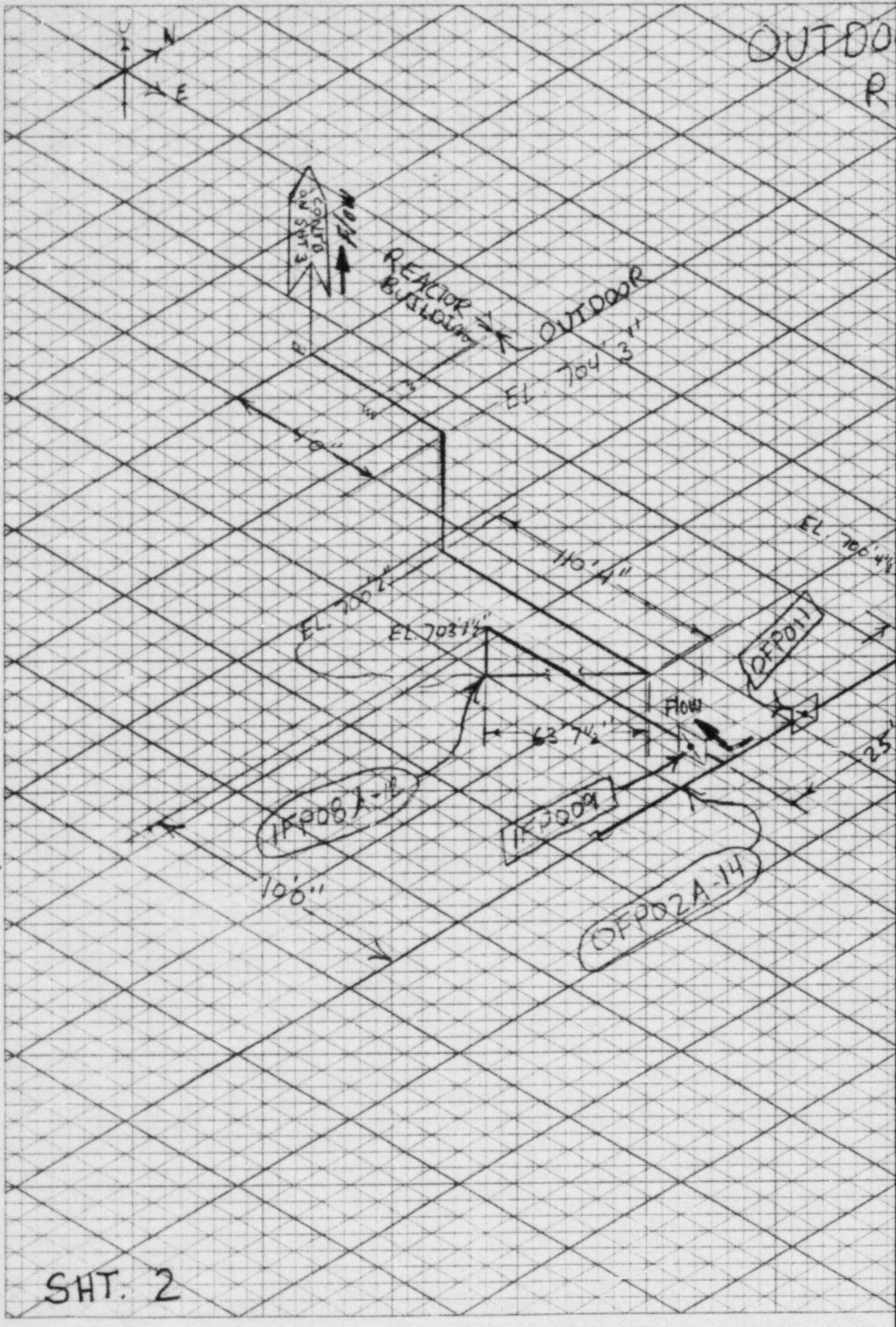
8311040130-10


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
4' 3 3/8"
CONT'D ON SHT 8
VIEW A-A
U
N
E
STRAINER
1WS01T
6' 4 1/2"
EL 720' 9"
FLOW
1WS02B-36
11' 4"
16' 10"
FLOW
FLOW
FLOW
EL. 705' 6"
24 x 20 RED. ELBOW
PUMP
1WS01PB
PUMP
1WS01PA
1WS01CA-24
20"
Typical for all 3 pumps



SHT 1/8

8811040130-11



K·E ISOMETRIC-ORTHOGRAPHIC ©1943 KEUFFEL & ESSER CO. MADE IN U.S.A.

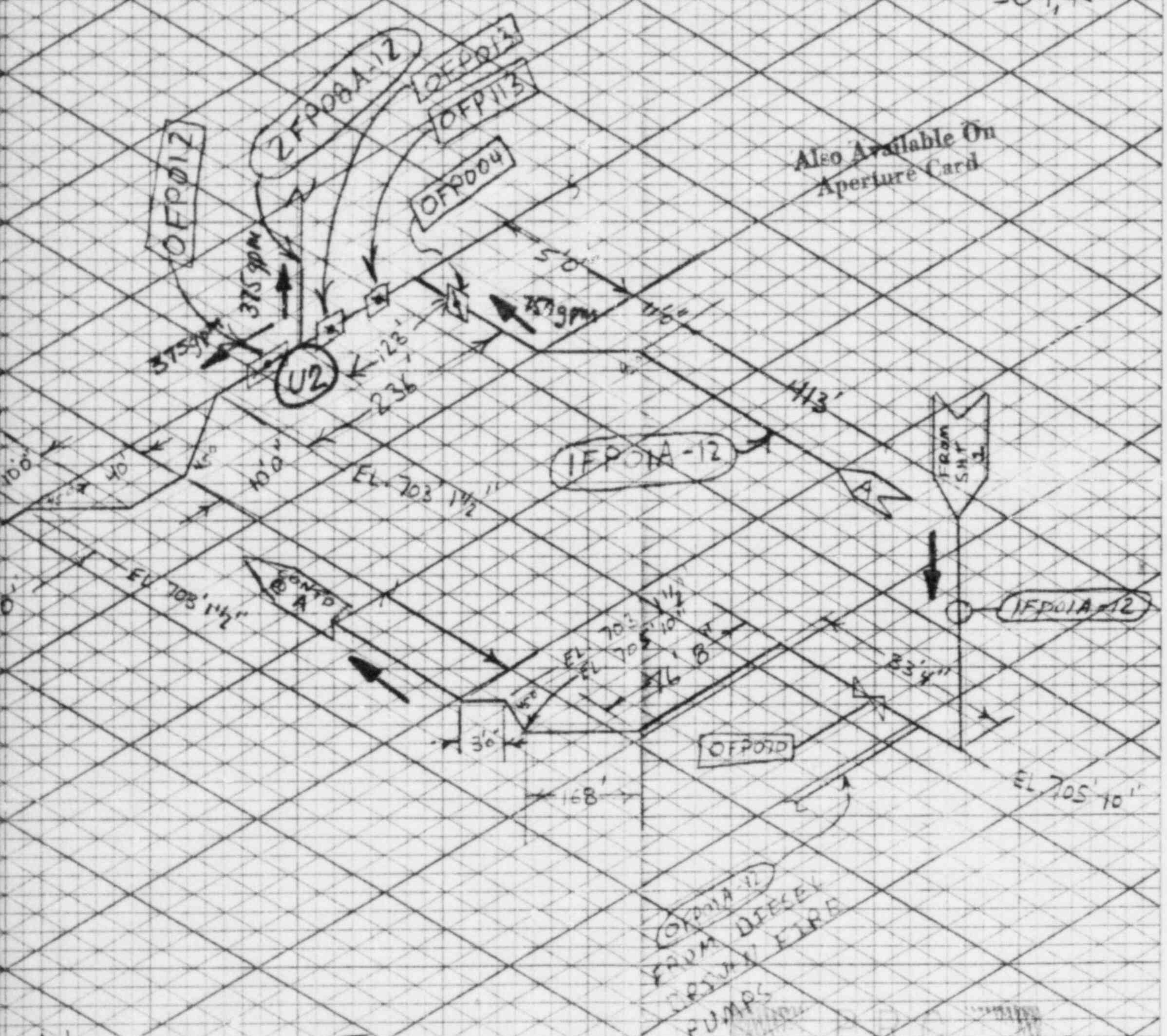
47 4030

SHT. 2

OR PIPING

EFERENCE DRAWINGS

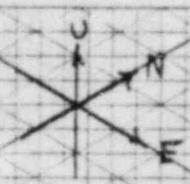
M-71-01, AB S-120, T S-119, R M-766-06, G -07, D -08, F -09, K



