Section 9
Appendices

Appendix A: Process flow diagrams and mass and energy balance sheets for one Alstom case

Appendix B: Two engine set case.

Appendix C: Process flow diagrams and mass and energy balance sheets for two direct fired custom turbine case (separate compressor).

Appendix D: Process flow diagrams and mass and energy balance sheets for two mixed air and syngas custom turbine case (same compressor).

Appendix E: Process flow diagrams and mass and energy balance sheets for two indirect turbine case (clean air turbine).

Appendix F: Process flow diagrams and mass and energy balance sheets for steam turbine case.

Appendix G: Rahr plant layout.

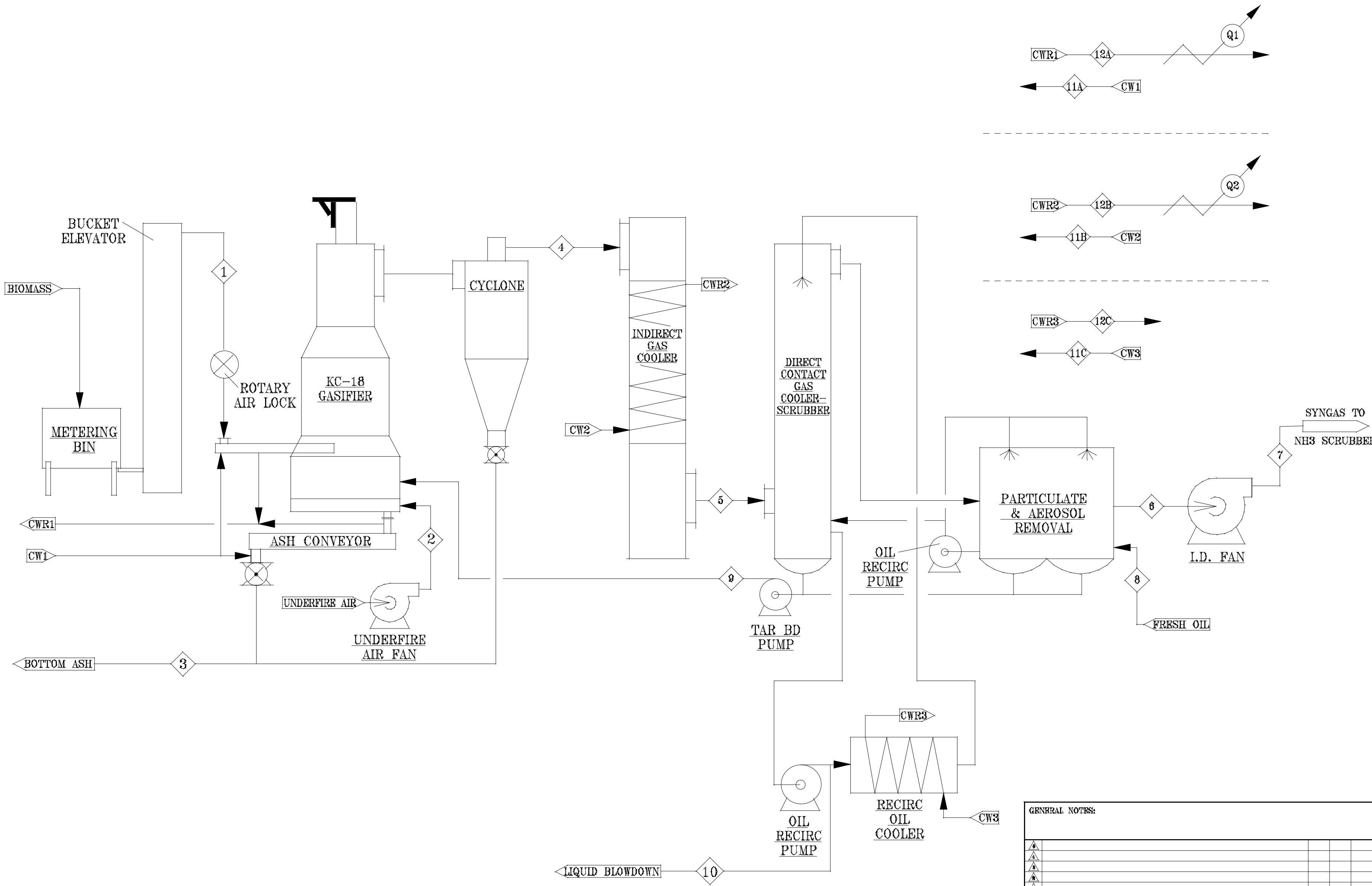
Appendix H: Biomass photographs and fuel lab analysis.

Appendix I: Detailed economics analysis of various scenarios at Rahr.

Appendix J: Turbine and engine set manufacturer specifications.

Appendix A: One Alstom Case

The following pages contain process flow diagrams and mass and energy balance sheets for 1 Alstom Case.



GENERAL NOTES:

REV.	DESCRIPTION	CHK	BY	DATE
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PRIMENERGY, L.L.C.
3172 N. TOLEDO
TULSA, OKLA. 74115

JOB NAME:	SEBESTA / NETL	DRAWN BY: KWM	CHECKED BY:
LOCATION:	MINNESOTA	SCALE: N.T.S.	APPROVED BY:
CONTRACTOR:	SEBESTA	DWG. DATE: 05/07/02	DATE APPROVED:

DESCRIPTION: PROCESS FLOW DIAGRAM – GASIFIER AND GAS CLEAN-UP SYSTEM FOR ALSTOM TURBINE WITH SYNGAS COMPRESSOR

JOB NUMBER	DISCIPLINE	SHEET NO.	REV.
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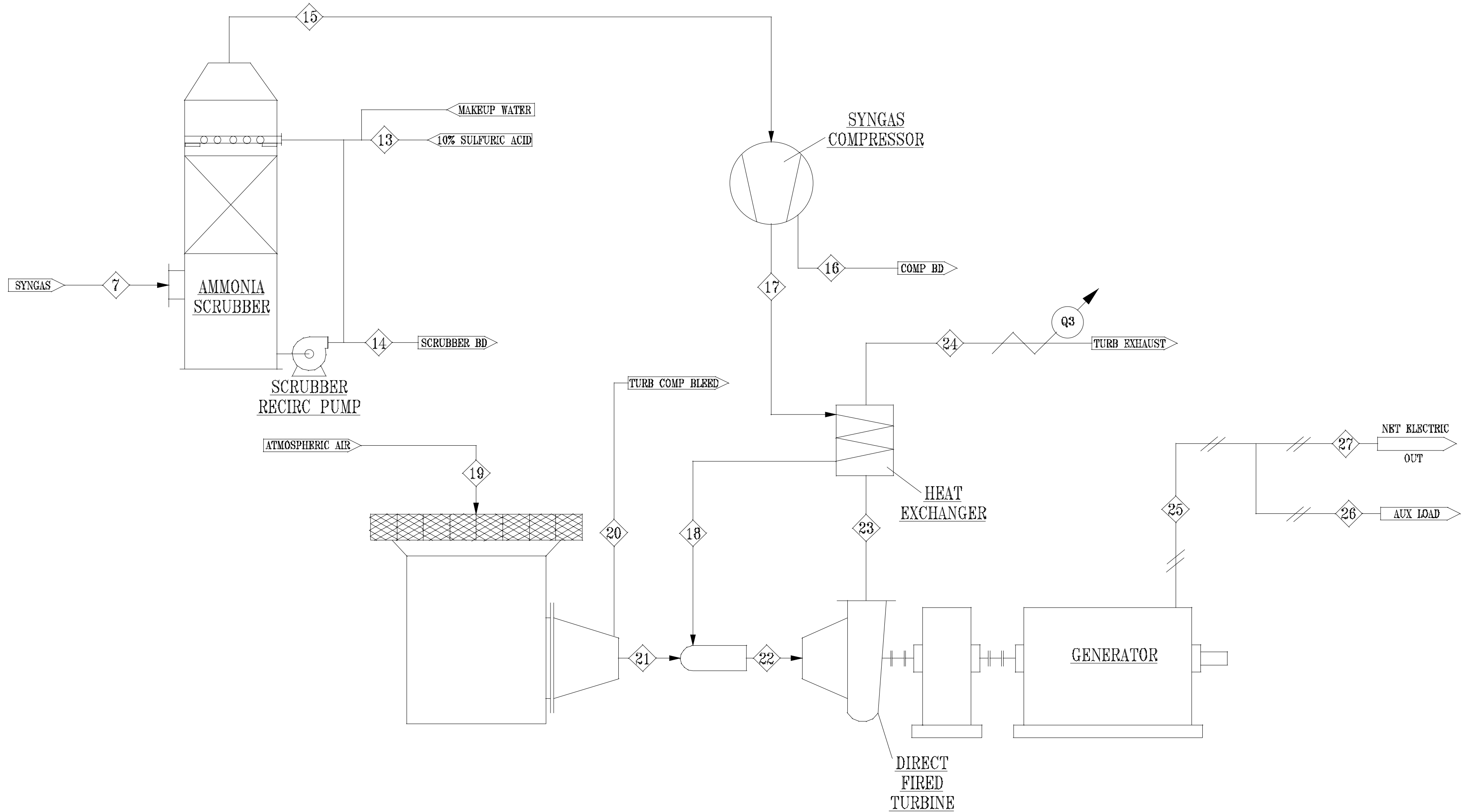

GENERAL NOTES:

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PRIMENERGY, L.L.C.
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JOB NAME: SEBESTA / NETL
LOCATION: MINNESOTA
CONTRACTOR: SEBESTA

DRAWN BY: kwm
CHECKED BY:
SCALE: N.T.S.
APPROVED BY:
DWG. DATE: 05/07/02
DATE APPROVED:

DESCRIPTION: PROCESS FLOW DIAGRAM – GASIFIER AND GAS CLEAN-UP SYSTEM FOR ALSTOM TURBINE WITH SYNGAS COMPRESSOR

JOB NUMBER	DISCIPLINE	SHEET NO.	REV.
0153	000	002F	0

CUSTOMER: SEBESTA / NETL

OPERATING CASE: ALSTOM TURBINE - SYNGAS COMPRESSED SEPARATE

Stream ID			1	2	3	4	5	6	7	8	9	10	11A	12A	Q1	11B	12B	Q2	11C	12C
Stream Name			BIOMASS FEED	GASIFIER AIR	GASIFIER BOTTOM ASH	GASIFIER SYNGAS	COOLED SYNGAS	CLEAN SYNGAS	SYNGAS TO AMMONIA SCRUBBER	FRESH OIL MAKEUP	TAR BD TO GASIFIER	GAS CLEANUP LIQUID BD	GASIFIER COOLING WATER SUPPLY	GASIFIER COOLING WATER RETURN	GASIFIER CW THERMAL ENERGY	IND. HEX COOLING WATER SUPPLY	IND. HEX COOLING WATER RETURN	IND. HEX CW THERMAL ENERGY	OIL HEX COOLING WATER SUPPLY	OIL HEX COOLING WATER RETURN
Pressure, psig ("w.c.-g)			----	(22.0)	----	(-3.0)	(-6.0)	(-16.0)	2.0	----	50	----	50	15		40	5		40	5
Temperature, °F			77	77	300	1300	500	105	110	77	115	115	140	170	170 - 140	140	170	170 - 140	85	95
Molecular Weight (lb/lbmole)			---	28.69	20.02	26.06	26.06	27.01	27.01	----	----	----	18.02	18.02		18.02	18.02		18.02	18.02
Component	Formula	mw	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	MMBtu/hr	lb/hr	lb/hr	MMBtu/hr	lb/hr	lb/hr
Carbon	C	12.01	4,891		565															
Hydrogen	H	1.01	622																	
Nitrogen	N	14.01	139																	
Oxygen	O	16.00	4,223																	
Sulfur	S	32.06	29																	
Methane	CH4	16.04				882	882	882	882											
Ethane	C2H6	30.07				116	116	116	116											
Ethylene	C2H4	28.05				254	254	254	254											
Propane	C3H8	44.10				6	6	6	6											
Propene	C3H6	42.08				35	35	35	35											
Butane-n	C4H10	58.12				29	29	29	29											
Pentane (gas)	C5H12	72.15				4	4	4	4											
Benzene	C6H6	78.11				179	179	179	179											
Ammonia	NH3	17.09				28	28	28	28											
Fuel Gas	CH4	16.04																		
Carbon Monoxide	CO	28.01				4,235	4,235	4,235	4,235											
Carbon Dioxide	CO2	44.01				4,807	4,807	4,807	4,807											
Hydrogen	H2	2.02				120	120	120	120											
Water (v)	H2O (v)	18.02		177		3,458	3,458	1,342	1,342											
Nitrogen	N2	28.01		14,250		14,366	14,366	14,366	14,366											
Oxygen	O2	32.00		4,314		293	293	293	293											
Sulfur Dioxide	SO2	64.06				58	58	58	58											
Ash	SiO2	60.08	571		565	6	6	6	6											
Sulfuric Acid	H2SO4	98.08																		
Ammonium Sulfate	(NH4)2SO4	132.14																		
Oil	-------	-------								25	13	13								
Tar	-------	-------									13	4								
Water (l)	H2O (l)	18.02	1,139								212	1,905	30,729	30,729		260,484	260,484		584,963	584,963
TOTAL			11,614	18,741	1,130	28,877	28,877	26,761	26,761	25	238	1,922	30,729	30,729		260,484	260,484		584,963	584,963
AVAILABLE ENERGY VALUE (LHV-Hv), Btu/lb			6,604			1,937.5	1,937.5	2,090.7	2,090.7											
AVAILABLE ENERGY, MMBtu/hr			76.70			55.95	55.95	55.95	55.95											
SENSIBLE ENERGY, MMBtu/hr						11.5	3.7								0.92			7.81		
FLOW RATE, SCFM (GPM)				4,132		7,010	7,010	6,267	6,267	(0.06)	(0.5)	(4.3)	(61)	(61)		(521)	(521)		(1,170)	(1,170)
FLOW RATE, ACFM				4,267		23,726	12,941	6,809	6,869											
ELECTRICAL OUTPUT, Kilowatts																				

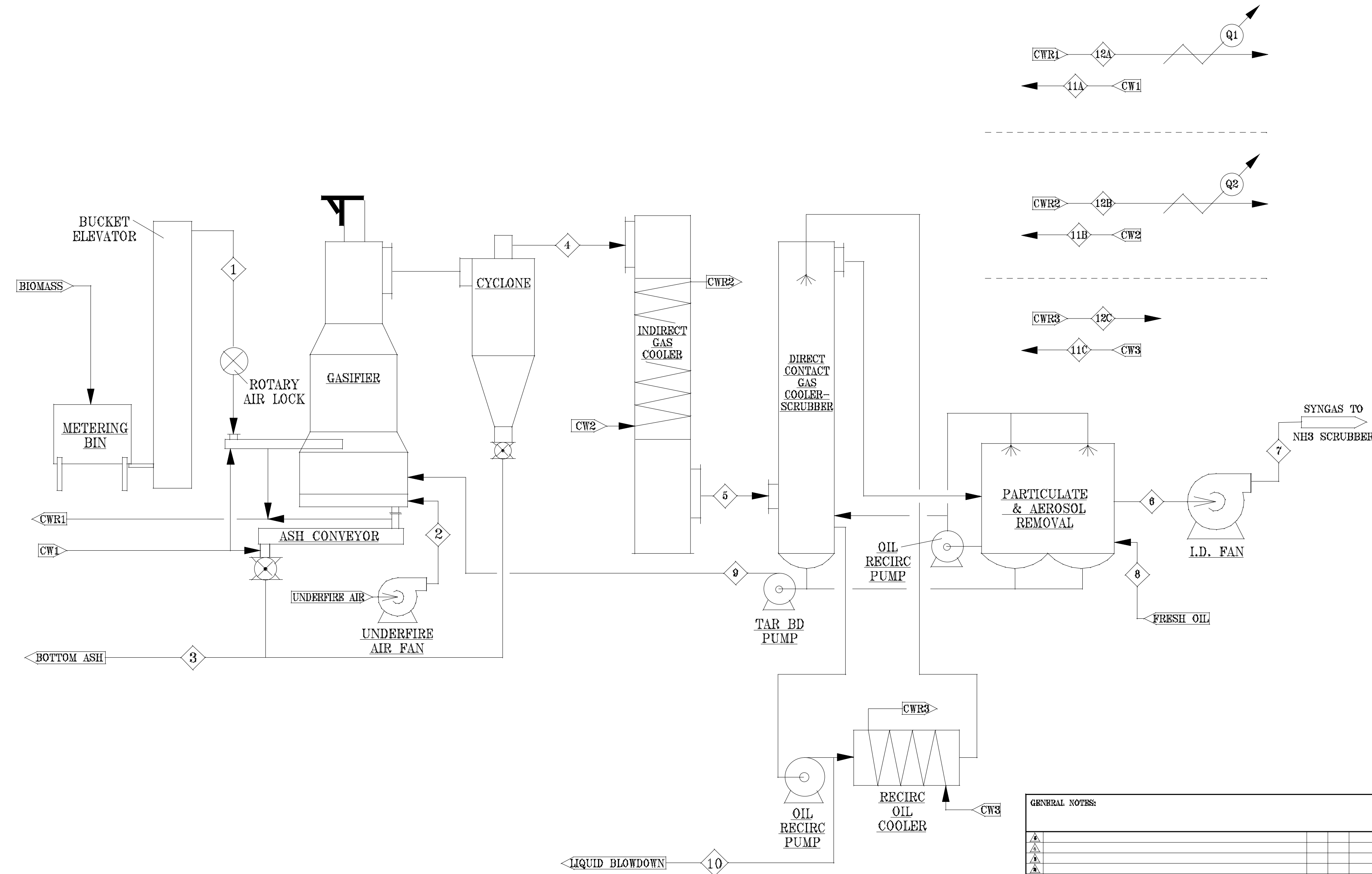
CUSTOMER: SEBESTA / NETL

OPERATING CASE: ALSTOM TURBINE - SYNGAS COMPRESSED SEPARATE

Stream ID			13	14	15	16	17	18	19	20	21	22	23	24	Q3	25	26	27
Stream Name			10% SULFURIC ACIT	AMMONIA SCRUBBER BD	SYNGAS TO COMPRESS	SYNGAS COMP BD	SYNGAS TO HEAT EXCH	HEATED SYNGAS TO TURBINE	ATMOS AIR TO TURBINE COMP	TURBINE COMP BLEED AIR	COMP AIR TO TURBINE	TURBINE INLET GAS	TURBINE EXHAUST TO HEAT EXCH	TURBINE EXHAUST OUT HEAT EXCH	TURBINE EXHAUST THERMAL ENERGY	GROSS ELECT OUTPUT	AUX LOAD	NET ELECT OUTPUT
Pressure, psig ("w.c.-g)			30	30	1.8	50	237	236	----	207	207	201	0.43	0.36				
Temperature, °F			77	110	110	110	300	490	70	677	677	1935	982	909	960 - 300			
Molecular Weight (lb/lbmole)			19.62	20.30	27.02	18.02	27.70	27.70	28.69	28.69	28.69	29.07	29.07	29.07				
Component	Formula	mw	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	MMBtu/hr	kilowats	kilowats	kilowatts
Carbon	C	12.01																
Hydrogen	H	1.01																
Nitrogen	N	14.01																
Oxygen	O	16.00																
Sulfur	S	32.06																
Methane	CH4	16.04			882		882	882										
Ethane	C2H6	30.07			116		116	116										
Ethylene	C2H4	28.05			254		254	254										
Propane	C3H8	44.10			6		6	6										
Propene	C3H6	42.08			35		35	35										
Butane-n	C4H10	58.12			29		29	29										
Pentane (gas)	C5H12	72.15			4		4	4										
Benzene	C6H6	78.11			179		179	179										
Ammonia	NH3	17.09																
Fuel Gas	CH4	16.04																
Carbon Monoxide	CO	28.01			4,235		4,235	4,235										
Carbon Dioxide	CO2	44.01			4,807		4,807	4,807				15,851	15,851	15,851				
Hydrogen	H2	2.02			120		120	120										
Water (v)	H2O (v)	18.02			1,342		95	95	1,270	81	1,188	5,102	5,102	5,102				
Nitrogen	N2	28.01			14,366		14,366	14,366	102,491	6,559	95,932	110,298	110,298	110,298				
Oxygen	O2	32.00			293		293	293	31,027	1,986	29,041	20,332	20,332	20,332				
Sulfur Dioxide	SO2	64.06			58		58	58				58	58	58				
Ash	SiO2	60.08																
Sulfuric Acid	H2SO4	98.08	81															
Ammonium Sulfate	(NH4)2SO4	132.14		110														
Oil	-------	-------																
Tar	-------	-------																
Water (l)	H2O (l)	18.02	733	733		1,247												
TOTAL			814	842	26,727	1,247	25,480	25,480	134,787	8,626	126,161	151,641	151,641	151,641				
AVAILABLE ENERGY VALUE (LHV-Hv), Btu/lb					2,085.0		2,187.0	2,187.0										
AVAILABLE ENERGY, MMBtu/hr					55.73		55.7	55.7										
SENSIBLE ENERGY, MMBtu/hr							1.59	2.94		1.29	18.85	77.51	35.61	3.01	24.19			
FLOW RATE, SCFM (GPM)			(1.6)	(1.7)	6,256	(2.5)	5,818	5,818	29,720	1,902	27,817	32,998	32,998	32,998				
FLOW RATE, ACFM					6,857		484	607	30,291	276	4,038	10,371	88,873	84,805				
ELECTRICAL OUTPUT, Kilowatts																4,945	1,825	3,120

Appendix B: Two Engine Set Case

The following pages contain process flow diagrams and mass and energy balance sheets for 2 engine sets.



