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**Pakistan  
Water and Power Development  
Authority**

**Lakhra Coal Mine and  
Power Generation Feasibility Study**

**Power Plant Feasibility**

**Volume VII**



**January 1986**

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Prepared by



**Gilbert/Commonwealth International, Inc.**

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LAKHRA COAL MINE AND  
POWER GENERATION FEASIBILITY STUDY

POWER PLANT FEASIBILITY

VOLUME VII

Submitted to

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By

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3.58	Plant and Transmission Capital Cost, Comparison of Lakhra Alternative, First Unit Only	3-111
3.59	Lakhra and Imported Coal Project Comparisons	3-112
3.60	Lakhra and Imported Coal Comparative Parameters, July 1985 Dollars	3-113
3.61	Diversified Maximum Demand at Generation Level (M)	3-114
3.62	Energy Requirement at Generation Level (GWH)	3-115
3.63	System Load Factor	3-116
3.64	Second Series of WASP-3 Computer Studies Generation Expansion Program with the Cost of 5100 Btu/lb Lakhra Coal Equal to \$30.50/MT (1081 ¢/KCAL X 10 <sup>6</sup> )	3-117
3.65	Lakhra or Khanot 500 kV Substation for Two 350 MW Units	3-119
3.66	Capital Costs of Lakhra Alternative Transmission Plans for Two 350 MW Units	3-120
3.67	Plant and Transmission Capital Cost Comparison of Lakhra Alternatives for Two 350 MW Units Year of Expenditure Dollars	3-121

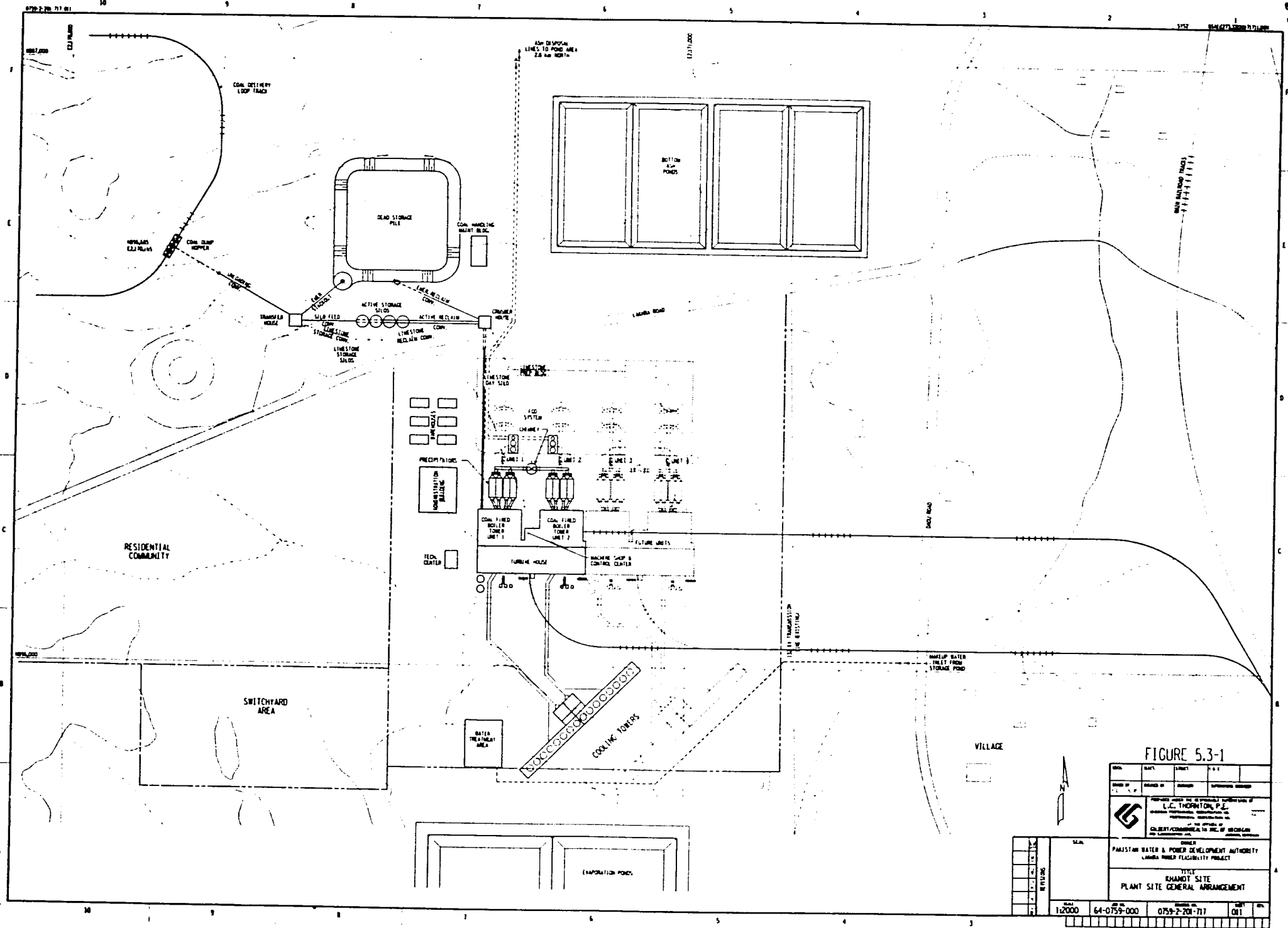


FIGURE 5.3-1

NO.	DATE	SHEET	OF	TOTAL
1		1	1	1
DRAWN BY		CHECKED BY		APPROVED BY
 L.C. THORNTON & P.C. CONSULTING ENGINEERS AND ARCHITECTS 1001 G ST. N.W. WASHINGTON, D.C. 20004				
OWNER PAKISTAN WATER & POWER DEVELOPMENT AUTHORITY LAMBA POWER FEASIBILITY PROJECT				
TITLE KHANLOT SITE PLANT SITE GENERAL ARRANGEMENT				
SCALE	DATE	NO. OF SHEETS	TOTAL SHEETS	REV.
1:2000	64-0759-000	0759-2-201-717	011	

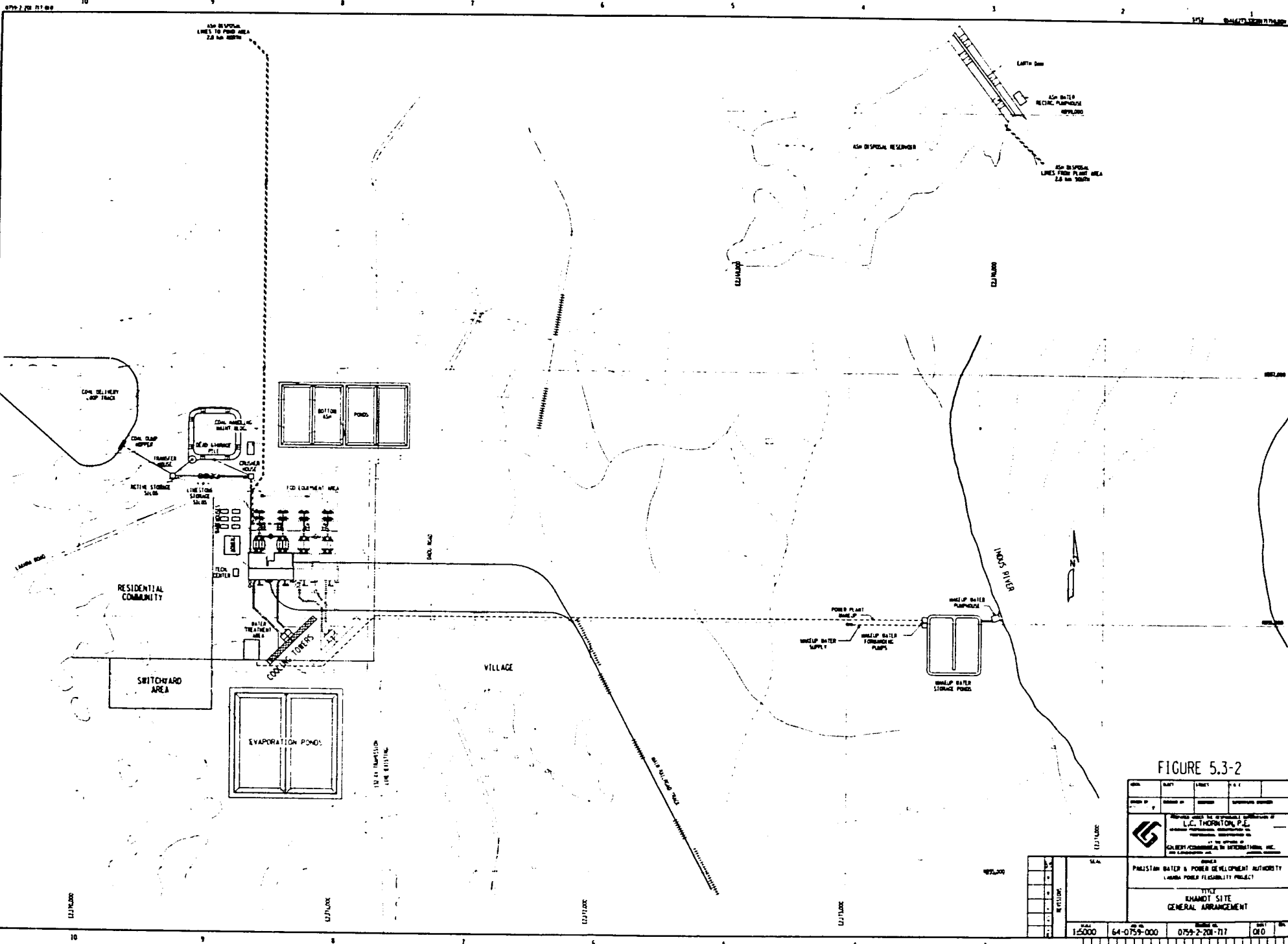



FIGURE 5.3-2

NO.	DATE	REVISION	BY
 L.C. THORNTON, P.E. CONSULTING ENGINEER 1000 N. 10th Street, Suite 100 Phoenix, Arizona 85006			
PREPARED BY THE SPECIALISTS OF <b>PAKISTAN WATER &amp; POWER DEVELOPMENT AUTHORITY</b> LAHORE POWER FEASIBILITY PROJECT SITE OF <b>KHANDI SITE</b> GENERAL ARRANGEMENT			
SCALE	PROJECT NO.	DRAWING NO.	SHEET NO.
1:5000	64-0759-000	0759-2-208-717	010