NO SCALE

Figure 2/8

8311040130-12



REACTOR BUILDING

Fuel Handling floor

Fire Protection Supply Line

NO SCALE

REFERENCE DRAWINGS

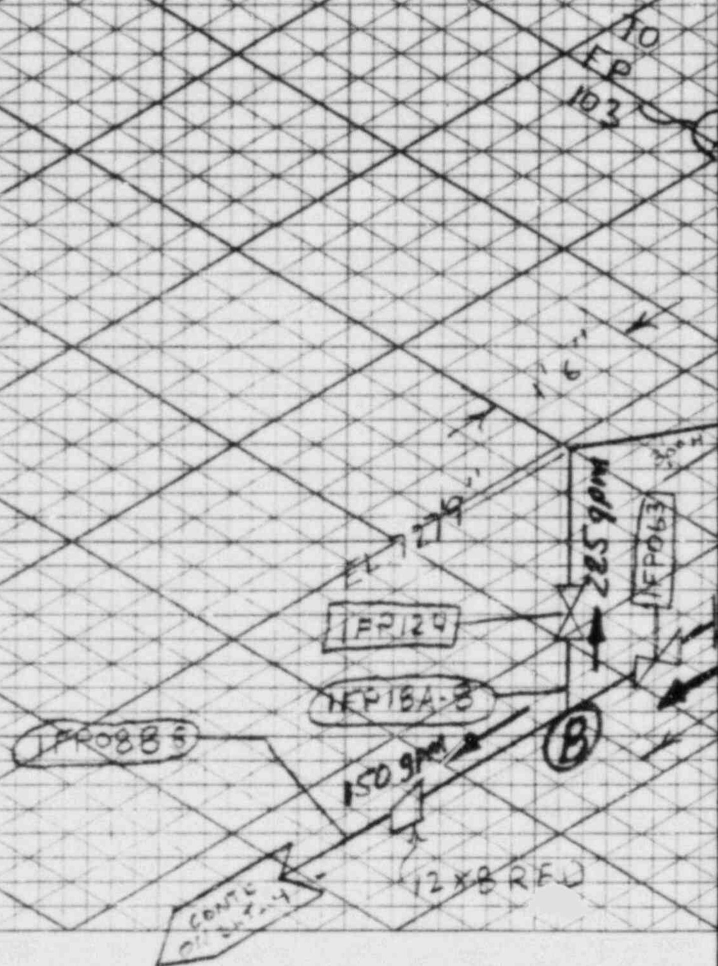
M-72-02, U

M-814-01, H

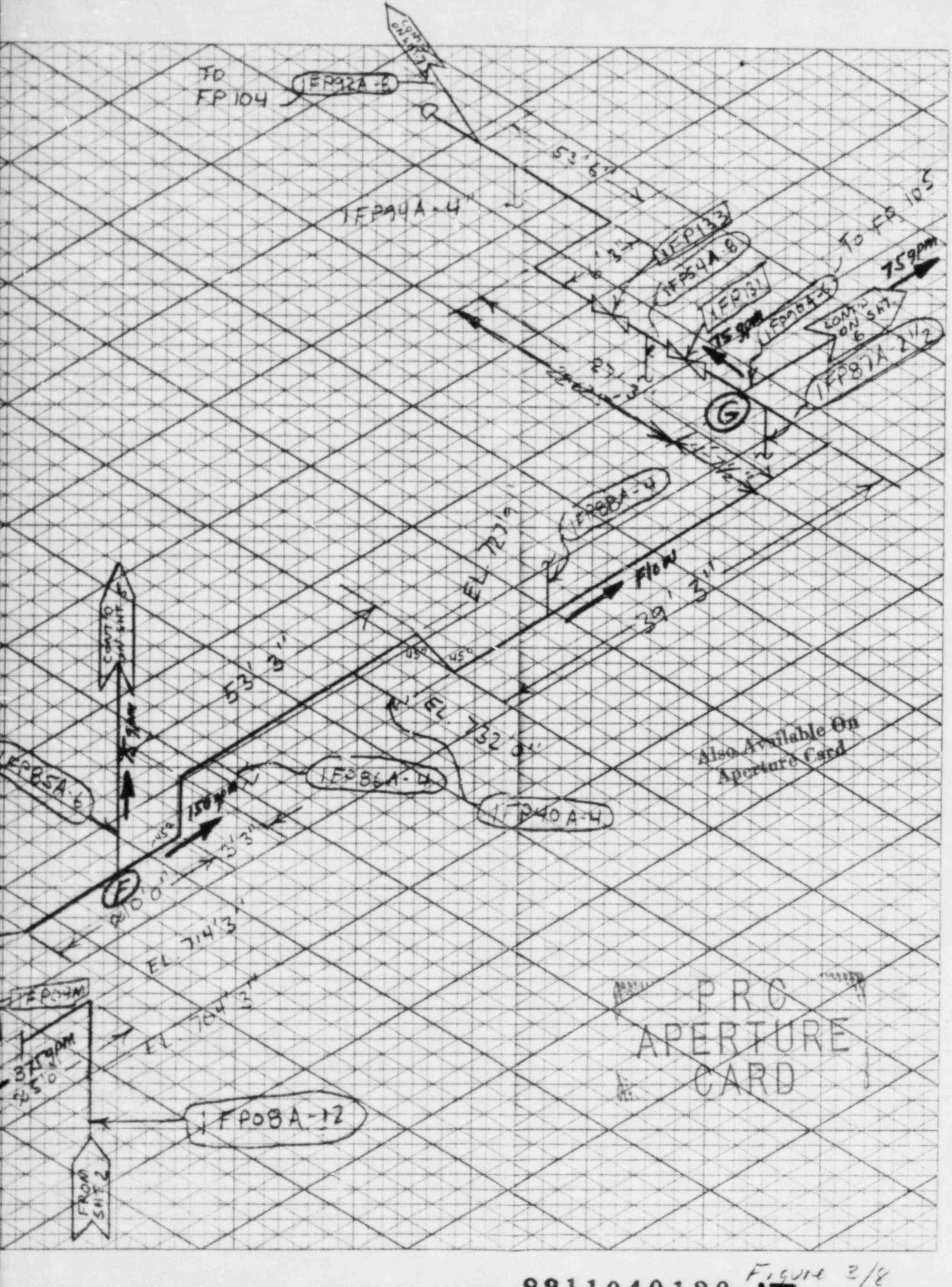
-03, J

-06, G

-07, G



SHT. 3



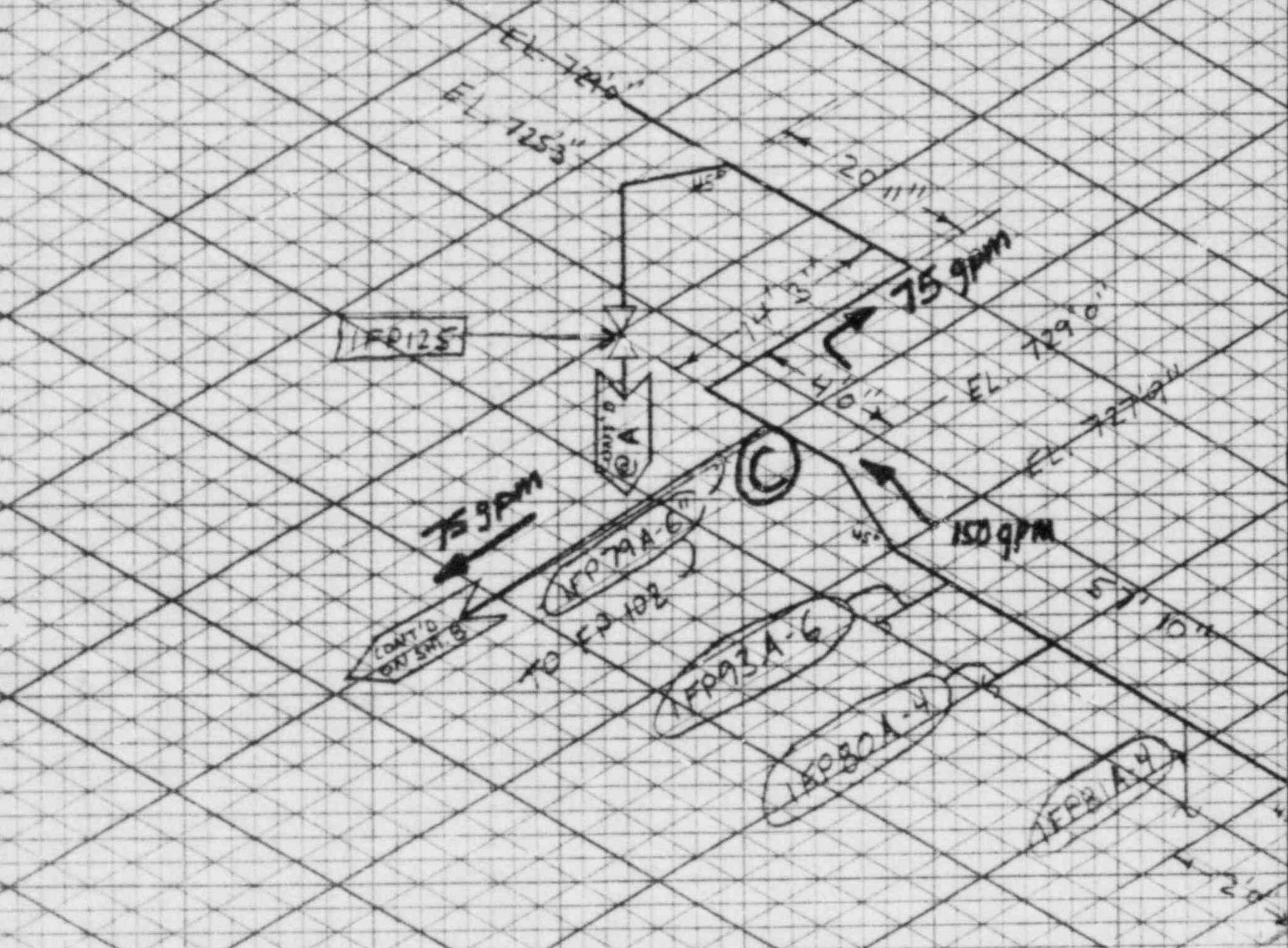
Also Available On Aperture Card

PRC APERTURE CARD

8311040130-13 Figure 2/8

Reactor Building
Fuel Handling Floor
Fire Protection Supply Pipe

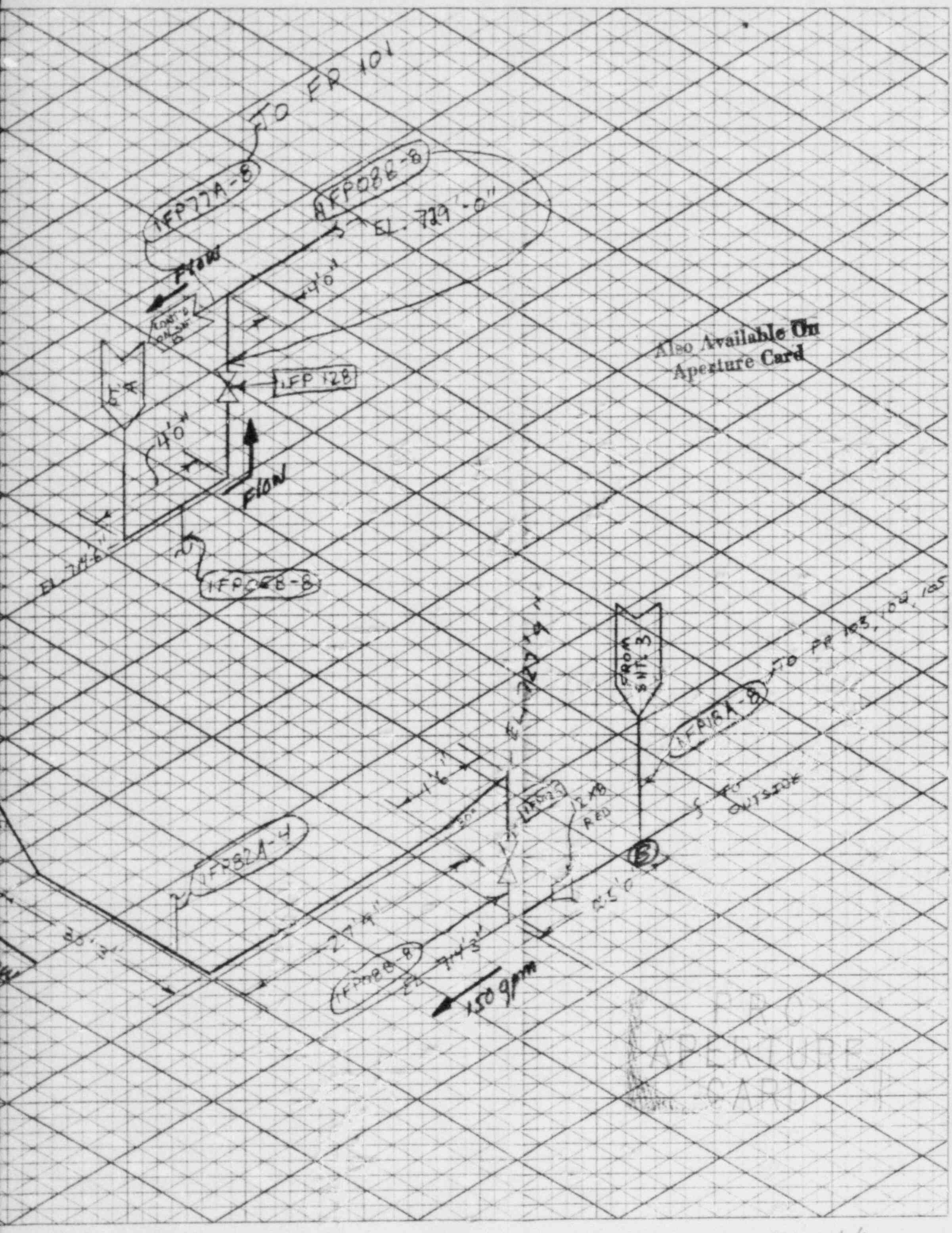
NO SCALE



Reference Drawings

