Appendices

Appendix A – WKE Case

Appendix B – TXU Case

Appendix C – BB Power Report on Boiler Penetraions

Appendix A – WKE Case

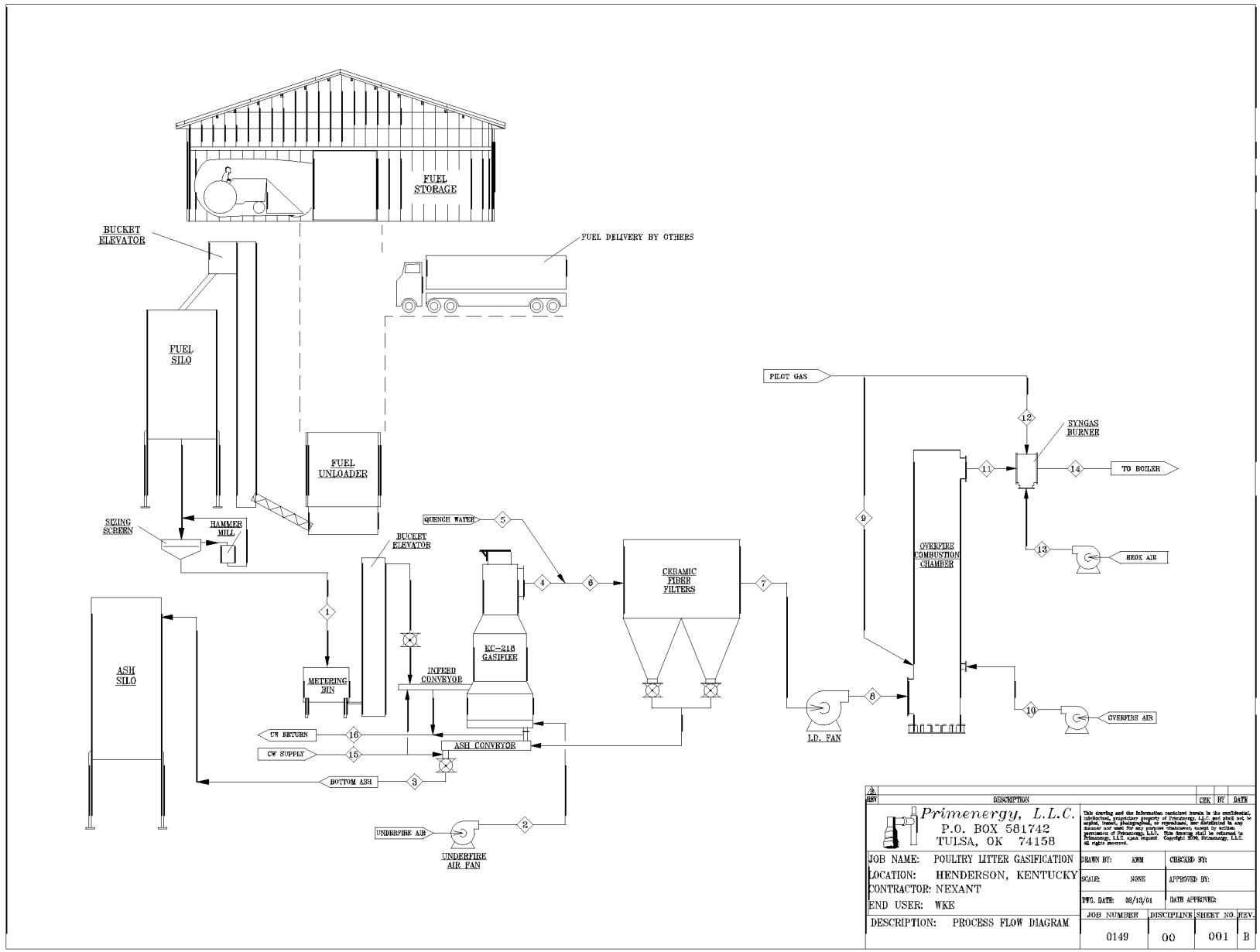

FUEL STORAGE
BUCKET ELEVATOR
FUEL DELIVERY BY OTHERS
FUEL SILO
FUEL UNLOADER
SIZING SCREEN
HAMMER MILL
BUCKET ELEVATOR
QUENCH WATER
5
4
6
CERAMIC FIBER FILTERS
7
PILOT GAS
12
SYNGAS BURNER
11
14
TO BOILER
9
OVERFIRE COMBUSTION CHAMBER
13
REDX AIR
ASH SILO
1
METERING BIN
INFEED CONVEYOR
KC-21S GASIFIER
I.D. FAN
8
10
OVERFIRE AIR
CW RETURN
16
CW SUPPLY
15
ASH CONVEYOR
BOTTOM ASH
3
UNDERFIRE AIR
2
UNDERFIRE AIR FAN
DESCRIPTION
CHK
BY
DATE
Primenergy, L.L.C.
P.O. BOX 581742
TULSA, OK 74158
JOB NAME: POULTRY LITTER GASIFICATION
LOCATION: HENDERSON, KENTUCKY
CONTRACTOR: NEXANT
END USER: WKE
DESCRIPTION: PROCESS FLOW DIAGRAM
DRAWN BY: KWM
CHECKED BY:
SCALE: NONE
APPROVED BY:
DWG. DATE: 02/13/01
DATE APPROVED:
JOB NUMBER
DISCIPLINE
SHEET NO.
REV.
0149
00
001
B

Table A-1 Reid Plant Single KC-18 Material and Energy Balance

Stream ID	1	2	3	4	5	6	7	8	9
Stream	GASIFIER	GASIFIER	GASIFIER	GASIFIER	QUENCH	HGF	HOT GAS	ID	PILOT
Name	FEED	COMB AIR	BOTTOM ASH	SYNGAS	WATER	INLET SYNGAS	FILTER EXHAUST	FAN EXHAUST	GAS
Pressure, psig ("w.c.-g)	----	(20.0)	----	(-0.25)	50	(-0.50)	(-10.0)	(8.0)	30
Temperature, °F	77	80	300	1550	77	1400	1382	1382	77
Molecular Weight (lb/lbmole)	---	28.68	67.17	24.95	18.02	24.69	24.66	24.66	16.04
Component	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h
Carbon	4,617		467						
Hydrogen	527								
Nitrogen	463								
Oxygen	3,416								
Sulfur	83								
Chlorine	0								
Fuel Gas									23
Carbon Monoxide				3,819		3,819	3,819	3,819	
Carbon Dioxide				9,207		9,207	9,207	9,207	
Hydrogen				421		421	421	421	
Water (v)		267		5,412		6,576	6,576	6,576	
Nitrogen		20,853		21,316		21,316	21,316	21,316	
Oxygen		6,313							
Sulfur Dioxide				166		166	166	166	
Hydrogen Chloride				0					
Ash	3,494		3,961	70		70			
Lime									
Water (l)	4,200				1,164				
TOTAL	16,800	27,433	4,428	40,410	1,164	41,574	41,505	41,505	23

Table A-1 Reid Plant Single KC-18 Material and Energy Balance (contd.)