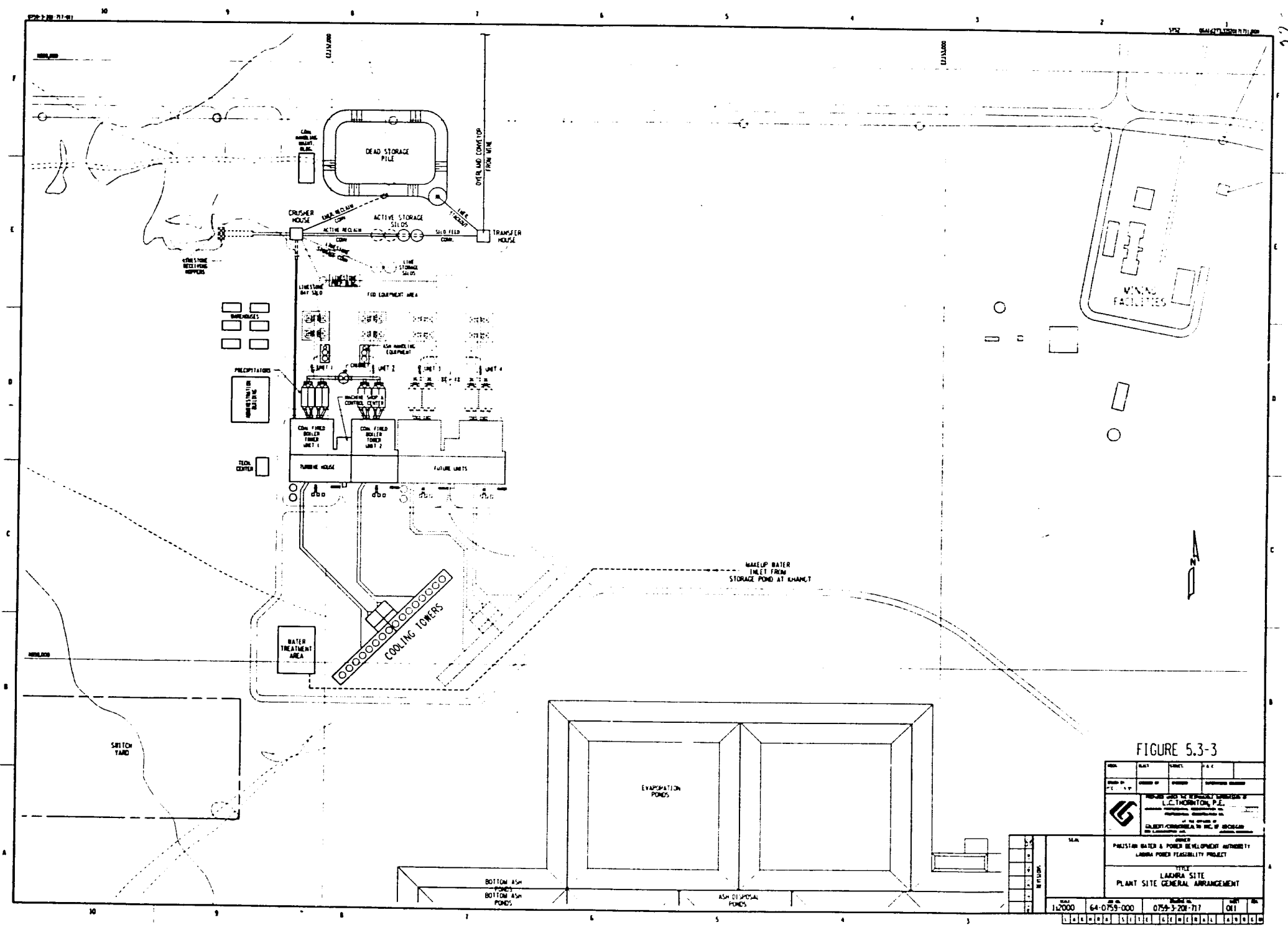


FIGURE 5.3-3

NO.	DATE	REVISION	BY	CHK
PREPARED BY: L.C. THORNTON, P.E. CONSULTING ENGINEER 1000 N. 17th St., Suite 100 Phoenix, Arizona 85016 PHONE: (602) 998-1111 FAX: (602) 998-1112				
OWNER: PALESTINE WATER & POWER DEVELOPMENT AUTHORITY LAGORIA POWER FEASIBILITY PROJECT				
TITLE: LAGORIA SITE PLANT SITE GENERAL ARRANGEMENT				
SCALE	PROJECT NO.	DATE	BY	CHK
1:12000	64-0759-000	0759-3-208-717	OH	
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100				

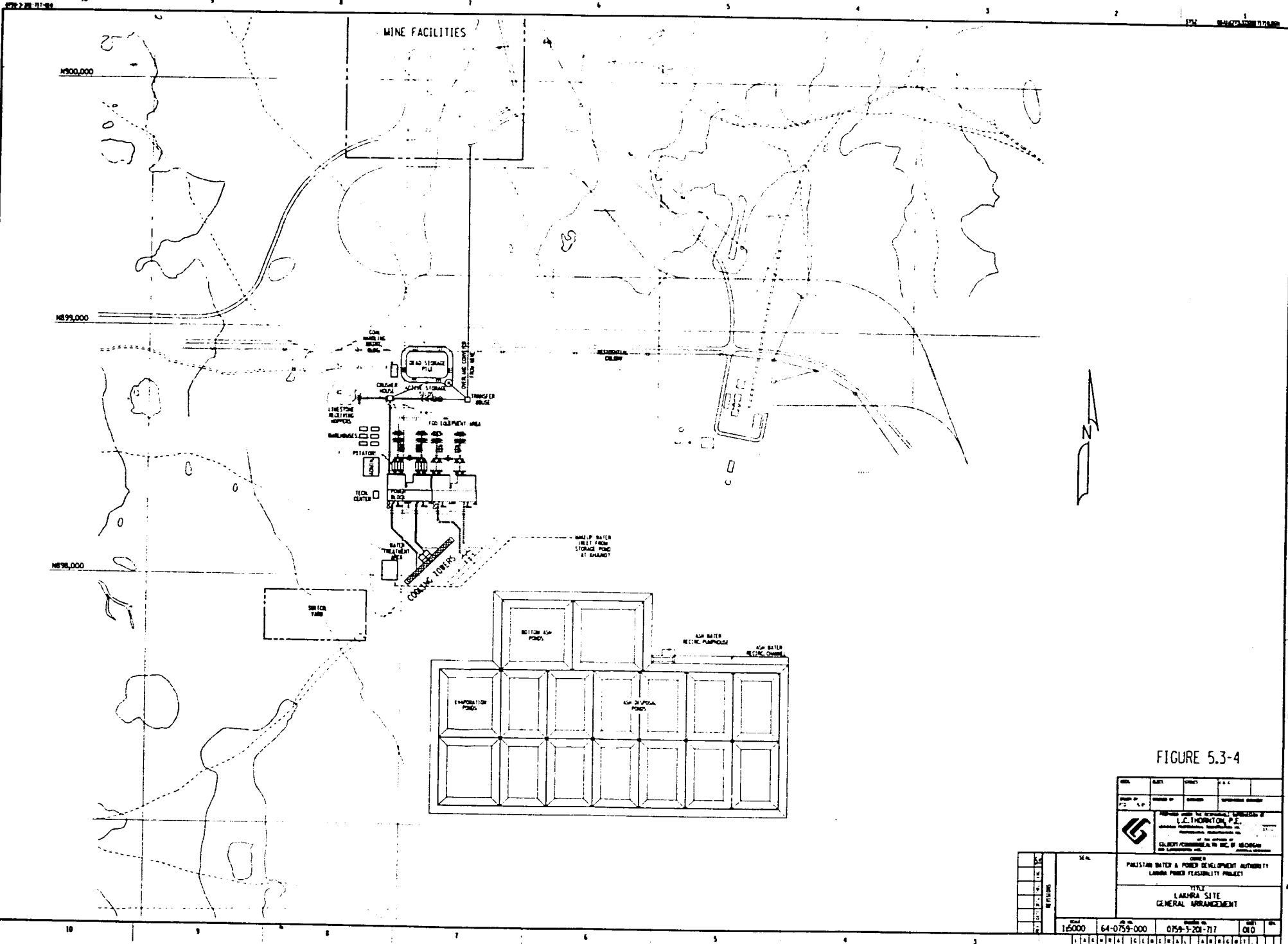

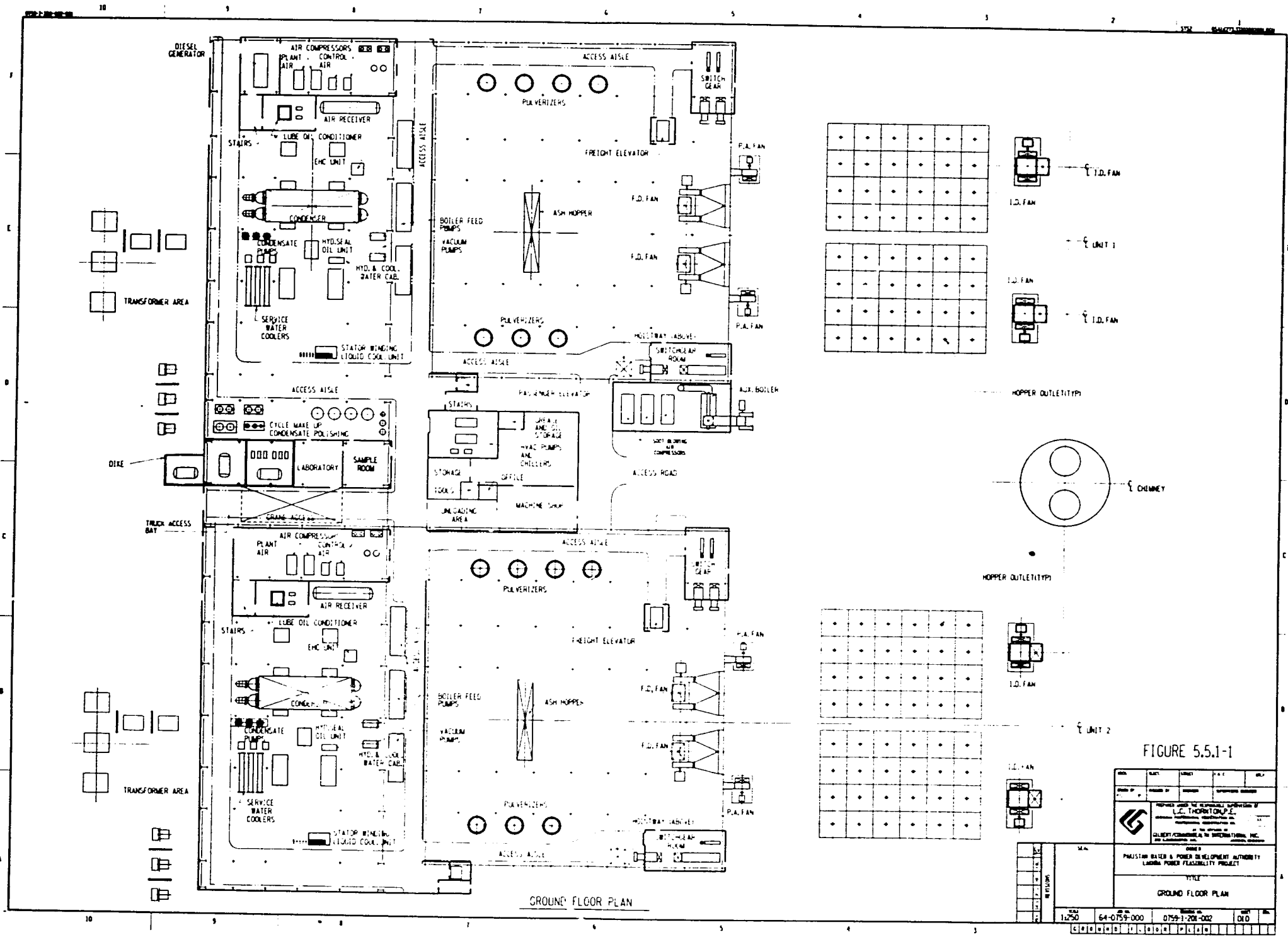


FIGURE 5.3-4

NO.	DATE	REVISION	BY	CHK.
1	10/1/77	ISSUED FOR CONSTRUCTION	...	...
 L.C. THORNTON P.E. LICENSE NO. 10000 CIVIL ENGINEER IN THE STATE OF GEORGIA				
PROJECT: PAKISTAN WATER & POWER DEVELOPMENT AUTHORITY LAHORA POWER FEASIBILITY PROJECT TITLE: LAKSHRA SITE GENERAL ARRANGEMENT				
Scale	1:5000	AS SHOWN	DATE	10/1/77
Sheet No.	64-0759-000	Sheet No.	0759-3-201-717	Sheet
1 2 3 4 5 6 7 8 9 10				





GROUND FLOOR PLAN

FIGURE 5.5.1-1

NO.	DATE	BY	CHK'D	APP'D
PROJECT UNDER THE SUPERVISION OF <b>THE PORTLAND GROUP, INC.</b> ENGINEERS, ARCHITECTS AND PLANNERS 1000 N. W. 10th St., Suite 1000 Fort Lauderdale, Florida, U.S.A.				
TITLE <b>PAKISTAN WATER &amp; POWER DEVELOPMENT AUTHORITY            LAHORE POWER FEASIBILITY PROJECT</b>				
SHEET NO. <b>GROUND FLOOR PLAN</b>				
SCALE	DATE	NO.	REV.	BY
1:250	64-0759-000	0759-1-201-002		