M-72-02, U
M-814-01, H
M-814-07, F
M-814-05, G
M-814-06, G

SHT. 4



Also Available On Aperture Card

APERTURE CARD

8311040130-
Figure 4/8

FIRE STATION

FP 153

Reference Drawings

M-72-02, V

M-814-01, H

-03, J

-06, G

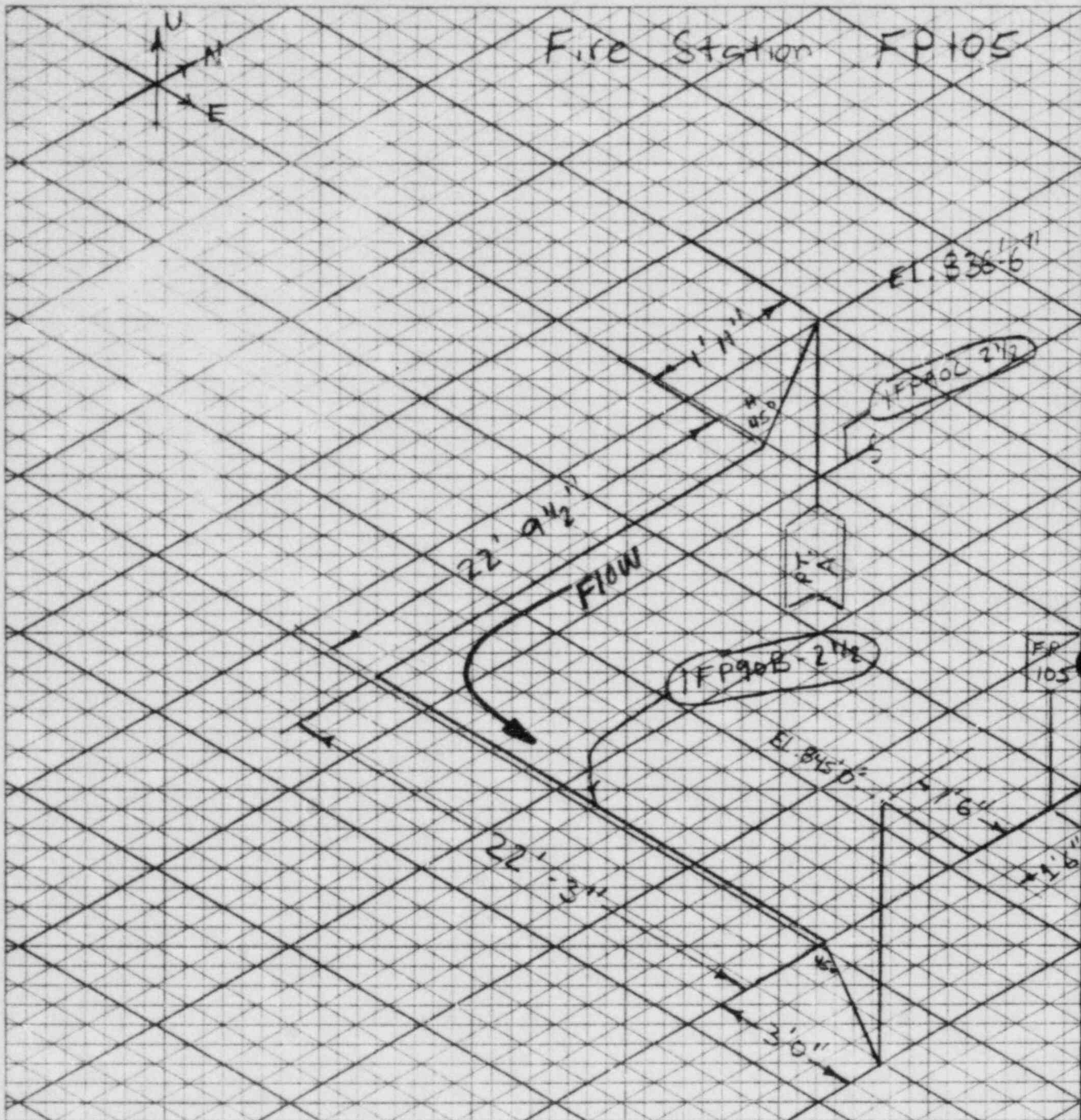
FROM SHT. 5

SHT. 5

Also Available On Aperture Card

8311040130-15

Figure 5/8



Reference Drawing

M-72-02, U

M-814-01, H

-03, J

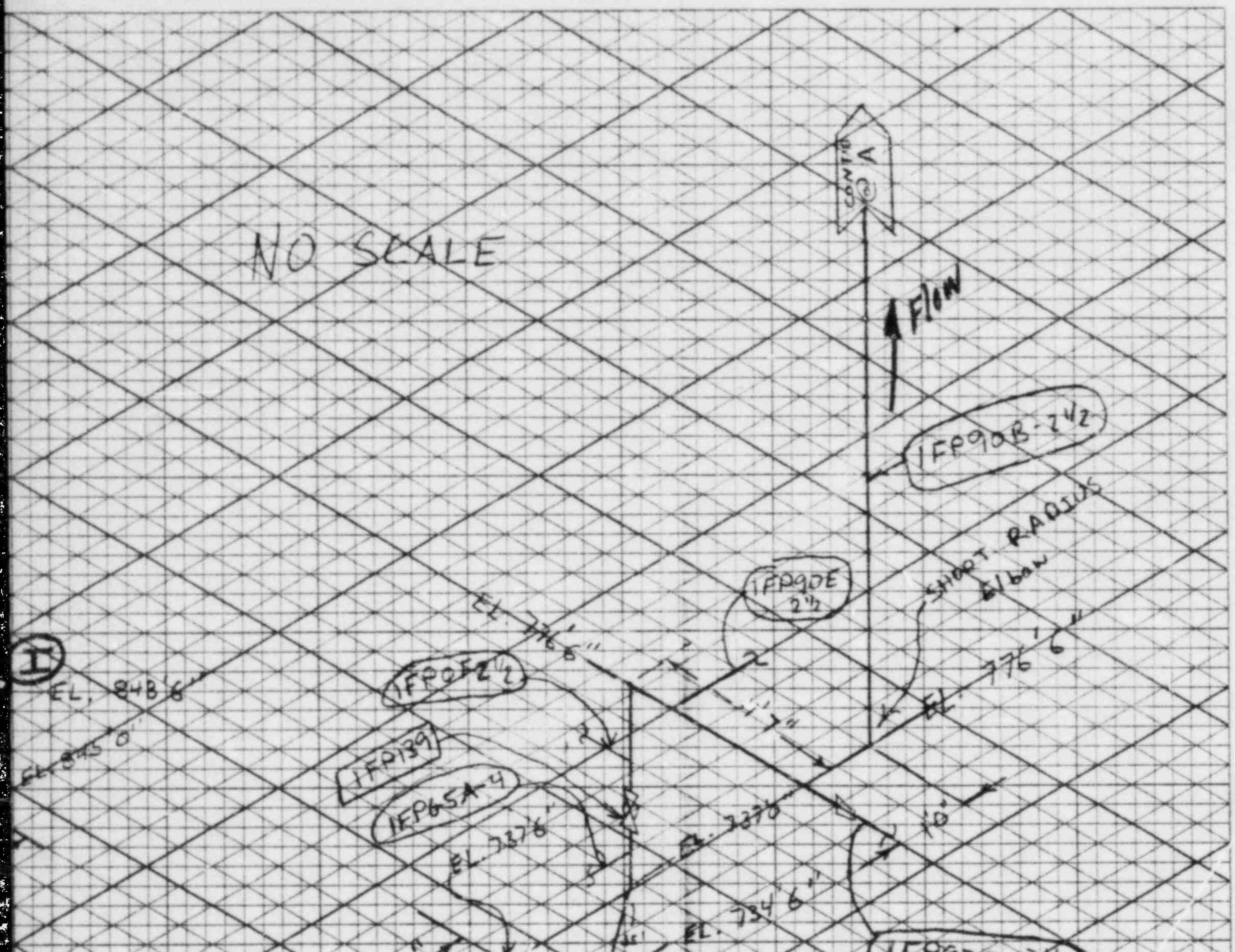
-07, G

SHT. 6

K+E ISOMETRIC-ORTHOGRAPHIC ©1943 KEUFFEL & ESSER CO. MADE IN U.S.A.