Stream ID	1	2	3	4	5	6	7	8	9
Stream	GASIFIER	GASIFIER	GASIFIER	GASIFIER	QUENCH	HGF	HOT GAS	ID	PILOT
Name	FEED	COMB	BOTTOM	SYNGAS	WATER	INLET	FILTER	FAN	GAS
		AIR	ASH			SYNGAS	EXHAUST	EXHAUST	
Pressure, psig ("w.c.-g)	----	(20.0)	----	(-0.25)	50	(-0.50)	(-10.0)	(8.0)	30
Temperature, °F	77	80	300	1550	77	1400	1382	1382	77
Molecular Weight (lb/lbmole)	---	28.68	67.17	24.95	18.02	24.69	24.66	24.66	16.04
Component	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h
TOTAL	16,800	27,433	4,428	40,410	1,164	41,574	41,505	41,505	23
AVAILABLE ENERGY VALUE (LHV-Hv), Btu/lb	4,196		14,100.0	953.9		927.1	928.7	928.7	21,502
AVAILABLE ENERGY, MMBtu/h	70.50		6.6	38.5	0.0	38.5	38.5	38.5	0.5
FLOW RATE, scfm (gpm)		6,050		10,243	(2.33)	10,652	10,644	10,644	9
FLOW RATE, acfm		6,283		39,593		38,100	37,701	37,701	9

Table A-1 Reid Plant Single KC-18 Material and Energy Balance (contd.)

Stream ID	10	11	12	13	14	15	16
Stream	OVERFIRE	OVERFIRE	PILOT	REOX	COMB	GASIFIER	GASIFIER
Name	COMB	SYNGAS	GAS	COMB	PROD TO	COOLING	CW
	AIR			AIR	BOILER	WATER	RETURN
Pressure, psig ("w.c.-g)	(13.0)	(7.0)	30	(13.0)	(6.0)	60	10
Temperature, °F	80	2400	scfm	80	2330	110	165
Molecular Weight (lb/lbmole)	28.68	26.96	16.04	28.68	28.02	18.02	18.02
Component	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h
Carbon							
Hydrogen							
Nitrogen							
Oxygen							
Sulfur							
Chlorine							
Fuel Gas			23				
Carbon Monoxide		633					
Carbon Dioxide		14,276			15,335		
Hydrogen		200					
Water (v)	157	8,756		245	10,844		
Nitrogen	12,257	33,574		19,099	52,673		
Oxygen	3,711			5,782	3,737		
Sulfur Dioxide							
Hydrogen Chloride							
Ash							
Lime							
Water (l)						26,738	26,738
TOTAL	16,125	57,440	23	25,125	82,588	26,738	26,738

Table A-1 Reid Plant Single KC-18 Material and Energy Balance (contd.)

Stream ID	10	11	12	13	14	15	16
Stream	OVERFIRE	OVERFIRE	PILOT	REOX	COMB	GASIFIER	GASIFIER
Name	COMB	SYNGAS	GAS	COMB	PROD TO	COOLING	CW
	AIR			AIR	BOILER	WATER	RETURN
Pressure, psig ("w.c.-g)	(13.0)	(7.0)	30	(13.0)	(6.0)	60	10
Temperature, °F	80	2400	scfm	80	2330	110	165
Molecular Weight (lb/lbmole)	28.68	26.96	16.04	28.68	28.02	18.02	18.02
Component	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h
TOTAL	16,125	57,440	23	25,125	82,588	26,738	26,738
AVAILABLE ENERGY VALUE (LHV-Hv), Btu/lb		229.0	21,502			0.0	1.0
AVAILABLE ENERGY, MMBtu/h		13.2	0.5			0.0	1.5
FLOW RATE, scfm (gpm)	3,556	13,478	9	5,541	18,642	(53.5)	(53.5)
FLOW RATE, acfm	3,693	74,129	8	5,754	100,031		

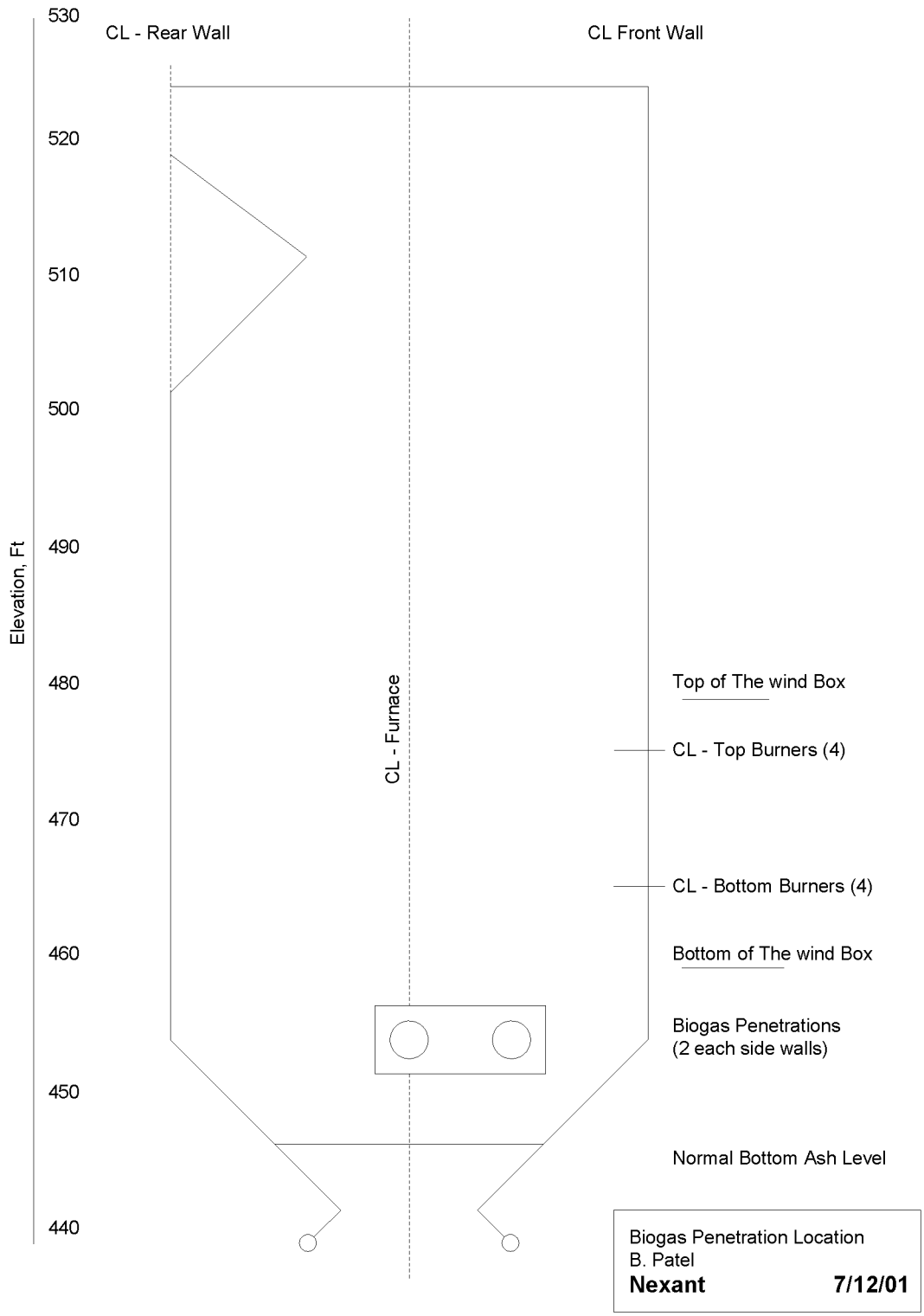
Table B-2 Reid Plant Cost Sensitive Analysis