GENERAL NOTES:

REV.	DESCRIPTION	CHK	BY	DATE
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1	MINOR CORRECTIONS		kwm	03/21/02

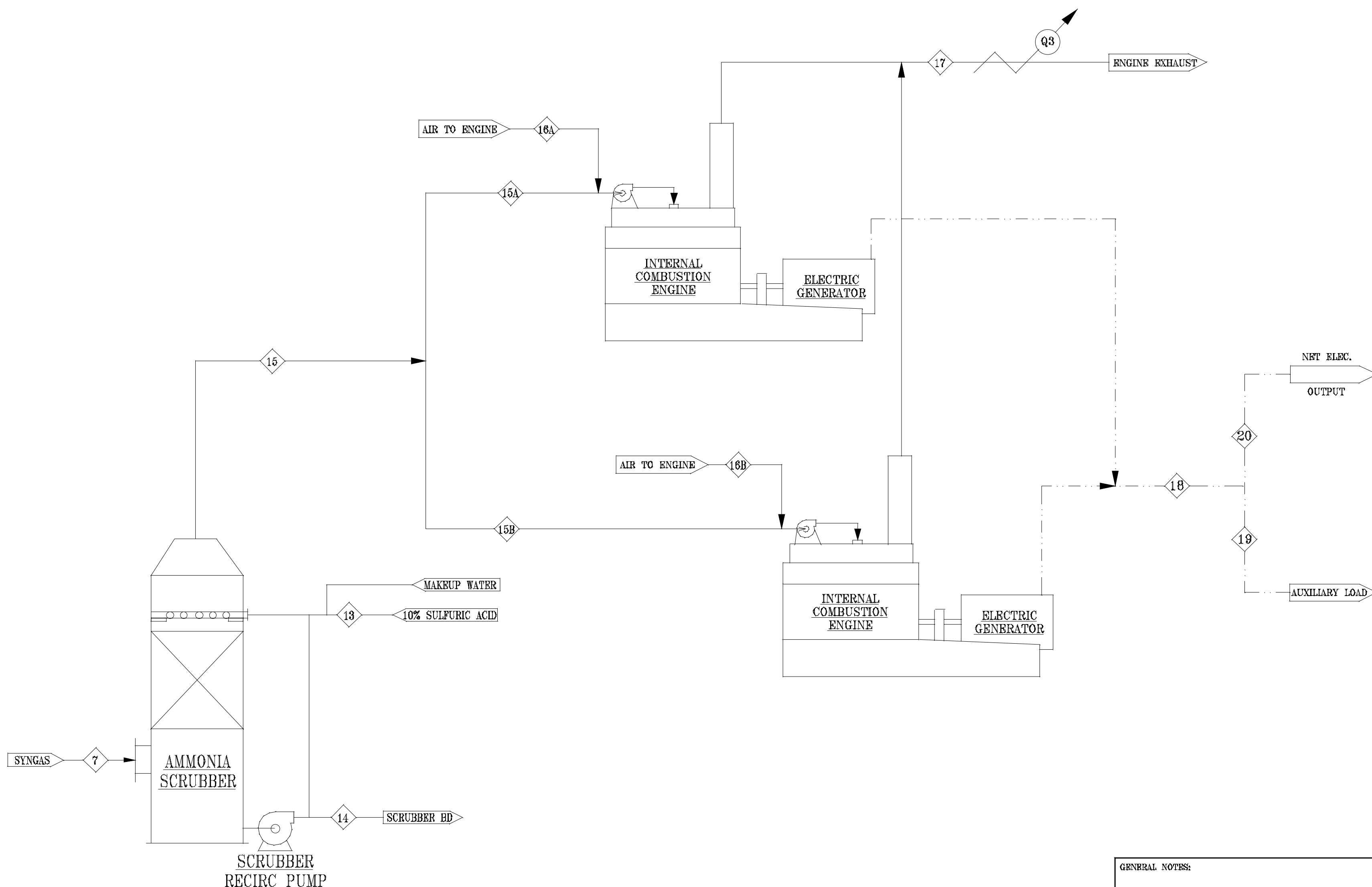
PRIMENERGY, L.L.C.
3172 N. TOLEDO
TULSA, OKLA. 74115

JOB NAME: SEBESTA / NETL
LOCATION: MINNESOTA
CONTRACTOR: SEBESTA

DRAWN BY: KWM
CHECKED BY:
SCALE: N.T.S.
APPROVED BY:
DWG. DATE: 01/07/02
DATE APPROVED:

DESCRIPTION: PROCESS FLOW DIAGRAM
GASIFIER AND GAS CLEAN-UP SYSTEM FOR GAS TURBINE

JOB NUMBER	DISCIPLINE	SHEET NO.	REV.
0153	000	001	1



GENERAL NOTES:

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PRIMENERGY, L.L.C.
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TULSA, OKLA. 74115

JOB NAME:	SEBESTA / NETL	DRAWN BY: KWM	CHECKED BY:
LOCATION:	MINNESOTA	SCALE: N.T.S.	APPROVED BY:
CONTRACTOR:	SEBESTA	DWG. DATE: 04/11/02	DATE APPROVED:

DESCRIPTION: PROCESS FLOW DIAGRAM – IC ENGINES USING SYNGAS AS FUEL

JOB NUMBER	DISCIPLINE	SHEET NO.	REV.
0153	000	002D	0

CUSTOMER: SEBESTA / NETL

OPERATING CASE: TWO JENBACHER IC ENGINES

Stream ID			1	2	3	4	5	6	7	8	9	10	11A	12A	Q1	11B	12B
Stream Name			BIOMASS FEED	GASIFIER AIR	GASIFIER BOTTOM ASH	GASIFIER SYNGAS	COOLED SYNGAS	CLEAN SYNGAS	SYNGAS TO AMMONIA SCRUBBER	FRESH OIL MAKEUP	TAR BD TO GASIFIER	GAS CLEANUP LIQUID BD	GASIFIER COOLING WATER SUPPLY	GASIFIER COOLING WATER RETURN	GASIFIER CW THERMAL ENERGY	IND. HEX COOLING WATER SUPPLY	IND. HEX COOLING WATER RETURN
Pressure, psig ("w.c.-g)			----	(22.0)	----	(-3.0)	(-6.0)	(-16.0)	1.7	----	50	----	50	15		40	5
Temperature, °F			77	77	300	1300	500	105	110	77	115	115	140	170	170 - 140	140	170
Molecular Weight (lb/lbmole)			---	28.69	20.02	26.10	26.10	27.05	27.05	----	----	----	18.02	18.02		18.02	18.02
Component	Formula	mw	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	MMBtu/hr	lb/hr	lb/hr
Carbon	C	12.01	2,467		285												
Hydrogen	H	1.01	314														
Nitrogen	N	14.01	72														
Oxygen	O	16.00	2,130														
Sulfur	S	32.06	15														
Methane	CH_4	16.04				444	444	444	444								
Ethane	C_2H_6	30.07				58	58	58	58								
Ethylene	C_2H_4	28.05				128	128	128	128								
Propane	C_3H_8	44.10				3	3	3	3								
Propene	C_3H_6	42.08				17	17	17	17								
Butane-n	C_4H_{10}	58.12				15	15	15	15								
Pentane (gas)	C_5H_{12}	72.15				2	2	2	2								
Benzene	C_6H_6	78.11				90	90	90	90								
Ammonia	NH_3	17.09				12	12	12	12								
Fuel Gas	CH_4	16.04															
Carbon Monoxide	CO	28.01				2,107	2,107	2,107	2,107								
Carbon Dioxide	CO_2	44.01				2,473	2,473	2,473	2,473								
Hydrogen	H_2	2.02				60	60	60	60								
Water (v)	H_2O (v)	18.02		89		1,736	1,736	676	676								
Nitrogen	N_2	28.01		7,170		7,233	7,233	7,233	7,233								
Oxygen	O_2	32.00		2,171		148	148	148	148								
Sulfur Dioxide	SO_2	64.06				29	29	29	29								
Ash	SiO_2	60.08	288		285	3	3	3	3								
Sulfuric Acid	H_2SO_4	98.08															
Ammonium Sulfate	$(NH_4)_2SO_4$	132.14															
Oil	-------	-------								24	12	12					
Tar	-------	-------									7	2					
Water (l)	H_2O (l)	18.02	574								106	954	16,906	16,906		131,254	131,254
TOTAL			5,861	9,430	570	14,560	14,560	13,500	13,500	24	125	969	16,906	16,906		131,254	131,254
AVAILABLE ENERGY VALUE (LHV-Hv), Btu/lb			6,604			1,926.5	1,926.5	2,077.8	2,077.8								
AVAILABLE ENERGY, MMBtu/hr			38.71			28.05	28.05	28.05	28.05								
SENSIBLE ENERGY, MMBtu/hr						5.8	1.9								0.51		
FLOW RATE, scfm (GPM)				2,079		3,529	3,529	3,157	3,157	(0.06)	(0.3)	(2.2)	(34)	(34)		(263)	(263)
FLOW RATE, acfm				2,147		11,944	6,515	3,430	3,460								
ELECTRICAL OUTPUT, Kilowatts																	

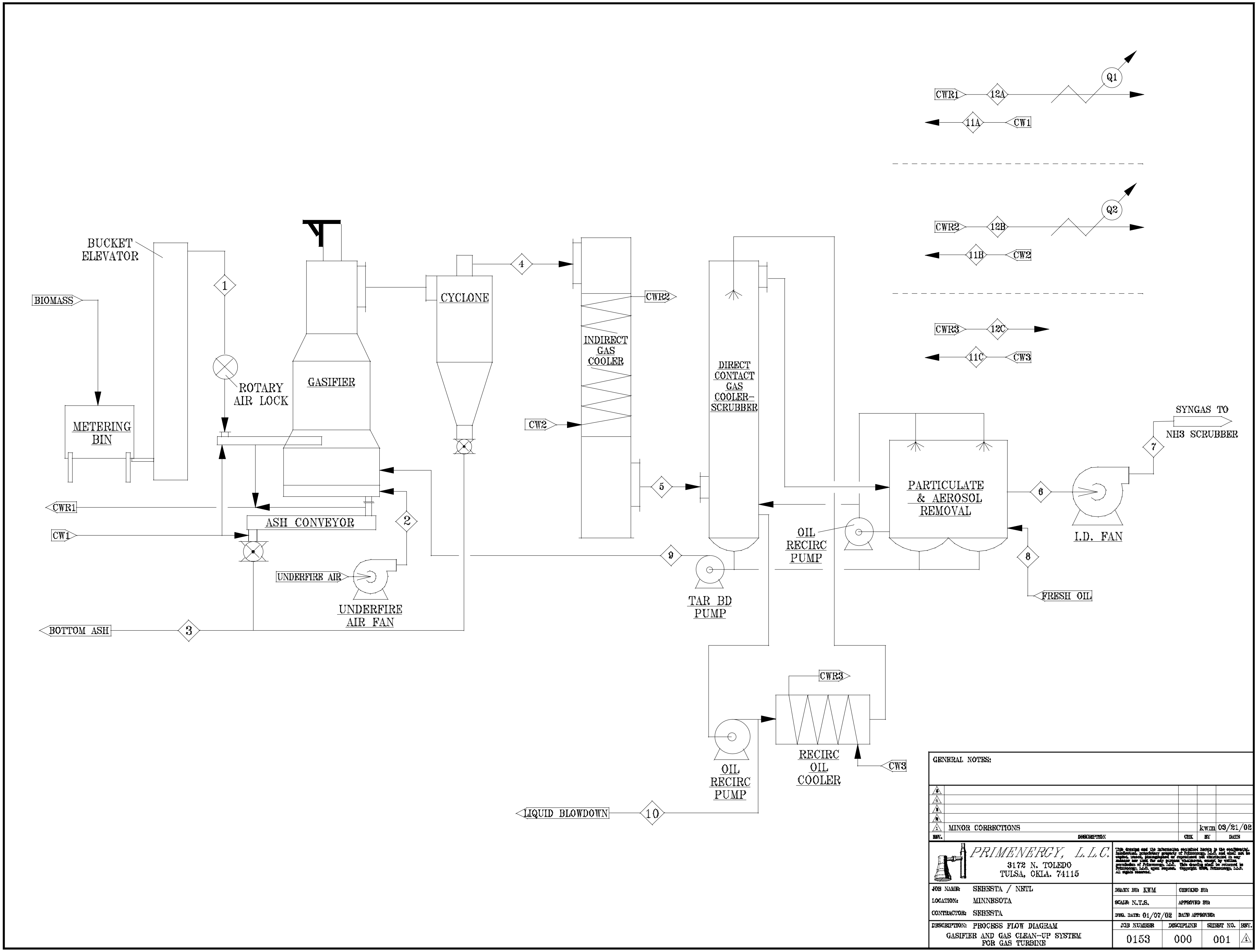
CUSTOMER: SEBESTA / NETL

OPERATING CASE: TWO JENBACHER IC ENGINES

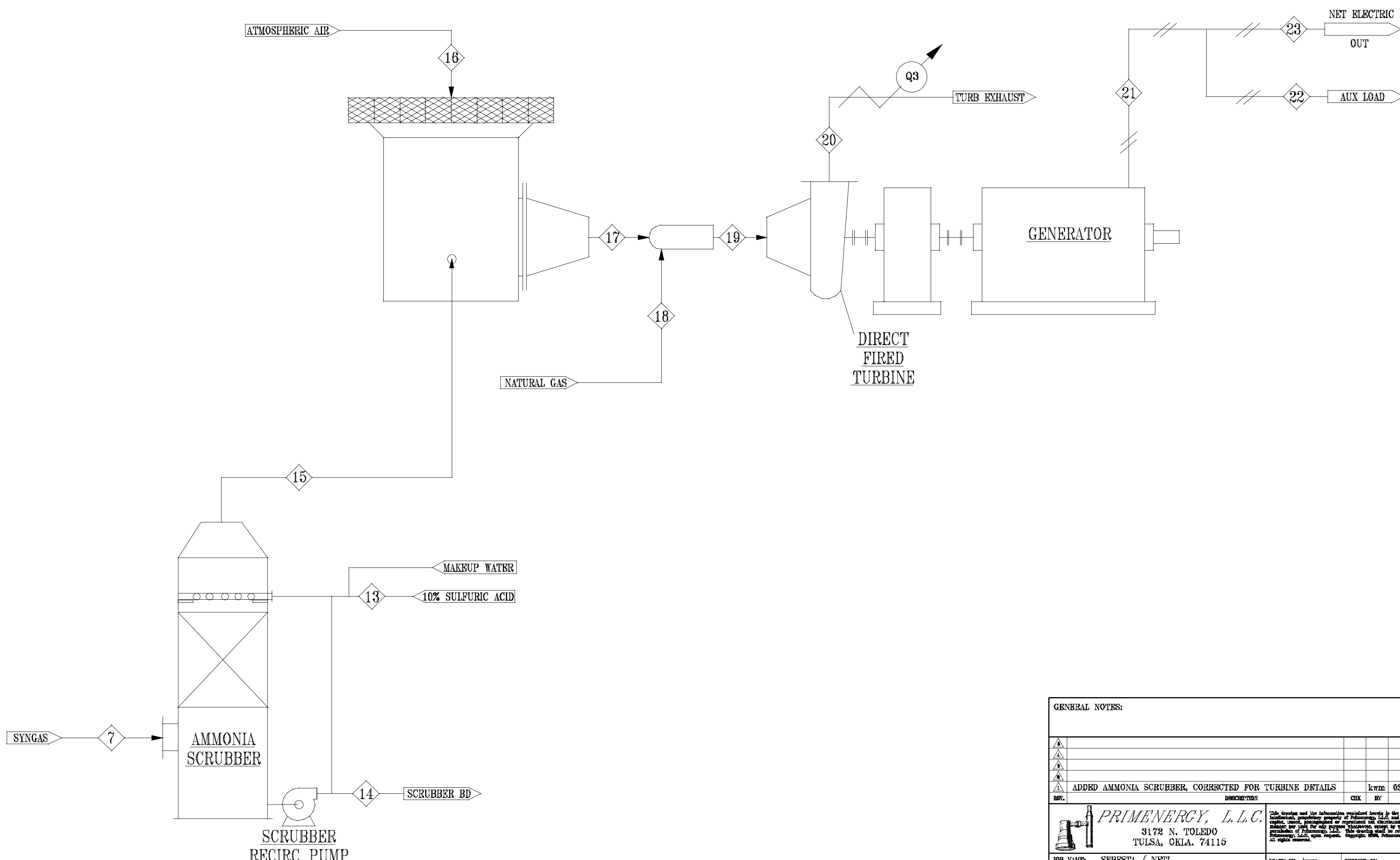
Stream ID			Q2	11C	12C	13	14	15	15A	15B	16A	16B	17	Q3	18	19	20
Stream Name			IND. HEX CW THERMAL ENERGY	OIL HEX COOLING WATER SUPPLY	OIL HEX COOLING WATER RETURN	10% SULFURIC ACIT	AMMONIA SCRUBBER BD	SYNGAS TO ENGINES	SYNGAS TO ENGINE #1	SYNGAS TO ENGINE #2	AIR TO ENGINE #1	AIR TO ENGINE #2	ENGINE EXHAUST GAS	ENGINE EXHAUST THERMAL ENERGY	GROSS ELECT OUTPUT	AUX LOAD	NET ELECT OUTPUT
Pressure, psig ("w.c.-g)				40	5	30	30	1.5	1.5	1.5	-----	-----	0.43				
Temperature, °F			170 - 140	85	95	77	110	110	100	100	77	77	941	960 - 300			
Molecular Weight (lb/lbmole)				18.02	18.02	19.62	20.30	27.06	27.06	27.06	28.69	28.69	29.08				
Component	Formula	mw	MMBtu/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	MMBtu/hr	kilowats	kilowats	kilowatts
Carbon	C	12.01															
Hydrogen	H	1.01															
Nitrogen	N	14.01															
Oxygen	O	16.00															
Sulfur	S	32.06															
Methane	CH4	16.04						444	222	222							
Ethane	C2H6	30.07						58	29	29							
Ethylene	C2H4	28.05						128	64	64							
Propane	C3H8	44.10						3	2	2							
Propene	C3H6	42.08						17	9	9							
Butane-n	C4H10	58.12						15	7	7							
Pentane (gas)	C5H12	72.15						2	1	1							
Benzene	C6H6	78.11						90	45	45							
Ammonia	NH3	17.09															
Fuel Gas	CH4	16.04															
Carbon Monoxide	CO	28.01						2,107	1,054	1,054							
Carbon Dioxide	CO2	44.01						2,473	1,237	1,237			7,996				
Hydrogen	H2	2.02						60	30	30							
Water (v)	H2O (v)	18.02						676	338	338	153	153	2,904				
Nitrogen	N2	28.01						7,233	3,617	3,617	12,310	12,310	31,853				
Oxygen	O2	32.00						148	74	74	3,727	3,727	3,081				
Sulfur Dioxide	SO2	64.06						29	15	15							
Ash	SiO2	60.08															
Sulfuric Acid	H2SO4	98.08				34											
Ammonium Sulfate	(NH4)2SO4	132.14					46										
Oil	-------	-------															
Tar	-------	-------															
Water (l)	H2O (l)	18.02		293,985	293,985	305	305										
TOTAL				293,985	293,985	339	351	13,485	6,743	6,743	16,189	16,189	45,835				
AVAILABLE ENERGY VALUE (LHV-Hv), Btu/lb								2,073	2,073	2,073							
AVAILABLE ENERGY, MMBtu/hr								27.96	13.98	13.98							
SENSIBLE ENERGY, MMBtu/hr			3.94										10.55	7.94			
FLOW RATE, scfm (GPM)				(588)	(588)	(0.7)	(0.7)	3,152	1,576	1,576	3,570	3,570	9,970				
FLOW RATE, acfm								3,132	1,539	1,539	3,686	3,686	26,092				
ELECTRICAL OUTPUT, Kilowatts															2,900	204	2,696

Appendix C: Two Direct Fired Custom Turbine Case

The following pages contain process flow diagrams and mass and energy balance sheets for direct fired 2 custom turbine case (separate compressor).



CWR1
12A
Q1
11A
CW1
CWR2
12B
Q2
11B
CW2
CWR3
12C
11C
CW3
BUCKET ELEVATOR
BIOMASS
1
METERING BIN
ROTARY AIR LOCK
GASIFIER
CYCLONE
4
CWR2
INDIRECT GAS COOLER
CW2
5
DIRECT CONTACT GAS COOLER-SCRUBBER
PARTICULATE & AEROSOL REMOVAL
6
I.D. FAN
7
SYNGAS TO NH3 SCRUBBER
OIL RECIRC PUMP
8
FRESH OIL
CWR1
ASH CONVEYOR
CW1
2
UNDERFIRE AIR
UNDERFIRE AIR FAN
9
TAR BD PUMP
BOTTOM ASH
3
CWR3
RECIRC OIL COOLER
CW3
OIL RECIRC PUMP
LIQUID BLOWDOWN
10
GENERAL NOTES:
5
4
3
2
1 MINOR CORRECTIONS kwm 03/21/02
REV. DESCRIPTION CHK BY DATE
PRIMENERGY, L.L.C.
3172 N. TOLEDO
TULSA, OKLA. 74115
JOB NAME: SEBESTA / NETL
LOCATION: MINNESOTA
CONTRACTOR: SEBESTA
DRAWN BY: KWM
CHECKED BY:
SCALE: N.T.S.
APPROVED BY:
DWG. DATE: 01/07/02
DATE APPROVED:
DESCRIPTION: PROCESS FLOW DIAGRAM
GASIFIER AND GAS CLEAN-UP SYSTEM FOR GAS TURBINE
JOB NUMBER 0153
DISCIPLINE 000
SHEET NO. 001
REV. 1



GENERAL NOTES:

REV.	DESCRIPTION	CHK	BY	DATE
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4				
3				
2				
1	ADDED AMMONIA SCRUBBER, CORRECTED FOR TURBINE DETAILS		kwm	03/13/02

PRIMENERGY, L.L.C.
3172 N. TOLEDO
TULSA, OKLA. 74115

JOB NAME:	SEBESTA / NETL	DRAWN BY: kwm	CHECKED BY:
LOCATION:	MINNESOTA	SCALE: N.T.S.	APPROVED BY:
CONTRACTOR:	SEBESTA	DWG. DATE: 01/07/02	DATE APPROVED:

DESCRIPTION: PROCESS FLOW DIAGRAM
DIRECT FIRED TURBINE
SYNGAS AND AIR MIXED

JOB NUMBER	DISCIPLINE	SHEET NO.	REV.
0153	000	002B	1

CUSTOMER: SEBESTA / NETL

OPERATING CASE: DIRECT FIRED TURBINE - SYNGAS AND AIR MIXED

Stream ID			1	2	3	4	5	6	7	8	9	10	11A	12A	Q1	11B	12B
Stream Name			BIOMASS FEED	GASIFIER AIR	GASIFIER BOTTOM ASH	GASIFIER SYNGAS	COOLED SYNGAS	CLEAN SYNGAS	SYNGAS TO AMMONIA SCRUBBER	FRESH OIL MAKEUP	TAR BD TO GASIFIER	GAS CLEANUP LIQUID BD	GASIFIER COOLING WATER SUPPLY	GASIFIER COOLING WATER RETURN	GASIFIER CW THERMAL ENERGY	IND. HEX COOLING WATER SUPPLY	IND. HEX COOLING WATER RETURN
Pressure, psig ("w.c.-g)			----	(22.0)	----	(-3.0)	(-6.0)	(-16.0)	2.0	----	50	----	50	15		40	5
Temperature, °F			77	77	300	1300	500	105	110	77	115	115	140	170	170 - 140	140	170
Molecular Weight (lb/lbmole)			---	28.69	20.02	26.09	26.09	27.03	27.03	----	----	----	18.02	18.02		18.02	18.02
Component	Formula	mw	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	MMBtu/hr	lb/hr	lb/hr
Carbon	C	12.01	8,184		945												
Hydrogen	H	1.01	1,034														
Nitrogen	N	14.01	202														
Oxygen	O	16.00	7,067														
Sulfur	S	32.06	49														
Methane	CH4	16.04				1,467	1,467	1,467	1,467								
Ethane	C2H6	30.07				193	193	193	193								
Ethylene	C2H4	28.05				423	423	423	423								
Propane	C3H8	44.10				10	10	10	10								
Propene	C3H6	42.08				58	58	58	58								
Butane-n	C4H10	58.12				49	49	49	49								
Pentane (gas)	C5H12	72.15				7	7	7	7								
Benzene	C6H6	78.11				298	298	298	298								
Ammonia	NH3	17.09				85	85	85	85								
Fuel Gas	CH4	16.04															
Carbon Monoxide	CO	28.01				7,045	7,045	7,045	7,045								
Carbon Dioxide	CO2	44.01				8,151	8,151	8,151	8,151								
Hydrogen	H2	2.02				200	200	200	200								
Water (v)	H2O (v)	18.02		292		5,673	5,673	2,232	2,232								
Nitrogen	N2	28.01		23,607		23,739	23,739	23,739	23,739								
Oxygen	O2	32.00		7,146		488	488	488	488								
Sulfur Dioxide	SO2	64.06				98	98	98	98								
Ash	SiO2	60.08	955		945	10	10	10	10								
Sulfuric Acid	H2SO4	98.08															
Ammonium Sulfate	(NH4)2SO4	132.14															
Oil	-------	-------								50	25	25					
Tar	-------	-------									22	7					
Water (l)	H2O (l)	18.02	1,905								344	3,096	58,382	58,382		432,950	432,950
TOTAL			19,396	31,046	1,891	47,991	47,991	44,551	44,551	50	391	3,129	58,382	58,382		432,950	432,950
AVAILABLE ENERGY VALUE (LHV-Hv), Btu/lb			6,604			1,945.7	1,945.7	2,096.0	2,096.0								
AVAILABLE ENERGY, MMBtu/hr			128.09			93.38	93.38	93.38	93.38								
SENSIBLE ENERGY, MMBtu/hr						19.1	6.1								1.75		
FLOW RATE, SCFM (GPM)				6,845		11,633	11,633	10,425	10,425	(0.13)	(0.9)	(7.0)	(117)	(117)		(866)	(866)
FLOW RATE, ACFM				7,069		39,374	21,477	11,328	11,428								
ELECTRICAL OUTPUT, Kilowatts																	