47 4030

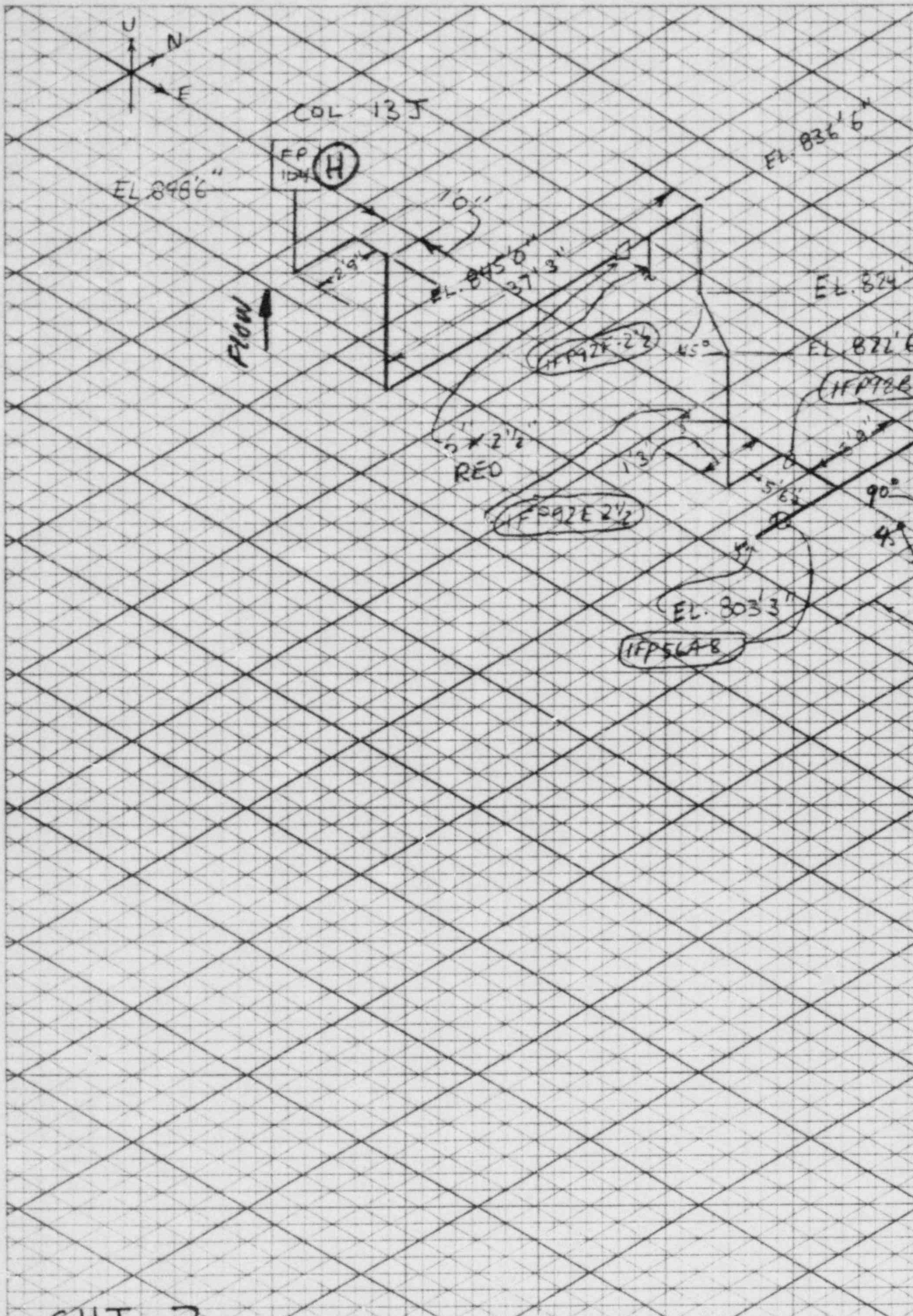
MEC A-14



8311040130-16

8311040130

Figure 6/8



SHT. 7

PAGE A-15

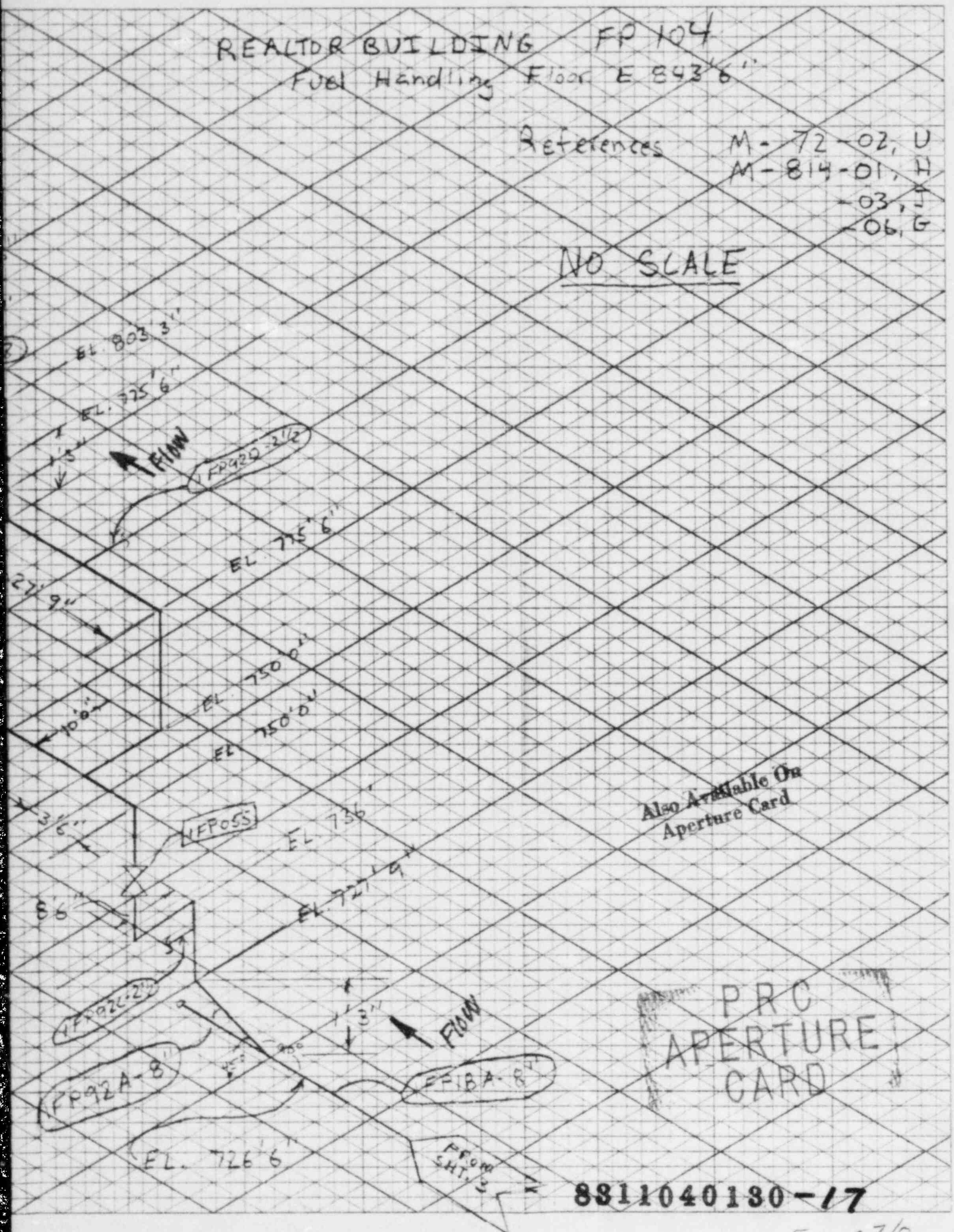
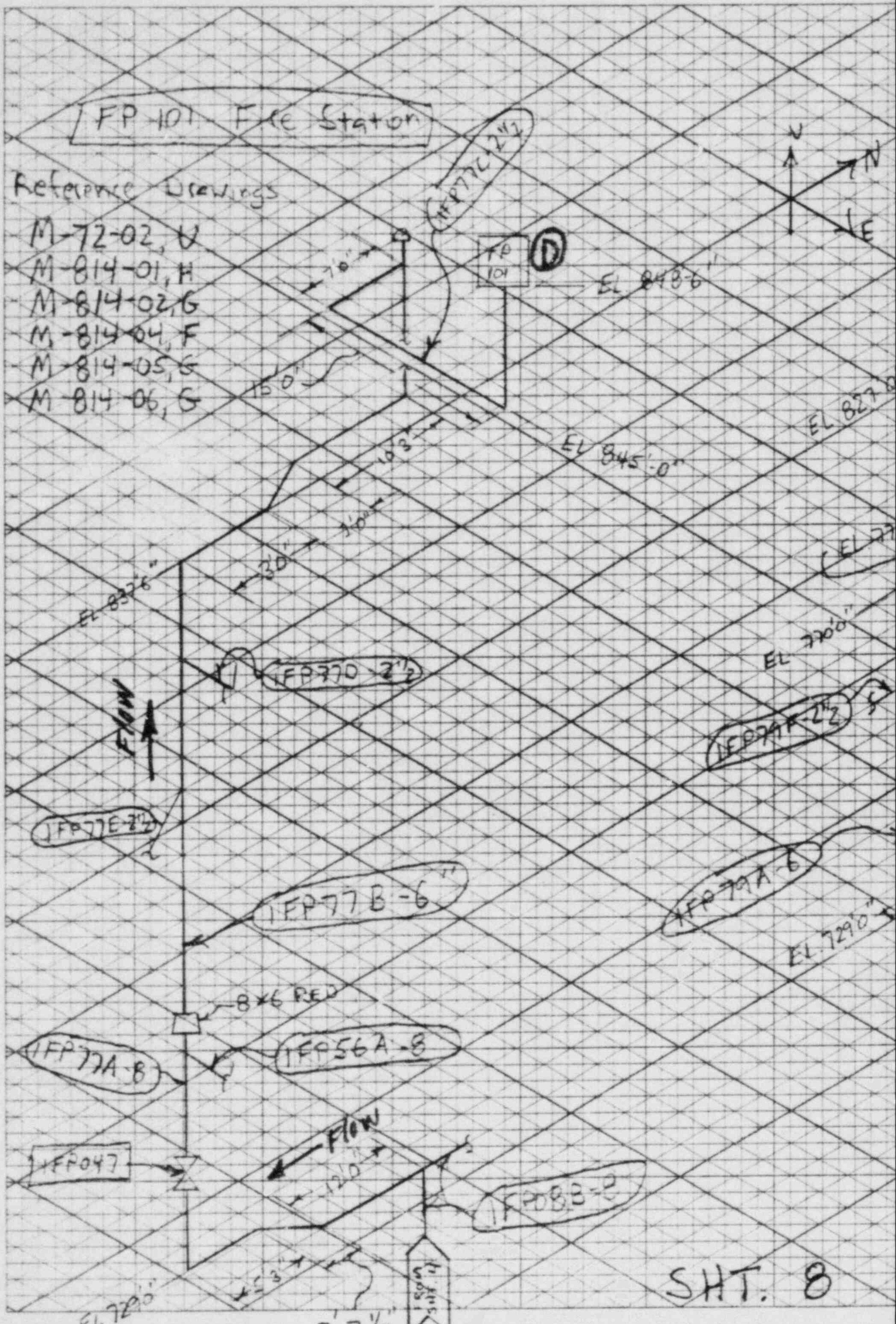
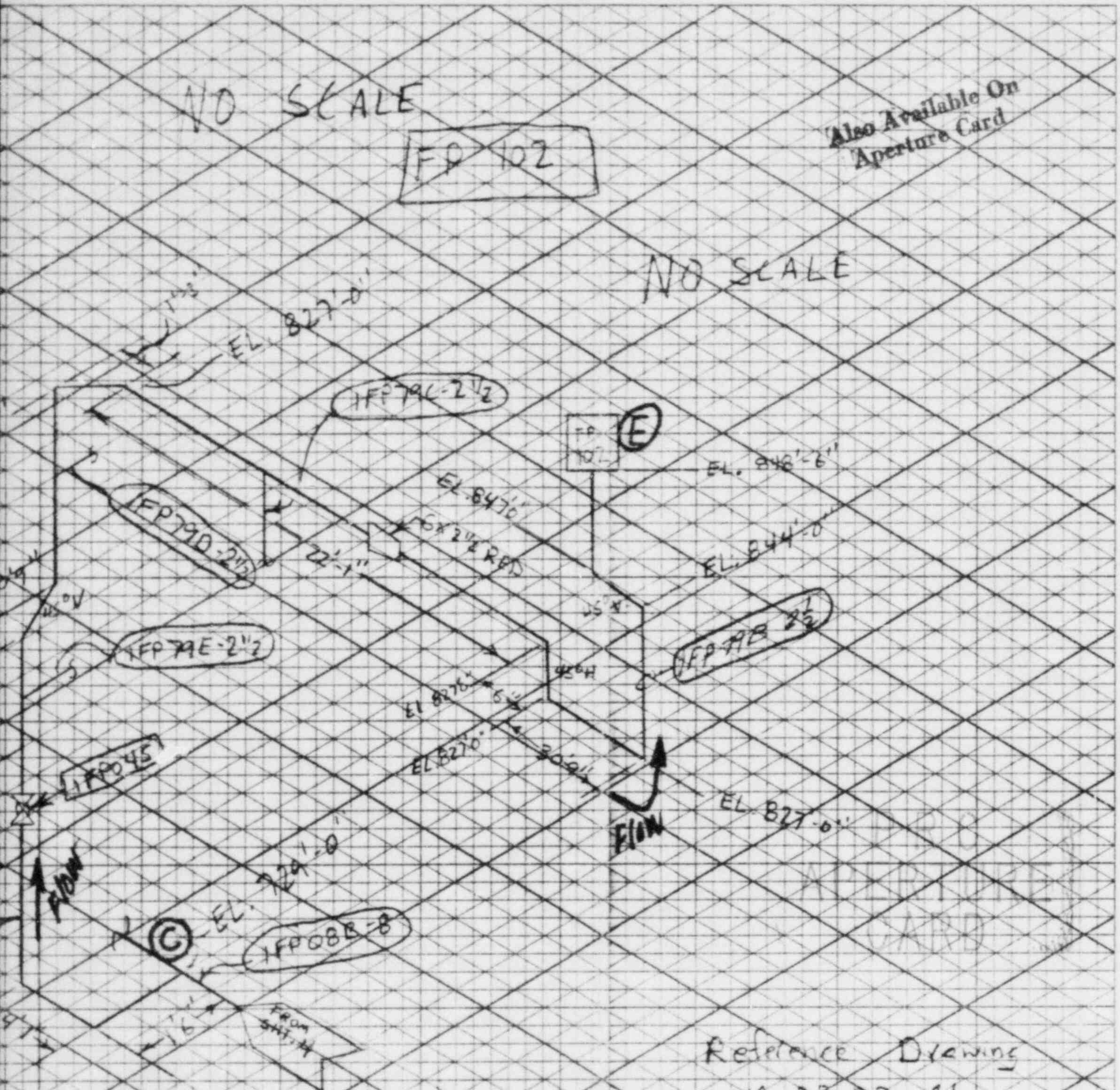

REALTOR BUILDING FP 104
Fuel Handling Floor E 843'6"
References M-72-02, U
M-814-01, H
-03, J
-06, G
NO SCALE
EL. 803'3"
EL. 775'6"
FLOW
FP920-2½"
EL. 775'6"
27'
9"
EL. 750'0"
10'0"
EL. 750'0"
3'6"
1FP055
EL. 736'
8'6"
EL. 721'9"
FP92C-2½"
3"
FLOW
FP92A-8"
FP18A-8"
EL. 726'6"
FROM SHT. 2
8311040130-17

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
FP 101
D
EL 848'-6"
EL 845'-0"
EL 837'-6"
EL 827'
EL 770'-0"
EL 729'-0"
EL 720'-0"
1FP77C-2½
1FP77D-2½
1FP77E-2½
1FP77B-6"
1FP79F-2½
1FP79A-6
8×6 RED
1FP56A-8
1FP77A-8
1FP047
1FP08B-8
FLOW
FLOW
7'0"
15'0"
10'3"
3'0"
12'0"
5'3"
0'7 1/16"
SHT 11
V
N
E
SHT. 8



Reference Drawing
M-72-02, 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.