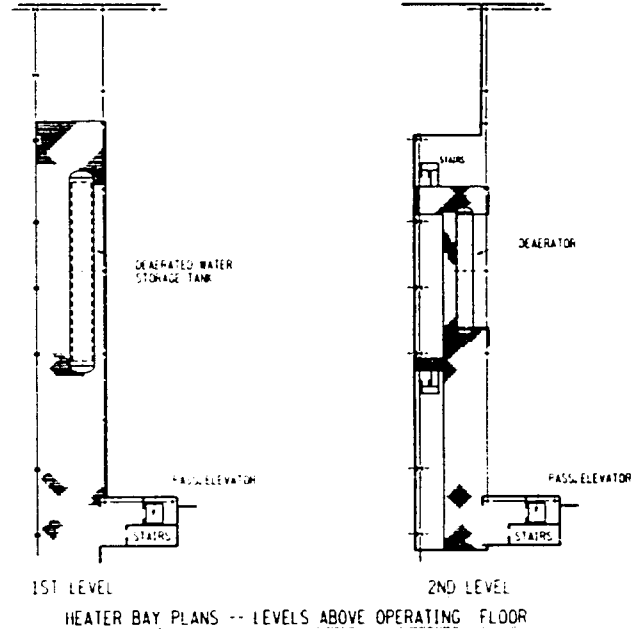
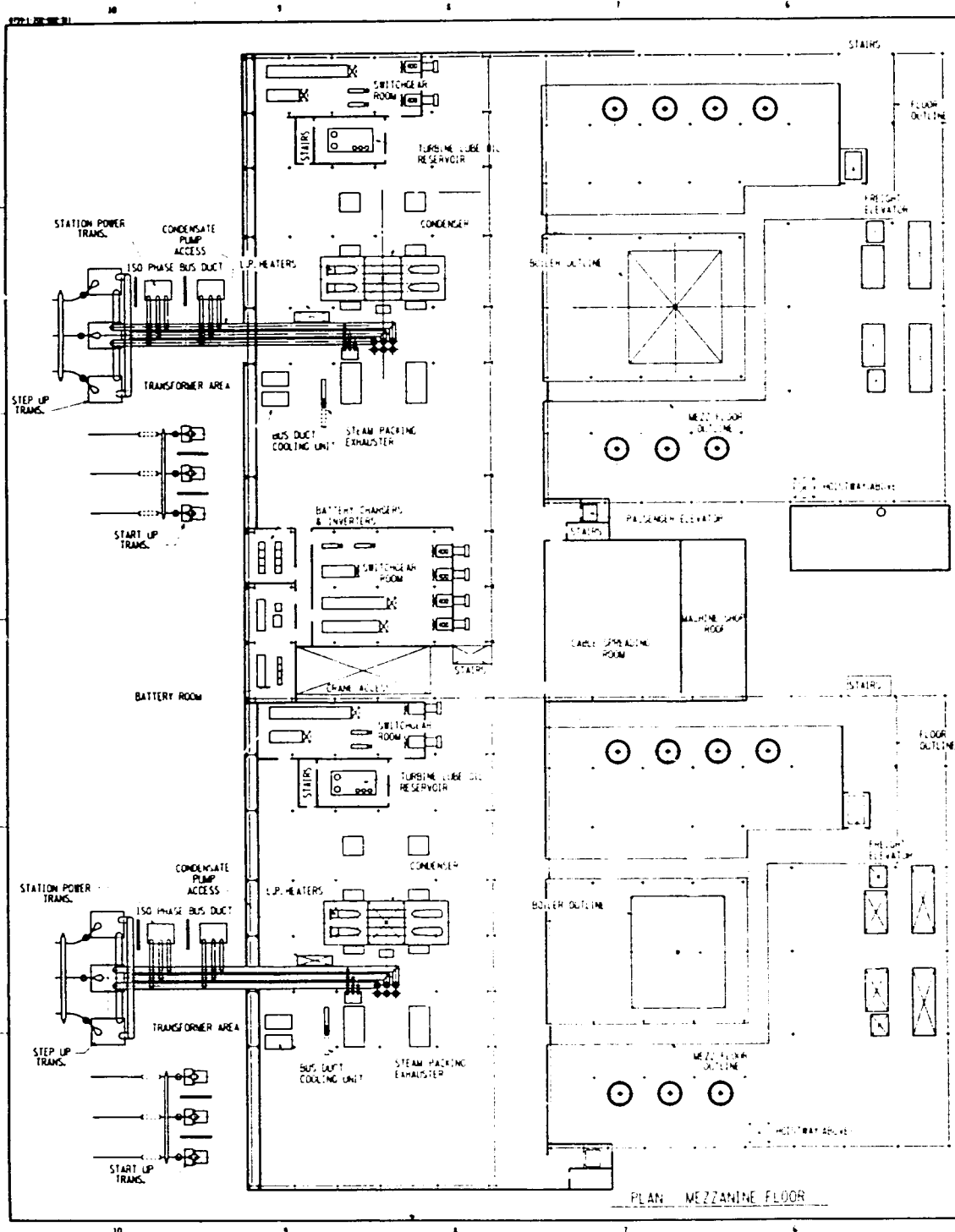


FIGURE 5.5.1-2

NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6	NO. 7	NO. 8	NO. 9	NO. 10	NO. 11	NO. 12	NO. 13	NO. 14	NO. 15	NO. 16	NO. 17	NO. 18	NO. 19	NO. 20
DATE		SCALE		PROJECT		SHEET NO.		SHEET TOTAL		DRAWN BY		CHECKED BY		APPROVED BY		DATE		PROJECT	
										L.A. THORNTON, P.E. LICENSE NO. 11050 REGISTERED PROFESSIONAL ENGINEER STATE OF CALIFORNIA									
PALM SPRING WATER & POWER DEVELOPMENT AUTHORITY LINCOLN POWER FEASIBILITY PROJECT										TITLE <b>MEZZANINE FLOOR AND          MISC. FLOOR PLANS</b>									
SCALE		PROJECT NO.		SHEET NO.		SHEET TOTAL		DATE		DRAWN BY		CHECKED BY		APPROVED BY		DATE		PROJECT	
1:250		64-0759-000		0759-1 202-002		011													

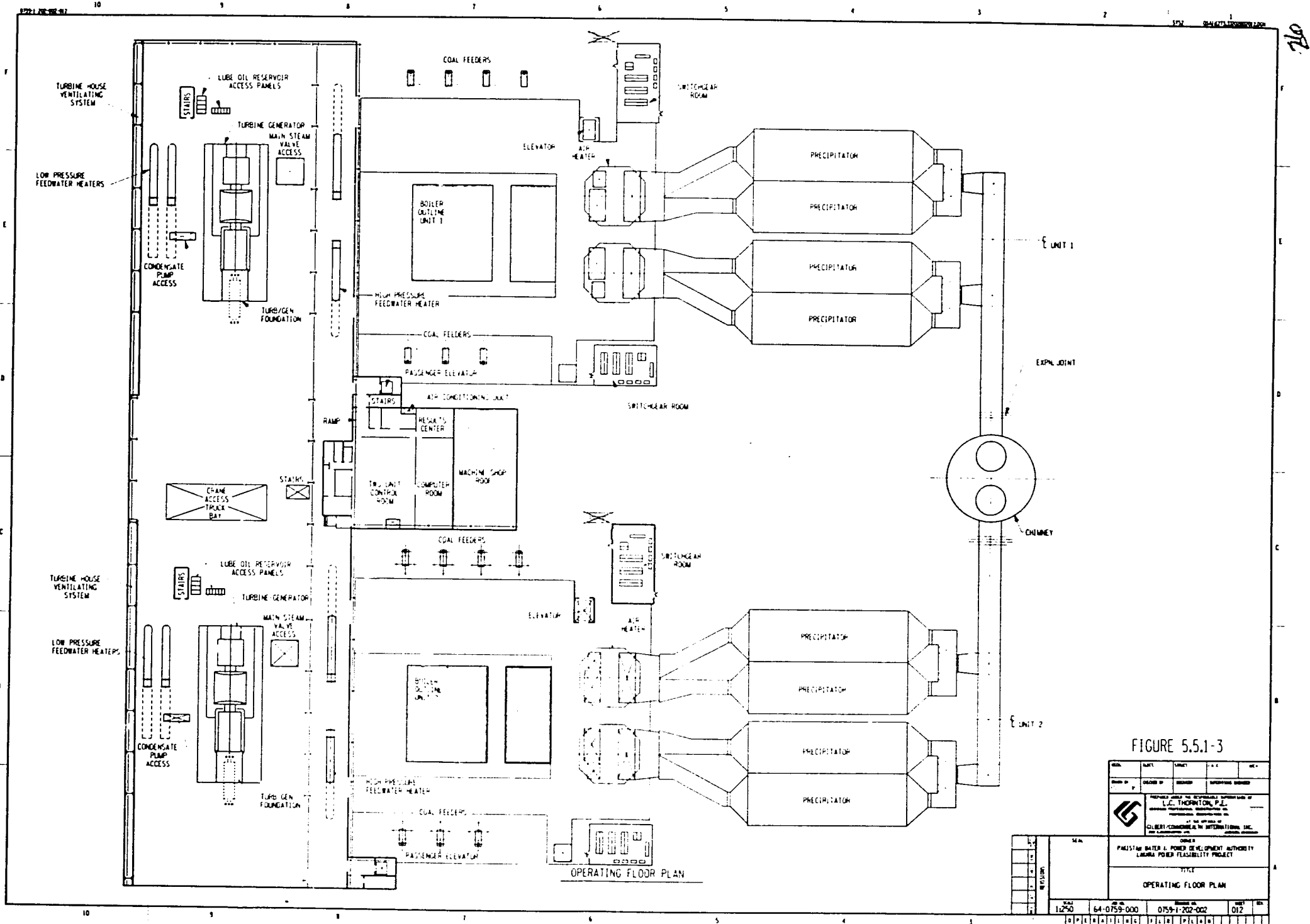



FIGURE 5.5.1-3

NO.	DATE	UNIT	REV.


 PREPARED BY THE RESPONSIBLE SUPERVISOR OF  
**L.J. THORNTON, P.E.**  
 GENERAL ENGINEERING, CONSULTING & ARCHITECTURE, INC.  
 1100 N. 17TH ST., SUITE 1000, DENVER, CO. 80202  
 A DIVISION OF  
**GILBERT COMMERCIAL INTERNATIONAL, INC.**  
 1700 N. 17TH ST., SUITE 1000, DENVER, CO. 80202

SCALE	1:250
NO.	64-0759-000
REV.	0759-1-202-002
DATE	012

PROJECT	PANJAB WATER & POWER DEVELOPMENT AUTHORITY LAMBIA POWER FEASIBILITY PROJECT
TITLE	OPERATING FLOOR PLAN

OPERATING FLOOR PLAN

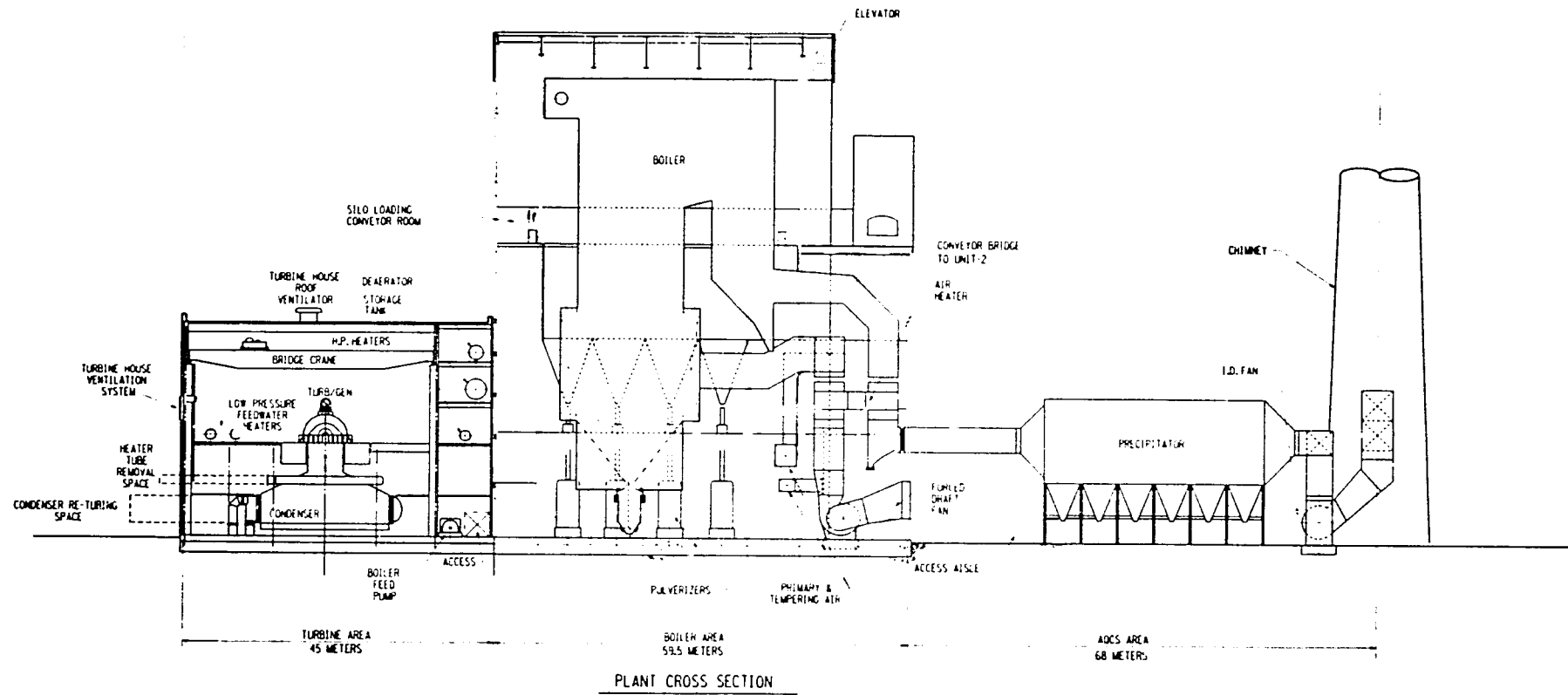
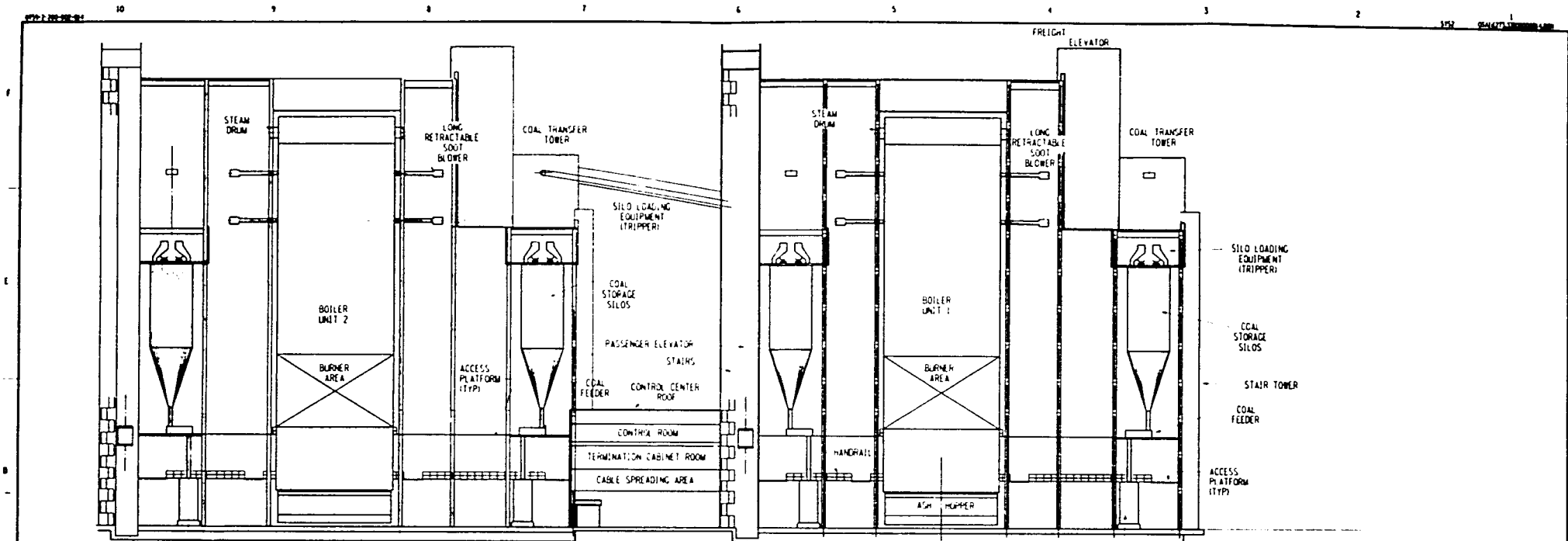