Case		Base Case	2	3	4	5	6	7	8
Litter Cost	$/ton	$ 12	$ 8	$ 10	$ 12	$ 6	$ 8	$ 10	$ 12
Ash Credits	$/Ton	$ (6)	$ (6)	$ (8)	$ (10)	$ (12)	$ (12)	$ (14)	$ (16)
Capital Cost		$ 9,500,000	$ 9,500,000	$ 9,500,000	$ 9,500,000	$ 8,900,000	$ 8,900,000	$ 8,900,000	$ 8,900,000
WKE Cost		$ 4,750,000	$ 4,750,000	$ 4,750,000	$ 4,750,000	$ 4,450,000	$ 4,450,000	$ 4,450,000	$ 4,450,000
Interest	%	7.5%	7.5%	7.0%	7.0%	7.0%	7.5%	7.0%	7.0%
Period	Years	10.0	10.0	15.0	15.0	15.0	10.0	10.0	10.0
Power Cost									
Fuel	c/kwh	1.74	1.12	1.35	1.58	0.56	0.87	1.10	1.33
O&M	c/kwh	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
Capital	c/kwh	2.39	2.39	1.80	1.80	1.69	2.24	2.19	2.19
Total	c/kwh	5.17	4.54	4.18	4.41	3.28	4.14	4.32	4.55