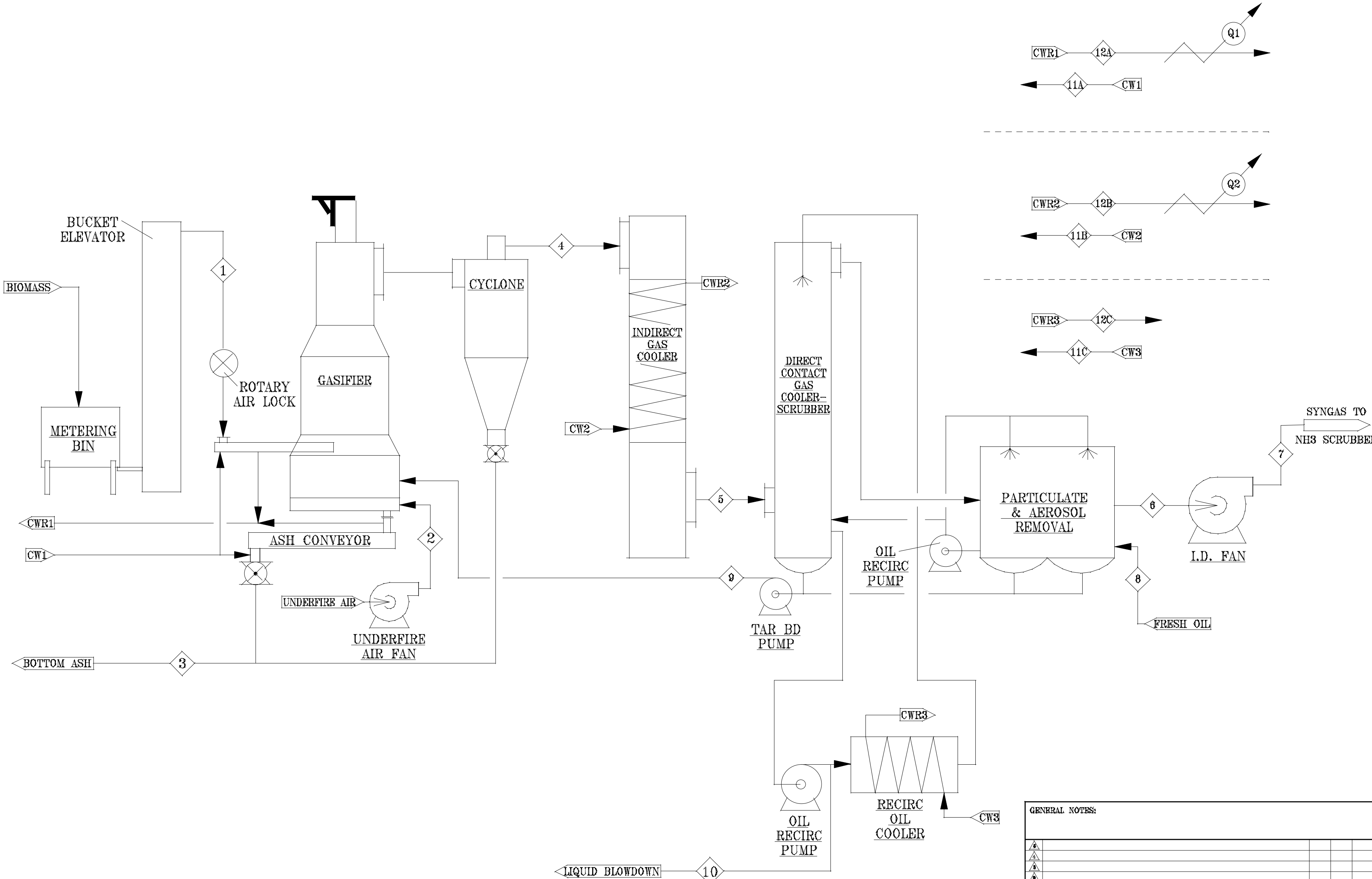
CUSTOMER: SEBESTA / NETL

OPERATING CASE: DIRECT FIRED TURBINE - SYNGAS AND AIR MIXED

Stream ID			Q2	11C	12C	13	14	15	16	17	18	19	20	Q3	21	22	23
Stream Name			IND. HEX CW THERMAL ENERGY	OIL HEX COOLING WATER SUPPLY	OIL HEX COOLING WATER RETURN	10% SULFURIC ACIT	AMMONIA SCRUBBER BD	SYNGAS TO COMPRESS	ATMOS AIR TO TURBINE COMP	COMP SYNGAS AND AIR MIX	NATURAL GAS	TURBINE INLET GAS	TURBINE EXHAUST GAS	TURBINE EXHAUST THERMAL ENERGY	GROSS ELECT OUTPUT	AUX LOAD	NET ELECT OUTPUT
Pressure, psig ("w.c.-g)				40	5	30	30	1.8	----	155	258	154	0.43				
Temperature, °F			170 - 140	85	95	77	110	110	77	602	77	1829	960	960 - 300			
Molecular Weight (lb/lbmole)				18.02	18.02	19.62	20.30	27.06	28.69	28.46	16.04	28.80	28.80				
Component	Formula	mw	MMBtu/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	MMBtu/hr	kilowats	kilowats	kilowatts
Carbon	C	12.01															
Hydrogen	H	1.01															
Nitrogen	N	14.01															
Oxygen	O	16.00															
Sulfur	S	32.06															
Methane	CH4	16.04						1,467		1,467							
Ethane	C2H6	30.07						193		193							
Ethylene	C2H4	28.05						423		423							
Propane	C3H8	44.10						10		10							
Propene	C3H6	42.08						58		58							
Butane-n	C4H10	58.12						49		49							
Pentane (gas)	C5H12	72.15						7		7							
Benzene	C6H6	78.11						298		298							
Ammonia	NH3	17.09															
Fuel Gas	CH4	16.04									1,101						
Carbon Monoxide	CO	28.01						7,045		7,045							
Carbon Dioxide	CO2	44.01						8,151		8,151		29,545	29,545				
Hydrogen	H2	2.02						200		200							
Water (v)	H2O (v)	18.02						2,232	2,711	4,944		13,770	13,770				
Nitrogen	N2	28.01						23,739	218,847	242,585		242,585	242,585				
Oxygen	O2	32.00						488	66,251	66,738		47,368	47,368				
Sulfur Dioxide	SO2	64.06						98		98		98	98				
Ash	SiO2	60.08															
Sulfuric Acid	H2SO4	98.08				245											
Ammonium Sulfate	(NH4)2SO4	132.14					330										
Oil	-------	-------															
Tar	-------	-------															
Water (l)	H2O (l)	18.02		962,994	962,994	2,207	2,207										
TOTAL				962,994	962,994	2,452	2,537	44,456	287,809	332,265	1,101	333,366	333,366				
AVAILABLE ENERGY VALUE (LHV-Hv), Btu/lb								2,085.3			21,500						
AVAILABLE ENERGY, MMBtu/hr								92.70			23.68						
SENSIBLE ENERGY, MMBtu/hr			12.99									160.70	57.57	38.92			
FLOW RATE, SCFM (GPM)				(1,926)	(1,926)	(4.9)	(5.1)	10,393	63,459	73,852	434	73,225	73,225				
FLOW RATE, ACFM								11,392	65,534	13,097	24	28,081	194,237				
ELECTRICAL OUTPUT, Kilowatts															10,226	501	9,725

Appendix D: Two Mixed Air and Syngas Custom Turbine Case

The following pages contain process flow diagrams and mass and energy balance sheets for two mixed air and syngas custom turbine case (same compressor).



GENERAL NOTES:

REV.	DESCRIPTION	CHK	BY	DATE
5				
4				
3				
2				
1	MINOR CORRECTIONS		kwm	03/21/02

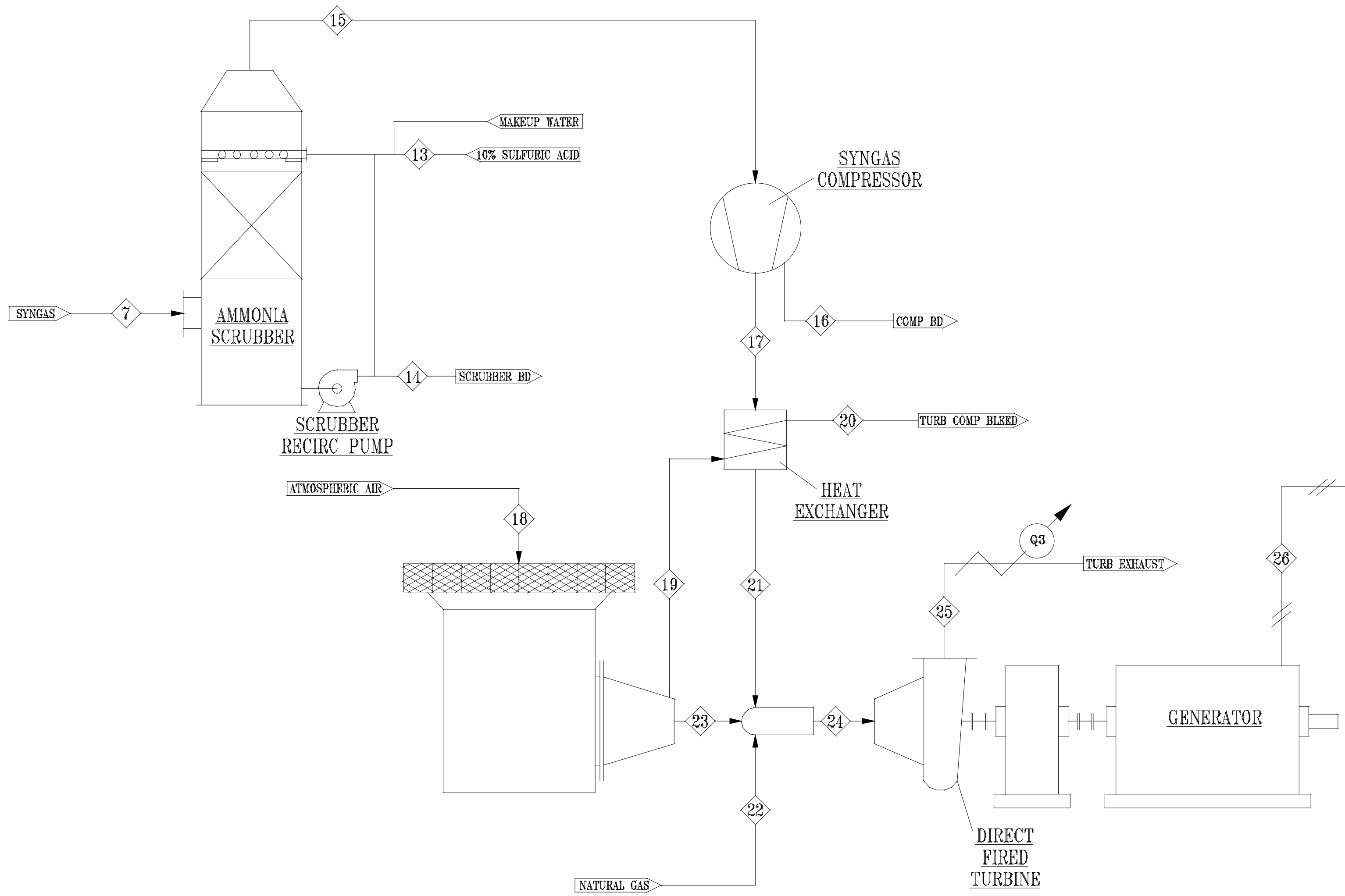
PRIMENERGY, L.L.C.
3172 N. TOLEDO
TULSA, OKLA. 74115

JOB NAME: SEBESTA / NETL
LOCATION: MINNESOTA
CONTRACTOR: SEBESTA

DRAWN BY: KWM
CHECKED BY:
SCALE: N.T.S.
APPROVED BY:
DWG. DATE: 01/07/02
DATE APPROVED:

DESCRIPTION: PROCESS FLOW DIAGRAM
GASIFIER AND GAS CLEAN-UP SYSTEM FOR GAS TURBINE

JOB NUMBER	DISCIPLINE	SHEET NO.	REV.
0153	000	001	1



GENERAL NOTES:

REV.	DESCRIPTION	CHK	BY	DATE
5				
4				
3				
2				
1	ADDED AMMONIA SCRUBBER, CORRECTED FOR TURBINE DETAILS		kwm	03/13/02

PRIMENERGY, L.L.C.
3172 N. TOLEDO
TULSA, OKLA. 74115

JOB NAME: SEBESTA / NETL
LOCATION: MINNESOTA
CONTRACTOR: SEBESTA

DRAWN BY: kwm
CHECKED BY:
SCALE: N.T.S.
APPROVED BY:
DWG. DATE: 01/07/02
DATE APPROVED:

DESCRIPTION: PROCESS FLOW DIAGRAM
DIRECT FIRED TURBINE
SYNGAS COMPRESSED SEPEARATELY

JOB NUMBER	DISCIPLINE	SHEET NO.	REV.
0153	000	002A	1

CUSTOMER: SEBESTA / NETL

OPERATING CASE: DIRECT FIRED TURBINE - SYNGAS COMPRESSED SEPARATE

Stream ID			1	2	3	4	5	6	7	8	9	10	11A	12A	Q1	11B	12B	Q2	11C	12C
Stream Name			BIOMASS FEED	GASIFIER AIR	GASIFIER BOTTOM ASH	GASIFIER SYNGAS	COOLED SYNGAS	CLEAN SYNGAS	SYNGAS TO AMMONIA SCRUBBER	FRESH OIL MAKEUP	TAR BD TO GASIFIER	GAS CLEANUP LIQUID BD	GASIFIER COOLING WATER SUPPLY	GASIFIER COOLING WATER RETURN	GASIFIER CW THERMAL ENERGY	IND. HEX COOLING WATER SUPPLY	IND. HEX COOLING WATER RETURN	IND. HEX CW THERMAL ENERGY	OIL HEX COOLING WATER SUPPLY	OIL HEX COOLING WATER RETURN
Pressure, psig ("w.c.-g)			----	(22.0)	----	(-3.0)	(-6.0)	(-16.0)	2.0	----	50	----	50	15		40	5		40	5
Temperature, °F			77	77	300	1300	500	105	110	77	115	115	140	170	170 - 140	140	170	170 - 140	85	95
Molecular Weight (lb/lbmole)			---	28.69	20.02	26.05	26.05	27.00	27.00	----	----	----	18.02	18.02		18.02	18.02		18.02	18.02
Component	Formula	mw	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	MMBtu/hr	lb/hr	lb/hr	MMBtu/hr	lb/hr	lb/hr
Carbon	C	12.01	13,006		1,503															
Hydrogen	H	1.01	1,652																	
Nitrogen	N	14.01	362																	
Oxygen	O	16.00	11,230																	
Sulfur	S	32.06	78																	
Methane	CH4	16.04				2,346	2,346	2,346	2,346											
Ethane	C2H6	30.07				308	308	308	308											
Ethylene	C2H4	28.05				677	677	677	677											
Propane	C3H8	44.10				16	16	16	16											
Propene	C3H6	42.08				92	92	92	92											
Butane-n	C4H10	58.12				78	78	78	78											
Pentane (gas)	C5H12	72.15				12	12	12	12											
Benzene	C6H6	78.11				476	476	476	476											
Ammonia	NH3	17.09				85	85	85	85											
Fuel Gas	CH4	16.04																		
Carbon Monoxide	CO	28.01				11,266	11,266	11,266	11,266											
Carbon Dioxide	CO2	44.01				12,768	12,768	12,768	12,768											
Hydrogen	H2	2.02				319	319	319	319											
Water (v)	H2O (v)	18.02		470		9,188	9,188	3,570	3,570											
Nitrogen	N2	28.01		37,927		38,218	38,218	38,218	38,218											
Oxygen	O2	32.00		11,481		780	780	780	780											
Sulfur Dioxide	SO2	64.06				155	155	155	155											
Ash	SiO2	60.08	1,518		1,503	15	15	15	15											
Sulfuric Acid	H2SO4	98.08																		
Ammonium Sulfate	(NH4)2SO4	132.14																		
Oil	-------	-------								50	25	25								
Tar	-------	-------									36	12								
Water (l)	H2O (l)	18.02	3,028								562	5,056	83,558	83,558		692,855	692,855		1,554,568	1,554,568
TOTAL			30,874	49,878	3,005	76,801	76,801	71,183	71,183	50	623	5,093	83,558	83,558		692,855	692,855		1,554,568	1,554,568
AVAILABLE ENERGY VALUE (LHV-Hv), Btu/lb			6,604			1,939.2	1,939.2	2,092.2	2,092.2											
AVAILABLE ENERGY, MMBtu/hr			203.90			148.93	148.93	148.93	148.93											
SENSIBLE ENERGY, MMBtu/hr						30.6	9.8								2.51			20.79		
FLOW RATE, SCFM (GPM)				10,998		18,645	18,645	16,673	16,673	(0.13)	(1.4)	(11.3)	(167)	(167)		(1,386)	(1,386)		(3,109)	(3,109)
FLOW RATE, ACFM				11,357		63,107	34,422	18,116	18,276											
ELECTRICAL OUTPUT, Kilowatts																				

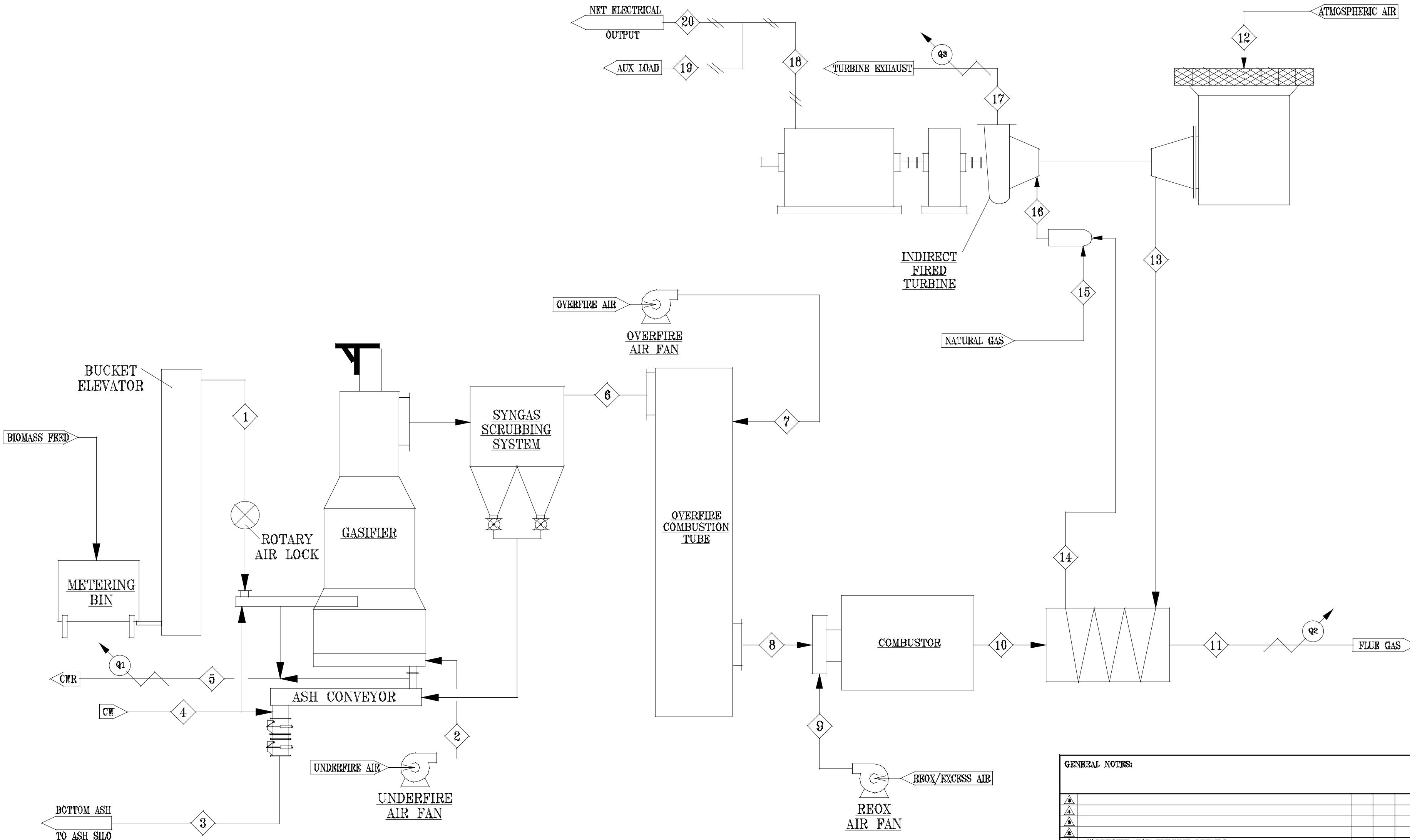
CUSTOMER: SEBESTA / NETL

OPERATING CASE: DIRECT FIRED TURBINE - SYNGAS COMPRESSED SEPARATE

Stream ID			13	14	15	16	17	18	19	20	21	22	23	24	25	Q3	26	27	28
Stream Name			10% SULFURIC ACID	AMMONIA SCRUBBER BD	SYNGAS TO COMPRESS	SYNGAS COMP BD	SYNGAS TO HEAT EXCH	ATMOS AIR TO TURBINE COMP	TURBINE COMP BLEED AIR	COOLED COMP BLEED AIR	HEAED SYNGAS TO TURBINE	NAT'L GAS	COMP AIR TO TURBINE	TURBINE INLET GAS	TURBINE EXHAUST GAS	TURBINE EXHAUST THERMAL ENERGY	GROSS ELECT OUT	AUX LOAD	NET ELECT OUT
Pressure, psig ("w.c.-g)			30	30	1.8	50	237	----	207	----	236	258	207	201	0.43				
Temperature, °F			77	110	110	110	300	70	677	413	506	77	677	1789	960	960 - 300			
Molecular Weight (lb/lbmole)			19.62	20.30	27.02	18.02	27.70	28.69	28.69	28.69	27.70	16.04	28.69	28.88	28.88				
Component	Formula	mw	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	MMBtu/hr	kilowats	kilowats	kilowatts
Carbon	C	12.01																	
Hydrogen	H	1.01																	
Nitrogen	N	14.01																	
Oxygen	O	16.00																	
Sulfur	S	32.06																	
Methane	CH4	16.04			2,346		2,346				2,346								
Ethane	C2H6	30.07			308		308				308								
Ethylene	C2H4	28.05			677		677				677								
Propane	C3H8	44.10			16		16				16								
Propene	C3H6	42.08			92		92				92								
Butane-n	C4H10	58.12			78		78				78								
Pentane (gas)	C5H12	72.15			12		12				12								
Benzene	C6H6	78.11			476		476				476								
Ammonia	NH3	17.09																	
Fuel Gas	CH4	16.04										1,729							
Carbon Monoxide	CO	28.01			11,266		11,266				11,266								
Carbon Dioxide	CO2	44.01			12,768		12,768				12,768			46,895	46,895				
Hydrogen	H2	2.02			319		319				319								
Water (v)	H2O (v)	18.02			3,570		253	5,364	573	573	253		4,791	19,088	19,088				
Nitrogen	N2	28.01			38,218		38,218	432,988	46,268	46,268	38,218		386,720	424,938	424,938				
Oxygen	O2	32.00			780		780	131,077	14,007	14,007	780		117,070	87,000	87,000				
Sulfur Dioxide	SO2	64.06			155		155				155			155	155				
Ash	SiO2	60.08																	
Sulfuric Acid	H2SO4	98.08	245																
Ammonium Sulfate	(NH4)2SO4	132.14		330															
Oil	-------	-------																	
Tar	-------	-------																	
Water (l)	H2O (l)	18.02	2,207	2,207		3,317													
TOTAL			2,452	2,537	71,083	3,317	67,766	569,429	60,848	60,848	67,766	1,729	508,581	578,076	578,076				
AVAILABLE ENERGY VALUE (LHV-Hv), Btu/lb					2,085.7		2,187.8				2,187.8	21,500							
AVAILABLE ENERGY, MMBtu/hr					148.26		148.3				148.3	37.18							
SENSIBLE ENERGY, MMBtu/hr							4.22		9.09	5.09	8.13		76.00	269.58	99.08	66.97			
FLOW RATE, SCFM (GPM)			(4.9)	(5.1)	16,640	(6.6)	15,475	125,554	13,416	13,416	15,475	682	112,138	126,598	126,598				
FLOW RATE, ACFM					18,240		1,287	127,969	1,948	22,524	1,643	38	16,278	37,364	335,813				
ELECTRICAL OUTPUT, Kilowatts																	16,560	6,576	9,984

Appendix E: Indirect Turbine Case

The following pages contain process flow diagrams and mass and energy balance sheets for indirect turbine case (clean air turbine).