FIGURE 5.5.1-4

	PREPARED UNDER THE TECHNICAL SUPERVISION OF <b>L.C. THORNTON &amp; P.E.</b> LICENSED PROFESSIONAL ENGINEERS IN PENNSYLVANIA, MISSOURI AND IN OHIO
	FOR THE SERVICE OF <b>GILBERT, CONSUMERS AND INTERNATIONAL, INC.</b> 1000 LEXINGTON AVENUE NEW YORK, N.Y. 10017
POWER <b>PAKISTAN WATER &amp; POWER DEVELOPMENT AUTHORITY</b> LAHORE POWER / UTILITY PROJECT	TITLE <b>PLANT CROSS SECTION</b>
SHEET NO. 12250	PROJECT NO. 64-0759-000
DRAWING NO. 0759-1-202-002	SHEET NO. 013

# Flow Diagrams

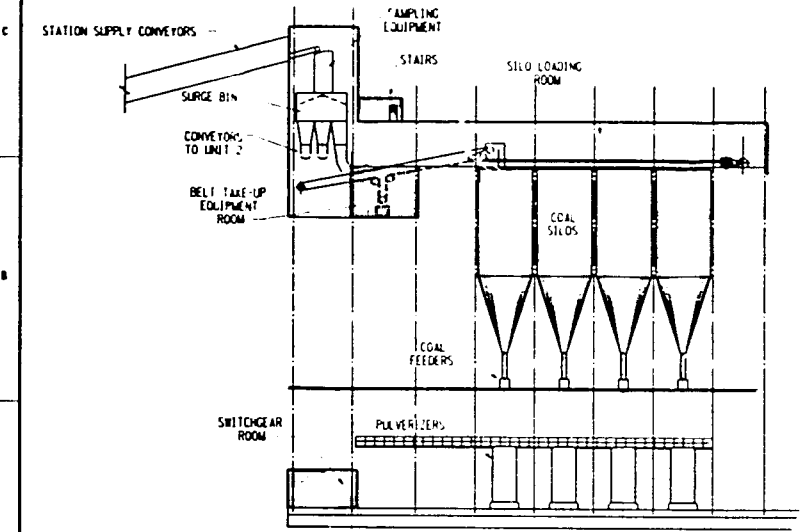


UNIT 2

UNIT 1

PULVERIZERS

LONGITUDINAL CROSS SECTION

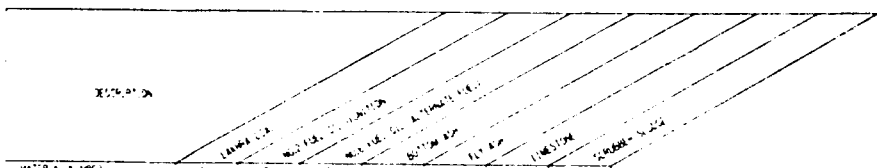
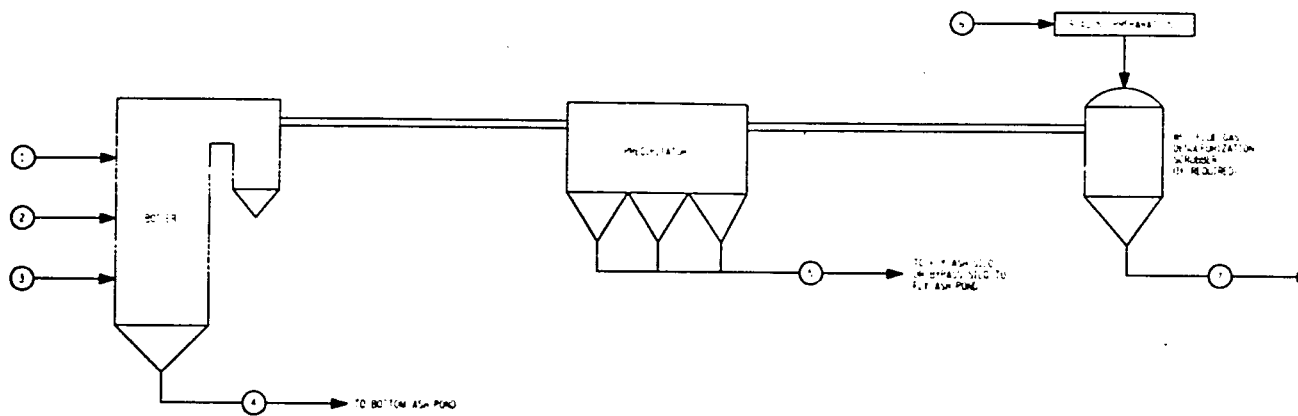


ELEVATION AT COAL SILOS

FIGURE 5.5.1-5

NO.	DATE	BY	CHKD
DESIGNED BY: L.C. THORNTON, P.E. CHECKED BY: L.C. THORNTON, P.E. AT THE OFFICE OF: CALVERT TECHNOLOGIES & THE INTERNATIONAL INC. 1000 CALVERT BLVD., WASHINGTON, D.C. 20004			
DRAWN BY: PAUL STONER PROJECT: PAULSTON WATER & POWER DEVELOPMENT AUTHORITY LEHIGH POWER FEASIBILITY PROJECT			
TITLE: LONGITUDINAL CROSS SECTION			
SCALE	NO. IN SET	DATE	REV.
1/2" = 1'-0"	12/250	64-0759-000	0759-1-202-002
PROJECT NO. 64-0759-000 DRAWING NO. 0759-1-202-002 SHEET NO. 084			






MATERIAL NAME	1	2	3	4	5	6	7
DESIGN TEMPERATURE	366	379	67	77	44		
DESIGN PRESSURE	348	25	245	41			
DESIGN GRADE	30	455	6				
DESIGN TEMPERATURE	20	79					

VOLUMETRIES LISTED ARE FOR ONE OF THE TWO 350 MM DIA. TUBES

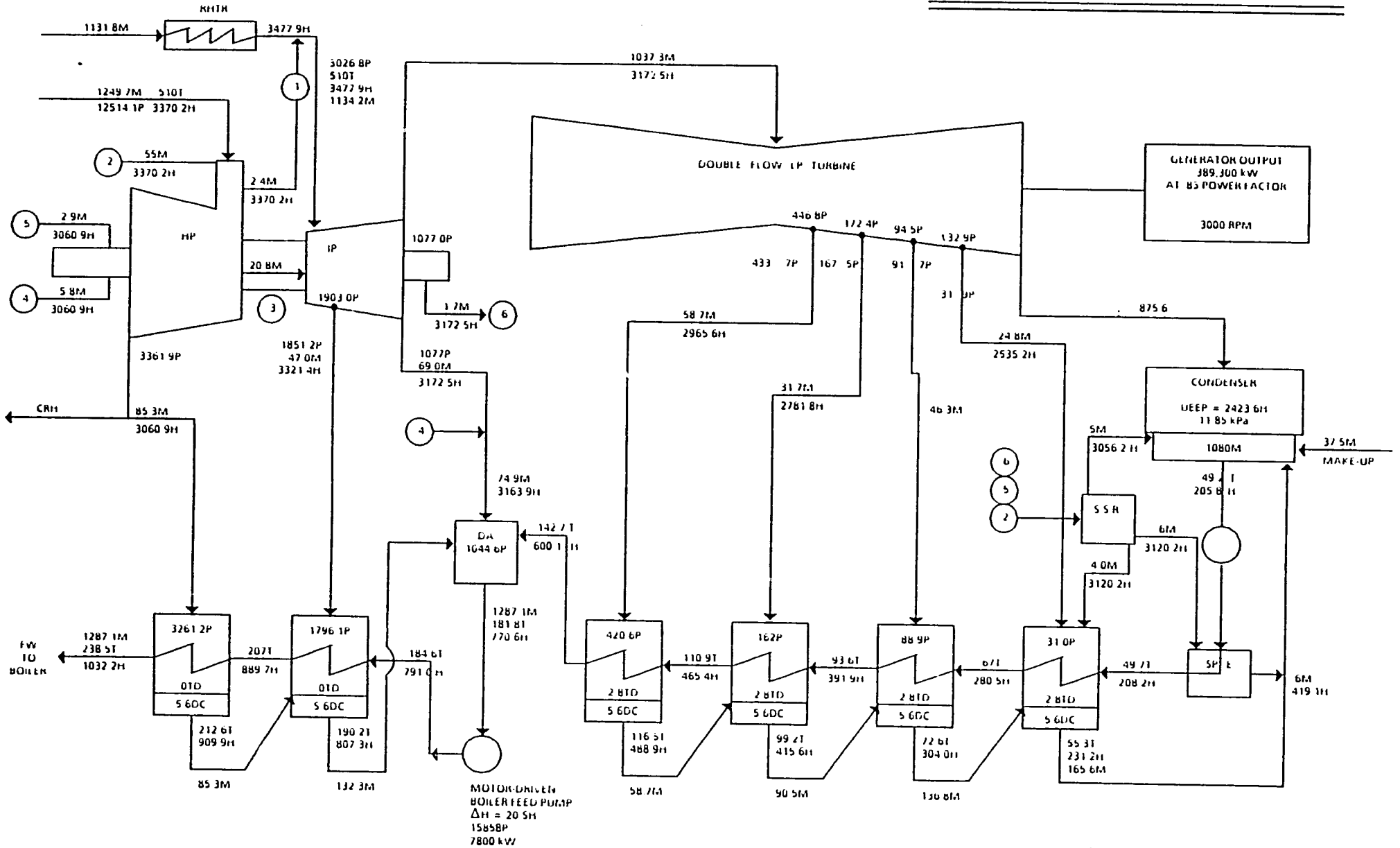
FIGURE 5.5.3-2

DESIGN	DRAWN	STRUCT.	P. & C.
DESIGNED BY A.C. OLIVE	CHECKED BY	APPROVED	SUPERVISOR ENGINEER
 PREPARED UNDER THE RESPONSIBLE SUPERVISION OF <b>R.T. UTTER, P.E.</b> <small>REGISTERED PROFESSIONAL ENGINEER IN THE STATE OF CALIFORNIA</small> <small>AT THE OFFICE OF CALBERT CONSULTANTS AND ENGINEERS, INC. 200 LAKESHORE BLVD. OAKLAND, CALIF. 94612</small>			