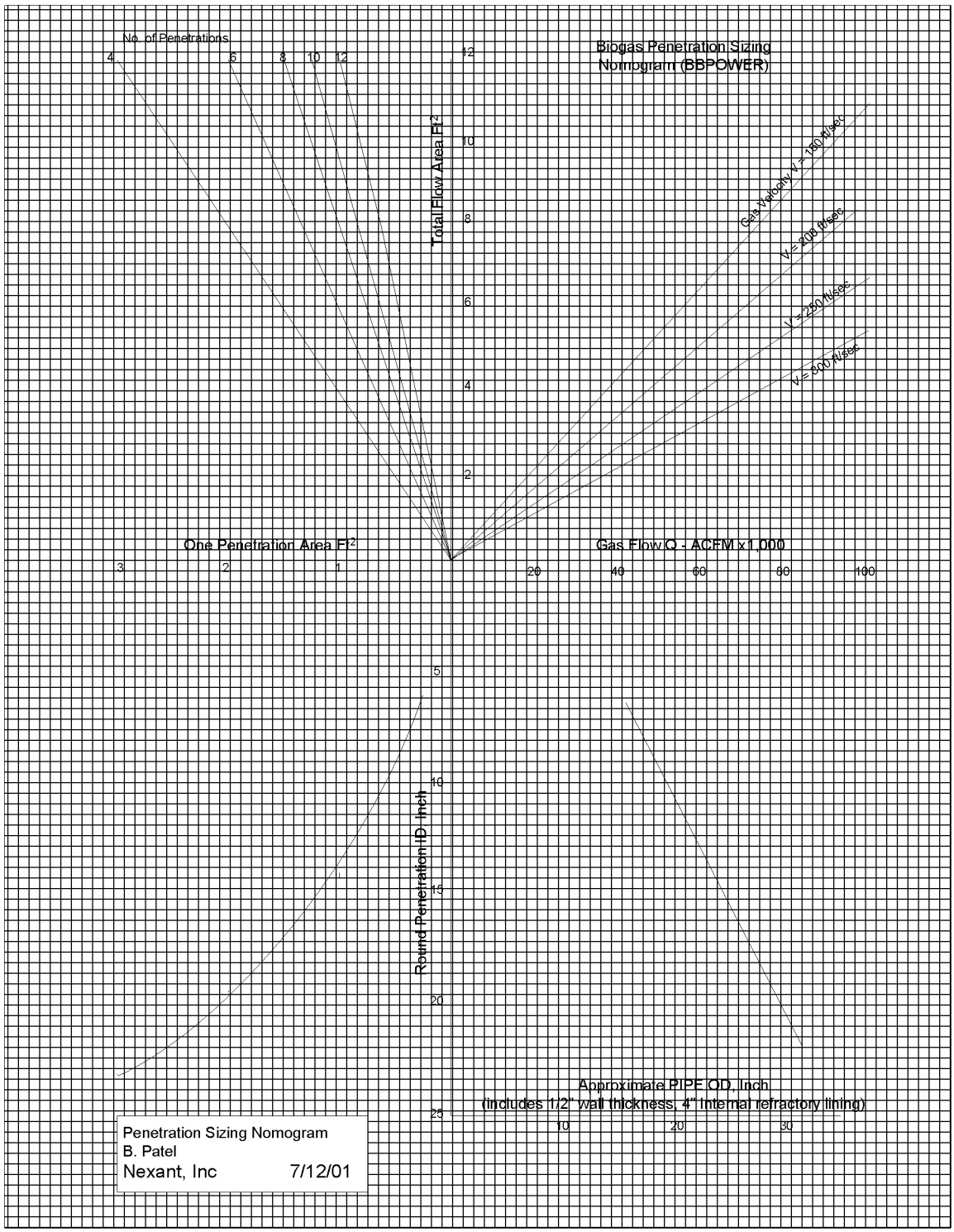
Table A-2 Electrical Power Consumption

SYSTEM MOTOR LIST & ELECTRICAL REQUIREMENT					
ITEM	MOTOR SIZE Hp	QTY SUPL.	QTY OPRTG	OPR FACTOR	ELEC. USAGE Kw
Fuel Receiving Hopper	15	1	1	0.40	4.5
Fuel Receiving Hopper Discharge Conveyor	15	1	1	0.40	4.5
Storage Silo Bucket Elevator	20	1	1	0.40	6.0
Separation Screen	5	1	1	0.40	1.5
Hammermill	50	1	1	0.40	14.9
Hammermill Air System	15	1	1	0.40	4.5
Silo Unloader	15	1	1	0.40	4.5
Silo Discharge Conveyor	10	1	1	0.40	3.0
Metering Bin Discharge Screw	5	1	1	0.50	1.9
Bucket Elevator	5	1	1	0.50	1.9
Fuel Feed Rotary Valve	5	1	1	0.50	1.9
Fuel Infeed Auger	5	1	1	0.50	1.9
Agitator	5	1	1	0.50	1.9
Ash Discharge Auger #1	3	1	1	0.50	1.1
Ash Discharge Auger #2	3	1	1	0.50	1.1
Ash Cooling Auger	5	1	1	0.50	1.9
Underfire Air Fan	40	1	1	0.85	25.5
Cooling Water Pump	10	2	1	0.38	2.8
Syngaas Compressor	100	1	1	0.65	48.6
Fly Ash Discharge Valve	1	2	2	0.50	0.7
Final Ash Conveyor	10	1	1	0.50	3.7
ID Fan	250	1	1	0.83	155.3
Overfire Air Fan	10	1	1	0.50	3.8
Reox/Recycle Fan	10	1	1	0.55	4.1
Air Compressor	100	1	1	0.50	37.4
Miscellaneous Electrical Usage	----	----	----	----	2.0
Total	**567.0**				**340.6**