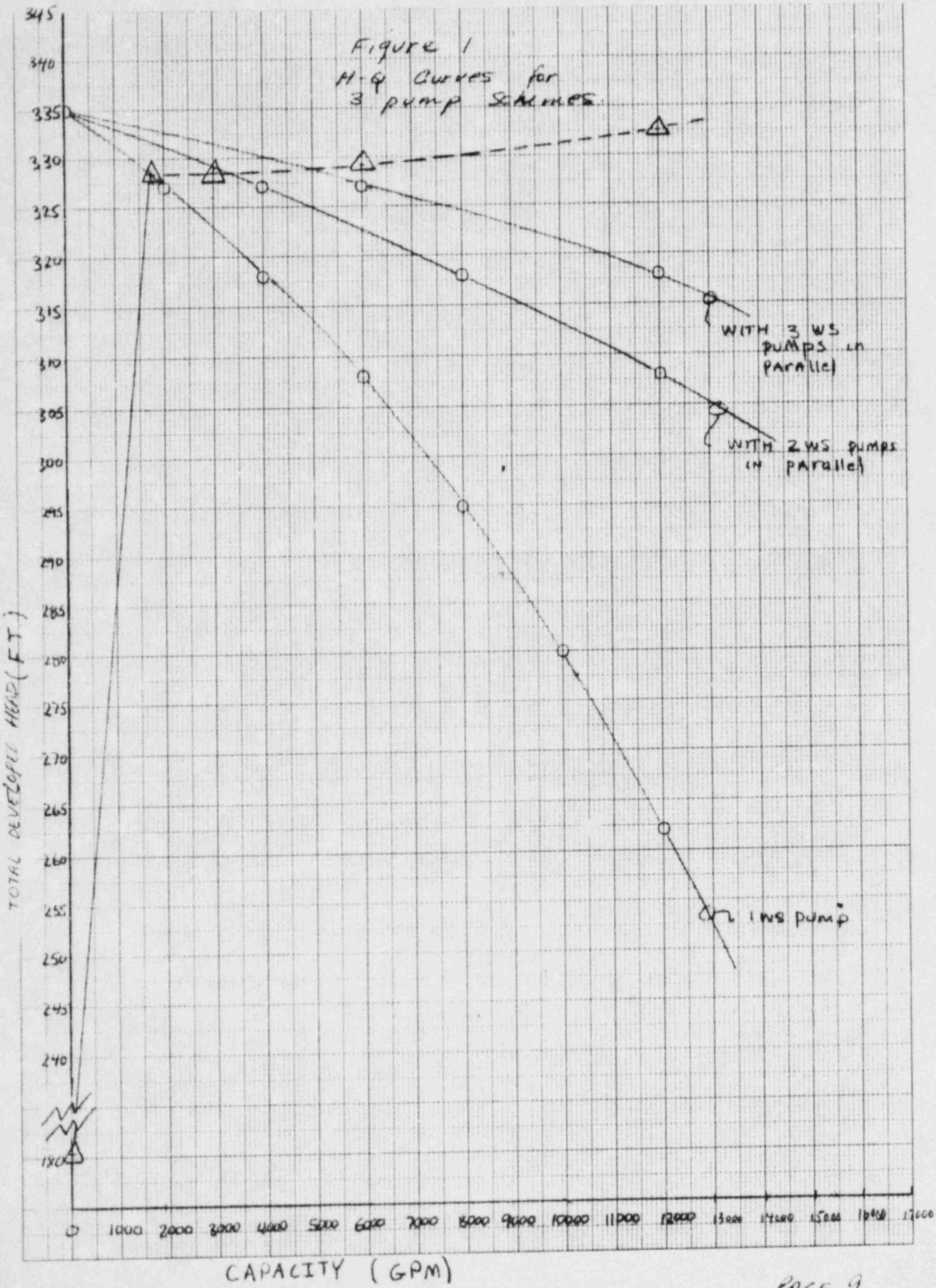
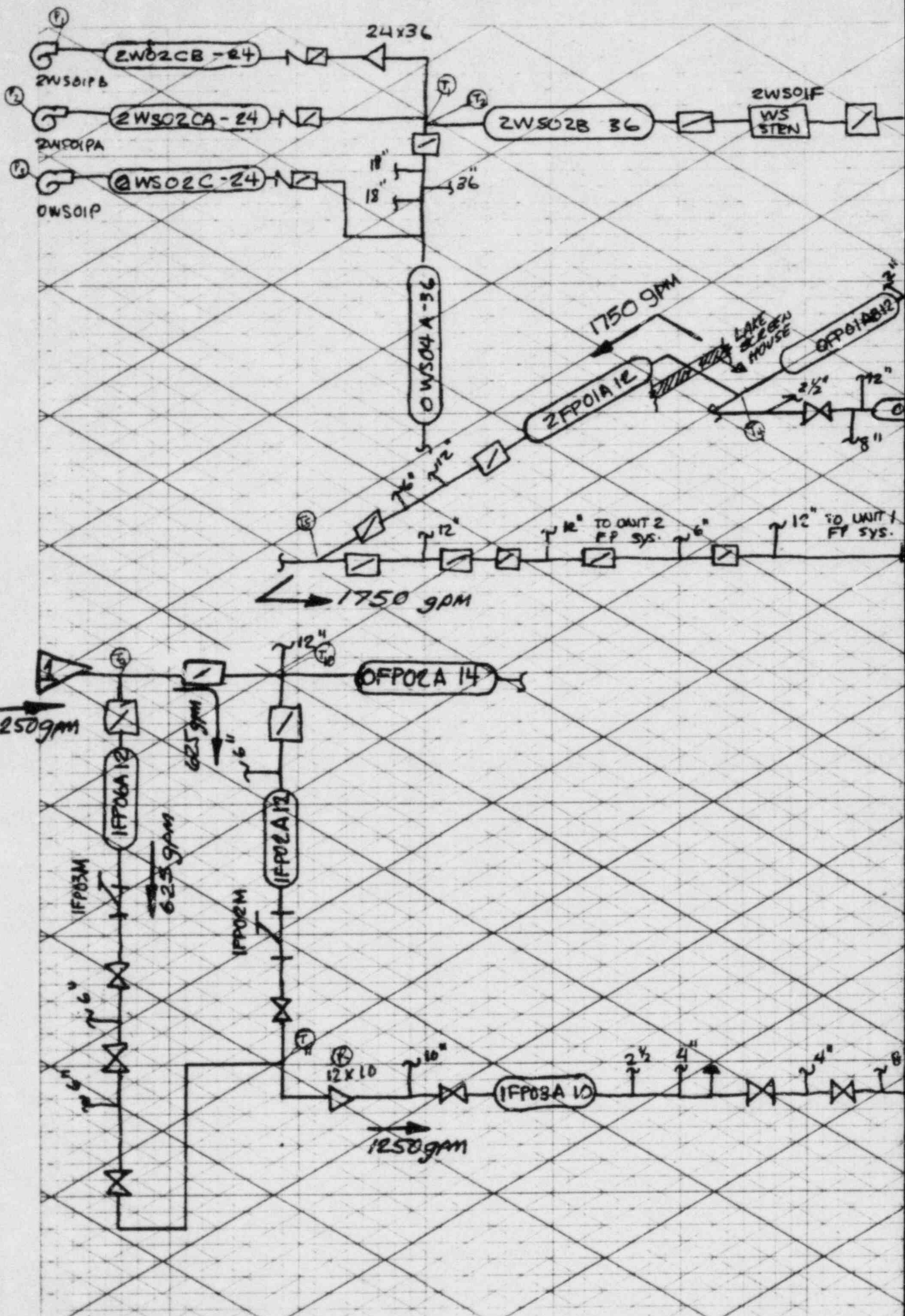
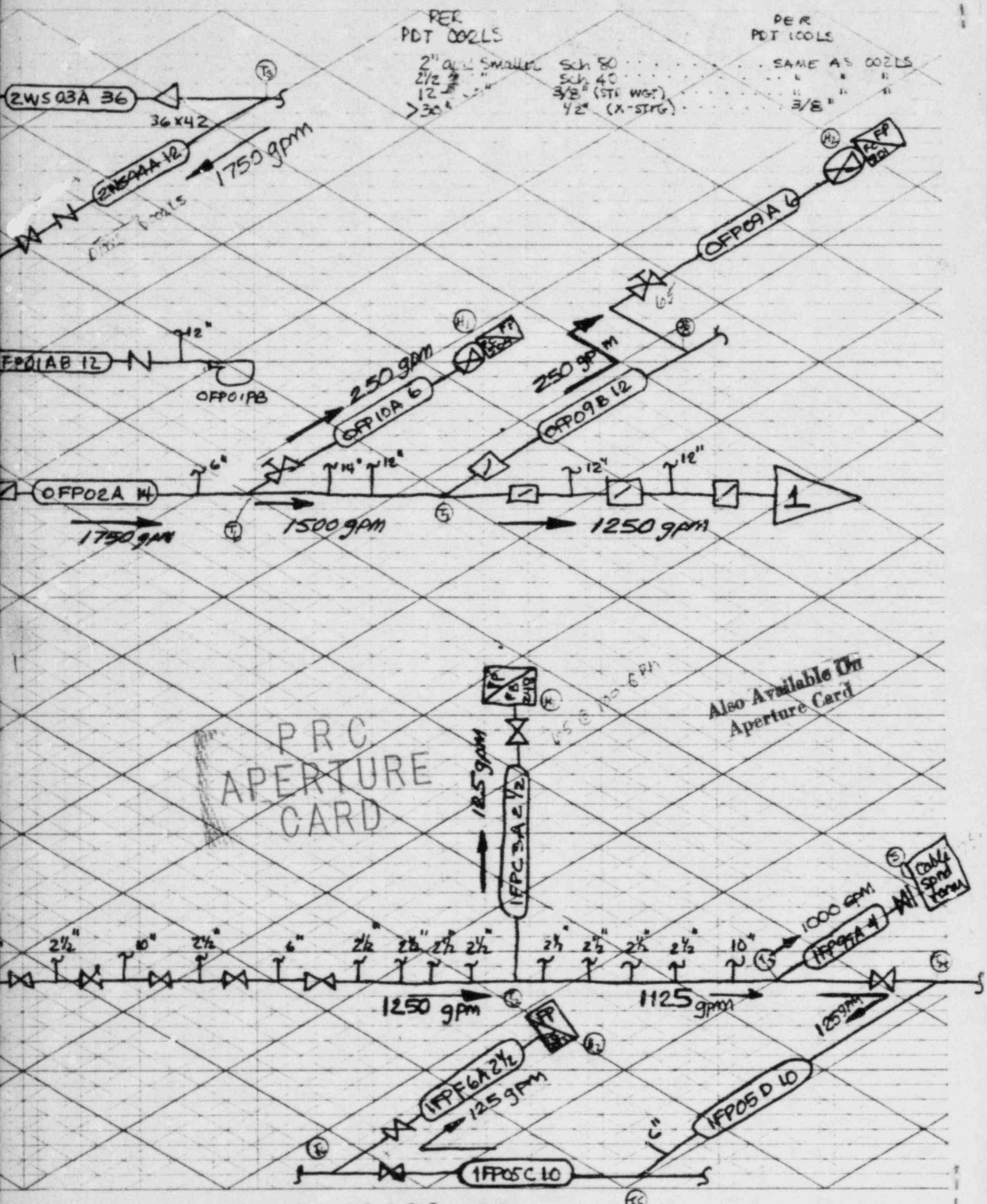


Figure 1
H-Q Curves for
3 pump Schemes
WITH 3 WS pumps in parallel
WITH 2 WS pumps in parallel
1 WS pump
TOTAL DEVELOPED HEAD (FT)
CAPACITY (GPM)
345
340
335
330
325
320
315
310
305
300
295
290
285
280
275
270
265
260
255
250
245
240
180
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000

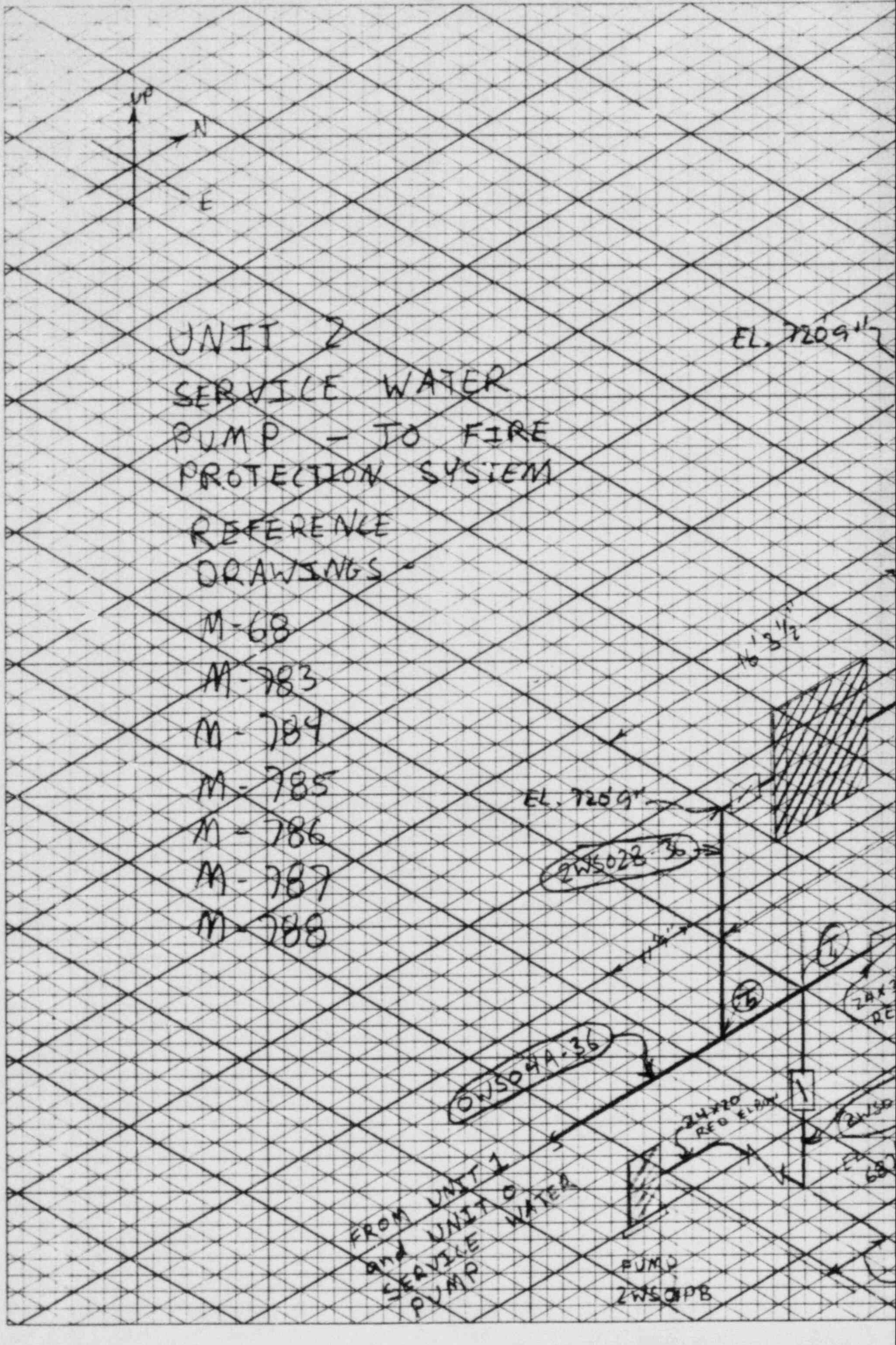
APPENDIX A

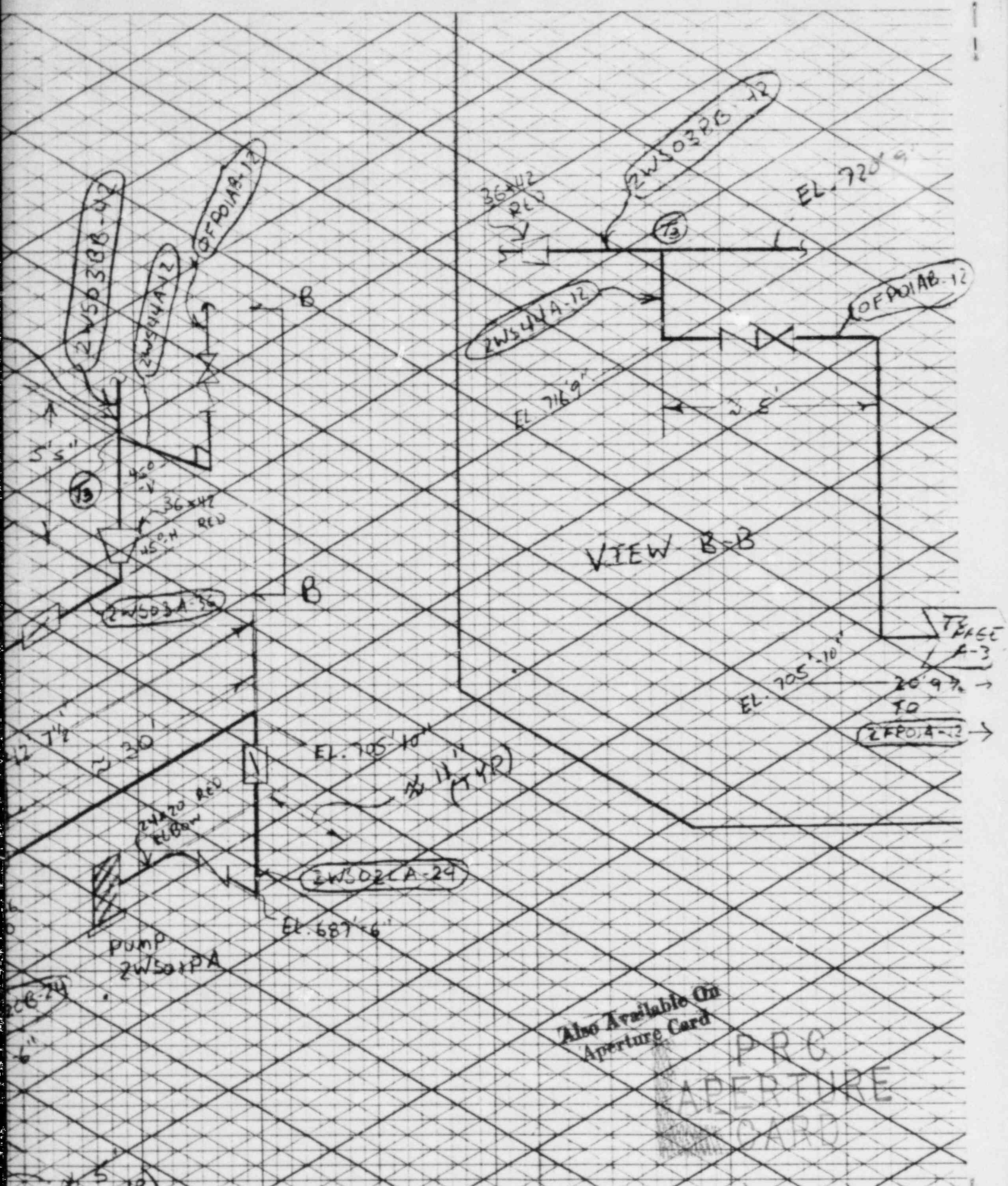


24X36
2W02CB-24
2WS01PB
2WS02CA-24
2WS01PA
0WS02C-24
0WS01P
2WS02B 36
2WS01F
WS STRN
18"
18"
36"
0WS04A-36
1750 gpm
LAKE SCREEN HOUSE
0FP01AB 12
2FP01A 12
2 1/2"
12"
8"
12"
12"
TO UNIT 2 FP SYS.
6"
12" TO UNIT 1 FP SYS.
1750 gpm
12"
0FP02A 14
1250gpm
625gpm
6"
1FP06A 12
1FP02A 12
623 gpm
1FP03M
1FP02M
6"
6"
12X10
10"
1FP03A 10
2 1/2
4"
4"
1250gpm