REVISIONS	NO.	DATE	BY	REASON
SCALE		NONE		
JOB NO.		64-0759-000		
DRAWING NO.		M-6		
SHEET NO.		1		



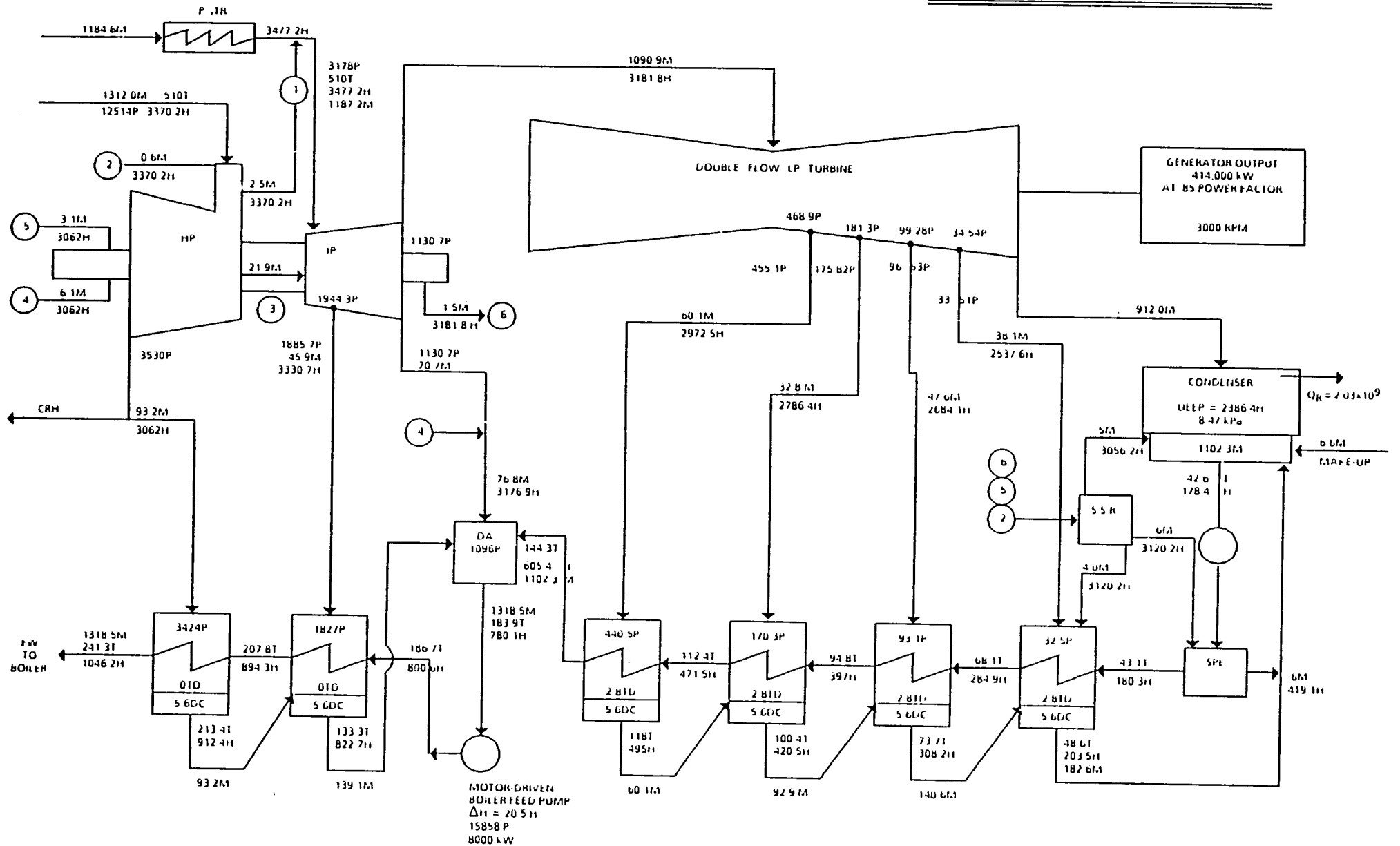
GUARANTEED - 11.85 kPa, 3% MU, TC2F



GROSS HEAT RATE = 8717 kJ/kWh  
(Heat Rate may vary depending on the T/G Vendor Selected)

M - Flow - tonnes/hr  
P - Pressure - kPa  
H - Enthalpy - kJ/kg  
T - Temperature - °C

LAKHRA POWER PLANT  
FEASIBILITY STUDY  
TYPICAL PRELIMINARY TURBINE HEAT BALANCE  
SI UNITS  
G/C II 11/12/85 HB-1  
FIGURE 5.5 AT 1

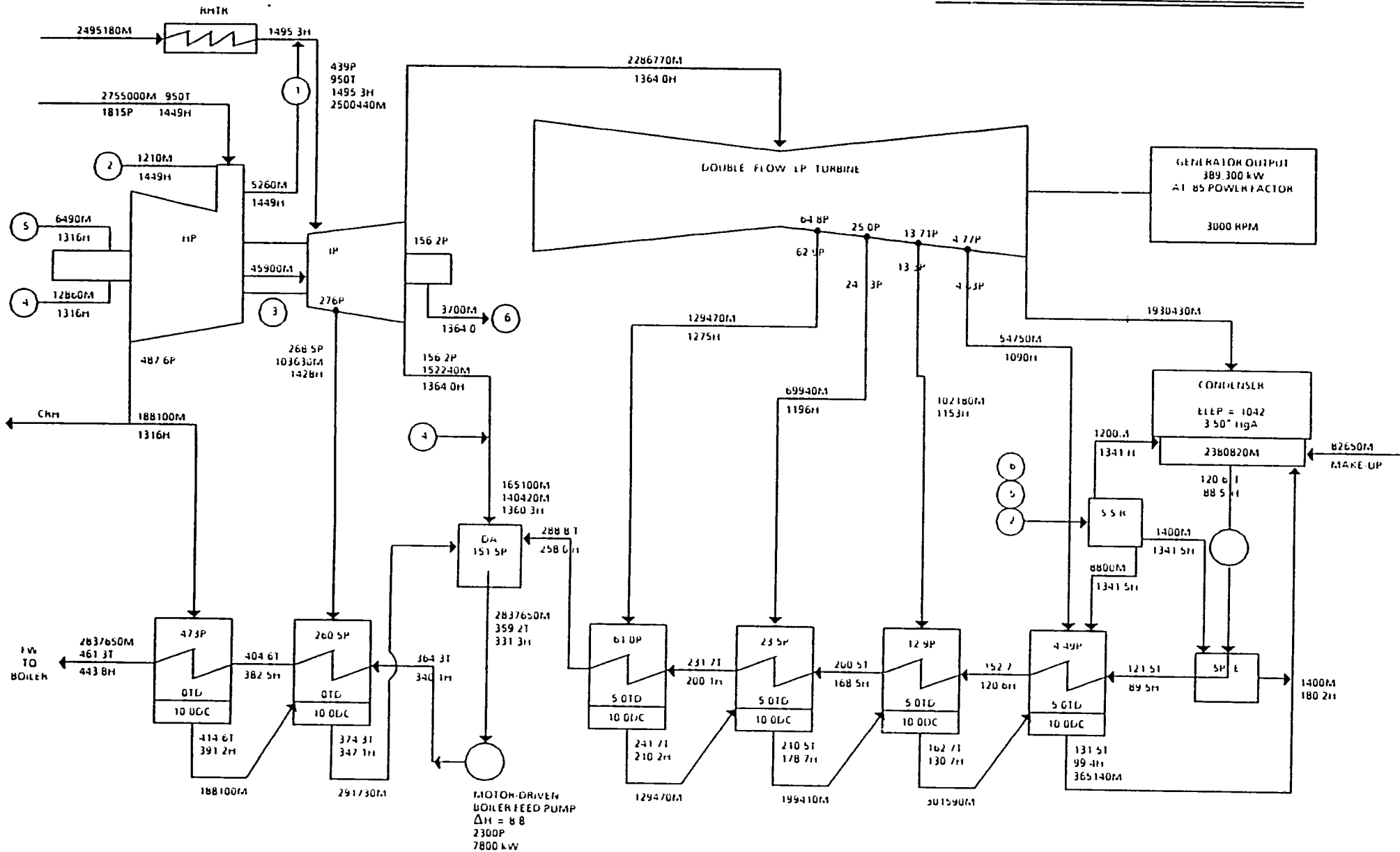


GROSS HEAT RATE = 8554 kJ/kWh  
 (Heat Rate May Vary Depending  
 on T/G Vendor Selected)

M - Flow - tonnes/hr  
 P - Pressure - kPa  
 H - Enthalpy - kJ/kg  
 T - Temperature - °C

LAKHRA POWER PLANT  
 FEASIBILITY STUDY  
 TYPICAL PRELIMINARY TURBINE HEAT BALANCE  
 SI UNITS  
 G/C II 11/12/85 HB-2  
 FIGURE 5.5.4I-2

**GUARANTEED - 3.5" HgA, 3% MU, TC2F**

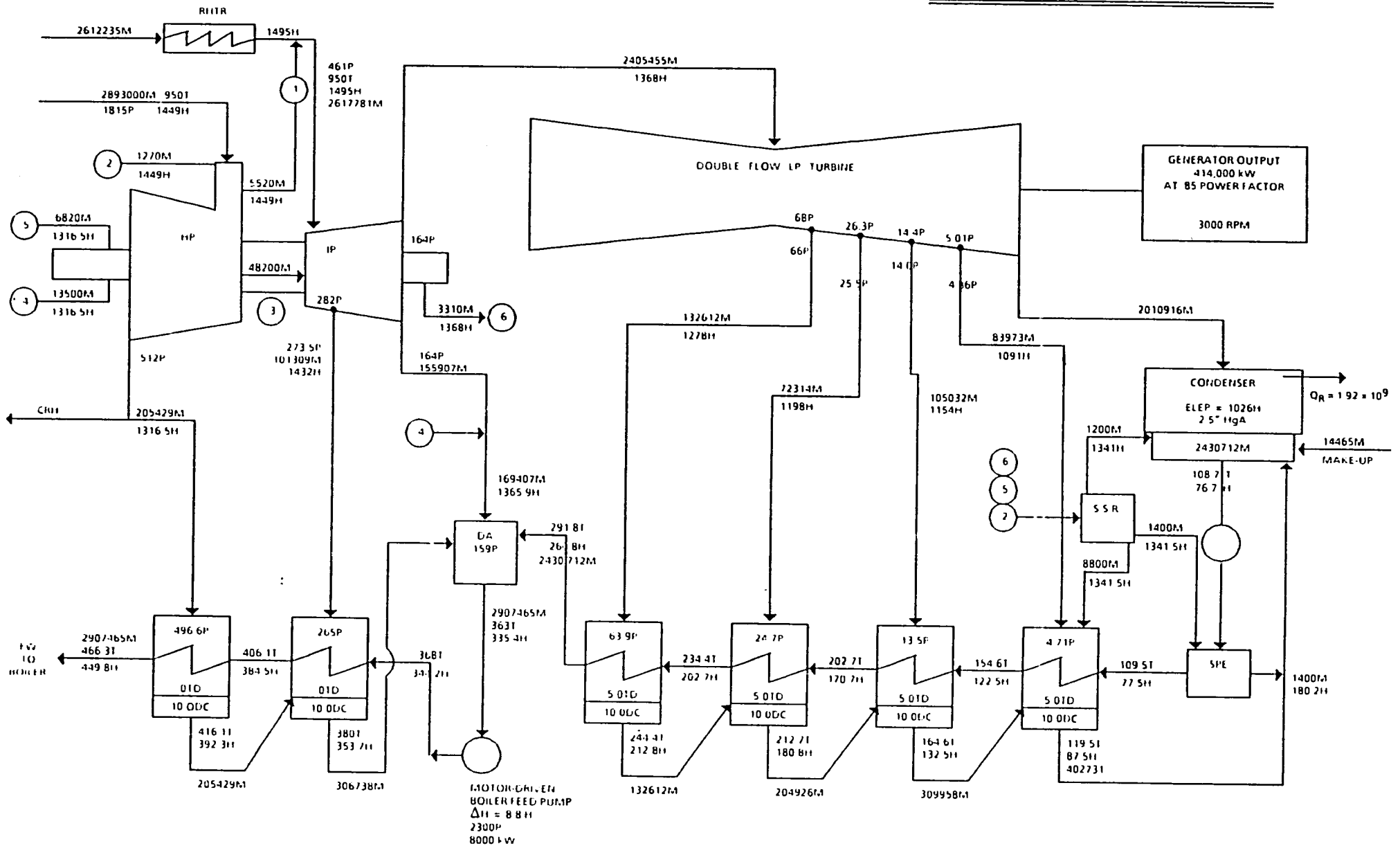


GROSS HEAT RATE = 8263 Btu/kWh  
 (Heat Rate may vary depending  
 on the T/G Vendor Selected)