GENERAL NOTES:

REV.	DESCRIPTION	CHK	BY	DATE
5				
4				
3				
2				
1	CORRECTED FOR TURBINE DETAILS		kwm	03/12/02

PRIMENERGY, L.L.C.
3172 N. TOLEDO
TULSA, OKLA. 74115

JOB NAME:	SEBESTA / NETL	DRAWN BY: KWM	CHECKED BY:
LOCATION:	MINNESOTA	SCALE: N.T.S.	APPROVED BY:
CONTRACTOR:	SEBESTA	DWG. DATE: 01/08/02	DATE APPROVED:

DESCRIPTION: PROCESS FLOW DIAGRAM
INDIRECT FIRED TURBINE

JOB NUMBER	DISCIPLINE	SHEET NO.	REV.
0153	000	003	1

CUSTOMER : SEBESTA / NETL

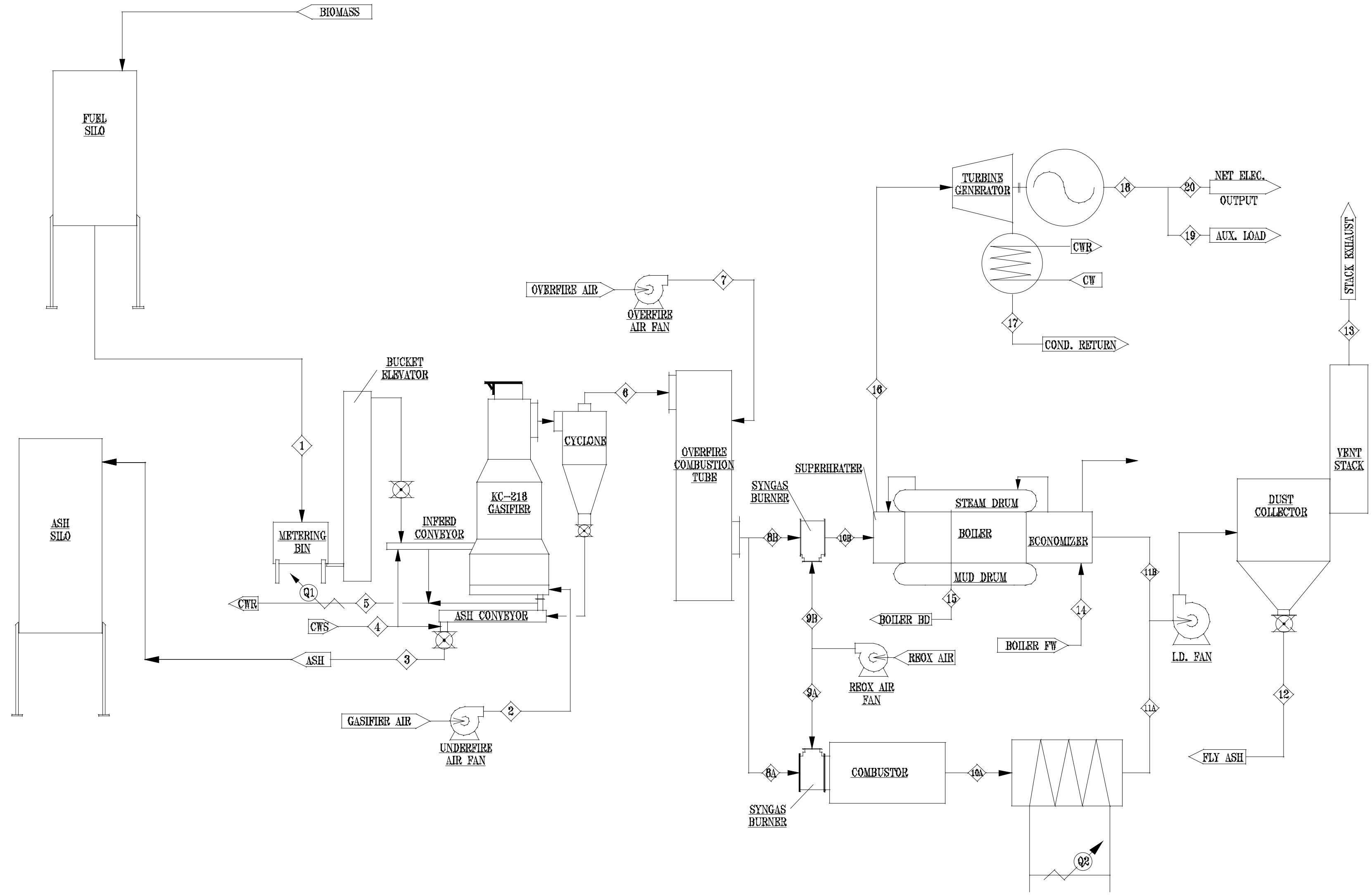
OPERATING CASE: INDIRECT FIRED TURBINE

Stream ID			1	2	3	4	5	Q1	6	7	8	9	10	11
Stream Name			GASIFIER FEED	GASIFIER AIR	GASIFIER BOTTOM ASH	GASIFIER COOLING WATER SUPPLY	GASIFIER COOLING WATER RETURN	GASIFIER CW THERMAL ENERGY	GASIFIER SYNGAS	OVERFIRE AIR	OVERFIRE SYNGAS	REOX COMB AIR	COMB PROD TO AIR HEATER	AIR HEATER EXHAUST
Pressure, psig ("w.c.-g)			----	(22.0)	----	50	15		(-10.0)	(5.0)	(-11.0)	(5.0)	(-12.0)	(-18.0)
Temperature, °F			77	77	300	140	170	170 -140	1283	77	2400	77	1900	736
Molecular Weight (lb/lbmole)			---	28.68	90.00	18.02	18.02		23.46	28.68	26.05	28.68	28.73	28.69
Component	Formula	mw	lb/h	lb/h	lb/h	lb/h	lb/h	MMBtu/hr	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h
Carbon	C	12.01	11,019		1,320									
Hydrogen	H	1.01	1,413											
Nitrogen	N	14.01	366											
Oxygen	O	16.00	9,515											
Sulfur	S	32.06	37											
Chlorine	Cl	35.45	29											
Fuel Gas	CH4	16.04												
Carbon Monoxide	CO	28.01							15,880		6,380			
Carbon Dioxide	CO2	44.01							10,540		25,473		35,498	
Hydrogen	H2	2.02							1,047		952			
Water (v)	H2O (v)	18.02		429					6,263	262	7,371	1,906	17,787	3,089
Nitrogen	N2	28.01		33,497					33,863	20,423	54,286	148,827	203,112	249,301
Oxygen	O2	32.00		10,140						6,183		45,054	33,852	75,470
Sulfur Dioxide	SO2	64.06							37					
Hydrogen Chloride	HCl	36.46												
Ash	SiO2	60.08	1,286		2,652									
Lime	CaCO3	100.09												
Water (l)	H2O (l)	18.02	2,566			58,650	58,650							
TOTAL			26,230	44,066	3,972	58,650	58,650		67,630	26,867	94,462	195,787	290,249	327,860
AVAILABLE ENERGY VALUE (LHV-Hv), Btu			6,604						1,830		819			
AVAILABLE ENERGY, MMBtu/hr			173.23						123.65		77.34			
SENSIBLE HEAT, MMBtu/hr									27.05		72.58		149.20	50.02
FLOW RATE, scfm (gpm)				9,718		(117.3)	(117.3)	1.76	18,234	5,925	22,934	43,178	63,897	72,291
FLOW RATE, acfm				10,036					61,124	6,119	126,138	44,589	289,996	166,213
ELECTRICAL RATE, kilowatts														

Stream ID			Q2	12	13	14	15	16	17	Q3	18	19	20
Stream Name			HEATER EXHAUST THERMAL ENERGY	COMB AIR TO TURBINE COMP	COMB AIR TO AIR HEATER	HEATED COMB AIR TO TURBINE	NATURAL GAS	TURBINE INLET GAS	TURBINE EXHAUST	TURBINE EXHAUST THERMAL ENERGY	GROSS ELECT OUTPUT	AUX LOAD	NET ELECT OUTPUT
Pressure, psig ("w.c.-g)				----	160	156	256	154	0.40				
Temperature, °F			736 - 300	77	602	1595	77	1829	917	917 - 300			
Molecular Weight (lb/lbmole)				28.69	28.69	28.69	16.04	28.61	28.61				
Component	Formula	mw	MMBtu/hr	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	MMBtu/hr	kW	kW	kW
Carbon	C	12.01											
Hydrogen	H	1.01											
Nitrogen	N	14.01											
Oxygen	O	16.00											
Sulfur	S	32.06											
Chlorine	Cl	35.45											
Fuel Gas	CH4	16.04					1,101.4						
Carbon Monoxide	CO	28.01											
Carbon Dioxide	CO2	44.01						3,021.4	3,021.4				
Hydrogen	H2	2.02											
Water (v)	H2O (v)	18.02		3,089	3,089	3,089		5,562	5,562				
Nitrogen	N2	28.01		249,301	249,301	249,301		249,301	249,301				
Oxygen	O2	32.00		75,470	75,470	75,470		71,076	71,076				
Sulfur Dioxide	SO2	64.06											
Hydrogen Chloride	HCl	36.46											
Ash	SiO2	60.08											
Lime	CaCO3	100.09											
Water (l)	H2O (l)	18.02											
TOTAL				327,860	327,860	327,860	1,101.4	328,961	328,961				
AVAILABLE ENERGY VALUE (LHV-Hv), Btu/lb							21,500						
AVAILABLE ENERGY, MMBtu/hr							23.68						
SENSIBLE HEAT, MMBtu/hr			33.09		21.37	65.22		154.11	70.22	51.58			
FLOW RATE, scfm (gpm)				72,291	72,291	72,291	434	72,725	72,725				
FLOW RATE, acfm				74,654	12,428	24,603	24	27,889	187,472				
ELECTRICAL RATE, kilowatts											10,091	756	9,334

Appendix F: Steam Turbine Case

The following pages contain process flow diagrams and mass and energy balance sheets for steam turbine case.



GENERAL NOTES:

REV.	DESCRIPTION	CHK	BY	DATE
5				
4				
3				
2				
1				

PRIMENERGY, L.L.C.
3172 N. TOLEDO
TULSA, OKLA. 74115

JOB NAME:	SEBESTA / NETL	DRAWN BY: KWM	CHECKED BY:
LOCATION:	MINNESOTA	SCALE: N.T.S.	APPROVED BY:
CONTRACTOR:	SEBESTA	DWG. DATE: 05/07/02	DATE APPROVED:

DESCRIPTION: PROCESS FLOW DIAGRAM
STEAM TURBINE

JOB NUMBER	DISCIPLINE	SHEET NO.	REV.
0153	000	001E	0

CUSTOMER : SEBESTA / NETL

OPERATING CASE: 5 MW STEAM TURBINE & GLYCOL HEATING

Stream ID			1	2	3	4	5	Q1	6	7	8A	9A	10A	11A	Q2
Stream Name			GASIFIER FEED	GASIFIER AIR	GASIFIER BOTTOM ASH	GASIFIER COOLING WATER SUPPLY	GASIFIER COOLING WATER RETURN	GASIFIER CW THERMAL ENERGY	GASIFIER SYNGAS	OVERFIRE AIR	OVERFIRE SYNGAS TO GLYCOL HEATER	GLYCOL HEATR REOX AIR	COMB PROD TO GLYCOL HEATER	GLYCOL HEATER EXHAUST	GLYCOL HEATER THERMAL ENERGY
Pressure, psig ("w.c.-g)			----	(22.0)	----	50	15	-----	(-3.0)	(8.0)	(-4.0)	(8.0)	(-5.0)	(-13.0)	-----
Temperature, °F			77	77	300	140	170	170 -140	1287	77	2400	77	2000	300	2000 - 30
Molecular Weight (lb/lbmole)			---	28.68	90.00	18.02	18.02	-----	23.43	28.68	26.02	28.68	28.74	28.74	-----
Component	Formula	mw	lb/h	lb/h	lb/h	lb/h	lb/h	MMBtu/hr	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	MMBtu/hr
Carbon	C	12.01	6,395		766										
Hydrogen	H	1.01	820												
Nitrogen	N	14.01	212												
Oxygen	O	16.00	5,522												
Sulfur	S	32.06	21												
Chlorine	Cl	35.45	17												
Fuel Gas	CH_4	16.04													
Carbon Monoxide	CO	28.01							9,245		694				
Carbon Dioxide	CO_2	44.01							6,072		2,718		3,809	3,809	
Hydrogen	H_2	2.02							610		103				
Water (v)	H_2O (v)	18.02		247					3,611	150	782	162	1,865	1,865	
Nitrogen	N_2	28.01		19,321					19,534	11,746	5,783	12,634	18,417	18,417	
Oxygen	O_2	32.00		5,849						3,556		3,825	2,610	2,610	
Sulfur Dioxide	SO_2	64.06							21		4		4	4	
Hydrogen Chloride	HCl	36.46													
Ash	SiO_2	60.08	746		1,539						0		0	0	
Lime	$CaCO_3$	100.09													
Water (l)	H_2O (l)	18.02	1,489			30,121	30,121								
TOTAL			15,223	25,418	2,305	30,121	30,121		39,093	15,452	10,085	16,621	26,705	26,705	
AVAILABLE ENERGY VALUE (LHV-Hv), Btu			6,604						1,842		832				
AVAILABLE ENERGY, MMBtu/hr			100.54						72.02		8.39				
SENSIBLE HEAT, MMBtu/hr									15.71		7.75		15.78	1.63	14.15
FLOW RATE, scfm (gpm)				5,606		(60.2)	(60.2)	0.90	10,555	3,408	2,452	3,665	5,877	5,877	
FLOW RATE, acfm				5,789					35,469	3,519	13,483	3,785	27,802	8,589	
ELECTRICAL RATE, kilowatts															

CUSTOMER : SEBESTA / NETL

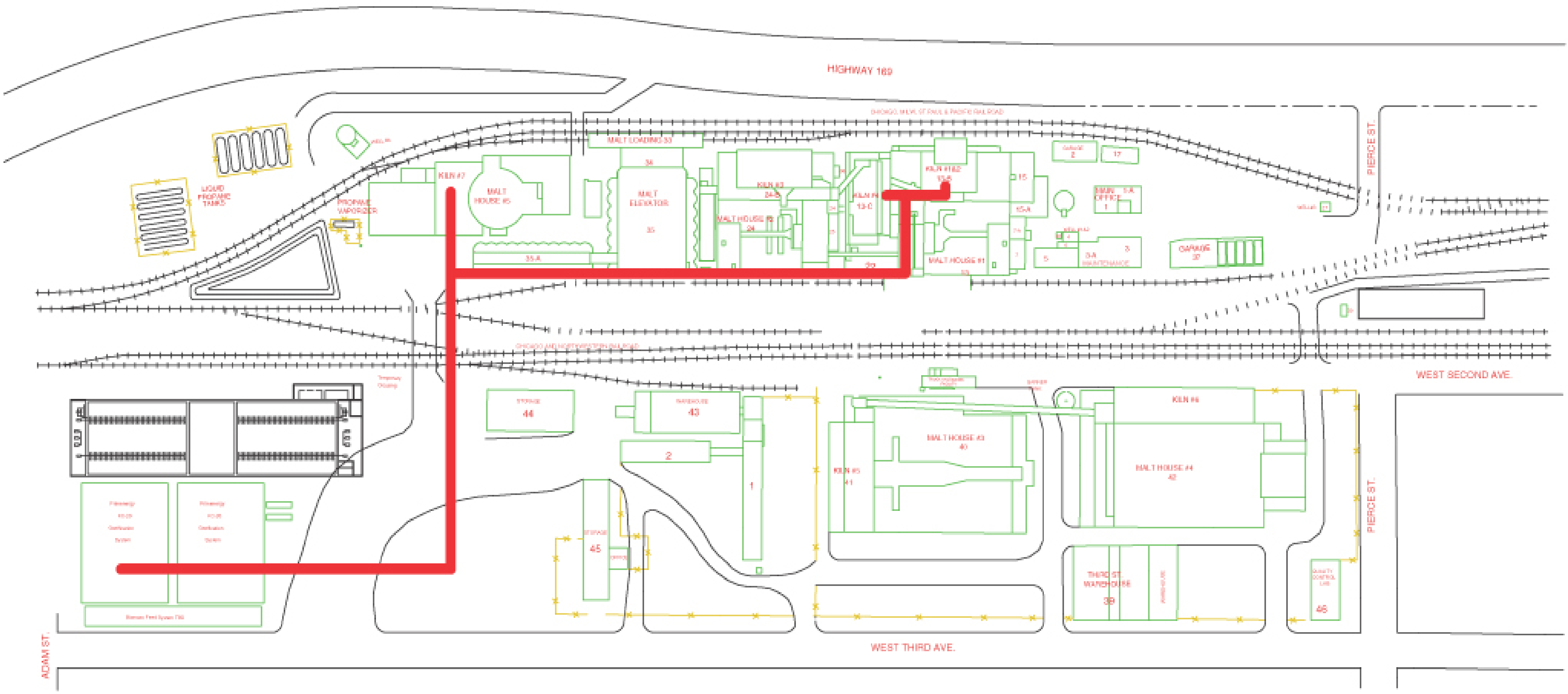
OPERATING CASE: 5 MW STEAM TURBINE & GLYCOL HEATING

Stream ID			8B	9B	10B	11B	12	13	14	15	16	17	18	19	20
Stream Name			OVERFIRE SYNGAS TO BOILER	BOILER REOX AIR	COMB PROD TO BOILER	ECON EXHAUST	FLY ASH	STACK EXHAUST	BOILER FW	BOILER BD	HIGH PRES STEAM	COND RETURN	GROSS ELECT OUTPUT	AUX LOAD	NET ELECT OUTPUT
Pressure, psig ("w.c.-g)			(-4.0)	(8.0)	(-5.0)	(-13.0)	----	----	645	600	600	(-366.4)			
Temperature, °F			2400	77	2489	340	250	331	250	489	750	115			
Molecular Weight (lb/lbmole)			26.02	28.68	28.76	28.76	60.08	28.75	18.02	18.02	18.02	18.02			
Component	Formula	mw	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	kW	kW	kW
Carbon	C	12.01													
Hydrogen	H	1.01													
Nitrogen	N	14.01													
Oxygen	O	16.00													
Sulfur	S	32.06													
Chlorine	Cl	35.45													
Fuel Gas	CH_4	16.04													
Carbon Monoxide	CO	28.01	3,061												
Carbon Dioxide	CO_2	44.01	11,984		16,793	16,793		20,601							
Hydrogen	H_2	2.02	454												
Water (v)	H_2O (v)	18.02	3,449	500	8,011	8,011		9,876			52,500				
Nitrogen	N_2	28.01	25,497	39,062	64,559	64,559		82,976							
Oxygen	O_2	32.00		11,825	6,470	6,470		9,080							
Sulfur Dioxide	SO_2	64.06	17		17	17		21							
Hydrogen Chloride	HCl	36.46													
Ash	SiO_2	60.08	1		1	1	1								
Lime	$CaCO_3$	100.09													
Water (l)	H_2O (l)	18.02							52,762	52,762		52,500			
TOTAL			44,463	51,387	95,850	95,850	1	122,555	52,762	52,762	52,500	52,500			
AVAILABLE ENERGY VALUE (LHV-Hv), Btu			832												
AVAILABLE ENERGY, MMBtu/hr			36.99												
SENSIBLE HEAT, MMBtu/hr			34.19		68.78	6.54		8.17							
FLOW RATE, scfm (gpm)			10,809	11,333	21,083	21,083		26,960	(105.5)	(105.5)	18,432	(105.0)			
FLOW RATE, acfm			59,448	11,703	119,577	32,435		41,025							
ELECTRICAL RATE, kilowatts													5,000	282	4,718

Appendix G: Rahr Plant Layout

The following page contains the Rahr plant layout.

RAHR PLANT LAYOUT



Appendix H: Biomass Photographs and Fuel Lab Analysis

The following pages contain biomass photographs and fuel lab analysis.

Biomass Photographs

The following illustrations show various biomasses.

Figure 9-1

Oat hulls for use as biomass.

Appendix H: Biomass Photographs and Fuel Lab Analysis

Figure 9-2

Rahr by-products for use as biomass.

Biomass Summary Analysis Data

The following tables contain data from the Hazen Research Laboratory obtained from biomass testing.