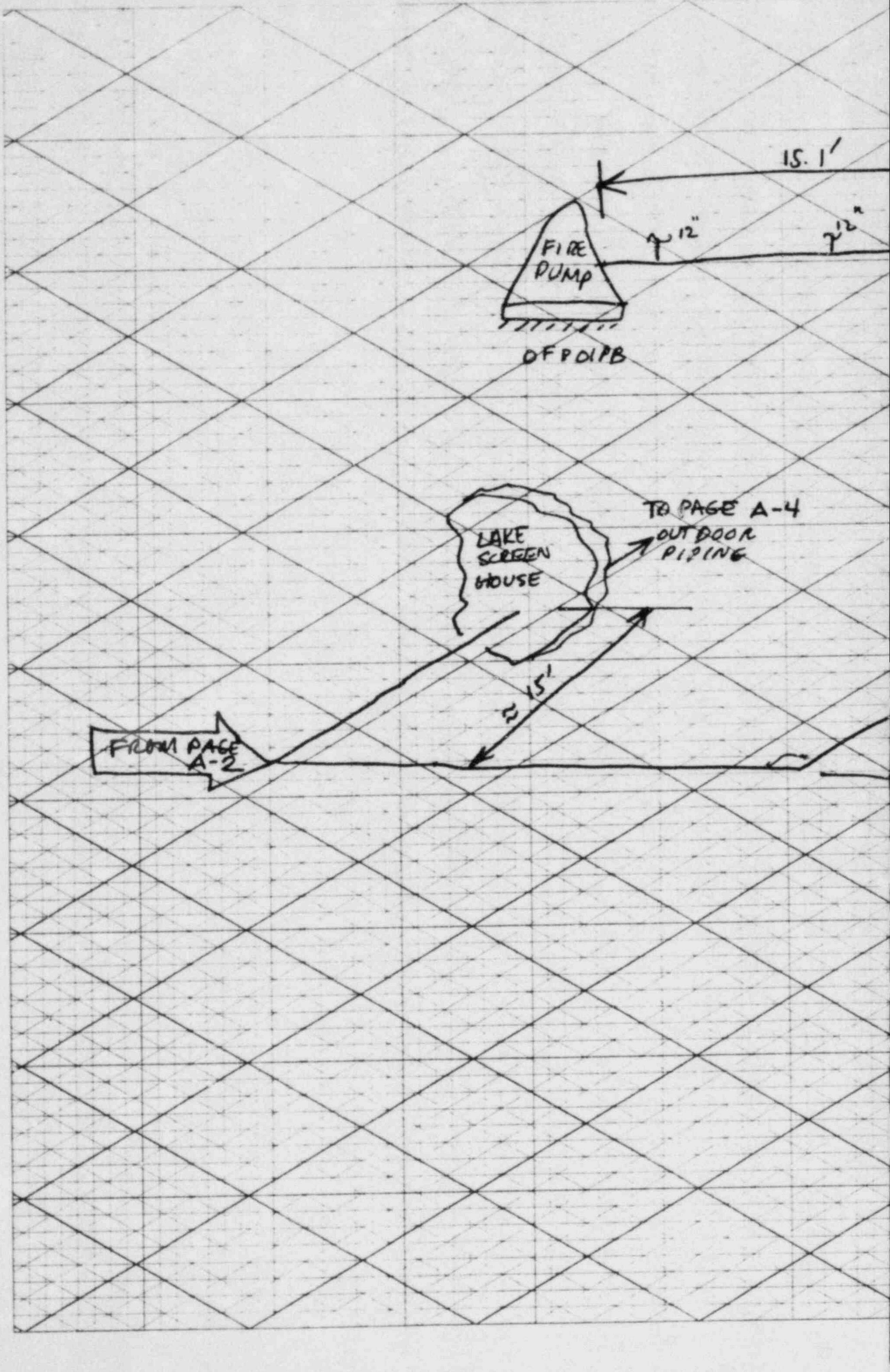


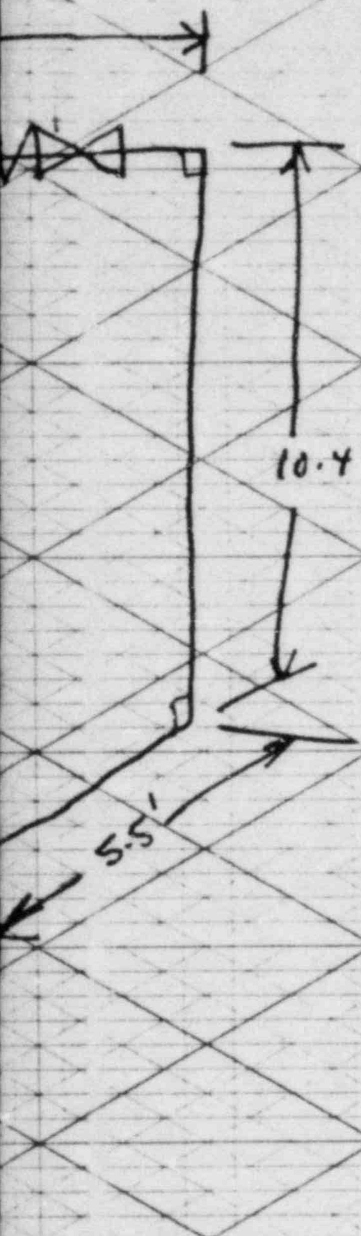
8311040130-19


UP
N
E
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
EL. 720'9"
2WS02B-36
0WS04A-36
24x20
RED ELBOW
FROM UNIT 1
and UNIT 0
SERVICE WATER
PUMP
PUMP
2WS01PB