M - Flow - lbs/hour  
 P - Pressure - psia  
 H - Enthalpy - Btu/lb  
 T - Temperature - °F

**LAKHRA POWER PLANT  
 FEASIBILITY STUDY  
 TYPICAL PRELIMINARY TURBINE HEAT BALANCE  
 ENGLISH UNITS  
 G/C II 11/12/85 HB-1  
 ETCHING 5 5 AT-2**

VWO - NP - 2.5" HgA, 0.5% MU, TC2F



GROSS HEAT RATE = 8108 Btu/kWh  
 (Heat Rate may vary depending  
 on the T/G Vendor Selected)

M - Flow - lbs/hour  
 P - Pressure - psia  
 H - Enthalpy - Btu/lb  
 T - Temperature - °F

LAKHRA POWER PLANT  
 FEASIBILITY STUDY  
 TYPICAL PRELIMINARY TURBINE HEAT BALANCE  
 ENGLISH UNITS  
 G/C II 11/12/85 HB-2  
 ETCHING 5 5 AT 4

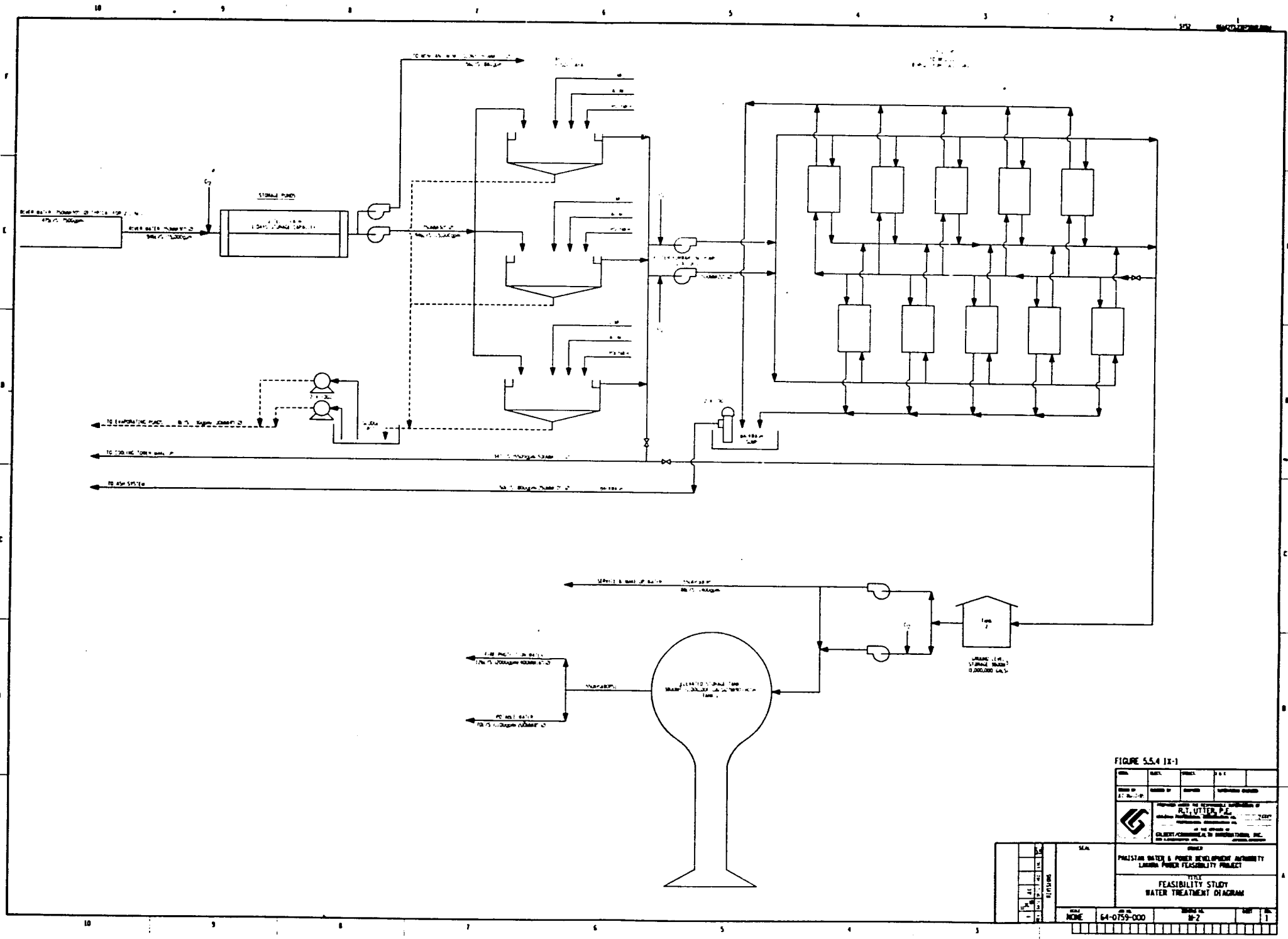


FIGURE 5.5.4 IX-1

NO.	DATE	PROJECT	REV.
1	11-10-64	PALESTINE WATER & POWER DEVELOPMENT AUTHORITY LADINA POWER FEASIBILITY PROJECT	1
PREPARED FOR THE TECHNICAL SERVICES OF <b>R.T. UTTER, P.E.</b> CONSULTING ENGINEERS, INC. 1000 W. 10th Street, Suite 100 Oklahoma City, Oklahoma 73106			
SHEET NO. <b>IF-2</b> OF <b>11</b> SHEETS PROJECT NO. <b>64-0759-000</b>			

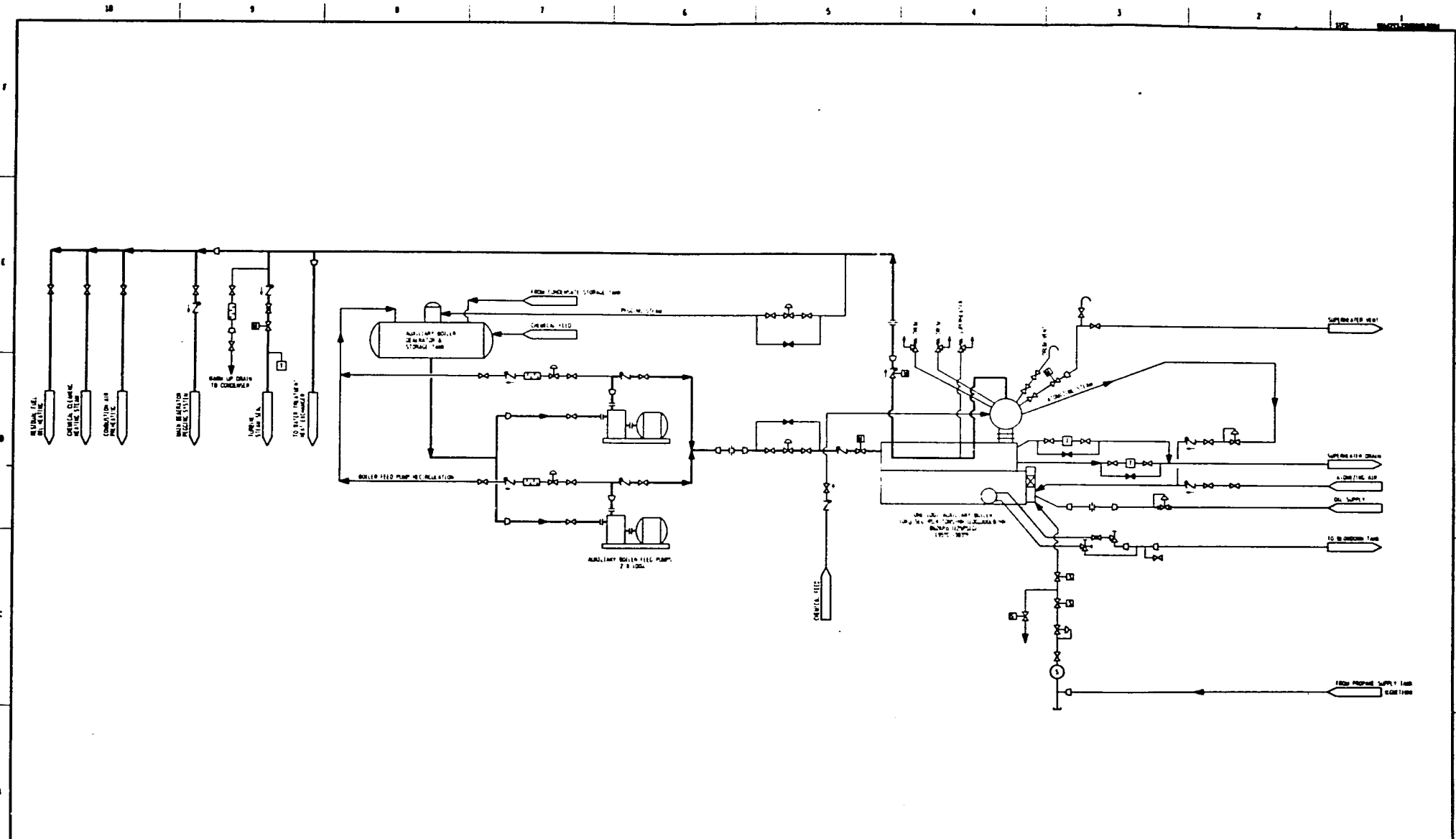



FIGURE 5.5.4 XI-1

NO.	REV.	DATE	BY	CHK.
1				
 <b>R.T. UTTER, P.E.</b> 7155 J 1000 NORTH AVENUE CHICAGO, ILLINOIS 60610 PHONE (312) 462-1234				
PROJECT: PASCAGO POWER & POWER DEVELOPMENT AUTHORITY LAMONA POWER FEASIBILITY PROJECT TYPE: FEASIBILITY STUDY AUXILIARY STEAM DIAGRAM				
SCALE	AS SHOWN			
DATE	NOV 1984	PROJECT NO.	64-0759-000	REV.
			1P-5	1

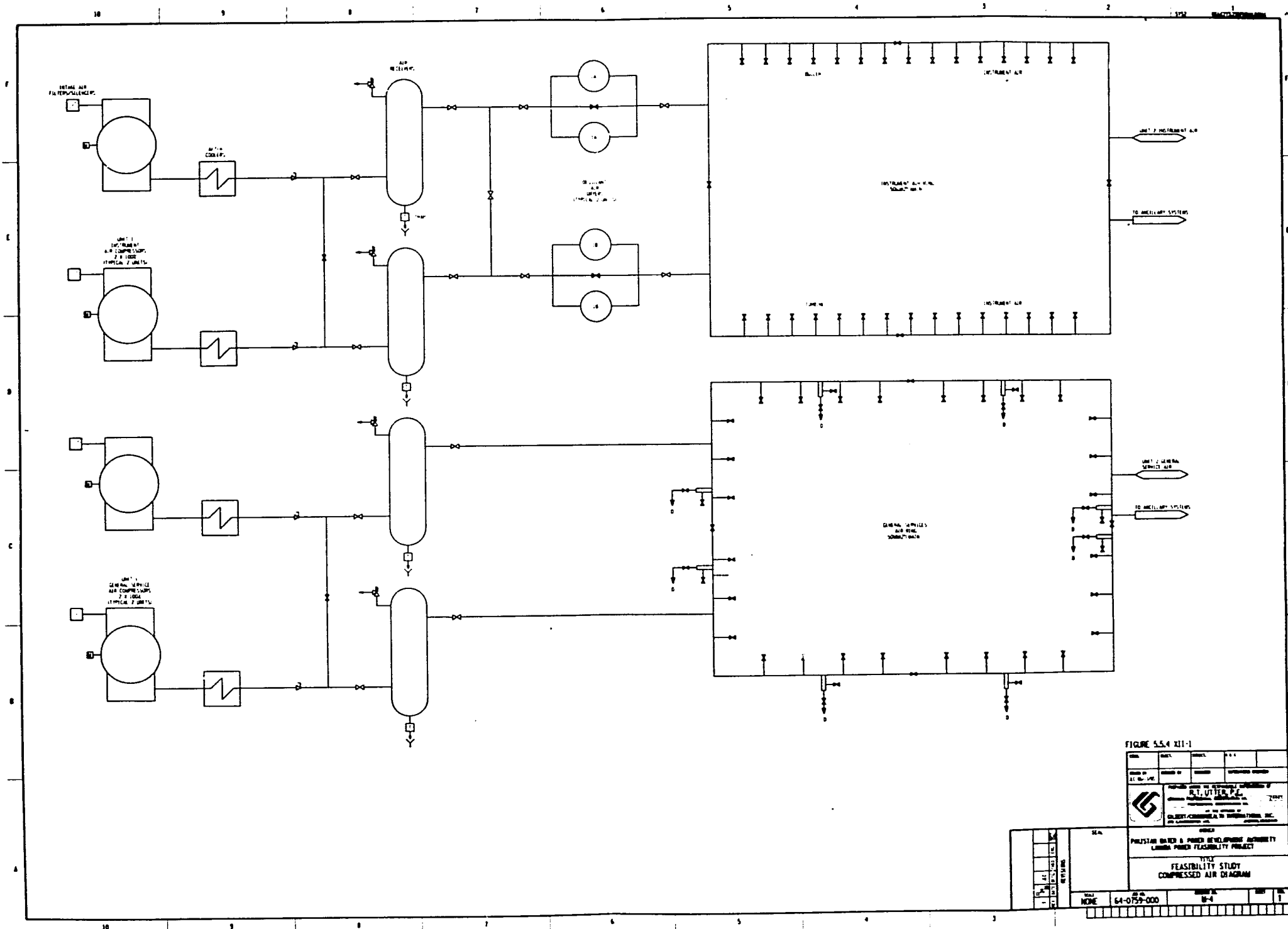


FIGURE 5.5.4 XII-1

NO.	REV.	DATE	BY	CHK.
1				
DESIGNED BY: [ ] CHECKED BY: [ ] APPROVED BY: [ ]				
PROJECT: [ ] CLIENT: [ ]				
TITLE: [ ]				
SHEET NO. [ ] OF [ ]				
PROJECT NO. [ ]				
DRAWING NO. [ ]				
SCALE: [ ]				
DATE: [ ]				