Table 9-1: Ground Oat Hull Summary Analysis

Hazen Research Report No. L74 / 01-1: Dated 11 December 2001

Reporting Basis	As Rec'd	Dry
PROXIMATE (%)		
Moisture	7.95%	0.00%
Ash	5.45%	5.92%
Volatile	71.53%	77.71%
Fixed C	15.07%	16.37%
Total	100.00%	100.00%
Sulfur	0.09%	0.10%
BTU/lb (HHV)	7193	7814
MMF BTU/lb	7642	8347
MAF BTU/lb		8306
ULTIMATE (%)		
Moisture	7.95%	0.00%
Carbon	42.77%	46.46%
Hydrogen	5.56%	6.04%
Nitrogen	0.54%	0.59%
Sulfur	0.09%	0.10%
Ash	5.45%	5.92%
Oxygen	37.64%	40.89%
Total	100.00%	100.00%
Chlorine**	0.13%	0.14%

Appendix H: Biomass Photographs and Fuel Lab Analysis

Reporting Basis	As Rec'd	Dry
ELEMENTAL ANALYSIS OF ASH (%)		
SiO_2	71.26%	
Al_2O_3	0.07%	
TiO_2	0.16%	
Fe_2O_3	0.22%	
CaO	2.15%	
MgO	2.55%	
Na_2O	1.14%	
K_2O	9.29%	
P_2O_5	5.21%	
SO_3	1.38%	
Cl	0.86%	
CO_2	0.15%	
Total	94.44%	
ASH FUSION TEMPERATURE (°F)		
	Oxidizing Atmosphere	**Reducing Atmosphere**
Initial	2700+	2676
Softening		2700+
Hemispherical		
Fluid		

** Chlorine not usually reported as part of the ultimate analysis

Table 9-2: Barley Dust and Chaff Summary Analysis

Hazen Research Report No. L74 / 01-2: Dated 11 December 2001

Reporting Basis	As Rec'd	Dry
PROXIMATE (%)		
Moisture	9.78%	0.00%
Ash	8.04%	8.91%
Volatile	68.41%	75.83%
Fixed C	13.77%	15.26%
Total	100.00%	100.00%
Sulfur	0.16%	0.18%
BTU/lb (HHV)	6910	7659
MMF BTU/lb	7566	8474
MAF BTU/lb		8409
ULTIMATE (%)		
Moisture	9.78%	0.00%
Carbon	40.47%	44.86%
Hydrogen	5.28%	5.85%
Nitrogen	1.58%	1.75%
Sulfur	0.16%	0.18%
Ash	8.04%	8.91%
Oxygen	34.69%	38.45%
Total	100.00%	100.00%
Chlorine**	0.17%	0.19%

Appendix H: Biomass Photographs and Fuel Lab Analysis

Reporting Basis	As Rec'd	Dry
ELEMENTAL ANALYSIS OF ASH (%)		
SiO2	60.09%	
Al2O3	1.70%	
TiO2	0.11%	
Fe2O3	1.10%	
CaO	3.90%	
MgO	3.20%	
Na2O	1.16%	
K2O	12.50%	
P2O5	9.78%	
SO3	1.51%	
Cl	1.64%	
CO2	0.50%	
Total	97.19%	
ASH FUSION TEMPERATURE (°F)		
	Oxidizing Atmosphere	**Reducing Atmosphere**
Initial	2362	2286
Softening	2528	2522
Hemispherical	2576	2560
Fluid	2581	2590

** Chlorine not usually reported as part of the ultimate analysis

Table 9-3: Wheaty Barley Summary Analysis

Hazen Research Report No. L74 / 01-3: Dated 11 December 2001

Reporting Basis	As Rec'd	Dry
PROXIMATE (%)		
Moisture	11.05%	0.00%
Ash	2.25%	2.53%
Volatile	70.56%	79.33%
Fixed C	16.14%	18.14%
Total	100.00%	100.00%
Sulfur	0.20%	0.22%
BTU/lb (HHV)	7108	7991
MMF BTU/lb	7283	8215
MAF BTU/lb		8199
ULTIMATE (%)		
Moisture	11.05%	0.00%
Carbon	41.39%	46.53%
Hydrogen	5.58%	6.28%
Nitrogen	1.93%	2.17%
Sulfur	0.20%	0.22%
Ash	2.25%	2.53%
Oxygen	37.60%	42.27%
Total	100.00%	100.00%
Chlorine**	0.08%	0.09%

Appendix H: Biomass Photographs and Fuel Lab Analysis

Reporting Basis	As Rec'd	Dry
ELEMENTAL ANALYSIS OF ASH (%)		
SiO2	23.84%	
Al2O3	0.94%	
TiO2	0.13%	
Fe2O3	0.96%	
CaO	3.51%	
MgO	9.33%	
Na2O	0.69%	
K2O	22.20%	
P2O5	38.55%	
SO3	0.71%	
Cl	<0.01%	
CO2	0.19%	
Total	101.05%	
ASH FUSION TEMPERATURE (°F)		
	Oxidizing Atmosphere	**Reducing Atmosphere**
Initial	2341	2270
Softening	2368	2400
Hemispherical	2383	2422
Fluid	2390	2442

** Chlorine not usually reported as part of the ultimate analysis

Table 9-4: Barley Needles Summary Analysis

Hazen Research Report No. L74 / 01-4: Dated 11 December 2001

Reporting Basis	As Rec'd	Dry
PROXIMATE (%)		
Moisture	11.25%	0.00%
Ash	2.46%	2.77%
Volatile	71.18%	80.20%
Fixed C	15.11%	17.03%
Total	100.00%	100.00%
Sulfur	0.18%	0.20%
BTU/lb (HHV)	7755	8738
MMF BTU/lb	7965	9007
MAF BTU/lb		8987
ULTIMATE (%)		
Moisture	11.25%	0.00%
Carbon	41.52%	46.78%
Hydrogen	5.56%	6.27%
Nitrogen	4.11%	4.63%
Sulfur	0.18%	0.20%
Ash	2.46%	2.77%
Oxygen	34.92%	39.35%
Total	100.00%	100.00%
Chlorine**	0.11%	0.12%

Appendix H: Biomass Photographs and Fuel Lab Analysis

Reporting Basis	As Rec'd	Dry
ELEMENTAL ANALYSIS OF ASH (%)		
SiO_2	32.38%	
Al_2O_3	<0.01	
TiO_2	0.93%	
Fe_2O_3	0.74%	
CaO	2.86%	
MgO	7.45%	
Na_2O	0.78%	
K_2O	22.20%	
P_2O_5	32.55%	
SO_3	1.31%	
Cl	0.21%	
CO_2	0.08%	
Total	101.49%	
ASH FUSION TEMPERATURE (°F)		
	Oxidizing Atmosphere	**Reducing Atmosphere**
Initial	2435	2408
Softening	2438	2453
Hemispherical	2439	2455
Fluid	2455	2472

** Chlorine not usually reported as part of the ultimate analysis

Table 9-5: Malt Sprouts Summary Analysis

Hazen Research Report No. L74 / 01-5: Dated 11 December 2001

Reporting Basis	As Rec'd	Dry
PROXIMATE (%)		
Moisture	4.95%	0.00%
Ash	5.45%	5.73%
Volatile	74.65%	78.54%
Fixed C	14.95%	15.73%
Total	100.00%	100.00%
Sulfur	0.36%	0.38%
BTU/lb (HHV)	7760	8165
MMF BTU/lb	8244	8703
MAF BTU/lb		8661
ULTIMATE (%)		
Moisture	4.95%	0.00%
Carbon	44.21%	46.51%
Hydrogen	5.86%	6.16%
Nitrogen	0.69%	0.73%
Sulfur	0.36%	0.38%
Ash	5.45%	5.73%
Oxygen	38.48%	40.49%
Total	100.00%	100.00%
Chlorine**	0.26%	0.27%

Appendix H: Biomass Photographs and Fuel Lab Analysis

Reporting Basis	As Rec'd	Dry
Elemental ANALYSIS OF ASH (%)		
SiO_2	29.76%	
Al_2O_3	<0.01	
TiO_2	0.86%	
Fe_2O_3	0.23%	
CaO	3.70%	
MgO	4.43%	
Na_2O	0.60%	
K_2O	23.90%	
P_2O_5	24.57%	
SO_3	2.47%	
Cl	3.15%	
CO_2	0.07%	
Total	93.74%	
ASH FUSION TEMPERATURE (°F)		
	Oxidizing Atmosphere	**Reducing Atmosphere**
Initial	2432	2301
Softening	2528	2460
Hemispherical	2630	2490
Fluid	2537	2550

** Chlorine not usually reported as part of the ultimate analysis

Table 9-6: Corn Stover Summary Analysis

Hazen Research Report No. L74 / 01-6: Dated 11 December 2001

Reporting Basis	As Rec'd	Dry
PROXIMATE (%)		
Moisture	11.75%	0.00%
Ash	4.63%	5.25%
Volatile	69.72%	79.00%
Fixed C	13.90%	15.75%
Total	100.00%	100.00%
Sulfur	0.09%	0.10%
BTU/lb (HHV)	7069	8010
MMF BTU/lb	7440	8491
MAF BTU/lb		8454
ULTIMATE (%)		
Moisture	11.75%	0.00%
Carbon	42.37%	48.01%
Hydrogen	4.83%	5.47%
Nitrogen	1.93%	2.19%
Sulfur	0.09%	0.10%
Ash	4.63%	5.25%
Oxygen	34.40%	38.98%
Total	100.00%	100.00%
Chlorine**	0.03%	0.03%

Appendix H: Biomass Photographs and Fuel Lab Analysis

Reporting Basis	As Rec'd	Dry
ELEMENTAL ANALYSIS OF ASH (%)		
SiO2	53.71%	
Al2O3	4.15%	
TiO2	0.27%	
Fe2O3	1.27%	
CaO	6.28%	
MgO	3.84%	
Na2O	0.87%	
K2O	17.10%	
P2O5	3.79%	
SO3	2.08%	
Cl	0.27%	
CO2	2.13%	
Total	95.76%	
ASH FUSION TEMPERATURE (°F)		
	Oxidizing Atmosphere	**Reducing Atmosphere**
Initial	1920	1850
Softening	2058	2030
Hemispherical	2226	2150
Fluid	2383	2312

** Chlorine not usually reported as part of the ultimate analysis

Appendix I: Detailed Economics Analysis of Various Scenarios at Rahr

The following pages contain detailed economic analysis of various scenarios at Rahr.

Detailed Economics for Scenario 1.2

Non-salary Inflation		2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas		13.3%	6.4%	2.6%	0.6%	0.4%	1.5%	0.5%	0.8%	1.5%	1.5%	1.1%	0.7%	1.0%	0.8%	0.9%
Electricity		-1.3%	-1.1%	-0.6%	-1.3%	-0.2%	1.0%	1.0%	0.9%	-1.1%	-0.3%	0.4%	0.1%	-0.9%	0.2%	0.3%
Biomass																

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Unit Expenses																
Residual Retail Electric Service																
Demand	$ 5.78 /kW	$ 5.82	$ 5.87	$ 5.95	$ 6.00	$ 6.10	$ 6.29	$ 6.48	$ 6.66	$ 6.72	$ 6.84	$ 7.00	$ 7.14	$ 7.22	$ 7.38	$ 7.55
Energy	$ 0.0322 /kWh	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04
Blended Retail	$ 0.0450 /kWh	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.06	$ 0.06	$ 0.06	$ 0.06
Natural Gas	$ 4.00 /MMBTU	$ 4.61	$ 5.00	$ 5.23	$ 5.37	$ 5.50	$ 5.69	$ 5.83	$ 5.99	$ 6.20	$ 6.42	$ 6.62	$ 6.79	$ 7.00	$ 7.19	$ 7.40
Biomass	$ 1.89 /MMBTU	$ 1.93	$ 1.97	$ 2.01	$ 2.05	$ 2.09	$ 2.13	$ 2.17	$ 2.22	$ 2.26	$ 2.31	$ 2.35	$ 2.40	$ 2.45	$ 2.50	$ 2.55
Water	$ 1.50 /kgal	$ 1.53	$ 1.56	$ 1.59	$ 1.62	$ 1.66	$ 1.69	$ 1.72	$ 1.76	$ 1.79	$ 1.83	$ 1.87	$ 1.90	$ 1.94	$ 1.98	$ 2.02
Conventional Operation																
Electricity	62,926,168 kWh	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921 MMBTU	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 2,831,678	$ 2,851,327	$ 2,877,847	$ 2,917,038	$ 2,937,917	$ 2,989,414	$ 3,079,426	$ 3,172,386	$ 3,263,479	$ 3,293,647	$ 3,350,137	$ 3,429,775	$ 3,500,315	$ 3,537,441	$ 3,614,463	$ 3,698,799
Natural Gas Expense	$ 2,259,686	$ 2,606,051	$ 2,825,169	$ 2,955,064	$ 3,031,380	$ 3,105,071	$ 3,212,719	$ 3,292,815	$ 3,386,486	$ 3,504,066	$ 3,626,277	$ 3,737,039	$ 3,837,911	$ 3,952,574	$ 4,062,969	$ 4,179,205
Subtotal, Electricity & Natural Gas	$ 5,091,364	$ 5,457,378	$ 5,703,016	$ 5,872,102	$ 5,969,297	$ 6,094,485	$ 6,292,145	$ 6,465,201	$ 6,649,965	$ 6,797,713	$ 6,976,414	$ 7,166,814	$ 7,338,226	$ 7,490,015	$ 7,677,432	$ 7,878,004
Annual Cogeneration Production																
Electricity	43,348,780 kWh	43,348,780	43,348,780	43,348,780	43,348,780	43,348,780	43,348,780	43,348,780	43,348,780	43,348,780	43,348,780	43,348,780	43,348,780	43,348,780	43,348,780	43,348,780
Thermal Cogen, Heat Recovered	573,183 MMBTU	573,183	573,183	573,183	573,183	573,183	573,183	573,183	573,183	573,183	573,183	573,183	573,183	573,183	573,183	573,183
Thermal Supplemental, Fuel	146 MMBTU	146	146	146	146	146	146	146	146	146	146	146	146	146	146	146
Residual Electric Load																
Electricity																
Demand, monthly average	5,083 kW	5,083	5,083	5,083	5,083	5,083	5,083	5,083	5,083	5,083	5,083	5,083	5,083	5,083	5,083	5,083
Energy	19,577,388 kWh	19,577,388	19,577,388	19,577,388	19,577,388	19,577,388	19,577,388	19,577,388	19,577,388	19,577,388	19,577,388	19,577,388	19,577,388	19,577,388	19,577,388	19,577,388
Water	10,049 kgal	10,049	10,049	10,049	10,049	10,049	10,049	10,049	10,049	10,049	10,049	10,049	10,049	10,049	10,049	10,049
Cogeneration Fuel	1,046,743 MMBTU	1,046,743	1,046,743	1,046,743	1,046,743	1,046,743	1,046,743	1,046,743	1,046,743	1,046,743	1,046,743	1,046,743	1,046,743	1,046,743	1,046,743	1,046,743
Fuel Mix																
Natural Gas	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%
Biomass	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%
Supplemental Fuel	146 MMBTU	146	146	146	146	146	146	146	146	146	146	146	146	146	146	146
Fuel Mix																
Natural Gas	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Expenses																
Fuel, Cogeneration System	$ 2,325,357	$ 2,458,918	$ 2,556,368	$ 2,628,709	$ 2,686,259	$ 2,743,760	$ 2,811,801	$ 2,872,616	$ 2,938,108	$ 3,011,280	$ 3,086,574	$ 3,159,358	$ 3,230,098	$ 3,305,656	$ 3,380,829	$ 3,458,556
Supplemental Fuel																
Biomass	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 584	$ 674	$ 730	$ 764	$ 783	$ 802	$ 830	$ 851	$ 875	$ 906	$ 937	$ 966	$ 992	$ 1,022	$ 1,050	$ 1,080
Water	$ 15,073	$ 15,375	$ 15,682	$ 15,996	$ 16,316	$ 16,642	$ 16,975	$ 17,314	$ 17,661	$ 18,014	$ 18,374	$ 18,742	$ 19,116	$ 19,499	$ 19,889	$ 20,286
Maintenance-Cogen	$ 195,070	$ 198,971	$ 202,951	$ 207,010	$ 211,150	$ 215,373	$ 219,681	$ 224,074	$ 228,556	$ 233,127	$ 237,789	$ 242,545	$ 247,396	$ 252,344	$ 257,391	$ 262,539
Residual Electric Service	$ 982,926	$ 989,746	$ 998,952	$ 1,012,556	$ 1,019,803	$ 1,037,679	$ 1,068,924	$ 1,101,192	$ 1,132,812	$ 1,143,284	$ 1,162,892	$ 1,190,536	$ 1,215,021	$ 1,227,909	$ 1,254,645	$ 1,283,919
Stand-by Service Charges	$ 131,789	$ 132,703	$ 133,938	$ 135,762	$ 136,733	$ 139,130	$ 143,319	$ 147,646	$ 151,885	$ 153,289	$ 155,918	$ 159,625	$ 162,908	$ 164,636	$ 168,220	$ 172,145
Sub-total Expenses with Cogeneration	$ 3,650,799	$ 3,796,387	$ 3,908,620	$ 4,000,796	$ 4,071,044	$ 4,153,386	$ 4,261,529	$ 4,363,693	$ 4,469,896	$ 4,559,900	$ 4,662,485	$ 4,771,771	$ 4,875,531	$ 4,971,065	$ 5,082,024	$ 5,198,525
Avoided Expense, Cogeneration	$ 1,440,565	$ 1,660,991	$ 1,794,396	$ 1,871,306	$ 1,898,253	$ 1,941,099	$ 2,030,616	$ 2,101,508	$ 2,180,069	$ 2,237,813	$ 2,313,929	$ 2,395,043	$ 2,462,695	$ 2,518,950	$ 2,595,408	$ 2,679,479
NPV, Avoided Expesne	$ 24,609,121															

Detailed Economics for Scenario 1.2

Non-salary Inflation	2.00%	2.00%	2.00%	2.00%
Natural Gas	1.0%	1.2%	1.4%	1.0%
Electricity	0.4%	0.0%	0.4%	0.1%
Biomass				

Year	17	18	19	20
Unit Expenses				
Residual Retail Electric Service				
Demand	$ 7.73	$ 7.89	$ 8.08	$ 8.24
Energy	$ 0.04	$ 0.04	$ 0.04	$ 0.05
Blended Retail	$ 0.06	$ 0.06	$ 0.06	$ 0.06
Natural Gas	$ 7.62	$ 7.86	$ 8.13	$ 8.37
Biomass	$ 2.60	$ 2.65	$ 2.70	$ 2.76
Water	$ 2.06	$ 2.10	$ 2.14	$ 2.19
Conventional Operation				
Electricity	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921	564,921	564,921	564,921
Electric Charges	$ 3,788,055	$ 3,865,029	$ 3,956,687	$ 4,038,378
Natural Gas Expense	$ 4,303,630	$ 4,439,696	$ 4,590,573	$ 4,729,657
Subtotal, Electricity & Natural Gas	$ 8,091,685	$ 8,304,725	$ 8,547,260	$ 8,768,035
Annual Cogeneration Production				
Electricity	43,348,780	43,348,780	43,348,780	43,348,780
Thermal Cogen, Heat Recovered	573,183	573,183	573,183	573,183
Thermal Supplemental, Fuel	146	146	146	146
Residual Electric Load				
Electricity				
Demand, monthly average	5,083	5,083	5,083	5,083
Energy	19,577,388	19,577,388	19,577,388	19,577,388
Water	10,049	10,049	10,049	10,049
Cogeneration Fuel	1,046,743	1,046,743	1,046,743	1,046,743
Fuel Mix				
Natural Gas	16%	16%	16%	16%
Biomass	84%	84%	84%	84%
Supplemental Fuel	146	146	146	146
Fuel Mix				
Natural Gas	100%	100%	100%	100%
Biomass	0%	0%	0%	0%
Expenses				
Fuel, Cogeneration System	$ 3,539,532	$ 3,624,774	$ 3,715,214	$ 3,803,183
Supplemental Fuel				
Biomass	$ -	$ -	$ -	$ -
Natural Gas	$ 1,112	$ 1,147	$ 1,186	$ 1,222
Water	$ 20,692	$ 21,106	$ 21,528	$ 21,959
Maintenance-Cogen	$ 267,789	$ 273,145	$ 278,608	$ 284,180
Residual Electric Service	$ 1,314,901	$ 1,341,620	$ 1,373,436	$ 1,401,793
Stand-by Service Charges	$ 176,299	$ 179,882	$ 184,148	$ 187,950
Sub-total Expenses with Cogeneration	$ 5,320,326	$ 5,441,674	$ 5,574,120	$ 5,700,287
Avoided Expense, Cogeneration	$ 2,771,359	$ 2,863,051	$ 2,973,140	$ 3,067,748

NPV, Avoided Expesne

Detailed Economics for Scenario 2.1

Salary Inflation		3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation		2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas		13.3%	6.4%	2.6%	0.6%	0.4%	1.5%	0.5%	0.8%	1.5%	1.5%	1.1%	0.7%	1.0%
Electricity		-1.3%	-1.1%	-0.6%	-1.3%	-0.2%	1.0%	1.0%	0.9%	-1.1%	-0.3%	0.4%	0.1%	-0.9%
Biomass														

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Unit Expenses														
Residual Retail Electric Service														
Demand	$ 5.78 /kW	$ 5.82	$ 5.87	$ 5.95	$ 6.00	$ 6.10	$ 6.29	$ 6.48	$ 6.66	$ 6.72	$ 6.84	$ 7.00	$ 7.14	$ 7.22
Energy	$ 0.0322 /kWh	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04
Blended Retail	$ 0.0450 /kWh	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.06	$ 0.06
Natural Gas	$ 4.00 /MMBTU	$ 4.61	$ 5.00	$ 5.23	$ 5.37	$ 5.50	$ 5.69	$ 5.83	$ 5.99	$ 6.20	$ 6.42	$ 6.62	$ 6.79	$ 7.00
Biomass	$ 1.89 /MMBTU	$ 1.93	$ 1.97	$ 2.01	$ 2.05	$ 2.09	$ 2.13	$ 2.17	$ 2.22	$ 2.26	$ 2.31	$ 2.35	$ 2.40	$ 2.45
Water	$ 1.50 /kgal	$ 1.53	$ 1.56	$ 1.59	$ 1.62	$ 1.66	$ 1.69	$ 1.72	$ 1.76	$ 1.79	$ 1.83	$ 1.87	$ 1.90	$ 1.94
Conventional Operation														
Electricity	62,926,168 kWh	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921 MMBTU	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 2,831,678	$ 2,851,327	$ 2,877,847	$ 2,917,038	$ 2,937,917	$ 2,989,414	$ 3,079,426	$ 3,172,386	$ 3,263,479	$ 3,293,647	$ 3,350,137	$ 3,429,775	$ 3,500,315	$ 3,537,441
Natural Gas Expense	$ 2,259,686	$ 2,606,051	$ 2,825,169	$ 2,955,064	$ 3,031,380	$ 3,105,071	$ 3,212,719	$ 3,292,815	$ 3,386,486	$ 3,504,066	$ 3,626,277	$ 3,737,039	$ 3,837,911	$ 3,952,574
Subtotal, Electricity & Natural Gas	$ 5,091,364	$ 5,457,378	$ 5,703,016	$ 5,872,102	$ 5,969,297	$ 6,094,485	$ 6,292,145	$ 6,465,201	$ 6,649,965	$ 6,797,713	$ 6,976,414	$ 7,166,814	$ 7,338,226	$ 7,490,015
Annual Cogeneration Production														
Electricity	62,560,849 kWh	62,560,849	62,560,849	62,560,849	62,560,849	62,560,849	62,560,849	62,560,849	62,560,849	62,560,849	62,560,849	62,560,849	62,560,849	62,560,849
Thermal Cogen, Heat Recovered	512,605 MMBTU	512,605	512,605	512,605	512,605	512,605	512,605	512,605	512,605	512,605	512,605	512,605	512,605	512,605
Thermal Supplemental, Fuel	33,227 MMBTU	33,227	33,227	33,227	33,227	33,227	33,227	33,227	33,227	33,227	33,227	33,227	33,227	33,227
Residual Electric Load														
Electricity														
Demand, monthly average	660 kW	660	660	660	660	660	660	660	660	660	660	660	660	660
Energy	365,319 kWh	365,319	365,319	365,319	365,319	365,319	365,319	365,319	365,319	365,319	365,319	365,319	365,319	365,319
Water	13,944 kgal	13,944	13,944	13,944	13,944	13,944	13,944	13,944	13,944	13,944	13,944	13,944	13,944	13,944
Cogeneration Fuel	1,452,475 MMBTU	1,452,475	1,452,475	1,452,475	1,452,475	1,452,475	1,452,475	1,452,475	1,452,475	1,452,475	1,452,475	1,452,475	1,452,475	1,452,475
Fuel Mix														
Natural Gas	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Supplemental Fuel	33,227 MMBTU	33,227	33,227	33,227	33,227	33,227	33,227	33,227	33,227	33,227	33,227	33,227	33,227	33,227
Fuel Mix														
Natural Gas	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Expenses														
Fuel, Cogeneration System	$ 2,749,234	$ 2,804,219	$ 2,860,303	$ 2,917,509	$ 2,975,859	$ 3,035,376	$ 3,096,084	$ 3,158,006	$ 3,221,166	$ 3,285,589	$ 3,351,301	$ 3,418,327	$ 3,486,693	$ 3,556,427
Supplemental Fuel														
Biomass	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 132,908	$ 153,280	$ 166,168	$ 173,808	$ 178,297	$ 182,631	$ 188,963	$ 193,674	$ 199,183	$ 206,099	$ 213,287	$ 219,802	$ 225,735	$ 232,479
Water	$ 20,916	$ 21,334	$ 21,761	$ 22,196	$ 22,640	$ 23,093	$ 23,554	$ 24,025	$ 24,506	$ 24,996	$ 25,496	$ 26,006	$ 26,526	$ 27,057
Maintenance-Cogen	$ 281,524	$ 287,154	$ 292,898	$ 298,756	$ 304,731	$ 310,825	$ 317,042	$ 323,383	$ 329,850	$ 336,447	$ 343,176	$ 350,040	$ 357,041	$ 364,181
Residual Electric Service	$ 57,564	$ 57,963	$ 58,503	$ 59,299	$ 59,724	$ 60,771	$ 62,600	$ 64,490	$ 66,342	$ 66,955	$ 68,104	$ 69,722	$ 71,156	$ 71,911
Stand-by Service Charges	$ 261,360	$ 263,174	$ 265,621	$ 269,239	$ 271,166	$ 275,919	$ 284,227	$ 292,807	$ 301,215	$ 303,999	$ 309,213	$ 316,564	$ 323,074	$ 326,501
Sub-total Expenses with Cogeneration	$ 3,503,506	$ 3,587,124	$ 3,665,254	$ 3,740,806	$ 3,812,416	$ 3,888,615	$ 3,972,470	$ 4,056,385	$ 4,142,262	$ 4,224,086	$ 4,310,577	$ 4,400,460	$ 4,490,225	$ 4,578,556
Avoided Expense, Cogeneration	$ 1,587,858	$ 1,870,254	$ 2,037,762	$ 2,131,296	$ 2,156,881	$ 2,205,870	$ 2,319,675	$ 2,408,816	$ 2,507,703	$ 2,573,627	$ 2,665,837	$ 2,766,354	$ 2,848,001	$ 2,911,459
NPV, Avoided Expesne	$ 28,215,702													