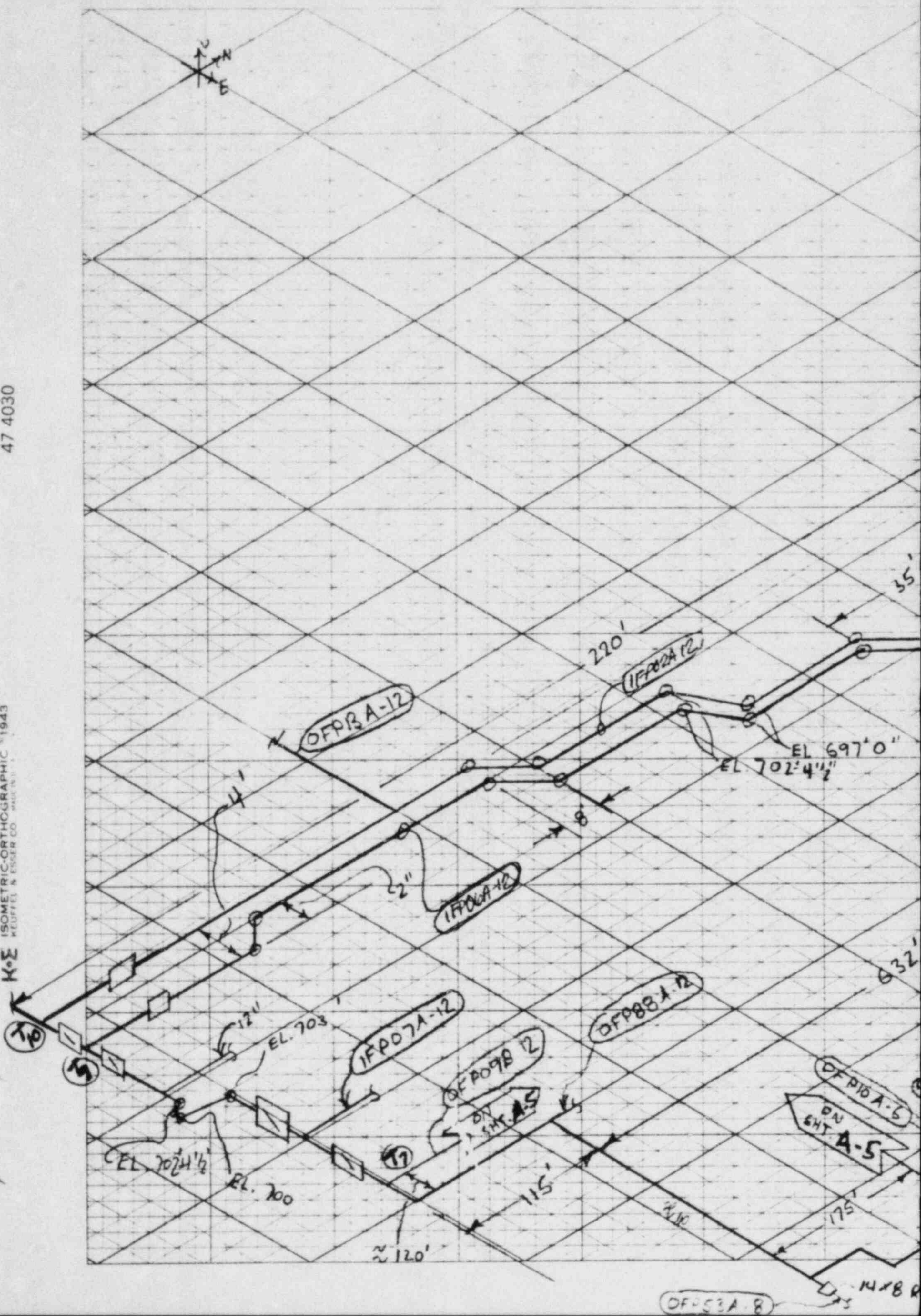


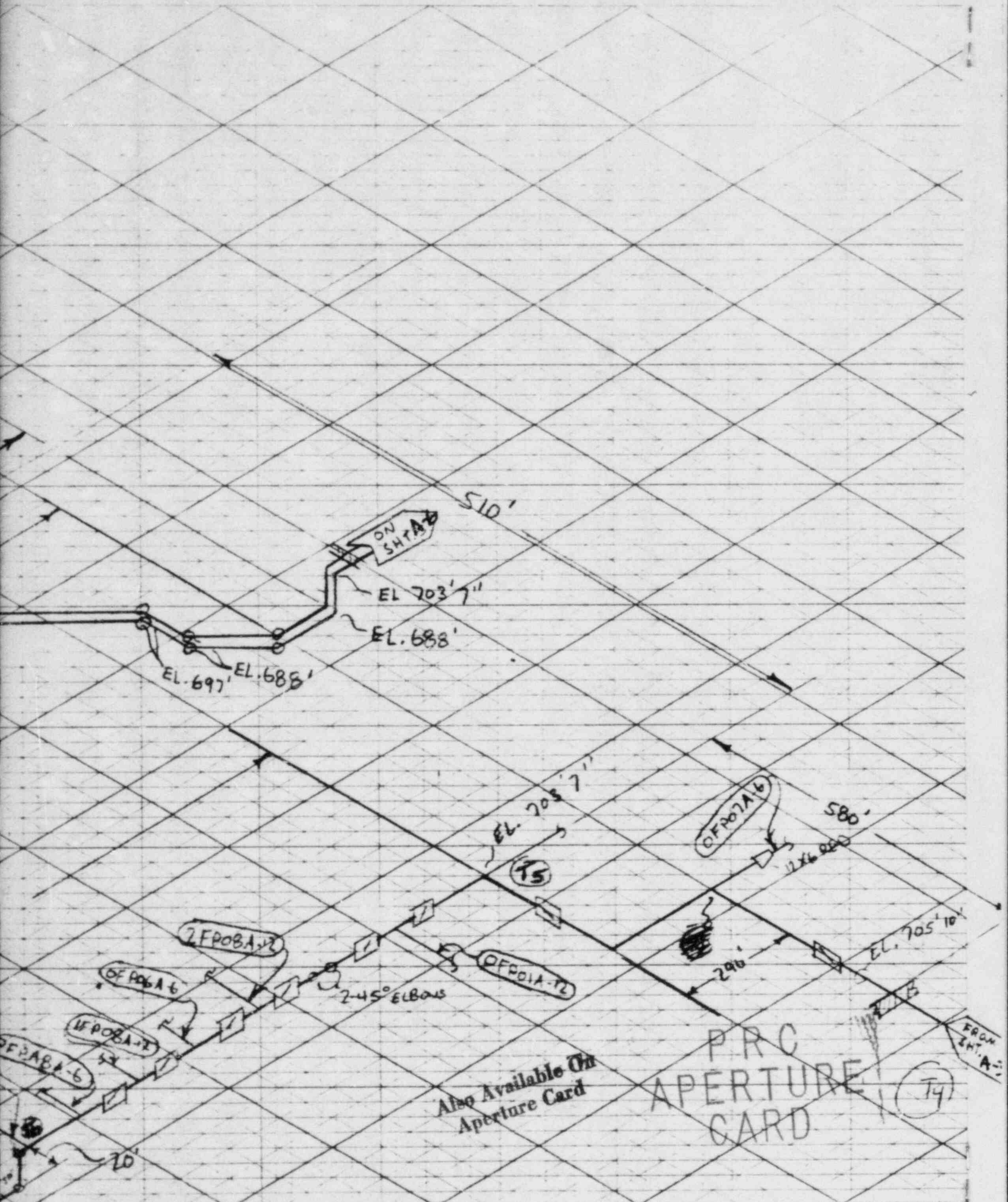
8311040130-20


15. 1'
12"
12"
FIRE PUMP
OFPOIPB
TO PAGE A-4 OUTDOOR PIPING
LAKE SCREEN HOUSE
15'
FROM PAGE A-2

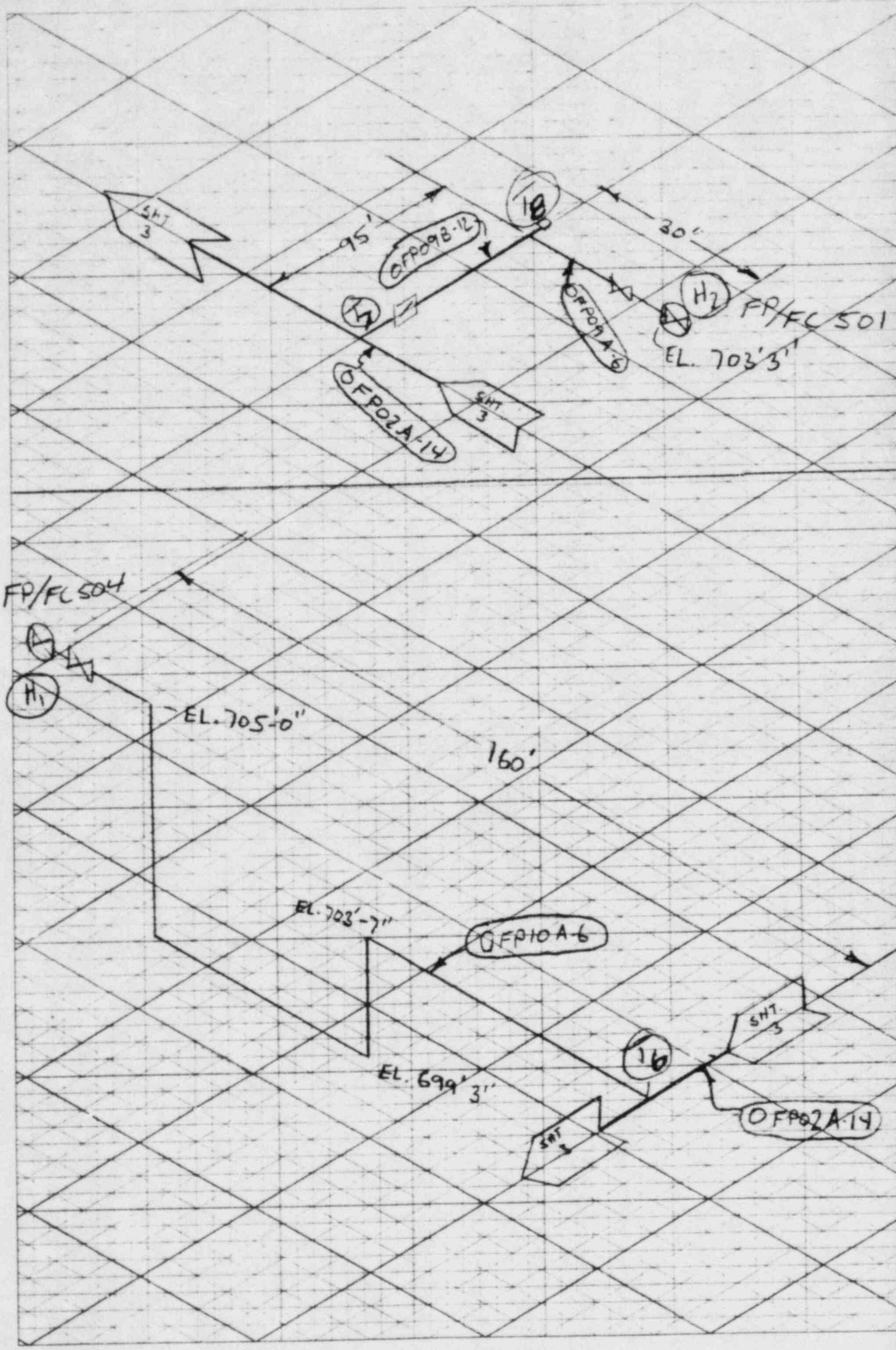


10.4'
5.5'


N
E
0FP13A-12
1FP02A-12
220'
35'
EL 697'0"
EL 702'4½"
8
4'
2"
1FP06A-12
32'
0FP88A-12
1FP07A-12
EL. 703'
12"
0FP09B-12
ON SHT. A-5
0FP10A-6
ON SHT. A-5
EL. 702'4½"
EL. 700
115'
175'
~120'
14x8 R
0FP53A-8

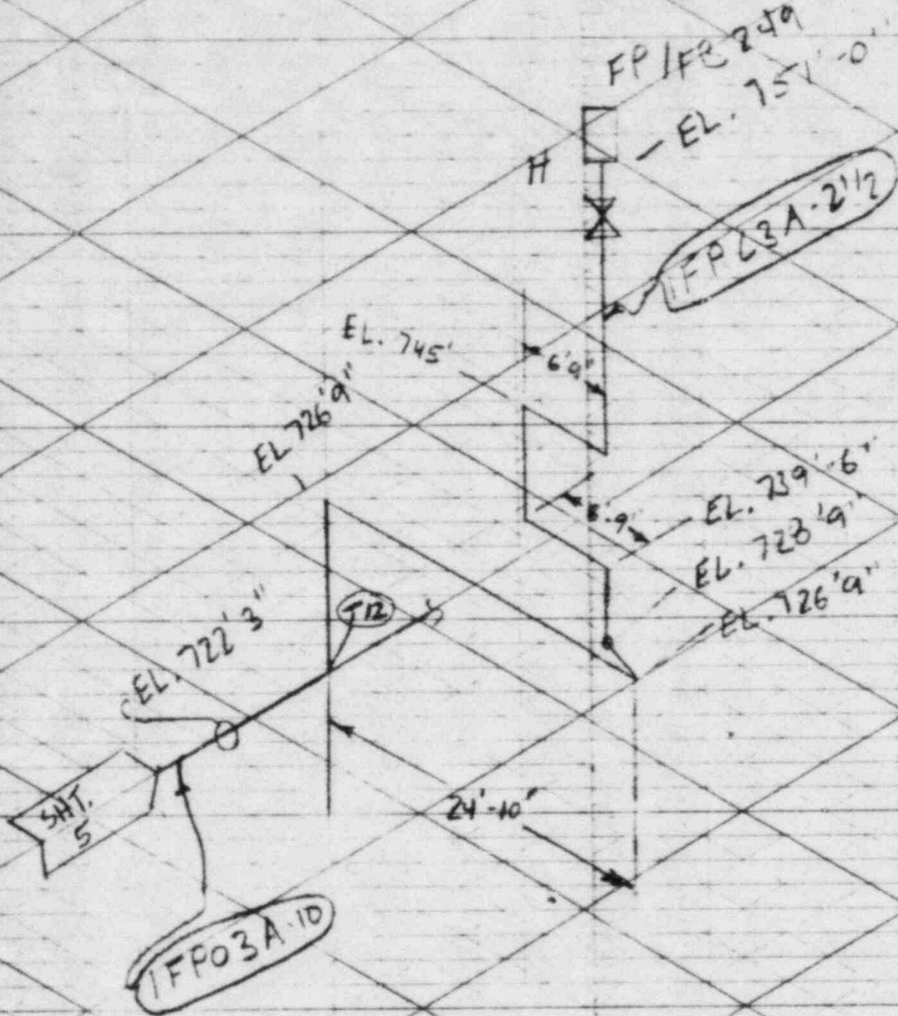


510'
ON SHT A-6
EL 703' 7"
EL. 688'
EL. 697'
EL. 688'
EL. 703' 7"
T5
0FP07A-6
580'
12x6 RED
EL. 705' 10"
2FP08A-T2
0FP01A-T2
2-45° ELBOWS
0FP06A-6
1FP08A-T2
0FP08A-6
296'
20'
FROM SHT. A-
T4