PREPARED BY: [ ]  
 R.T. UTTER, P.E.  
 CONSULTING ENGINEER  
 1000 [ ]  
 [ ]

PRUSTAN BAKER & PARTNER DEVELOPMENT ARCHITECTS  
 LAMAR POWER FEASIBILITY PROJECT  
 TYPE: [ ]  
 COMPRESSED AIR DIAGRAM

NO.	REV.	DATE	BY	CHK.
1				

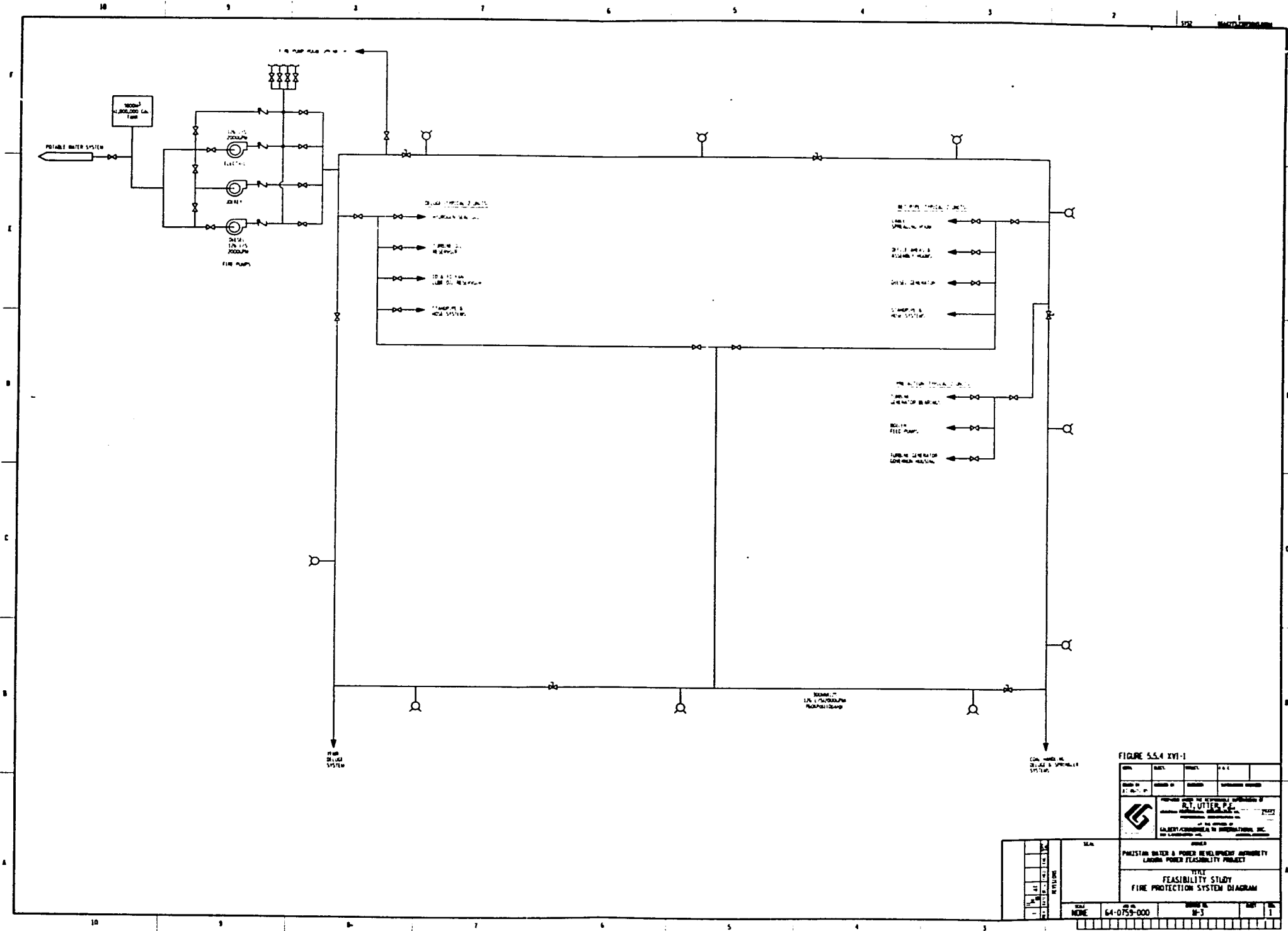

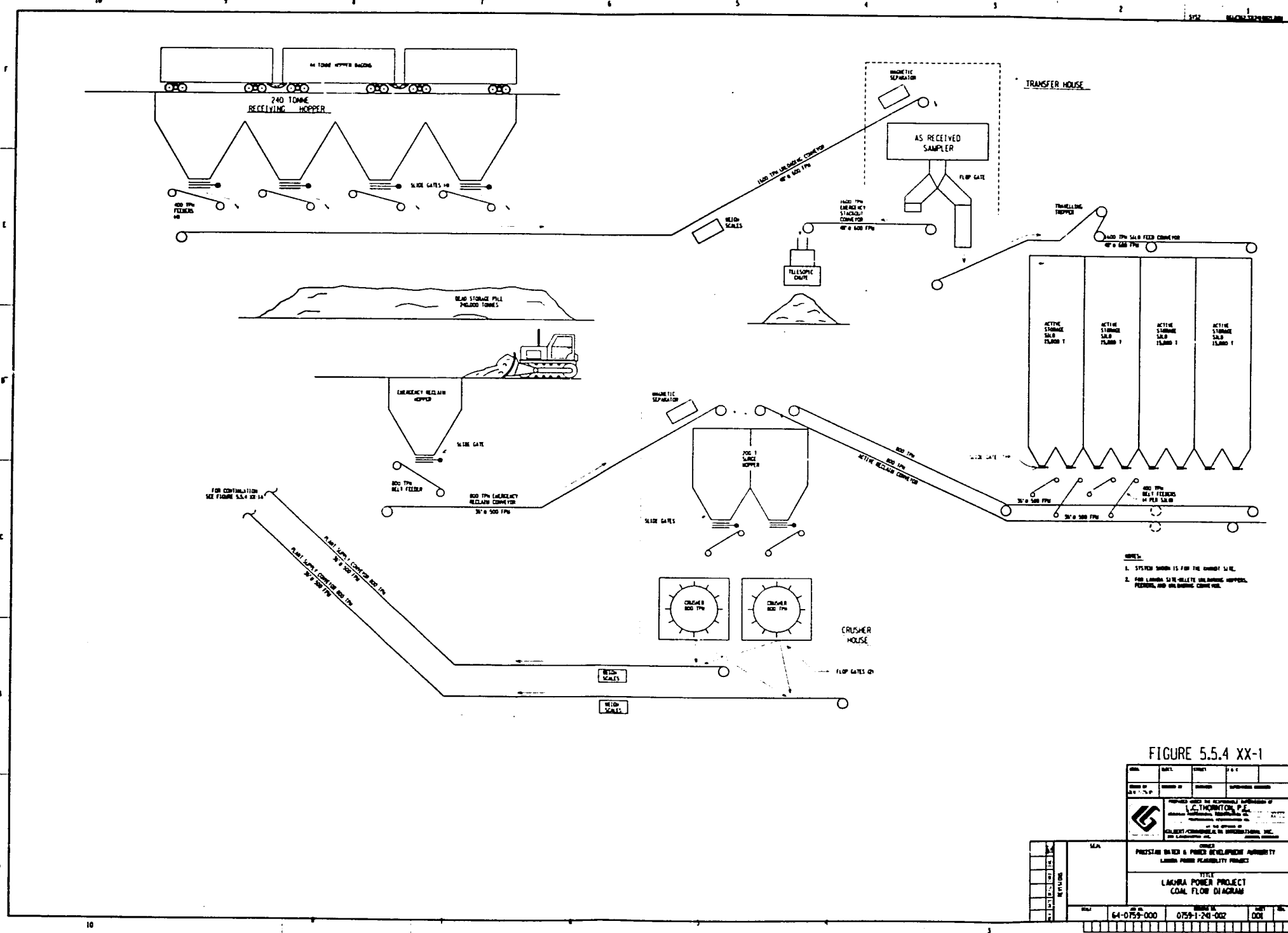


FIGURE 55.4 XVI-1

NO.	DATE	REVISION	BY	CHK
1	12/1/64	ISSUED	...	...
 PREPARED UNDER THE TECHNICAL SUPERVISION OF <b>S.T. UTTER, P.E.</b> CONSULTING ENGINEER 1000 MARKET STREET PHILADELPHIA, PENNSYLVANIA IN THE INTEREST OF <b>PAKISTAN COMMISSION FOR INVESTIGATIONS, INC.</b> 1000 MARKET STREET PHILADELPHIA, PENNSYLVANIA				
PROJECT <b>PAKISTAN WATER &amp; POWER DEVELOPMENT AUTHORITY          LAHORA POWER FEASIBILITY PROJECT</b>				
TITLE <b>FEASIBILITY STUDY          FIRE PROTECTION SYSTEM DIAGRAM</b>				
SCALE	PROJECT NO.		DATE	BY
AS SHOWN	64-0759-000		12-1-64	...





- NOTES:**
- 1. SYSTEM SHOWN IS FOR THE SHAROT SILO.
  - 2. FOR LAKURA SILO BELT FEEDER, HOPPER, FEEDER, AND UNLOADING CONVEYOR.