Detailed Economics for Scenario 2.1

Salary Inflation	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas	0.8%	0.9%	1.0%	1.2%	1.4%	1.0%
Electricity	0.2%	0.3%	0.4%	0.0%	0.4%	0.1%
Biomass						

Year	15	16	17	18	19	20
Unit Expenses						
Residual Retail Electric Service						
Demand	$ 7.38	$ 7.55	$ 7.73	$ 7.89	$ 8.08	$ 8.24
Energy	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.05
Blended Retail	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06
Natural Gas	$ 7.19	$ 7.40	$ 7.62	$ 7.86	$ 8.13	$ 8.37
Biomass	$ 2.50	$ 2.55	$ 2.60	$ 2.65	$ 2.70	$ 2.76
Water	$ 1.98	$ 2.02	$ 2.06	$ 2.10	$ 2.14	$ 2.19
Conventional Operation						
Electricity	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 3,614,463	$ 3,698,799	$ 3,788,055	$ 3,865,029	$ 3,956,687	$ 4,038,378
Natural Gas Expense	$ 4,062,969	$ 4,179,205	$ 4,303,630	$ 4,439,696	$ 4,590,573	$ 4,729,657
Subtotal, Electricity & Natural Gas	$ 7,677,432	$ 7,878,004	$ 8,091,685	$ 8,304,725	$ 8,547,260	$ 8,768,035
Annual Cogeneration Production						
Electricity	62,560,849	62,560,849	62,560,849	62,560,849	62,560,849	62,560,849
Thermal Cogen, Heat Recovered	512,605	512,605	512,605	512,605	512,605	512,605
Thermal Supplemental, Fuel	33,227	33,227	33,227	33,227	33,227	33,227
Residual Electric Load						
Electricity						
Demand, monthly average	660	660	660	660	660	660
Energy	365,319	365,319	365,319	365,319	365,319	365,319
Water	13,944	13,944	13,944	13,944	13,944	13,944
Cogeneration Fuel	1,452,475	1,452,475	1,452,475	1,452,475	1,452,475	1,452,475
Fuel Mix						
Natural Gas	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%
Supplemental Fuel	33,227	33,227	33,227	33,227	33,227	33,227
Fuel Mix						
Natural Gas	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%
Expenses						
Fuel, Cogeneration System	$ 3,627,556	$ 3,700,107	$ 3,774,109	$ 3,849,591	$ 3,926,583	$ 4,005,115
Supplemental Fuel						
Biomass	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 238,972	$ 245,808	$ 253,127	$ 261,130	$ 270,004	$ 278,184
Water	$ 27,598	$ 28,150	$ 28,713	$ 29,287	$ 29,873	$ 30,470
Maintenance-Cogen	$ 371,465	$ 378,894	$ 386,472	$ 394,202	$ 402,086	$ 410,127
Residual Electric Service	$ 73,477	$ 75,191	$ 77,006	$ 78,571	$ 80,434	$ 82,095
Stand-by Service Charges	$ 333,610	$ 341,394	$ 349,632	$ 356,737	$ 365,197	$ 372,737
Sub-total Expenses with Cogeneration	$ 4,672,678	$ 4,769,544	$ 4,869,059	$ 4,969,517	$ 5,074,176	$ 5,178,728
Avoided Expense, Cogeneration	$ 3,004,754	$ 3,108,460	$ 3,222,626	$ 3,335,208	$ 3,473,084	$ 3,589,307

NPV, Avoided Expesne

Detailed Economics for Scenario 2.2

Salary Inflation	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas	13.3%	6.4%	2.6%	0.6%	0.4%	1.5%	0.5%	0.8%	1.5%	1.5%	1.1%	0.7%	1.0%
Electricity	-1.3%	-1.1%	-0.6%	-1.3%	-0.2%	1.0%	1.0%	0.9%	-1.1%	-0.3%	0.4%	0.1%	-0.9%
Biomass													

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Unit Expenses														
Residual Retail Electric Service														
Demand	$ 5.78 /kW	$ 5.82	$ 5.87	$ 5.95	$ 6.00	$ 6.10	$ 6.29	$ 6.48	$ 6.66	$ 6.72	$ 6.84	$ 7.00	$ 7.14	$ 7.22
Energy	$ 0.0322 /kWh	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04
Blended Retail	$ 0.0450 /kWh	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.06	$ 0.06
Natural Gas	$ 4.00 /MMBTU	$ 4.61	$ 5.00	$ 5.23	$ 5.37	$ 5.50	$ 5.69	$ 5.83	$ 5.99	$ 6.20	$ 6.42	$ 6.62	$ 6.79	$ 7.00
Biomass	$ 1.89 /MMBTU	$ 1.93	$ 1.97	$ 2.01	$ 2.05	$ 2.09	$ 2.13	$ 2.17	$ 2.22	$ 2.26	$ 2.31	$ 2.35	$ 2.40	$ 2.45
Water	$ 1.50 /kgal	$ 1.53	$ 1.56	$ 1.59	$ 1.62	$ 1.66	$ 1.69	$ 1.72	$ 1.76	$ 1.79	$ 1.83	$ 1.87	$ 1.90	$ 1.94
Conventional Operation														
Electricity	62,926,168 kWh	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921 MMBTU	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 2,831,678	$ 2,851,327	$ 2,877,847	$ 2,917,038	$ 2,937,917	$ 2,989,414	$ 3,079,426	$ 3,172,386	$ 3,263,479	$ 3,293,647	$ 3,350,137	$ 3,429,775	$ 3,500,315	$ 3,537,441
Natural Gas Expense	$ 2,259,686	$ 2,606,051	$ 2,825,169	$ 2,955,064	$ 3,031,380	$ 3,105,071	$ 3,212,719	$ 3,292,815	$ 3,386,486	$ 3,504,066	$ 3,626,277	$ 3,737,039	$ 3,837,911	$ 3,952,574
Subtotal, Electricity & Natural Gas	$ 5,091,364	$ 5,457,378	$ 5,703,016	$ 5,872,102	$ 5,969,297	$ 6,094,485	$ 6,292,145	$ 6,465,201	$ 6,649,965	$ 6,797,713	$ 6,976,414	$ 7,166,814	$ 7,338,226	$ 7,490,015
Annual Cogeneration Production														
Electricity	62,112,612 kWh	62,112,612	62,112,612	62,112,612	62,112,612	62,112,612	62,112,612	62,112,612	62,112,612	62,112,612	62,112,612	62,112,612	62,112,612	62,112,612
Thermal Cogen, Heat Recovered	541,184 MMBTU	541,184	541,184	541,184	541,184	541,184	541,184	541,184	541,184	541,184	541,184	541,184	541,184	541,184
Thermal Supplemental, Fuel	14,354 MMBTU	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354
Residual Electric Load														
Electricity														
Demand, monthly average	944 kW	944	944	944	944	944	944	944	944	944	944	944	944	944
Energy	813,556 kWh	813,556	813,556	813,556	813,556	813,556	813,556	813,556	813,556	813,556	813,556	813,556	813,556	813,556
Water	13,184 kgal	13,184	13,184	13,184	13,184	13,184	13,184	13,184	13,184	13,184	13,184	13,184	13,184	13,184
Cogeneration Fuel	1,373,297 MMBTU	1,373,297	1,373,297	1,373,297	1,373,297	1,373,297	1,373,297	1,373,297	1,373,297	1,373,297	1,373,297	1,373,297	1,373,297	1,373,297
Fuel Mix														
Natural Gas	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Supplemental Fuel	14,354 MMBTU	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354	14,354
Fuel Mix														
Natural Gas	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Expenses														
Fuel, Cogeneration System	$ 2,656,781	$ 2,717,570	$ 2,776,164	$ 2,833,552	$ 2,890,661	$ 2,948,806	$ 3,008,939	$ 3,069,520	$ 3,131,618	$ 3,195,517	$ 3,260,752	$ 3,326,938	$ 3,394,141	$ 3,462,987
Supplemental Fuel														
Biomass	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 57,416	$ 66,217	$ 71,784	$ 75,085	$ 77,024	$ 78,896	$ 81,631	$ 83,667	$ 86,047	$ 89,034	$ 92,140	$ 94,954	$ 97,517	$ 100,430
Water	$ 19,775	$ 20,171	$ 20,574	$ 20,986	$ 21,406	$ 21,834	$ 22,270	$ 22,716	$ 23,170	$ 23,634	$ 24,106	$ 24,588	$ 25,080	$ 25,582
Maintenance-Cogen	$ 279,507	$ 285,097	$ 290,799	$ 296,615	$ 302,547	$ 308,598	$ 314,770	$ 321,066	$ 327,487	$ 334,037	$ 340,717	$ 347,532	$ 354,482	$ 361,572
Residual Electric Service	$ 91,672	$ 92,308	$ 93,167	$ 94,436	$ 95,112	$ 96,779	$ 99,693	$ 102,702	$ 105,651	$ 106,628	$ 108,457	$ 111,035	$ 113,319	$ 114,521
Stand-by Service Charges	$ 245,414	$ 247,117	$ 249,416	$ 252,812	$ 254,622	$ 259,085	$ 266,886	$ 274,943	$ 282,838	$ 285,452	$ 290,348	$ 297,250	$ 303,363	$ 306,581
Sub-total Expenses with Cogeneration	$ 3,350,566	$ 3,428,480	$ 3,501,904	$ 3,573,486	$ 3,641,372	$ 3,713,998	$ 3,794,190	$ 3,874,613	$ 3,956,811	$ 4,034,301	$ 4,116,521	$ 4,202,297	$ 4,287,903	$ 4,371,673
Avoided Expense, Cogeneration	$ 1,740,798	$ 2,028,898	$ 2,201,112	$ 2,298,616	$ 2,327,925	$ 2,380,487	$ 2,497,955	$ 2,590,588	$ 2,693,154	$ 2,763,412	$ 2,859,893	$ 2,964,517	$ 3,050,323	$ 3,118,342
NPV, Avoided Expense	$ 30,340,047													

Detailed Economics for Scenario 2.2

Salary Inflation	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas	0.8%	0.9%	1.0%	1.2%	1.4%	1.0%
Electricity	0.2%	0.3%	0.4%	0.0%	0.4%	0.1%
Biomass						

Year	15	16	17	18	19	20
Unit Expenses						
Residual Retail Electric Service						
Demand	$ 7.38	$ 7.55	$ 7.73	$ 7.89	$ 8.08	$ 8.24
Energy	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.05
Blended Retail	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06
Natural Gas	$ 7.19	$ 7.40	$ 7.62	$ 7.86	$ 8.13	$ 8.37
Biomass	$ 2.50	$ 2.55	$ 2.60	$ 2.65	$ 2.70	$ 2.76
Water	$ 1.98	$ 2.02	$ 2.06	$ 2.10	$ 2.14	$ 2.19
Conventional Operation						
Electricity	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 3,614,463	$ 3,698,799	$ 3,788,055	$ 3,865,029	$ 3,956,687	$ 4,038,378
Natural Gas Expense	$ 4,062,969	$ 4,179,205	$ 4,303,630	$ 4,439,696	$ 4,590,573	$ 4,729,657
Subtotal, Electricity & Natural Gas	$ 7,677,432	$ 7,878,004	$ 8,091,685	$ 8,304,725	$ 8,547,260	$ 8,768,035
Annual Cogeneration Production						
Electricity	62,112,612	62,112,612	62,112,612	62,112,612	62,112,612	62,112,612
Thermal Cogen, Heat Recovered	541,184	541,184	541,184	541,184	541,184	541,184
Thermal Supplemental, Fuel	14,354	14,354	14,354	14,354	14,354	14,354
Residual Electric Load						
Electricity						
Demand, monthly average	944	944	944	944	944	944
Energy	813,556	813,556	813,556	813,556	813,556	813,556
Water	13,184	13,184	13,184	13,184	13,184	13,184
Cogeneration Fuel	1,373,297	1,373,297	1,373,297	1,373,297	1,373,297	1,373,297
Fuel Mix						
Natural Gas	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%
Supplemental Fuel	14,354	14,354	14,354	14,354	14,354	14,354
Fuel Mix						
Natural Gas	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%
Expenses						
Fuel, Cogeneration System	$ 3,533,043	$ 3,604,592	$ 3,677,722	$ 3,752,547	$ 3,829,175	$ 3,906,960
Supplemental Fuel						
Biomass	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 103,235	$ 106,189	$ 109,350	$ 112,808	$ 116,641	$ 120,175
Water	$ 26,093	$ 26,615	$ 27,147	$ 27,690	$ 28,244	$ 28,809
Maintenance-Cogen	$ 368,804	$ 376,180	$ 383,703	$ 391,377	$ 399,205	$ 407,189
Residual Electric Service	$ 117,014	$ 119,744	$ 122,634	$ 125,126	$ 128,093	$ 130,738
Stand-by Service Charges	$ 313,256	$ 320,566	$ 328,301	$ 334,972	$ 342,916	$ 349,996
Sub-total Expenses with Cogeneration	$ 4,461,445	$ 4,553,885	$ 4,648,858	$ 4,744,521	$ 4,844,274	$ 4,943,867
Avoided Expense, Cogeneration	$ 3,215,987	$ 3,324,119	$ 3,442,827	$ 3,560,204	$ 3,702,986	$ 3,824,168

NPV, Avoided Expense

Detailed Economics for Scenario 2.3

Salary Inflation		3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation		2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas		13.3%	6.4%	2.6%	0.6%	0.4%	1.5%	0.5%	0.8%	1.5%	1.5%	1.1%	0.7%	1.0%
Electricity		-1.3%	-1.1%	-0.6%	-1.3%	-0.2%	1.0%	1.0%	0.9%	-1.1%	-0.3%	0.4%	0.1%	-0.9%
Biomass														

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Unit Expenses														
Residual Retail Electric Service														
Demand	$ 5.78 /kW	$ 5.82	$ 5.87	$ 5.95	$ 6.00	$ 6.10	$ 6.29	$ 6.48	$ 6.66	$ 6.72	$ 6.84	$ 7.00	$ 7.14	$ 7.22
Energy	$ 0.0322 /kWh	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04
Blended Retail	$ 0.0450 /kWh	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.06	$ 0.06
Natural Gas	$ 4.00 /MMBTU	$ 4.61	$ 5.00	$ 5.23	$ 5.37	$ 5.50	$ 5.69	$ 5.83	$ 5.99	$ 6.20	$ 6.42	$ 6.62	$ 6.79	$ 7.00
Biomass	$ 1.89 /MMBTU	$ 1.93	$ 1.97	$ 2.01	$ 2.05	$ 2.09	$ 2.13	$ 2.17	$ 2.22	$ 2.26	$ 2.31	$ 2.35	$ 2.40	$ 2.45
Water	$ 1.50 /kgal	$ 1.53	$ 1.56	$ 1.59	$ 1.62	$ 1.66	$ 1.69	$ 1.72	$ 1.76	$ 1.79	$ 1.83	$ 1.87	$ 1.90	$ 1.94
Conventional Operation														
Electricity	62,926,168 kWh	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921 MMBTU	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 2,831,678	$ 2,851,327	$ 2,877,847	$ 2,917,038	$ 2,937,917	$ 2,989,414	$ 3,079,426	$ 3,172,386	$ 3,263,479	$ 3,293,647	$ 3,350,137	$ 3,429,775	$ 3,500,315	$ 3,537,441
Natural Gas Expense	$ 2,259,686	$ 2,606,051	$ 2,825,169	$ 2,955,064	$ 3,031,380	$ 3,105,071	$ 3,212,719	$ 3,292,815	$ 3,386,486	$ 3,504,066	$ 3,626,277	$ 3,737,039	$ 3,837,911	$ 3,952,574
Subtotal, Electricity & Natural Gas	$ 5,091,364	$ 5,457,378	$ 5,703,016	$ 5,872,102	$ 5,969,297	$ 6,094,485	$ 6,292,145	$ 6,465,201	$ 6,649,965	$ 6,797,713	$ 6,976,414	$ 7,166,814	$ 7,338,226	$ 7,490,015
Annual Cogeneration Production														
Electricity	62,606,612 kWh	62,606,612	62,606,612	62,606,612	62,606,612	62,606,612	62,606,612	62,606,612	62,606,612	62,606,612	62,606,612	62,606,612	62,606,612	62,606,612
Thermal Cogen, Heat Recovered	584,593 MMBTU	584,593	584,593	584,593	584,593	584,593	584,593	584,593	584,593	584,593	584,593	584,593	584,593	584,593
Thermal Supplemental, Fuel	146 MMBTU	146	146	146	146	146	146	146	146	146	146	146	146	146
Residual Electric Load														
Electricity														
Demand, monthly average	625 kW	625	625	625	625	625	625	625	625	625	625	625	625	625
Energy	319,556 kWh	319,556	319,556	319,556	319,556	319,556	319,556	319,556	319,556	319,556	319,556	319,556	319,556	319,556
Water	14,513 kgal	14,513	14,513	14,513	14,513	14,513	14,513	14,513	14,513	14,513	14,513	14,513	14,513	14,513
Cogeneration Fuel	1,511,762 MMBTU	1,511,762	1,511,762	1,511,762	1,511,762	1,511,762	1,511,762	1,511,762	1,511,762	1,511,762	1,511,762	1,511,762	1,511,762	1,511,762
Fuel Mix														
Natural Gas	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Biomass	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Supplemental Fuel	146 MMBTU	146	146	146	146	146	146	146	146	146	146	146	146	146
Fuel Mix														
Natural Gas	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Expenses														
Fuel, Cogeneration System	$ 3,352,033	$ 3,543,190	$ 3,682,876	$ 3,786,779	$ 3,869,609	$ 3,952,384	$ 4,050,202	$ 4,137,735	$ 4,231,953	$ 4,337,135	$ 4,445,362	$ 4,550,027	$ 4,651,796	$ 4,760,453
Supplemental Fuel														
Biomass	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 584	$ 674	$ 730	$ 764	$ 783	$ 802	$ 830	$ 851	$ 875	$ 906	$ 937	$ 966	$ 992	$ 1,022
Water	$ 21,769	$ 22,205	$ 22,649	$ 23,102	$ 23,564	$ 24,035	$ 24,516	$ 25,006	$ 25,506	$ 26,016	$ 26,537	$ 27,067	$ 27,609	$ 28,161
Maintenance-Cogen	$ 281,730	$ 287,365	$ 293,112	$ 298,974	$ 304,954	$ 311,053	$ 317,274	$ 323,619	$ 330,092	$ 336,693	$ 343,427	$ 350,296	$ 357,302	$ 364,448
Residual Electric Service	$ 53,663	$ 54,035	$ 54,538	$ 55,280	$ 55,676	$ 56,652	$ 58,358	$ 60,120	$ 61,846	$ 62,418	$ 63,488	$ 64,997	$ 66,334	$ 67,038
Stand-by Service Charges	$ 263,578	$ 265,407	$ 267,875	$ 271,523	$ 273,467	$ 278,260	$ 286,638	$ 295,291	$ 303,770	$ 306,579	$ 311,837	$ 319,250	$ 325,816	$ 329,271
Sub-total Expenses with Cogeneration	$ 3,973,357	$ 4,172,875	$ 4,321,780	$ 4,436,422	$ 4,528,052	$ 4,623,186	$ 4,737,818	$ 4,842,623	$ 4,954,042	$ 5,069,747	$ 5,191,588	$ 5,312,603	$ 5,429,848	$ 5,550,393
Avoided Expense, Cogeneration	$ 1,118,007	$ 1,284,503	$ 1,381,236	$ 1,435,680	$ 1,441,245	$ 1,471,299	$ 1,554,327	$ 1,622,578	$ 1,695,923	$ 1,727,966	$ 1,784,826	$ 1,854,211	$ 1,908,378	$ 1,939,622
NPV, Avoided Expesne	$ 18,989,059													

Detailed Economics for Scenario 2.3

Salary Inflation	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas	0.8%	0.9%	1.0%	1.2%	1.4%	1.0%
Electricity	0.2%	0.3%	0.4%	0.0%	0.4%	0.1%
Biomass						

Year	15	16	17	18	19	20
Unit Expenses						
Residual Retail Electric Service						
Demand	$ 7.38	$ 7.55	$ 7.73	$ 7.89	$ 8.08	$ 8.24
Energy	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.05
Blended Retail	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06
Natural Gas	$ 7.19	$ 7.40	$ 7.62	$ 7.86	$ 8.13	$ 8.37
Biomass	$ 2.50	$ 2.55	$ 2.60	$ 2.65	$ 2.70	$ 2.76
Water	$ 1.98	$ 2.02	$ 2.06	$ 2.10	$ 2.14	$ 2.19
Conventional Operation						
Electricity	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 3,614,463	$ 3,698,799	$ 3,788,055	$ 3,865,029	$ 3,956,687	$ 4,038,378
Natural Gas Expense	$ 4,062,969	$ 4,179,205	$ 4,303,630	$ 4,439,696	$ 4,590,573	$ 4,729,657
Subtotal, Electricity & Natural Gas	$ 7,677,432	$ 7,878,004	$ 8,091,685	$ 8,304,725	$ 8,547,260	$ 8,768,035
Annual Cogeneration Production						
Electricity	62,606,612	62,606,612	62,606,612	62,606,612	62,606,612	62,606,612
Thermal Cogen, Heat Recovered	584,593	584,593	584,593	584,593	584,593	584,593
Thermal Supplemental, Fuel	146	146	146	146	146	146
Residual Electric Load						
Electricity						
Demand, monthly average	625	625	625	625	625	625
Energy	319,556	319,556	319,556	319,556	319,556	319,556
Water	14,513	14,513	14,513	14,513	14,513	14,513
Cogeneration Fuel	1,511,762	1,511,762	1,511,762	1,511,762	1,511,762	1,511,762
Fuel Mix						
Natural Gas	15%	15%	15%	15%	15%	15%
Biomass	85%	85%	85%	85%	85%	85%
Supplemental Fuel	146	146	146	146	146	146
Fuel Mix						
Natural Gas	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%
Expenses						
Fuel, Cogeneration System	$ 4,868,579	$ 4,980,365	$ 5,096,803	$ 5,219,343	$ 5,349,314	$ 5,475,783
Supplemental Fuel						
Biomass	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 1,050	$ 1,080	$ 1,112	$ 1,147	$ 1,186	$ 1,222
Water	$ 28,724	$ 29,299	$ 29,885	$ 30,482	$ 31,092	$ 31,714
Maintenance-Cogen	$ 371,737	$ 379,171	$ 386,755	$ 394,490	$ 402,380	$ 410,427
Residual Electric Service	$ 68,497	$ 70,096	$ 71,787	$ 73,246	$ 74,983	$ 76,531
Stand-by Service Charges	$ 336,441	$ 344,291	$ 352,599	$ 359,764	$ 368,295	$ 375,899
Sub-total Expenses with Cogeneration	$ 5,675,028	$ 5,804,302	$ 5,938,940	$ 6,078,472	$ 6,227,250	$ 6,371,577
Avoided Expense, Cogeneration	$ 2,002,404	$ 2,073,702	$ 2,152,745	$ 2,226,253	$ 2,320,010	$ 2,396,458
NPV, Avoided Expesne						

Detailed Economics for Scenario 2.4

Salary Inflation		3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation		2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas		13.3%	6.4%	2.6%	0.6%	0.4%	1.5%	0.5%	0.8%	1.5%	1.5%	1.1%	0.7%	1.0%
Electricity		-1.3%	-1.1%	-0.6%	-1.3%	-0.2%	1.0%	1.0%	0.9%	-1.1%	-0.3%	0.4%	0.1%	-0.9%
Biomass														