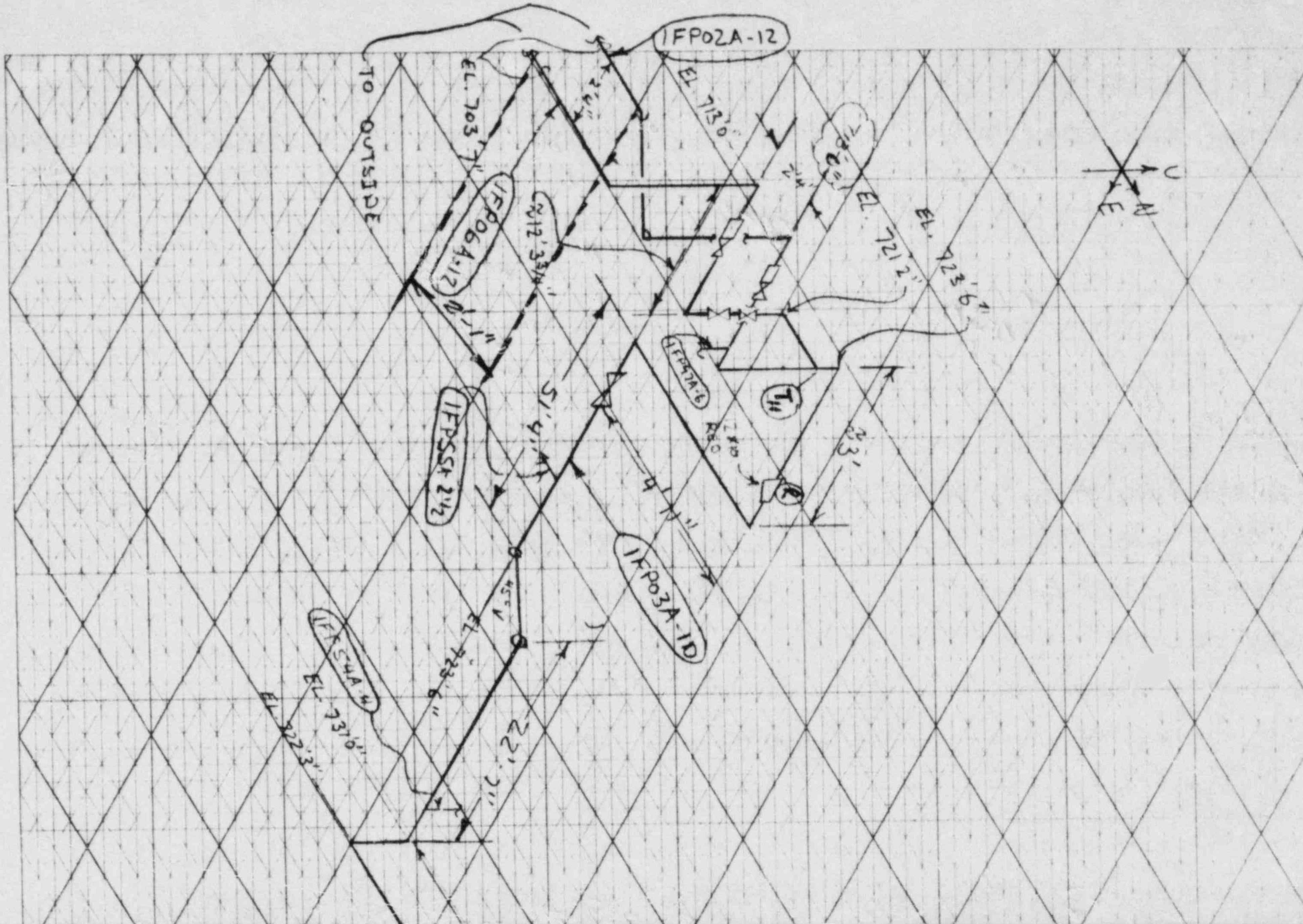
47 4030

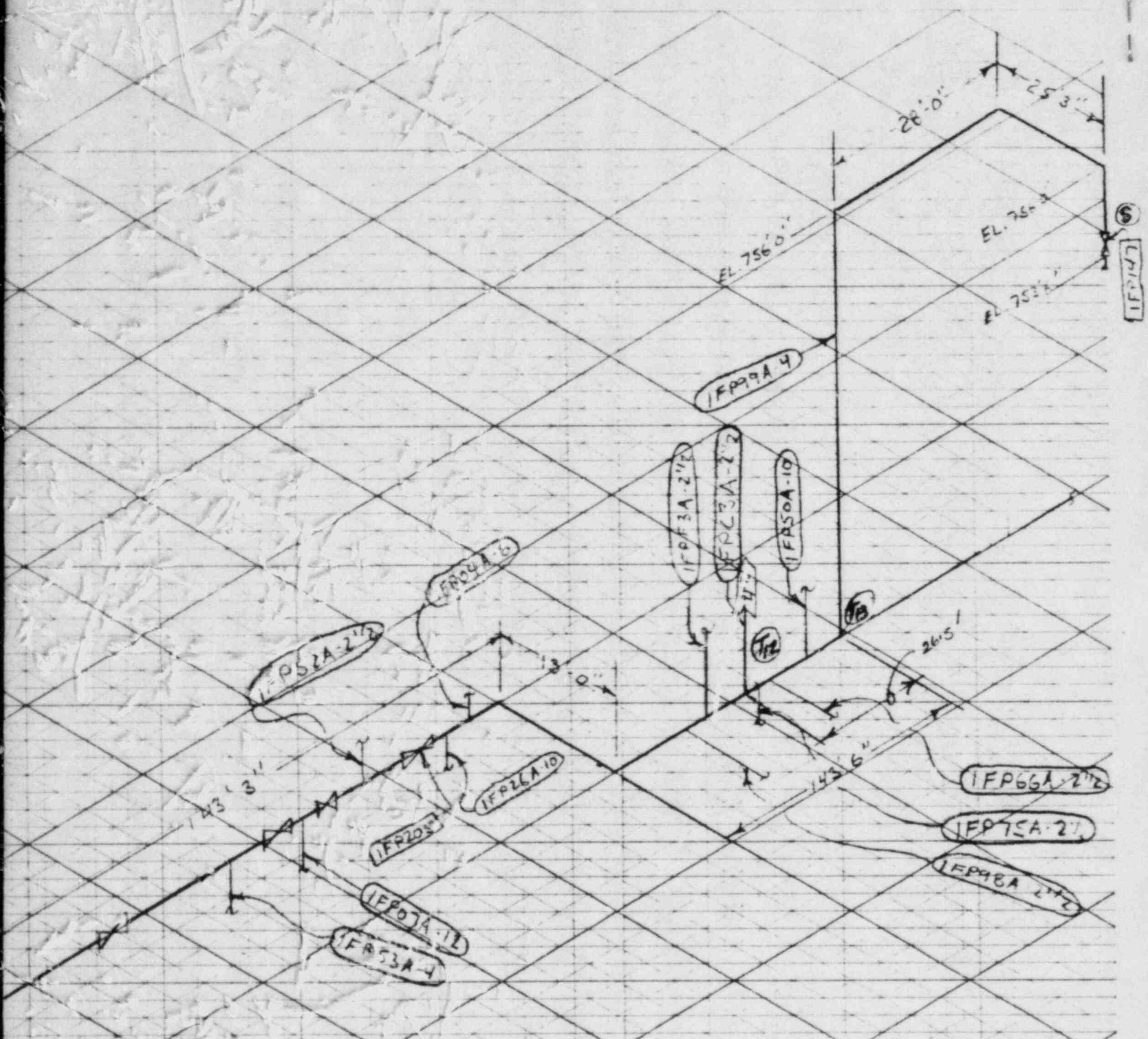
K&E ISOMETRIC-ORTHOGRAPHIC ©1943



HOSE STATIONS FOR CABLE SPREADING AREA

K+E ISOMETRIC-ORTHOGRAPHIC ©1943 KEUFFEL & ESSER CO. 47 4030

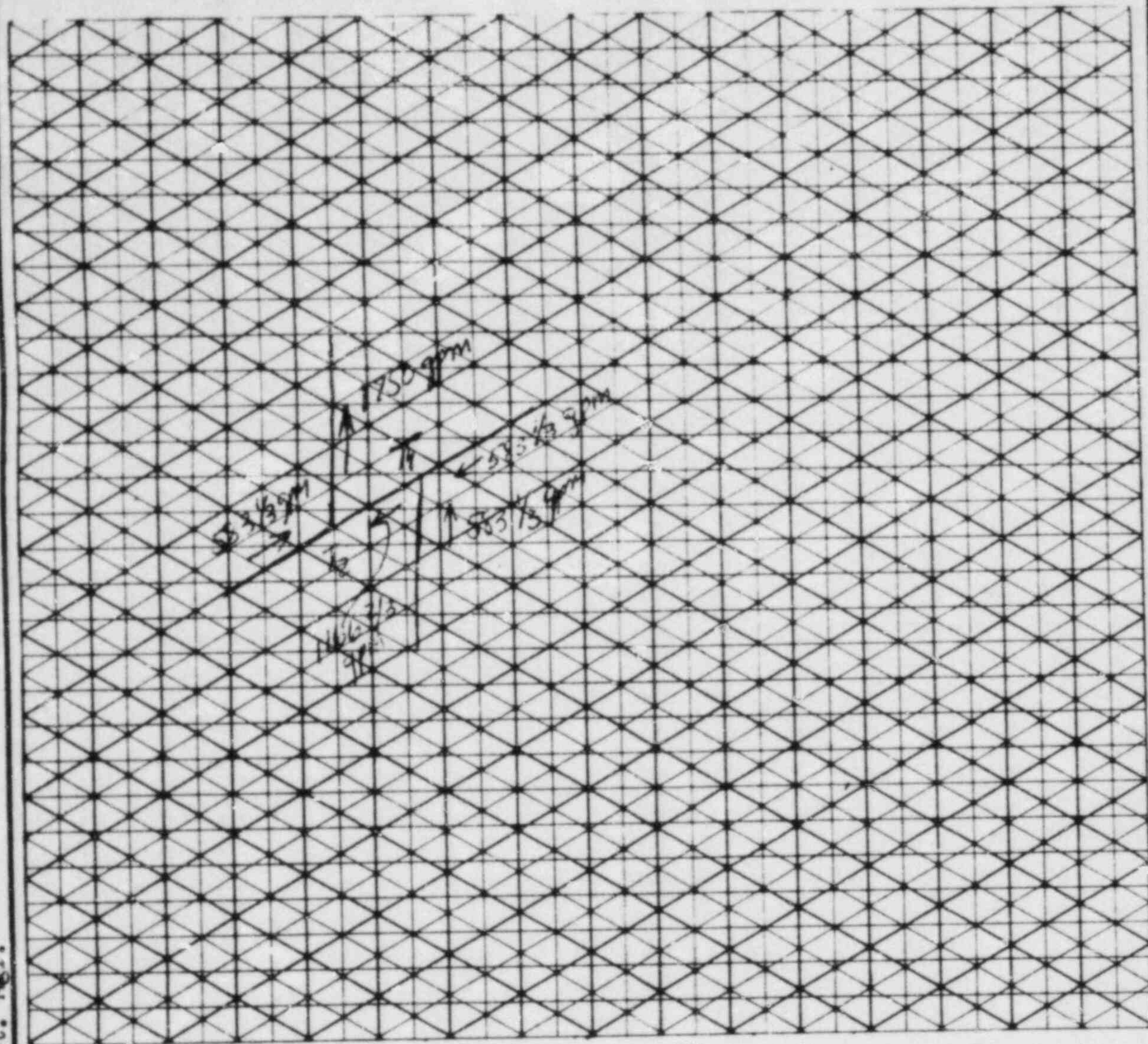




28'-0"
25'3"
EL. 756'0"
EL. 753'
1FP99A-4
1FP50A-10
1FP94A-6
1FP52A-2½
13'-0"
143'-3"
143'-6"
1FP26A-10
1FP205
1FP66A-2½
1FP75A-2½
1FP98A-2½
1FP53A-4

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

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					
ING CHECK VALVE	135	1 / 135				
SC GATE VALVE	13					
utterfly 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)		.445	.389	.195		
/100'(b) (FT/100 FT)		.005	.003	.001		
L ΔH (7x10) (FT)		.022	.002	.004		
S SELECTED		24	36	36		
NUMBER		2WS02[illegible]	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

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

SARGENT & LUNDY

REV. DATE

Page of

Form MES-2.16.1 Approved by [signature] 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.)

STRAINER
≈ΔH= 1.0 ft

STRAINER
2W SOIF
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

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: $T_2 - T_3$	[illegible]	$T_2 \cdot T_3$	$T_3 - T_4$
...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				[illegible]		
...42 Flow thru Branch	39					1 / 39
... flow thru [illegible]	6				1 / 6	
...L/D			130	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	.002	1.1607
...ΔH (7x10) (FT)			.023	.010	0	4.2
...SELECTED			36"	36	42	12"
...NUMBER			2WS02B	2WS03[illegible]	2WS03[illegible]	2WS44A OFPO1A

...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 $\Delta H = 0$ Due to small velocity

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

D. CONTROL VALVES

Also Available On Aperture Card

PRC APERTURE CARD

ΔH_D (FT)=

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

ΔH_F(FT)≃ 5.2 ft

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

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. PIPING

(a) PAGE / ITEM	DE
7 / 3	90° I
7 / 4	45° I
7 / 5	STD.
7 / 6	STD.
6 / 1a	CONV.
6 / 4a	SWING
6 / 5a	DISC
	Bu
	[illegible]
	[illegible]
	[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
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 [signature] Dept. Mgr.
Rev. Orig. (2-1-73)

AND VALVES

SCRIPTION (a)	(c) L/D	$T_7 - T_9$	$T_6 - T_7$	$T_5 - T_6$	$T_4 - T_5$	
		QUANTITY / L/D x QUANTITY OF FITTINGS FOR SIZES LISTED				
LONG RAD. ELBOW	20		3 / 60		1 / 20	
LONG 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		
...it Flow thru Branch	57				1 / 57	
L/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	4.9[illegible]	
...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		0FP02A	0FP02A	0FP02A	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)=

$\Delta H_F = \Delta H_A + \Delta H_B + \Delta H_C + \Delta H_D$
(0) (0) (0)

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

Form MES-2.16.1 Approved by [signature] 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.)

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
	[illegible]
	/
	[illegible]
	[illegible]

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: $T_{10} \to T_{11}$	$T_{?} \to T_{11}$	$T_{9} \to T_{?}$		
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'			
flow thru run	10	1 / 10'	2 / 20'			
butterfly valve	40	1 / 40'	1 / 40'	1 / [illegible]		
12→14 flow thru ?arch	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'	1.1042		
. STR. PIPE (1x2)	(FT)	348	456'	83.9'		
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[illegible]		
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

PRO APERTURE CARD

Also Available On Aperture Card

ΔH_D (FT)=

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

1.26

ΔH_F(FT) ≅ 2.3

PROJECT:

CLIENT: JOB NO.

CALC. NO.

ATE

ATE

ATE

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 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 [signature] 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_{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					
. GLOBF 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	
Butterfly 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	1.40	
00'(b) (FT/100 FT)		26.5	.24	<.021	.24	
Δ H (7x10) (FT)		26.5	.574	<.04	.19	
SELECTED		2½"	6"	12"	6"	
UMBER		IFFL3A	OFP10A	OFP09B	OFP07A	

AL Δ H (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)	Δ H (FT.)

ΔH_C (FT)

PRC APERTURE CARD

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

D. CONTROL VALVES

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)=

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

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
	FL
	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	

Form MES-2.16.1 Approved by H.A. Wagener 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: $T_3 \to S$	$T_{12} \to T_{13}$	$R \to T_{11}$	$T_{11} \to 1$	
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		
C GATE VALVE	13			8 / 104		
10x4 thru branch	42	1 / 42				
10 w thru run 10	12		1 / 12			
10 thru run 10	5		3 / 15	8 / 40		
thru run 10 → 10	8			2 / 16		
thru run 10	16			1 / 16		
thru run 10	12			1 / 12		
reducer	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)		84.2	1.122	1.5	.623	
Δ H (7x10) (FT)		104.50	.741	10.23	.28	
S SELECTED		4	10	10	12	
NUMBER		1FP9-4	1FP03A	1FP03A	1FP02A	

OTAL Δ H (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)	Δ H (FT.)

ΔH_C (FT) 0

12 x 10 reducer has negligible ΔH due to small velocity

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

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)= 116 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 of

8311040130-30 PAGE A-12

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 [illegible signature] Dept. Mgr.
Rev. Orig. (2-1-73)

G AND VALVES FROM FIRE PUMP TO T4

DESCRIPTION (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		OF P01AC				

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

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

Also Available On Aperture Card

0

ΔH_D (FT)=

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

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

Page of