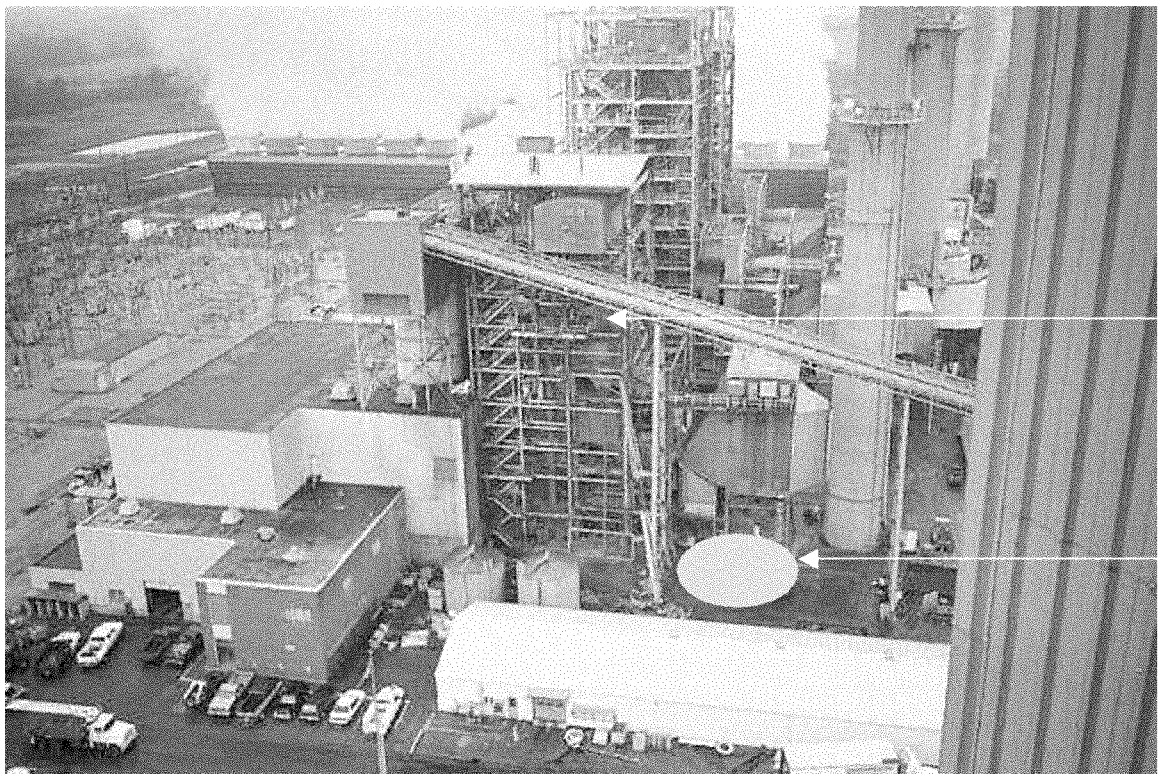
Reid Plant Boiler Penetration Schematic



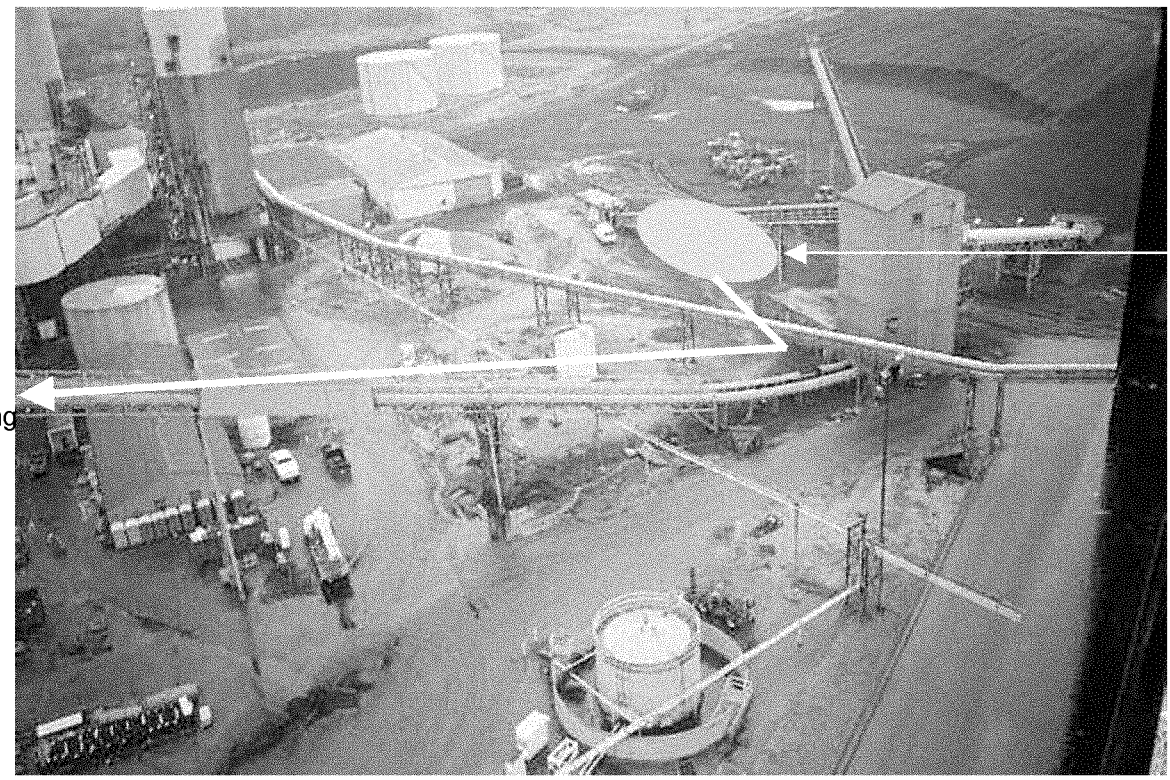
Boiler Penetration Sizing Nomogram



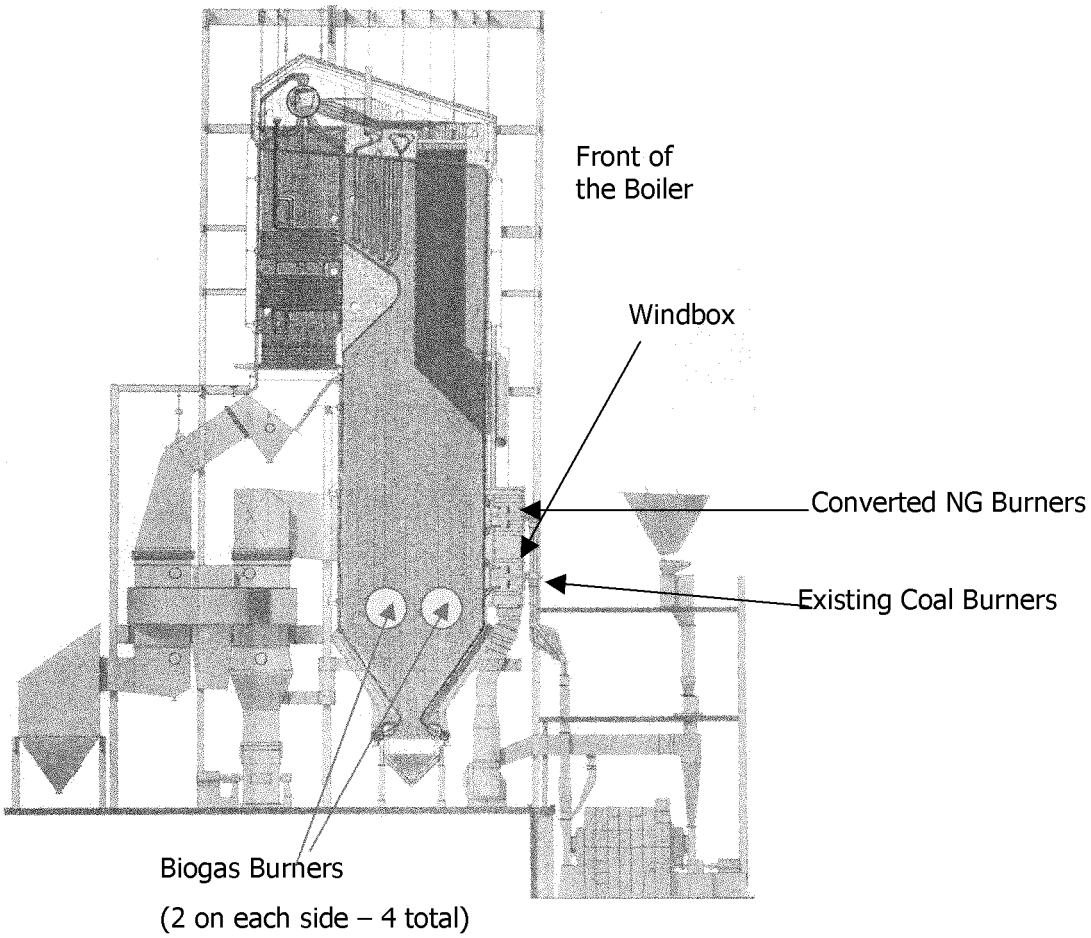
Proposed Gasifier Location at Reid Plant