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Unit Expenses														
Residual Retail Electric Service														
Demand	$ 5.78 /kW	$ 5.82	$ 5.87	$ 5.95	$ 6.00	$ 6.10	$ 6.29	$ 6.48	$ 6.66	$ 6.72	$ 6.84	$ 7.00	$ 7.14	$ 7.22
Energy	$ 0.0322 /kWh	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04
Blended Retail	$ 0.0450 /kWh	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.06	$ 0.06
Natural Gas	$ 4.00 /MMBTU	$ 4.61	$ 5.00	$ 5.23	$ 5.37	$ 5.50	$ 5.69	$ 5.83	$ 5.99	$ 6.20	$ 6.42	$ 6.62	$ 6.79	$ 7.00
Biomass	$ 1.89 /MMBTU	$ 1.93	$ 1.97	$ 2.01	$ 2.05	$ 2.09	$ 2.13	$ 2.17	$ 2.22	$ 2.26	$ 2.31	$ 2.35	$ 2.40	$ 2.45
Water	$ 1.50 /kgal	$ 1.53	$ 1.56	$ 1.59	$ 1.62	$ 1.66	$ 1.69	$ 1.72	$ 1.76	$ 1.79	$ 1.83	$ 1.87	$ 1.90	$ 1.94
Conventional Operation														
Electricity	62,926,168 kWh	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921 MMBTU	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 2,831,678	$ 2,851,327	$ 2,877,847	$ 2,917,038	$ 2,937,917	$ 2,989,414	$ 3,079,426	$ 3,172,386	$ 3,263,479	$ 3,293,647	$ 3,350,137	$ 3,429,775	$ 3,500,315	$ 3,537,441
Natural Gas Expense	$ 2,259,686	$ 2,606,051	$ 2,825,169	$ 2,955,064	$ 3,031,380	$ 3,105,071	$ 3,212,719	$ 3,292,815	$ 3,386,486	$ 3,504,066	$ 3,626,277	$ 3,737,039	$ 3,837,911	$ 3,952,574
Subtotal, Electricity & Natural Gas	$ 5,091,364	$ 5,457,378	$ 5,703,016	$ 5,872,102	$ 5,969,297	$ 6,094,485	$ 6,292,145	$ 6,465,201	$ 6,649,965	$ 6,797,713	$ 6,976,414	$ 7,166,814	$ 7,338,226	$ 7,490,015
Annual Cogeneration Production														
Electricity	62,452,911 kWh	62,452,911	62,452,911	62,452,911	62,452,911	62,452,911	62,452,911	62,452,911	62,452,911	62,452,911	62,452,911	62,452,911	62,452,911	62,452,911
Thermal Cogen, Heat Recovered	532,600 MMBTU	532,600	532,600	532,600	532,600	532,600	532,600	532,600	532,600	532,600	532,600	532,600	532,600	532,600
Thermal Supplemental, Fuel	21,178 MMBTU	21,178	21,178	21,178	21,178	21,178	21,178	21,178	21,178	21,178	21,178	21,178	21,178	21,178
Residual Electric Load														
Electricity														
Demand, monthly average	733 kW	733	733	733	733	733	733	733	733	733	733	733	733	733
Energy	473,257 kWh	473,257	473,257	473,257	473,257	473,257	473,257	473,257	473,257	473,257	473,257	473,257	473,257	473,257
Water	8,869 kgal	8,869	8,869	8,869	8,869	8,869	8,869	8,869	8,869	8,869	8,869	8,869	8,869	8,869
Cogeneration Fuel	974,640 MMBTU	974,640	974,640	974,640	974,640	974,640	974,640	974,640	974,640	974,640	974,640	974,640	974,640	974,640
Fuel Mix														
Natural Gas	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%
Biomass	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%	84%
Supplemental Fuel	21,178 MMBTU	21,178	21,178	21,178	21,178	21,178	21,178	21,178	21,178	21,178	21,178	21,178	21,178	21,178
Fuel Mix														
Natural Gas	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Expenses														
Fuel, Cogeneration System	$ 2,165,179	$ 2,289,541	$ 2,380,277	$ 2,447,636	$ 2,501,221	$ 2,554,762	$ 2,618,115	$ 2,674,741	$ 2,735,722	$ 2,803,854	$ 2,873,961	$ 2,941,731	$ 3,007,599	$ 3,077,953
Supplemental Fuel														
Biomass	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 84,712	$ 97,697	$ 105,911	$ 110,781	$ 113,642	$ 116,404	$ 120,440	$ 123,442	$ 126,954	$ 131,362	$ 135,943	$ 140,096	$ 143,877	$ 148,176
Water	$ 13,304	$ 13,570	$ 13,841	$ 14,118	$ 14,401	$ 14,689	$ 14,982	$ 15,282	$ 15,588	$ 15,899	$ 16,217	$ 16,542	$ 16,872	$ 17,210
Maintenance-Cogen	$ 281,038	$ 286,659	$ 292,392	$ 298,240	$ 304,205	$ 310,289	$ 316,494	$ 322,824	$ 329,281	$ 335,866	$ 342,584	$ 349,435	$ 356,424	$ 363,553
Residual Electric Service	$ 66,097	$ 66,556	$ 67,175	$ 68,090	$ 68,577	$ 69,779	$ 71,880	$ 74,050	$ 76,176	$ 76,880	$ 78,199	$ 80,058	$ 81,704	$ 82,571
Stand-by Service Charges	$ 256,740	$ 258,522	$ 260,926	$ 264,479	$ 266,372	$ 271,041	$ 279,203	$ 287,631	$ 295,890	$ 298,625	$ 303,747	$ 310,968	$ 317,363	$ 320,730
Sub-total Expenses with Cogeneration	$ 2,867,070	$ 3,012,544	$ 3,120,522	$ 3,203,344	$ 3,268,417	$ 3,336,964	$ 3,421,114	$ 3,497,970	$ 3,579,611	$ 3,662,487	$ 3,750,651	$ 3,838,830	$ 3,923,840	$ 4,010,192
Avoided Expense, Cogeneration	$ 2,224,294	$ 2,444,834	$ 2,582,494	$ 2,668,758	$ 2,700,880	$ 2,757,521	$ 2,871,031	$ 2,967,231	$ 3,070,354	$ 3,135,226	$ 3,225,763	$ 3,327,984	$ 3,414,386	$ 3,479,823
NPV, Avoided Expesne	$ 34,707,841													

Detailed Economics for Scenario 2.4

Salary Inflation	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas	0.8%	0.9%	1.0%	1.2%	1.4%	1.0%
Electricity	0.2%	0.3%	0.4%	0.0%	0.4%	0.1%
Biomass						

Year	15	16	17	18	19	20
Unit Expenses						
Residual Retail Electric Service						
Demand	$ 7.38	$ 7.55	$ 7.73	$ 7.89	$ 8.08	$ 8.24
Energy	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.05
Blended Retail	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06
Natural Gas	$ 7.19	$ 7.40	$ 7.62	$ 7.86	$ 8.13	$ 8.37
Biomass	$ 2.50	$ 2.55	$ 2.60	$ 2.65	$ 2.70	$ 2.76
Water	$ 1.98	$ 2.02	$ 2.06	$ 2.10	$ 2.14	$ 2.19
Conventional Operation						
Electricity	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 3,614,463	$ 3,698,799	$ 3,788,055	$ 3,865,029	$ 3,956,687	$ 4,038,378
Natural Gas Expense	$ 4,062,969	$ 4,179,205	$ 4,303,630	$ 4,439,696	$ 4,590,573	$ 4,729,657
Subtotal, Electricity & Natural Gas	$ 7,677,432	$ 7,878,004	$ 8,091,685	$ 8,304,725	$ 8,547,260	$ 8,768,035
Annual Cogeneration Production						
Electricity	62,452,911	62,452,911	62,452,911	62,452,911	62,452,911	62,452,911
Thermal Cogen, Heat Recovered	532,600	532,600	532,600	532,600	532,600	532,600
Thermal Supplemental, Fuel	21,178	21,178	21,178	21,178	21,178	21,178
Residual Electric Load						
Electricity						
Demand, monthly average	733	733	733	733	733	733
Energy	473,257	473,257	473,257	473,257	473,257	473,257
Water	8,869	8,869	8,869	8,869	8,869	8,869
Cogeneration Fuel	974,640	974,640	974,640	974,640	974,640	974,640
Fuel Mix						
Natural Gas	16%	16%	16%	16%	16%	16%
Biomass	84%	84%	84%	84%	84%	84%
Supplemental Fuel	21,178	21,178	21,178	21,178	21,178	21,178
Fuel Mix						
Natural Gas	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%
Expenses						
Fuel, Cogeneration System	$ 3,147,947	$ 3,220,320	$ 3,295,718	$ 3,375,088	$ 3,459,299	$ 3,541,208
Supplemental Fuel						
Biomass	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 152,314	$ 156,672	$ 161,336	$ 166,437	$ 172,093	$ 177,307
Water	$ 17,554	$ 17,905	$ 18,263	$ 18,629	$ 19,001	$ 19,381
Maintenance-Cogen	$ 370,824	$ 378,240	$ 385,805	$ 393,521	$ 401,391	$ 409,419
Residual Electric Service	$ 84,369	$ 86,337	$ 88,421	$ 90,218	$ 92,357	$ 94,264
Stand-by Service Charges	$ 327,713	$ 335,359	$ 343,452	$ 350,431	$ 358,741	$ 366,148
Sub-total Expenses with Cogeneration	$ 4,100,721	$ 4,194,834	$ 4,292,995	$ 4,394,324	$ 4,502,883	$ 4,607,728
Avoided Expense, Cogeneration	$ 3,576,711	$ 3,683,170	$ 3,798,690	$ 3,910,401	$ 4,044,377	$ 4,160,307

NPV, Avoided Expesne

Detailed Economics for Scenario 2.5

Salary Inflation	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas	13.3%	6.4%	2.6%	0.6%	0.4%	1.5%	0.5%	0.8%	1.5%	1.5%	1.1%
Electricity	-1.3%	-1.1%	-0.6%	-1.3%	-0.2%	1.0%	1.0%	0.9%	-1.1%	-0.3%	0.4%
Biomass											

Year	1	2	3	4	5	6	7	8	9	10	11	12
Unit Expenses												
Residual Retail Electric Service												
Demand	$ 5.78 /kW	$ 5.82	$ 5.87	$ 5.95	$ 6.00	$ 6.10	$ 6.29	$ 6.48	$ 6.66	$ 6.72	$ 6.84	$ 7.00
Energy	$ 0.0322 /kWh	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04
Blended Retail	$ 0.0450 /kWh	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05
Natural Gas	$ 4.00 /MMBTU	$ 4.61	$ 5.00	$ 5.23	$ 5.37	$ 5.50	$ 5.69	$ 5.83	$ 5.99	$ 6.20	$ 6.42	$ 6.62
Biomass	$ 1.89 /MMBTU	$ 1.93	$ 1.97	$ 2.01	$ 2.05	$ 2.09	$ 2.13	$ 2.17	$ 2.22	$ 2.26	$ 2.31	$ 2.35
Water	$ 1.50 /kgal	$ 1.53	$ 1.56	$ 1.59	$ 1.62	$ 1.66	$ 1.69	$ 1.72	$ 1.76	$ 1.79	$ 1.83	$ 1.87
Conventional Operation												
Electricity	62,926,168 kWh	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921 MMBTU	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 2,831,678	$ 2,851,327	$ 2,877,847	$ 2,917,038	$ 2,937,917	$ 2,989,414	$ 3,079,426	$ 3,172,386	$ 3,263,479	$ 3,293,647	$ 3,350,137	$ 3,429,775
Natural Gas Expense	$ 2,259,686	$ 2,606,051	$ 2,825,169	$ 2,955,064	$ 3,031,380	$ 3,105,071	$ 3,212,719	$ 3,292,815	$ 3,386,486	$ 3,504,066	$ 3,626,277	$ 3,737,039
Subtotal, Electricity & Natural Gas	$ 5,091,364	$ 5,457,378	$ 5,703,016	$ 5,872,102	$ 5,969,297	$ 6,094,485	$ 6,292,145	$ 6,465,201	$ 6,649,965	$ 6,797,713	$ 6,976,414	$ 7,166,814
Annual Cogeneration Production												
Electricity	62,147,183 kWh	62,147,183	62,147,183	62,147,183	62,147,183	62,147,183	62,147,183	62,147,183	62,147,183	62,147,183	62,147,183	62,147,183
Thermal Cogen, Heat Recovered	585,399 MMBTU	585,399	585,399	585,399	585,399	585,399	585,399	585,399	585,399	585,399	585,399	585,399
Thermal Supplemental, Fuel	95 MMBTU	95	95	95	95	95	95	95	95	95	95	95
Residual Electric Load												
Electricity												
Demand, monthly average	922 kW	922	922	922	922	922	922	922	922	922	922	922
Energy	778,985 kWh	778,985	778,985	778,985	778,985	778,985	778,985	778,985	778,985	778,985	778,985	778,985
Water	2,321 kgal	2,321	2,321	2,321	2,321	2,321	2,321	2,321	2,321	2,321	2,321	2,321
Cogeneration Fuel	1,311,057 MMBTU	1,311,057	1,311,057	1,311,057	1,311,057	1,311,057	1,311,057	1,311,057	1,311,057	1,311,057	1,311,057	1,311,057
Fuel Mix												
Natural Gas	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%
Biomass	88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	88%
Supplemental Fuel	95 MMBTU	95	95	95	95	95	95	95	95	95	95	95
Fuel Mix												
Natural Gas	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Expenses												
Fuel, Cogeneration System	$ 2,813,079	$ 2,953,215	$ 3,058,787	$ 3,140,401	$ 3,208,003	$ 3,275,802	$ 3,354,002	$ 3,425,494	$ 3,501,750	$ 3,585,668	$ 3,671,899	$ 3,755,986
Supplemental Fuel												
Biomass	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 380	$ 438	$ 475	$ 497	$ 510	$ 522	$ 540	$ 554	$ 569	$ 589	$ 610	$ 628
Water	$ 3,481	$ 3,550	$ 3,621	$ 3,694	$ 3,768	$ 3,843	$ 3,920	$ 3,998	$ 4,078	$ 4,160	$ 4,243	$ 4,328
Maintenance-Cogen	$ 279,662	$ 285,255	$ 290,960	$ 296,780	$ 302,715	$ 308,769	$ 314,945	$ 321,244	$ 327,669	$ 334,222	$ 340,906	$ 347,725
Residual Electric Service	$ 89,022	$ 89,639	$ 90,473	$ 91,705	$ 92,362	$ 93,981	$ 96,810	$ 99,733	$ 102,597	$ 103,545	$ 105,321	$ 107,825
Stand-by Service Charges	$ 246,418	$ 248,128	$ 250,435	$ 253,846	$ 255,663	$ 260,144	$ 267,977	$ 276,067	$ 283,994	$ 286,619	$ 291,535	$ 298,465
Sub-total Expenses with Cogeneration	$ 3,432,041	$ 3,580,225	$ 3,694,752	$ 3,786,922	$ 3,863,021	$ 3,943,062	$ 4,038,194	$ 4,127,090	$ 4,220,657	$ 4,314,803	$ 4,414,514	$ 4,514,957
Avoided Expense, Cogeneration	$ 1,659,323	$ 1,877,153	$ 2,008,264	$ 2,085,180	$ 2,106,276	$ 2,151,423	$ 2,253,951	$ 2,338,111	$ 2,429,308	$ 2,482,910	$ 2,561,900	$ 2,651,857
NPV, Avoided Expesne	$ 27,363,214											

Detailed Economics for Scenario 2.5

Salary Inflation	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas	0.7%	1.0%	0.8%	0.9%	1.0%	1.2%	1.4%	1.0%
Electricity	0.1%	-0.9%	0.2%	0.3%	0.4%	0.0%	0.4%	0.1%
Biomass								

Year	13	14	15	16	17	18	19	20
Unit Expenses								
Residual Retail Electric Service								
Demand	$ 7.14	$ 7.22	$ 7.38	$ 7.55	$ 7.73	$ 7.89	$ 8.08	$ 8.24
Energy	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.05
Blended Retail	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06
Natural Gas	$ 6.79	$ 7.00	$ 7.19	$ 7.40	$ 7.62	$ 7.86	$ 8.13	$ 8.37
Biomass	$ 2.40	$ 2.45	$ 2.50	$ 2.55	$ 2.60	$ 2.65	$ 2.70	$ 2.76
Water	$ 1.90	$ 1.94	$ 1.98	$ 2.02	$ 2.06	$ 2.10	$ 2.14	$ 2.19
Conventional Operation								
Electricity	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 3,500,315	$ 3,537,441	$ 3,614,463	$ 3,698,799	$ 3,788,055	$ 3,865,029	$ 3,956,687	$ 4,038,378
Natural Gas Expense	$ 3,837,911	$ 3,952,574	$ 4,062,969	$ 4,179,205	$ 4,303,630	$ 4,439,696	$ 4,590,573	$ 4,729,657
Subtotal, Electricity & Natural Gas	$ 7,338,226	$ 7,490,015	$ 7,677,432	$ 7,878,004	$ 8,091,685	$ 8,304,725	$ 8,547,260	$ 8,768,035
Annual Cogeneration Production								
Electricity	62,147,183	62,147,183	62,147,183	62,147,183	62,147,183	62,147,183	62,147,183	62,147,183
Thermal Cogen, Heat Recovered	585,399	585,399	585,399	585,399	585,399	585,399	585,399	585,399
Thermal Supplemental, Fuel	95	95	95	95	95	95	95	95
Residual Electric Load								
Electricity								
Demand, monthly average	922	922	922	922	922	922	922	922
Energy	778,985	778,985	778,985	778,985	778,985	778,985	778,985	778,985
Water	2,321	2,321	2,321	2,321	2,321	2,321	2,321	2,321
Cogeneration Fuel	1,311,057	1,311,057	1,311,057	1,311,057	1,311,057	1,311,057	1,311,057	1,311,057
Fuel Mix								
Natural Gas	12%	12%	12%	12%	12%	12%	12%	12%
Biomass	88%	88%	88%	88%	88%	88%	88%	88%
Supplemental Fuel	95	95	95	95	95	95	95	95
Fuel Mix								
Natural Gas	100%	100%	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%	0%	0%
Expenses								
Fuel, Cogeneration System	$ 3,838,383	$ 3,925,707	$ 4,012,950	$ 4,102,950	$ 4,196,382	$ 4,294,233	$ 4,397,407	$ 4,498,521
Supplemental Fuel								
Biomass	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 645	$ 665	$ 683	$ 703	$ 724	$ 747	$ 772	$ 795
Water	$ 4,415	$ 4,503	$ 4,593	$ 4,685	$ 4,778	$ 4,874	$ 4,972	$ 5,071
Maintenance-Cogen	$ 354,679	$ 361,773	$ 369,008	$ 376,388	$ 383,916	$ 391,594	$ 399,426	$ 407,415
Residual Electric Service	$ 110,042	$ 111,209	$ 113,631	$ 116,282	$ 119,088	$ 121,508	$ 124,389	$ 126,958
Stand-by Service Charges	$ 304,604	$ 307,834	$ 314,537	$ 321,876	$ 329,643	$ 336,342	$ 344,318	$ 351,427
Sub-total Expenses with Cogeneration	$ 4,612,767	$ 4,711,691	$ 4,815,402	$ 4,922,884	$ 5,034,532	$ 5,149,298	$ 5,271,284	$ 5,390,187
Avoided Expense, Cogeneration	$ 2,725,459	$ 2,778,324	$ 2,862,030	$ 2,955,120	$ 3,057,153	$ 3,155,427	$ 3,275,976	$ 3,377,848

NPV, Avoided Expesne

Detailed Economics for Scenario 2.6

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Salary Inflation		3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation		2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas		13.3%	6.4%	2.6%	0.6%	0.4%	1.5%	0.5%	0.8%	1.5%	1.5%	1.1%	0.7%	1.0%
Electricity		-1.3%	-1.1%	-0.6%	-1.3%	-0.2%	1.0%	1.0%	0.9%	-1.1%	-0.3%	0.4%	0.1%	-0.9%
Biomass														

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Unit Expenses														
Residual Retail Electric Service														
Demand	$ 5.78 /kW	$ 5.82	$ 5.87	$ 5.95	$ 6.00	$ 6.10	$ 6.29	$ 6.48	$ 6.66	$ 6.72	$ 6.84	$ 7.00	$ 7.14	$ 7.22
Energy	$ 0.0322 /kWh	$ 0.0324	$ 0.0327	$ 0.0332	$ 0.0334	$ 0.0340	$ 0.0350	$ 0.0361	$ 0.0371	$ 0.0375	$ 0.0381	$ 0.0390	$ 0.0398	$ 0.0402
Blended Retail	$ 0.0450 /kWh	$ 0.0453	$ 0.0457	$ 0.0464	$ 0.0467	$ 0.0475	$ 0.0489	$ 0.0504	$ 0.0519	$ 0.0523	$ 0.0532	$ 0.0545	$ 0.0556	$ 0.0562
Natural Gas	$ 4.00 /MMBTU	$ 4.61	$ 5.00	$ 5.23	$ 5.37	$ 5.50	$ 5.69	$ 5.83	$ 5.99	$ 6.20	$ 6.42	$ 6.62	$ 6.79	$ 7.00
Biomass	$ 1.89 /MMBTU	$ 1.93	$ 1.97	$ 2.01	$ 2.05	$ 2.09	$ 2.13	$ 2.17	$ 2.22	$ 2.26	$ 2.31	$ 2.35	$ 2.40	$ 2.45
Water	$ 1.50 /kgal	$ 1.53	$ 1.56	$ 1.59	$ 1.62	$ 1.66	$ 1.69	$ 1.72	$ 1.76	$ 1.79	$ 1.83	$ 1.87	$ 1.90	$ 1.94
Conventional Operation														
Electricity	62,926,168 kWh	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921 MMBTU	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 2,831,678	$ 2,851,327	$ 2,877,847	$ 2,917,038	$ 2,937,917	$ 2,989,414	$ 3,079,426	$ 3,172,386	$ 3,263,479	$ 3,293,647	$ 3,350,137	$ 3,429,775	$ 3,500,315	$ 3,537,441
Natural Gas Expense	$ 2,259,686	$ 2,606,051	$ 2,825,169	$ 2,955,064	$ 3,031,380	$ 3,105,071	$ 3,212,719	$ 3,292,815	$ 3,386,486	$ 3,504,066	$ 3,626,277	$ 3,737,039	$ 3,837,911	$ 3,952,574
Subtotal, Electricity & Natural Gas	$ 5,091,364	$ 5,457,378	$ 5,703,016	$ 5,872,102	$ 5,969,297	$ 6,094,485	$ 6,292,145	$ 6,465,201	$ 6,649,965	$ 6,797,713	$ 6,976,414	$ 7,166,814	$ 7,338,226	$ 7,490,015
Annual Cogeneration Production														
Electricity	46,455,272 kWh	46,455,272	46,455,272	46,455,272	46,455,272	46,455,272	46,455,272	46,455,272	46,455,272	46,455,272	46,455,272	46,455,272	46,455,272	46,455,272
Thermal Cogen, Heat Recovered	403,147 MMBTU	403,147	403,147	403,147	403,147	403,147	403,147	403,147	403,147	403,147	403,147	403,147	403,147	403,147
Thermal Supplemental, Fuel	109,391 MMBTU	109,391	109,391	109,391	109,391	109,391	109,391	109,391	109,391	109,391	109,391	109,391	109,391	109,391
Residual Electric Load														
Electricity														
Demand, monthly average	4,683 kW	4,683	4,683	4,683	4,683	4,683	4,683	4,683	4,683	4,683	4,683	4,683	4,683	4,683
Energy	16,470,896 kWh	16,470,896	16,470,896	16,470,896	16,470,896	16,470,896	16,470,896	16,470,896	16,470,896	16,470,896	16,470,896	16,470,896	16,470,896	16,470,896
Water	2,193 kgal	2,193	2,193	2,193	2,193	2,193	2,193	2,193	2,193	2,193	2,193	2,193	2,193	2,193
Total Fuel	776,396 MMBTU	776,396	776,396	776,396	776,396	776,396	776,396	776,396	776,396	776,396	776,396	776,396	776,396	776,396
Fuel, Engine Generators	667,005 MMBTU	667,005	667,005	667,005	667,005	667,005	667,005	667,005	667,005	667,005	667,005	667,005	667,005	667,005
Fuel Mix														
Natural Gas	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Supplemental, Conventional Boilers	109,391 MMBTU	109,391	109,391	109,391	109,391	109,391	109,391	109,391	109,391	109,391	109,391	109,391	109,391	109,391
Fuel Mix														
Natural Gas	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Expenses														
Fuel, Cogeneration System	$ 1,262,502	$ 1,287,752	$ 1,313,507	$ 1,339,777	$ 1,366,572	$ 1,393,904	$ 1,421,782	$ 1,450,217	$ 1,479,222	$ 1,508,806	$ 1,538,982	$ 1,569,762	$ 1,601,157	$ 1,633,180
Supplemental Fuel														
Biomass	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 437,564	$ 504,634	$ 547,064	$ 572,217	$ 586,994	$ 601,264	$ 622,109	$ 637,618	$ 655,757	$ 678,525	$ 702,190	$ 723,638	$ 743,170	$ 765,374
Water	$ 3,290	$ 3,355	$ 3,422	$ 3,491	$ 3,561	$ 3,632	$ 3,705	$ 3,779	$ 3,854	$ 3,931	$ 4,010	$ 4,090	$ 4,172	$ 4,255
Maintenance-Cogen	$ 301,959	$ 307,998	$ 314,158	$ 320,441	$ 326,850	$ 333,387	$ 340,055	$ 346,856	$ 353,793	$ 360,869	$ 368,086	$ 375,448	$ 382,957	$ 390,616
Residual Electric Service	$ 855,153	$ 861,087	$ 869,095	$ 880,931	$ 887,236	$ 902,788	$ 929,971	$ 958,045	$ 985,555	$ 994,665	$ 1,011,725	$ 1,035,775	$ 1,057,078	$ 1,068,290
Stand-by Service Charges	$ 142,349	$ 143,337	$ 144,670	$ 146,640	$ 147,689	$ 150,278	$ 154,803	$ 159,476	$ 164,056	$ 165,572	$ 168,412	$ 172,415	$ 175,961	$ 177,828
Sub-total Expenses with Cogeneration	$ 3,002,816	$ 3,108,163	$ 3,191,916	$ 3,263,497	$ 3,318,902	$ 3,385,253	$ 3,472,425	$ 3,555,991	$ 3,642,237	$ 3,712,368	$ 3,793,405	$ 3,881,128	$ 3,964,495	$ 4,039,543
Avoided Expense, Cogeneration	$ 2,088,548	$ 2,349,215	$ 2,511,100	$ 2,608,605	$ 2,650,395	$ 2,709,232	$ 2,819,720	$ 2,909,210	$ 3,007,728	$ 3,085,345	$ 3,183,009	$ 3,285,686	$ 3,373,731	$ 3,450,472
Present Value, Avoided Expense	**$ 34,053,292**													