**FIGURE 5.5.4 XX-1**

NO.	DATE	BY	CHK'D BY	REVISION
PROJECT UNDER THE RESPONSIBLE SUPERVISION OF <b>C. THORNTON, P.E.</b> CONSULTING ENGINEER, 1000 W. 10TH AVENUE, DENVER, CO. 80202				
PREPARED BY THE OFFICE OF <b>CONSULTING ENGINEER, INC.</b> 1000 W. 10TH AVENUE, DENVER, CO. 80202				
OWNER: <b>PRESTON WATER &amp; POWER DEVELOPMENT AUTHORITY</b> LAKURA POWER FEASIBILITY PROJECT				
TITLE: <b>LAKURA POWER PROJECT</b> <b>COAL FLOW DIAGRAM</b>				
SCALE:				
DATE:	64-0759-000	0759-1-240-002	CON	

40

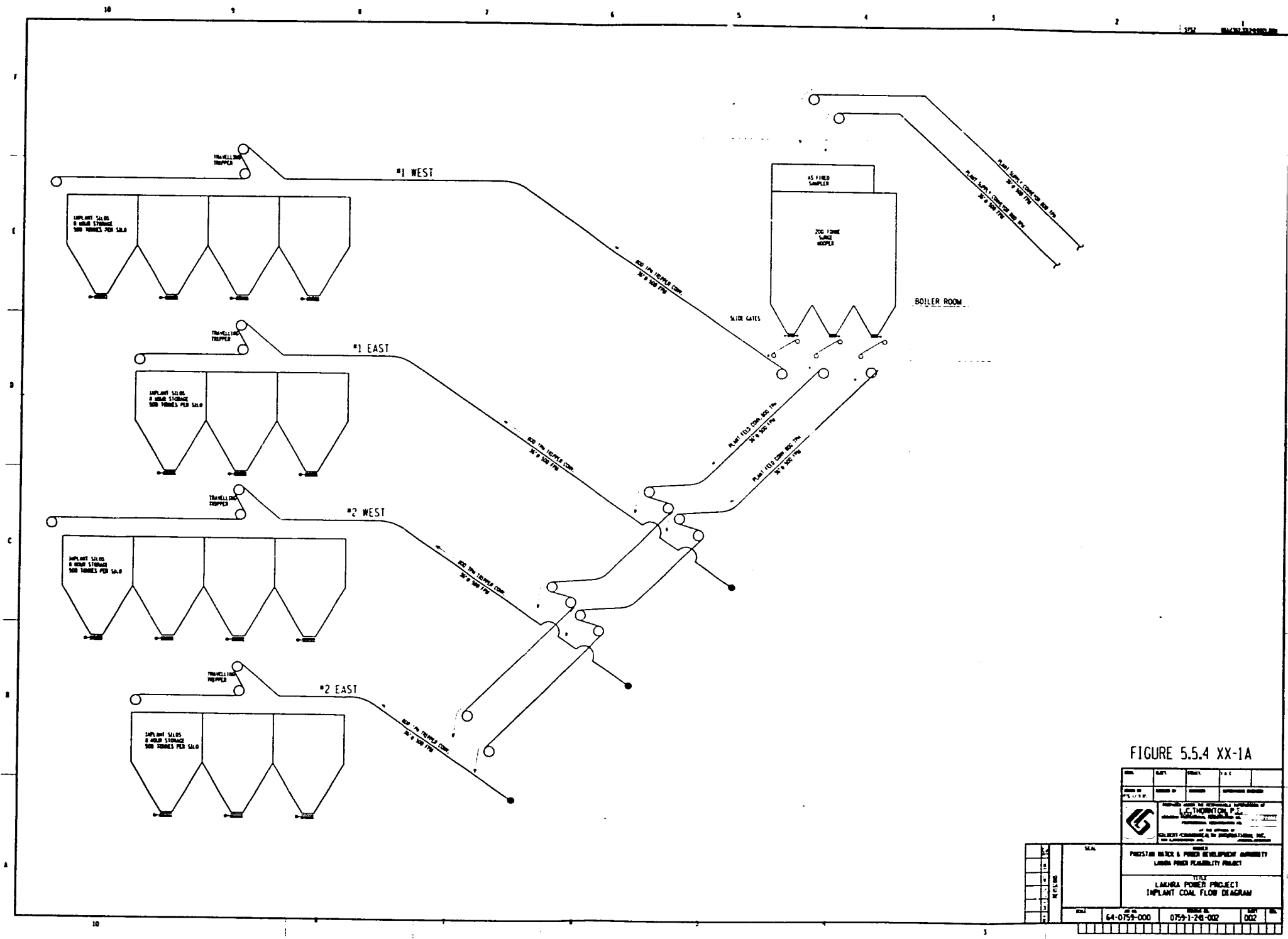


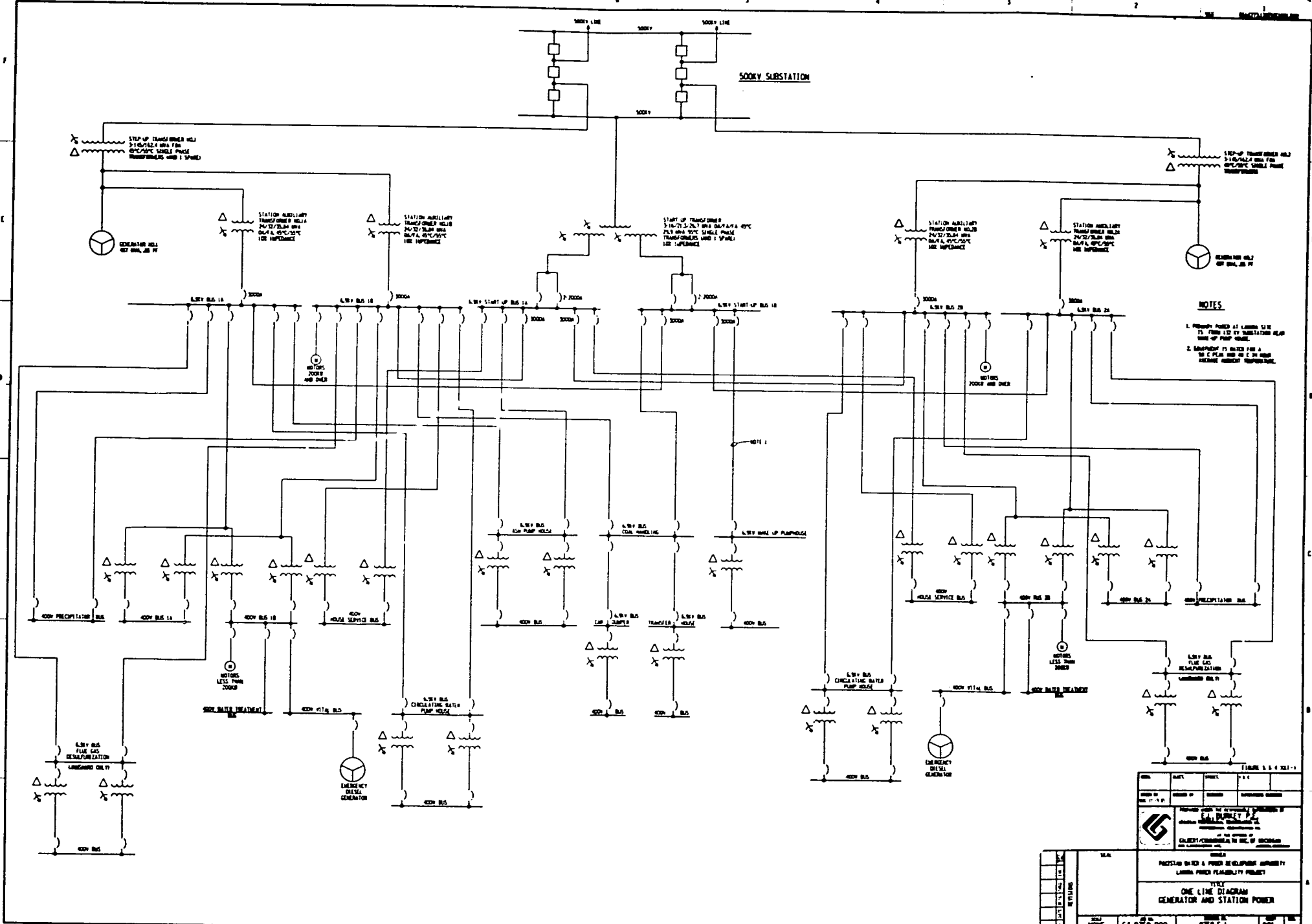
FIGURE 5.5.4 XX-1A

NO.	DATE	REVISION	BY

PREPARED BY: <b>L. THORNTON, P. E.</b> PROJECT ENGINEER	
CHECKED BY: <b> </b> PROJECT ENGINEER	
TITLE: <b>LAKSHRA POWER PROJECT INPLANT COAL FLOW DIAGRAM</b>	
SHEET NO: <b>64-0759-000</b>	SHEET TOTAL: <b>0759-1-248-002</b>


PROJECT: <b>PRESTON WATER &amp; POWER DEVELOPMENT AUTHORITY LAKSHRA POWER PROJECT</b>
TITLE: <b>LAKSHRA POWER PROJECT INPLANT COAL FLOW DIAGRAM</b>
SHEET NO: <b>64-0759-000</b>
SHEET TOTAL: <b>0759-1-248-002</b>

# Single Line Diagrams



**NOTES**

1. PROPERTY POWER AT LAMINA IS TO BE FROM 110 KV SUBSTATION NEAR SIDE OF PUMP HOUSE.
2. EQUIPMENT IS RATED FOR A 100 C FLOW AND 40 C TO 60 C WIND. EXCEPT WHERE NOTED OTHERWISE.

REV.	DATE	BY	CHK'D	NO.
 <p><b>E.I. DURETT &amp; CO.</b> ENGINEERS</p>				
PROJECT NO. 64-0759-000 SHEET NO. 0759-E-1				
TITLE: <b>ONE LINE DIAGRAM                  GENERATOR AND STATION POWER</b>				

SCALE	AS SHOWN
DATE	64-0759-000
REV.	0759-E-1
DRAWN BY	OCN
CHECKED BY	

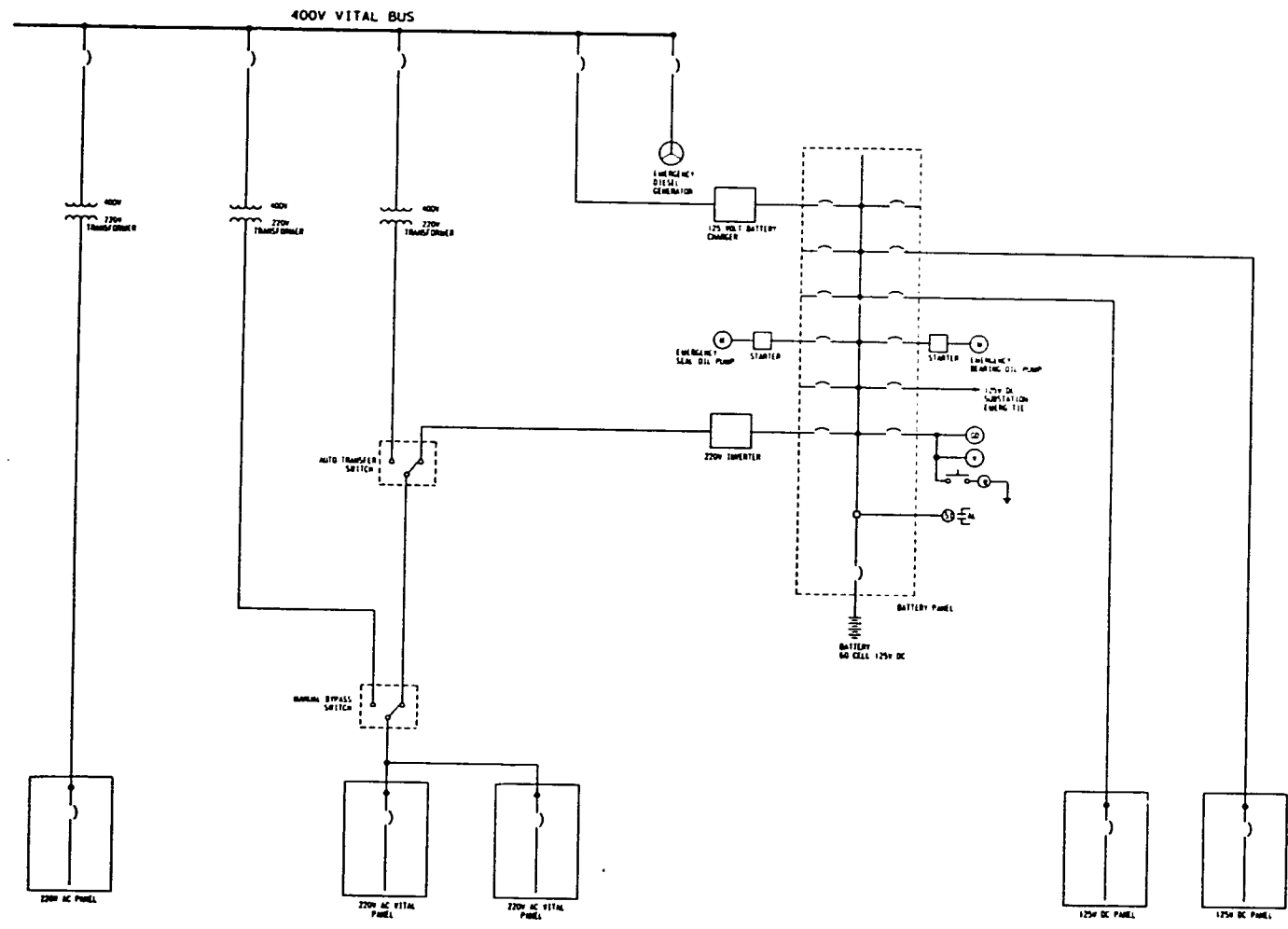


FIGURE 6.6-4 0211-1

DATE	PLACED	REVISED	BY
DESIGNED BY	CHECKED BY	APPROVED BY	
 <b>E.L. BUREY P.E.</b> <small>REGISTERED PROFESSIONAL ENGINEER</small>			
<small>AT THE REQUEST OF</small> <b>POWERMAN NUCLEAR &amp; POWER DEVELOPMENT AUTHORITY</b> <small>LAUREN POWER FEASIBILITY PROJECT</small>			
<b>ONE LINE DIAGRAM</b> <b>EMERGENCY POWER SYSTEM</b>			
SCALE	DATE	PROJECT NO.	REV.
NONE	64-0759-000	0759-E-1	002