Fuel Receiving and Storage

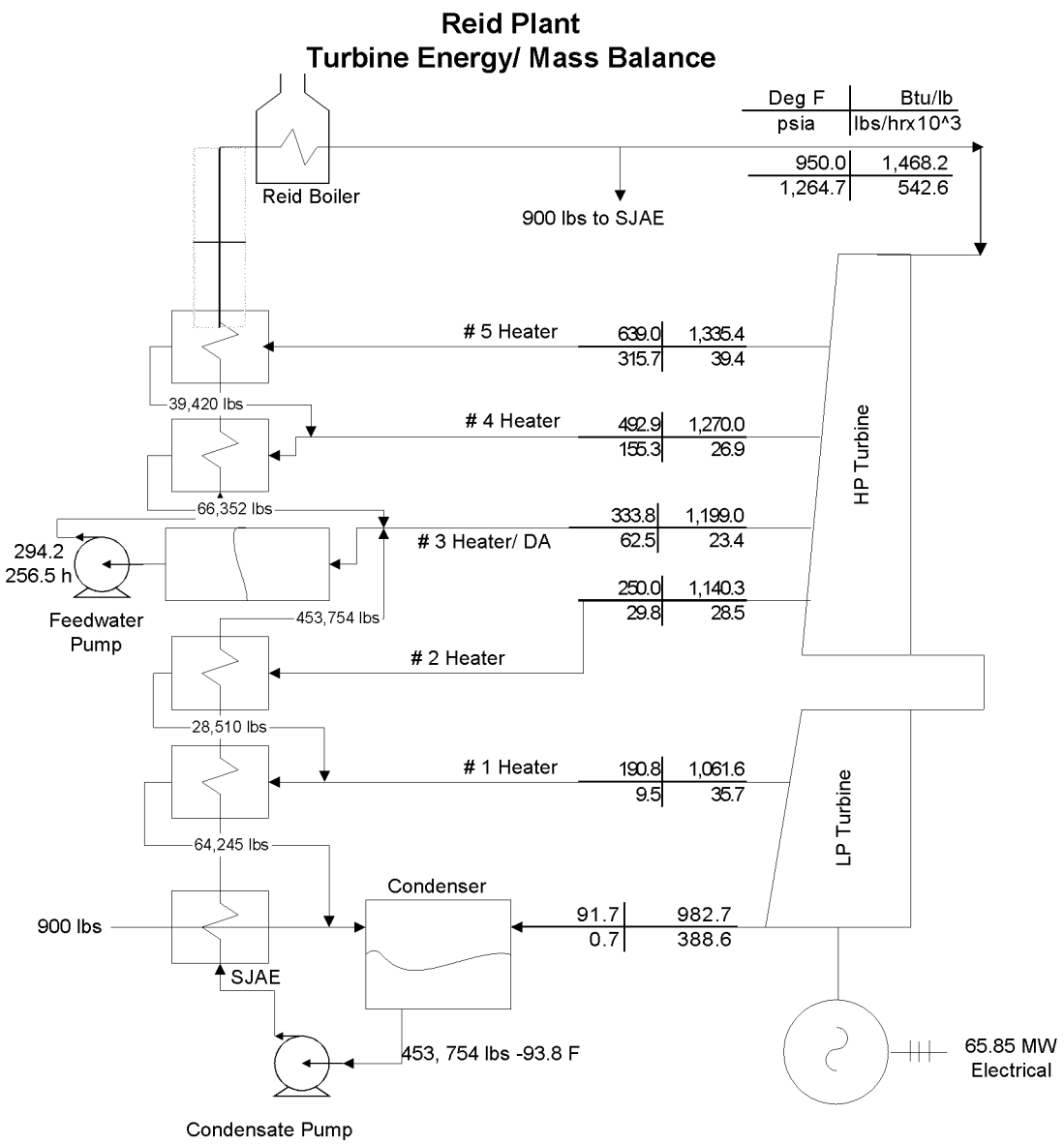


Reid Plant Boiler Penetrations



- Four Penetrations
- 2 on each side of the boiler
- Just below the lower windbox line
- Pressure at the burner –10”-12” of WC
- Velocity at the burner 150~300 ft/sec
- Flow 70,000~100,000 scfm

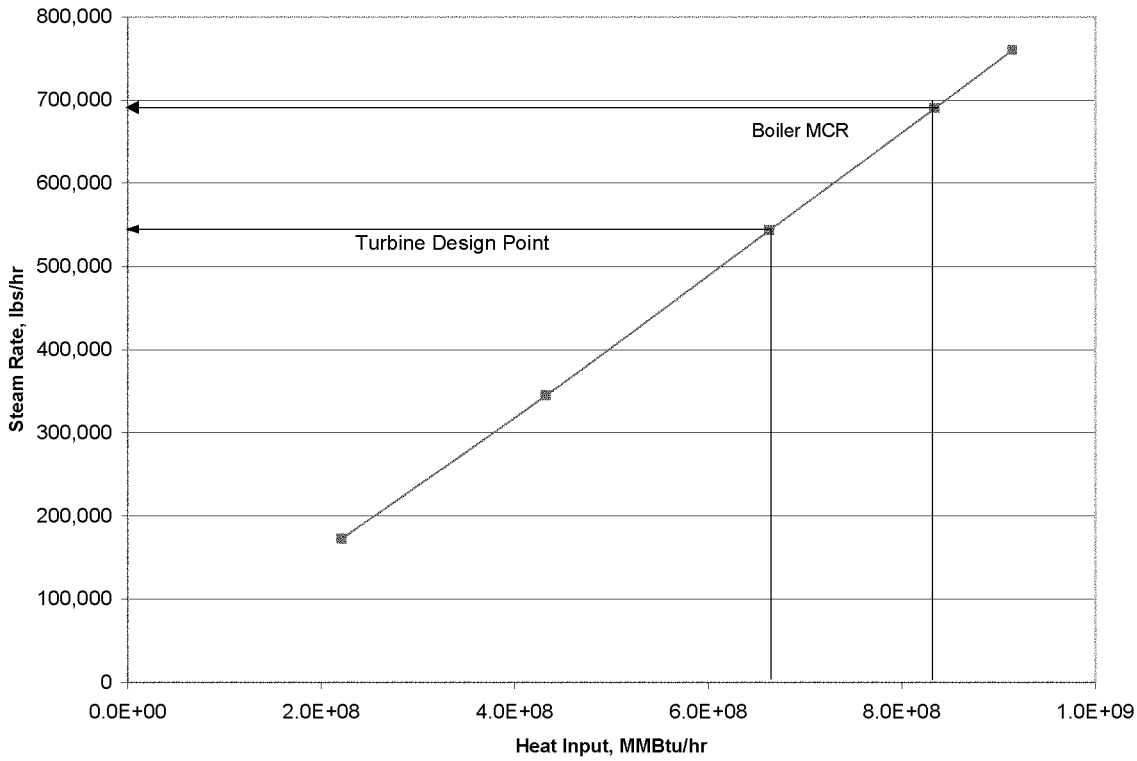
Reid Plant Turbine Energy Balance
Turbine Name Plate Data by GE

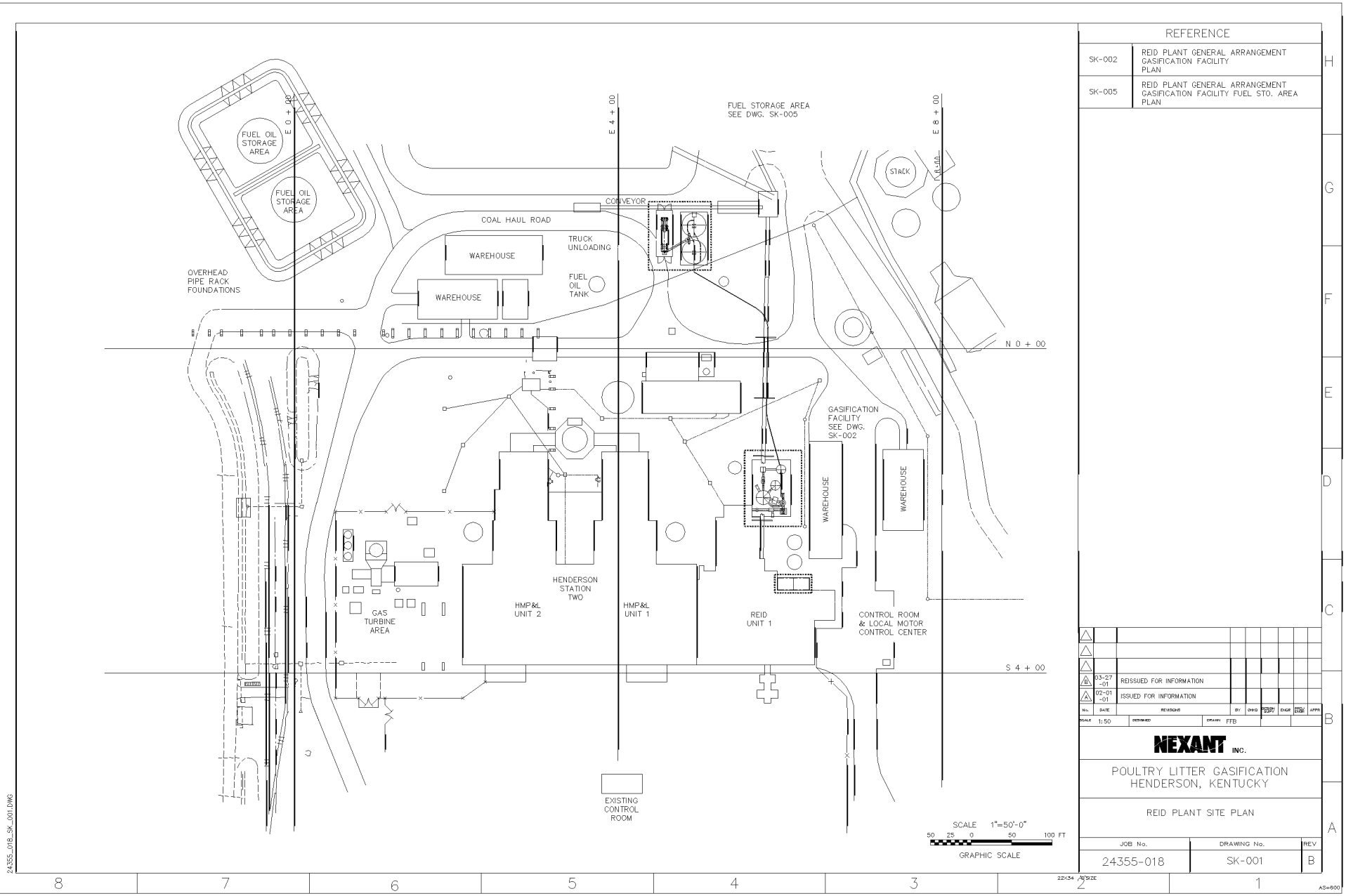


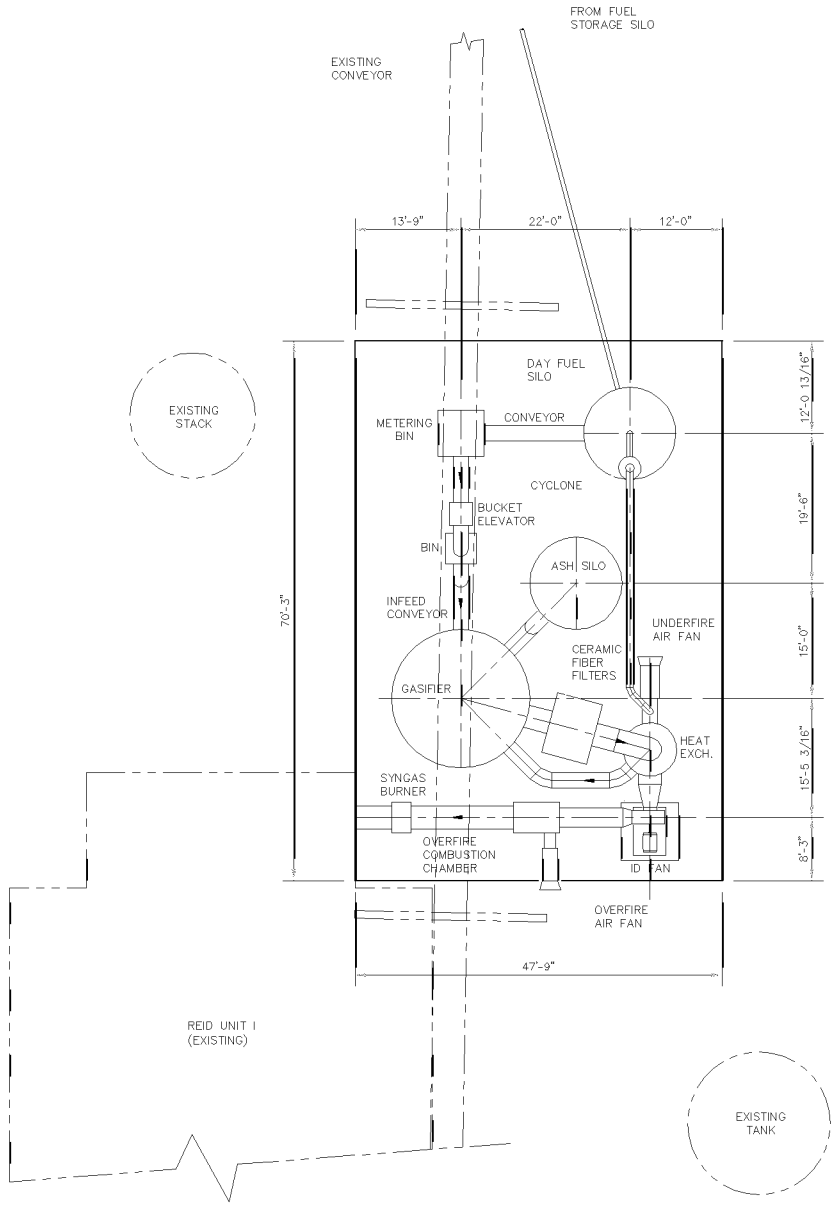
Ref: GE Design Case @ 65.85 MW Gross Turbine Output

B. Patel/ 3/23/01
Nexant Inc.

Turbine Design Point steam Load v/s Boiler heat Input




REFERENCE
SK-002 REID PLANT GENERAL ARRANGEMENT GASIFICATION FACILITY PLAN
SK-005 REID PLANT GENERAL ARRANGEMENT GASIFICATION FACILITY FUEL STO. AREA PLAN
FUEL OIL STORAGE AREA
FUEL OIL STORAGE AREA
E 0 + 00
E 4 + 00
E 8 + 00
FUEL STORAGE AREA SEE DWG. SK-005
STACK
CONVEYOR
COAL HAUL ROAD
TRUCK UNLOADING
WAREHOUSE
WAREHOUSE
FUEL OIL TANK
OVERHEAD PIPE RACK FOUNDATIONS
N 0 + 00
S 4 + 00
GASIFICATION FACILITY SEE DWG. SK-002
WAREHOUSE
WAREHOUSE
HENDERSON STATION TWO
HMP&L UNIT 2
HMP&L UNIT 1
REID UNIT 1
GAS TURBINE AREA
CONTROL ROOM & LOCAL MOTOR CONTROL CENTER
EXISTING CONTROL ROOM
SCALE 1"=50'-0"
50 25 0 50 100 FT
GRAPHIC SCALE
03-27-01 REISSUED FOR INFORMATION
02-01-01 ISSUED FOR INFORMATION
SCALE 1:50
DRAWN FFB
NEXANT INC.
POULTRY LITTER GASIFICATION
HENDERSON, KENTUCKY
REID PLANT SITE PLAN
JOB No. 24355-018
DRAWING No. SK-001
REV B
24355_018_SK_001.DWG
22X34 A1 SIZE
AS=600



NOTES

1. FOR REFERENCE SEE DRAWING SK-001.

NO.	DATE	REVISIONS	BY	CHKD	ENGR	APPR
B	03-27-01	REISSUED FOR INFORMATION				
A	02-01-01	ISSUED FOR INFORMATION				

SCALE 1/8"=1'-0" | DESIGNED | DRAWN FFB

SCALE 1/8"=1'-0"
8 4 0 8 16 FT
GRAPHIC SCALE

Gasification Based Biomass Cogeneration, Phase

NEXANT Inc.

POULTRY LITTER GASIFICATION
HENDERSON, KENTUCKY

REID PLANT GENERAL ARRANGEMENT
GASIFICATION FACILITY
PLAN

JOB No.	DRAWING No.	REV
24355-018	SK-002	B

22X34 B SIZE

24355_018_SK_002.DWG

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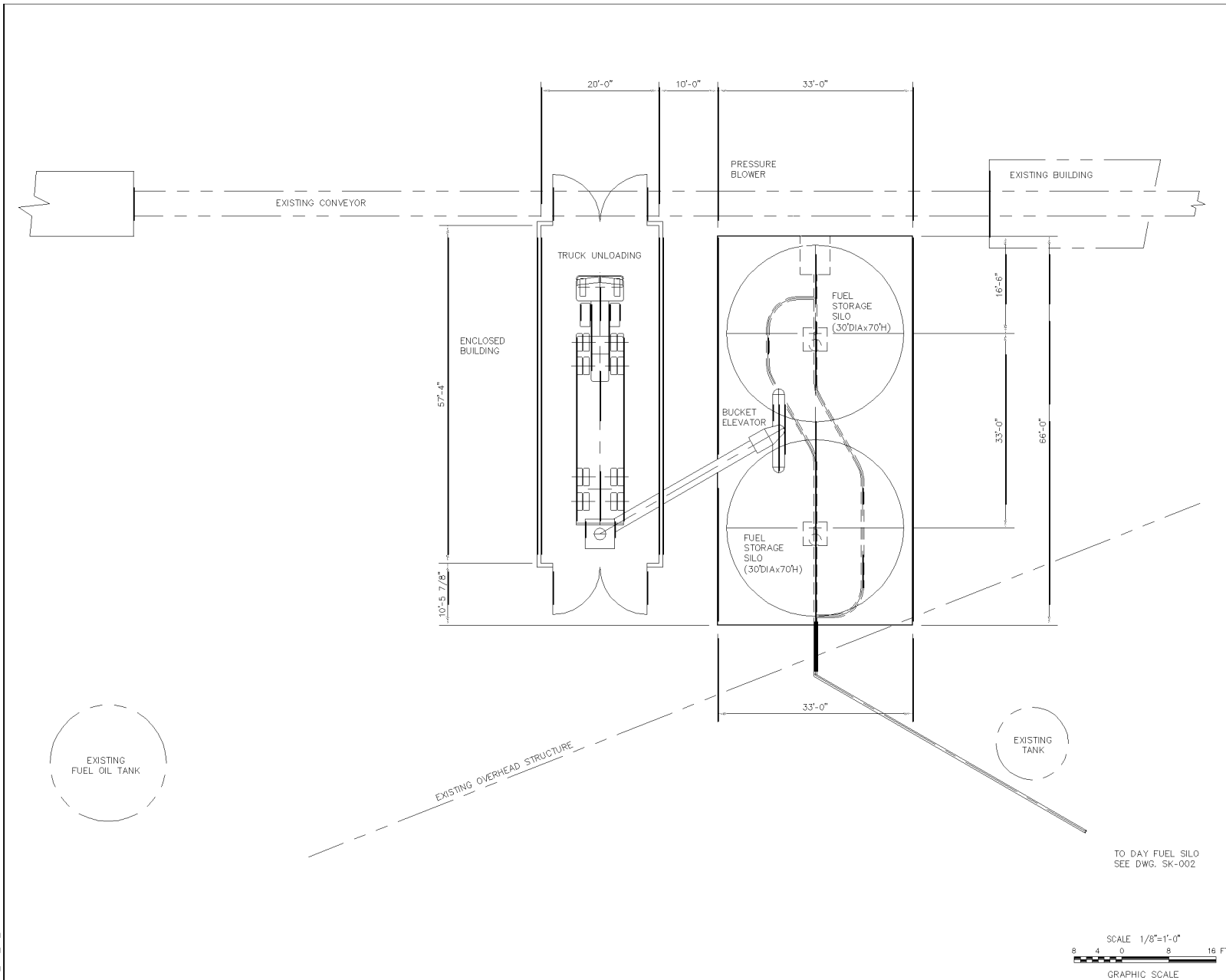

NOTES

1. FOR REFERENCE SEE DRAWING SK-001.

No.	DATE	REVISIONS	BY	CHKD	DESIGN SUPV	ENGR	PROJ MGR	APPR
A	03-27-01	ISSUED FOR INFORMATION						

SCALE 1/8"=1'-0" | DESIGNED | DRAWN FFB

NEXANT INC.

POULTRY LITTER GASIFICATION
HENDERSON, KENTUCKY

REID PLANT GENERAL ARRANGEMENT
GASIFICATION FACILITY FUEL STORAGE AREA PLAN

JOB No.	DRAWING No.	REV
24355-018	SK-005	A

22X34 (D) SIZE

24355_018_SK_005.DWG