Detailed Economics for Scenario 2.6

Salary Inflation	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas	0.8%	0.9%	1.0%	1.2%	1.4%	1.0%
Electricity	0.2%	0.3%	0.4%	0.0%	0.4%	0.1%
Biomass						

Year	15	16	17	18	19	20
Unit Expenses						
Residual Retail Electric Service						
Demand	$ 7.38	$ 7.55	$ 7.73	$ 7.89	$ 8.08	$ 8.24
Energy	$ 0.0411	$ 0.0421	$ 0.0431	$ 0.0440	$ 0.0450	$ 0.0459
Blended Retail	$ 0.0574	$ 0.0588	$ 0.0602	$ 0.0614	$ 0.0629	$ 0.0642
Natural Gas	$ 7.19	$ 7.40	$ 7.62	$ 7.86	$ 8.13	$ 8.37
Biomass	$ 2.50	$ 2.55	$ 2.60	$ 2.65	$ 2.70	$ 2.76
Water	$ 1.98	$ 2.02	$ 2.06	$ 2.10	$ 2.14	$ 2.19
Conventional Operation						
Electricity	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 3,614,463	$ 3,698,799	$ 3,788,055	$ 3,865,029	$ 3,956,687	$ 4,038,378
Natural Gas Expense	$ 4,062,969	$ 4,179,205	$ 4,303,630	$ 4,439,696	$ 4,590,573	$ 4,729,657
Subtotal, Electricity & Natural Gas	$ 7,677,432	$ 7,878,004	$ 8,091,685	$ 8,304,725	$ 8,547,260	$ 8,768,035
Annual Cogeneration Production						
Electricity	46,455,272	46,455,272	46,455,272	46,455,272	46,455,272	46,455,272
Thermal Cogen, Heat Recovered	403,147	403,147	403,147	403,147	403,147	403,147
Thermal Supplemental, Fuel	109,391	109,391	109,391	109,391	109,391	109,391
Residual Electric Load						
Electricity						
Demand, monthly average	4,683	4,683	4,683	4,683	4,683	4,683
Energy	16,470,896	16,470,896	16,470,896	16,470,896	16,470,896	16,470,896
Water	2,193	2,193	2,193	2,193	2,193	2,193
Total Fuel	776,396	776,396	776,396	776,396	776,396	776,396
Fuel, Engine Generators	667,005	667,005	667,005	667,005	667,005	667,005
Fuel Mix						
Natural Gas	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%
Supplemental, Conventional Boilers	109,391	109,391	109,391	109,391	109,391	109,391
Fuel Mix						
Natural Gas	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%
Expenses						
Fuel, Cogeneration System	$ 1,665,844	$ 1,699,161	$ 1,733,144	$ 1,767,807	$ 1,803,163	$ 1,839,226
Supplemental Fuel						
Biomass	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ 786,751	$ 809,258	$ 833,352	$ 859,700	$ 888,915	$ 915,848
Water	$ 4,340	$ 4,427	$ 4,516	$ 4,606	$ 4,698	$ 4,792
Maintenance-Cogen	$ 398,428	$ 406,397	$ 414,525	$ 422,815	$ 431,272	$ 439,897
Residual Electric Service	$ 1,091,550	$ 1,117,019	$ 1,143,974	$ 1,167,220	$ 1,194,900	$ 1,219,570
Stand-by Service Charges	$ 181,700	$ 185,939	$ 190,426	$ 194,296	$ 198,903	$ 203,010
Sub-total Expenses with Cogeneration	$ 4,128,613	$ 4,222,201	$ 4,319,937	$ 4,416,444	$ 4,521,851	$ 4,622,343
Avoided Expense, Cogeneration	$ 3,548,819	$ 3,655,803	$ 3,771,748	$ 3,888,281	$ 4,025,409	$ 4,145,692
Present Value, Avoided Expense						

Detailed Economics for Scenario 2.7

Salary Inflation	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas	13.3%	6.4%	2.6%	0.6%	0.4%	1.5%	0.5%	0.8%	1.5%	1.5%	1.1%	0.7%
Electricity	-1.3%	-1.1%	-0.6%	-1.3%	-0.2%	1.0%	1.0%	0.9%	-1.1%	-0.3%	0.4%	0.1%
Biomass												

Year	1	2	3	4	5	6	7	8	9	10	11	12	13
Unit Expenses													
Residual Retail Electric Service													
Demand	$ 5.78 /kW	$ 5.82	$ 5.87	$ 5.95	$ 6.00	$ 6.10	$ 6.29	$ 6.48	$ 6.66	$ 6.72	$ 6.84	$ 7.00	$ 7.14
Energy	$ 0.0322 /kWh	$ 0.0324	$ 0.0327	$ 0.0332	$ 0.0334	$ 0.0340	$ 0.0350	$ 0.0361	$ 0.0371	$ 0.0375	$ 0.0381	$ 0.0390	$ 0.0398
Blended Retail	$ 0.0450 /kWh	$ 0.0453	$ 0.0457	$ 0.0464	$ 0.0467	$ 0.0475	$ 0.0489	$ 0.0504	$ 0.0519	$ 0.0523	$ 0.0532	$ 0.0545	$ 0.0556
Natural Gas	$ 4.00 /MMBTU	$ 4.61	$ 5.00	$ 5.23	$ 5.37	$ 5.50	$ 5.69	$ 5.83	$ 5.99	$ 6.20	$ 6.42	$ 6.62	$ 6.79
Biomass	$ 1.89 /MMBTU	$ 1.93	$ 1.97	$ 2.01	$ 2.05	$ 2.09	$ 2.13	$ 2.17	$ 2.22	$ 2.26	$ 2.31	$ 2.35	$ 2.40
Water	$ 1.50 /kgal	$ 1.53	$ 1.56	$ 1.59	$ 1.62	$ 1.66	$ 1.69	$ 1.72	$ 1.76	$ 1.79	$ 1.83	$ 1.87	$ 1.90
Conventional Operation													
Electricity	62,926,168 kWh	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921 MMBTU	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 2,831,678	$ 2,851,327	$ 2,877,847	$ 2,917,038	$ 2,937,917	$ 2,989,414	$ 3,079,426	$ 3,172,386	$ 3,263,479	$ 3,293,647	$ 3,350,137	$ 3,429,775	$ 3,500,315
Natural Gas Expense	$ 2,259,686	$ 2,606,051	$ 2,825,169	$ 2,955,064	$ 3,031,380	$ 3,105,071	$ 3,212,719	$ 3,292,815	$ 3,386,486	$ 3,504,066	$ 3,626,277	$ 3,737,039	$ 3,837,911
Subtotal, Electricity & Natural Gas	$ 5,091,364	$ 5,457,378	$ 5,703,016	$ 5,872,102	$ 5,969,297	$ 6,094,485	$ 6,292,145	$ 6,465,201	$ 6,649,965	$ 6,797,713	$ 6,976,414	$ 7,166,814	$ 7,338,226
Annual Cogeneration Production													
Electricity	23,616,960 kWh	23,616,960	23,616,960	23,616,960	23,616,960	23,616,960	23,616,960	23,616,960	23,616,960	23,616,960	23,616,960	23,616,960	23,616,960
Thermal Cogen, Heat Recovered	208,138 MMBTU	208,138	208,138	208,138	208,138	208,138	208,138	208,138	208,138	208,138	208,138	208,138	208,138
Thermal Supplemental, Fuel	327,260 MMBTU	327,260	327,260	327,260	327,260	327,260	327,260	327,260	327,260	327,260	327,260	327,260	327,260
Residual Electric Load													
Electricity													
Demand, monthly average	7,379 kW	7,379	7,379	7,379	7,379	7,379	7,379	7,379	7,379	7,379	7,379	7,379	7,379
Energy	39,309,208 kWh	39,309,208	39,309,208	39,309,208	39,309,208	39,309,208	39,309,208	39,309,208	39,309,208	39,309,208	39,309,208	39,309,208	39,309,208
Water	2,190 kgal	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190
Total Fuel	666,352 MMBTU	666,352	666,352	666,352	666,352	666,352	666,352	666,352	666,352	666,352	666,352	666,352	666,352
Fuel, Engine Generators	339,092 MMBTU	339,092	339,092	339,092	339,092	339,092	339,092	339,092	339,092	339,092	339,092	339,092	339,092
Fuel Mix													
Natural Gas	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Supplemental, Conventional Boilers	327,260 MMBTU	327,260	327,260	327,260	327,260	327,260	327,260	327,260	327,260	327,260	327,260	327,260	327,260
Fuel Mix													
Natural Gas	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Expenses													
Fuel, Cogeneration System	$ 641,831	$ 654,668	$ 667,761	$ 681,117	$ 694,739	$ 708,634	$ 722,806	$ 737,262	$ 752,008	$ 767,048	$ 782,389	$ 798,037	$ 813,997
Supplemental Fuel													
Biomass	$ 619,435	$ 631,824	$ 644,460	$ 657,350	$ 670,497	$ 683,907	$ 697,585	$ 711,536	$ 725,767	$ 740,282	$ 755,088	$ 770,190	$ 785,594
Natural Gas	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Water	$ 3,285	$ 3,351	$ 3,418	$ 3,486	$ 3,556	$ 3,627	$ 3,699	$ 3,773	$ 3,849	$ 3,926	$ 4,004	$ 4,084	$ 4,166
Maintenance-Cogen	$ 153,510	$ 156,580	$ 159,712	$ 162,906	$ 166,164	$ 169,487	$ 172,877	$ 176,335	$ 179,861	$ 183,459	$ 187,128	$ 190,870	$ 194,688
Residual Electric Service	$ 1,777,541	$ 1,789,875	$ 1,806,523	$ 1,831,124	$ 1,844,231	$ 1,876,557	$ 1,933,061	$ 1,991,415	$ 2,048,597	$ 2,067,535	$ 2,102,996	$ 2,152,987	$ 2,197,267
Stand-by Service Charges	$ 142,349	$ 143,337	$ 144,670	$ 146,640	$ 147,689	$ 150,278	$ 154,803	$ 159,476	$ 164,056	$ 165,572	$ 168,412	$ 172,415	$ 175,961
Sub-total Expenses with Cogeneration	$ 3,337,951	$ 3,379,634	$ 3,426,543	$ 3,482,623	$ 3,526,876	$ 3,592,491	$ 3,684,832	$ 3,779,797	$ 3,874,138	$ 3,927,822	$ 4,000,017	$ 4,088,584	$ 4,171,673
Avoided Expense, Cogeneration	$ 1,753,413	$ 2,077,744	$ 2,276,473	$ 2,389,479	$ 2,442,421	$ 2,501,994	$ 2,607,313	$ 2,685,404	$ 2,775,827	$ 2,869,891	$ 2,976,397	$ 3,078,230	$ 3,166,553
Present Value, Avoided Expense	**$ 31,475,617**												

Detailed Economics for Scenario 2.7

Salary Inflation	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas	1.0%	0.8%	0.9%	1.0%	1.2%	1.4%	1.0%
Electricity	-0.9%	0.2%	0.3%	0.4%	0.0%	0.4%	0.1%
Biomass							

Year	14	15	16	17	18	19	20
Unit Expenses							
Residual Retail Electric Service							
Demand	$ 7.22	$ 7.38	$ 7.55	$ 7.73	$ 7.89	$ 8.08	$ 8.24
Energy	$ 0.0402	$ 0.0411	$ 0.0421	$ 0.0431	$ 0.0440	$ 0.0450	$ 0.0459
Blended Retail	$ 0.0562	$ 0.0574	$ 0.0588	$ 0.0602	$ 0.0614	$ 0.0629	$ 0.0642
Natural Gas	$ 7.00	$ 7.19	$ 7.40	$ 7.62	$ 7.86	$ 8.13	$ 8.37
Biomass	$ 2.45	$ 2.50	$ 2.55	$ 2.60	$ 2.65	$ 2.70	$ 2.76
Water	$ 1.94	$ 1.98	$ 2.02	$ 2.06	$ 2.10	$ 2.14	$ 2.19
Conventional Operation							
Electricity	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 3,537,441	$ 3,614,463	$ 3,698,799	$ 3,788,055	$ 3,865,029	$ 3,956,687	$ 4,038,378
Natural Gas Expense	$ 3,952,574	$ 4,062,969	$ 4,179,205	$ 4,303,630	$ 4,439,696	$ 4,590,573	$ 4,729,657
Subtotal, Electricity & Natural Gas	$ 7,490,015	$ 7,677,432	$ 7,878,004	$ 8,091,685	$ 8,304,725	$ 8,547,260	$ 8,768,035
Annual Cogeneration Production							
Electricity	23,616,960	23,616,960	23,616,960	23,616,960	23,616,960	23,616,960	23,616,960
Thermal Cogen, Heat Recovered	208,138	208,138	208,138	208,138	208,138	208,138	208,138
Thermal Supplemental, Fuel	327,260	327,260	327,260	327,260	327,260	327,260	327,260
Residual Electric Load							
Electricity							
Demand, monthly average	7,379	7,379	7,379	7,379	7,379	7,379	7,379
Energy	39,309,208	39,309,208	39,309,208	39,309,208	39,309,208	39,309,208	39,309,208
Water	2,190	2,190	2,190	2,190	2,190	2,190	2,190
Total Fuel	666,352	666,352	666,352	666,352	666,352	666,352	666,352
Fuel, Engine Generators	339,092	339,092	339,092	339,092	339,092	339,092	339,092
Fuel Mix							
Natural Gas	0%	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%	100%
Supplemental, Conventional Boilers	327,260	327,260	327,260	327,260	327,260	327,260	327,260
Fuel Mix							
Natural Gas	0%	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%	100%
Expenses							
Fuel, Cogeneration System	$ 830,277	$ 846,883	$ 863,820	$ 881,097	$ 898,719	$ 916,693	$ 935,027
Supplemental Fuel							
Biomass	$ 801,305	$ 817,332	$ 833,678	$ 850,352	$ 867,359	$ 884,706	$ 902,400
Natural Gas	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Water	$ 4,249	$ 4,334	$ 4,421	$ 4,510	$ 4,600	$ 4,692	$ 4,786
Maintenance-Cogen	$ 198,582	$ 202,553	$ 206,604	$ 210,736	$ 214,951	$ 219,250	$ 223,635
Residual Electric Service	$ 2,220,573	$ 2,268,922	$ 2,321,863	$ 2,377,891	$ 2,426,211	$ 2,483,747	$ 2,535,028
Stand-by Service Charges	$ 177,828	$ 181,700	$ 185,939	$ 190,426	$ 194,296	$ 198,903	$ 203,010
Sub-total Expenses with Cogeneration	$ 4,232,814	$ 4,321,724	$ 4,416,326	$ 4,515,012	$ 4,606,135	$ 4,707,991	$ 4,803,886
Avoided Expense, Cogeneration	$ 3,257,201	$ 3,355,708	$ 3,461,678	$ 3,576,673	$ 3,698,590	$ 3,839,269	$ 3,964,149
Present Value, Avoided Expense							

Detailed Economics for Scenario 3.1

Salary Inflation		3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation		2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas		13.3%	6.4%	2.6%	0.6%	0.4%	1.5%	0.5%	0.8%	1.5%	1.5%	1.1%	0.7%	1.0%	0.8%	0.9%
Electricity		-1.3%	-1.1%	-0.6%	-1.3%	-0.2%	1.0%	1.0%	0.9%	-1.1%	-0.3%	0.4%	0.1%	-0.9%	0.2%	0.3%
Merchant Power Sales		0.7%	0.9%	1.4%	0.7%	1.8%	3.0%	3.0%	2.9%	0.9%	1.7%	2.4%	2.1%	1.1%	2.2%	2.3%
Biomass																

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Unit Expenses																
Residual Retail Electric Service																
Demand	$ 5.78 /kW	$ 5.82	$ 5.87	$ 5.95	$ 6.00	$ 6.10	$ 6.29	$ 6.48	$ 6.66	$ 6.72	$ 6.84	$ 7.00	$ 7.14	$ 7.22	$ 7.38	$ 7.55
Energy	$ 0.0322 /kWh	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04
Blended Retail	$ 0.0450 /kWh	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.06	$ 0.06	$ 0.06	$ 0.06
Natural Gas	$ 4.00 /MMBTU	$ 4.61	$ 5.00	$ 5.23	$ 5.37	$ 5.50	$ 5.69	$ 5.83	$ 5.99	$ 6.20	$ 6.42	$ 6.62	$ 6.79	$ 7.00	$ 7.19	$ 7.40
Biomass	$ 1.89 /MMBTU	$ 1.93	$ 1.97	$ 2.01	$ 2.05	$ 2.09	$ 2.13	$ 2.17	$ 2.22	$ 2.26	$ 2.31	$ 2.35	$ 2.40	$ 2.45	$ 2.50	$ 2.55
Merchantg Power	$ 0.0750 /kWh	$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.08	$ 0.09	$ 0.09	$ 0.09	$ 0.09	$ 0.09	$ 0.09	$ 0.10	$ 0.10
Water	$ 1.50 /kgal	$ 1.53	$ 1.56	$ 1.59	$ 1.62	$ 1.66	$ 1.69	$ 1.72	$ 1.76	$ 1.79	$ 1.83	$ 1.87	$ 1.90	$ 1.94	$ 1.98	$ 2.02
Conventional Operation																
Electricity	62,926,168 kWh	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921 MMBTU	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 2,831,678	$ 2,851,327	$ 2,877,847	$ 2,917,038	$ 2,937,917	$ 2,989,414	$ 3,079,426	$ 3,172,386	$ 3,263,479	$ 3,293,647	$ 3,350,137	$ 3,429,775	$ 3,500,315	$ 3,537,441	$ 3,614,463	$ 3,698,799
Natural Gas Expense	$ 2,259,686	$ 2,606,051	$ 2,825,169	$ 2,955,064	$ 3,031,380	$ 3,105,071	$ 3,212,719	$ 3,292,815	$ 3,386,486	$ 3,504,066	$ 3,626,277	$ 3,737,039	$ 3,837,911	$ 3,952,574	$ 4,062,969	$ 4,179,205
Subtotal, Electricity & Natural Gas	$ 5,091,364	$ 5,457,378	$ 5,703,016	$ 5,872,102	$ 5,969,297	$ 6,094,485	$ 6,292,145	$ 6,465,201	$ 6,649,965	$ 6,797,713	$ 6,976,414	$ 7,166,814	$ 7,338,226	$ 7,490,015	$ 7,677,432	$ 7,878,004
Annual Cogeneration Production																
Electricity	62,926,168 kWh	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Thermal Cogen, Heat Recovered	587,432 MMBTU	587,432	587,432	587,432	587,432	587,432	587,432	587,432	587,432	587,432	587,432	587,432	587,432	587,432	587,432	587,432
Thermal Supplemental, Fuel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Residual Electric Load																
Electricity																
Demand, monthly average	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water	2,586 kgal	2,586	2,586	2,586	2,586	2,586	2,586	2,586	2,586	2,586	2,586	2,586	2,586	2,586	2,586	2,586
Cogeneration Fuel	1,460,957 MMBTU	1,460,957	1,460,957	1,460,957	1,460,957	1,460,957	1,460,957	1,460,957	1,460,957	1,460,957	1,460,957	1,460,957	1,460,957	1,460,957	1,460,957	1,460,957
Fuel Mix																
Natural Gas	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Supplemental Fuel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel Mix																
Natural Gas	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Biomass	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Expenses																
Fuel, Cogeneration System	$ 2,765,288	$ 2,820,594	$ 2,877,005	$ 2,934,546	$ 2,993,236	$ 3,053,101	$ 3,114,163	$ 3,176,446	$ 3,239,975	$ 3,304,775	$ 3,370,870	$ 3,438,288	$ 3,507,054	$ 3,577,195	$ 3,648,739	$ 3,721,713
Supplemental Fuel																
Biomass	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Water	$ 3,879	$ 3,956	$ 4,036	$ 4,116	$ 4,199	$ 4,283	$ 4,368	$ 4,456	$ 4,545	$ 4,636	$ 4,728	$ 4,823	$ 4,919	$ 5,018	$ 5,118	$ 5,220
Maintenance-Cogen	$ 283,168	$ 288,831	$ 294,608	$ 300,500	$ 306,510	$ 312,640	$ 318,893	$ 325,271	$ 331,776	$ 338,412	$ 345,180	$ 352,084	$ 359,125	$ 366,308	$ 373,634	$ 381,107
Residual Electric Service	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Stand-by Service Charges	$ 322,080	$ 324,315	$ 327,331	$ 331,789	$ 334,164	$ 340,021	$ 350,259	$ 360,833	$ 371,194	$ 374,625	$ 381,051	$ 390,109	$ 398,132	$ 402,355	$ 411,115	$ 420,708
Sub-total Expenses with Cogeneration	$ 3,374,415	$ 3,437,697	$ 3,502,980	$ 3,570,951	$ 3,638,109	$ 3,710,045	$ 3,787,684	$ 3,867,005	$ 3,947,490	$ 4,022,448	$ 4,101,829	$ 4,185,303	$ 4,269,231	$ 4,350,876	$ 4,438,607	$ 4,528,748
Avoided Expense, Cogeneration	$ 1,716,949	$ 2,019,681	$ 2,200,036	$ 2,301,151	$ 2,331,188	$ 2,384,440	$ 2,504,461	$ 2,598,196	$ 2,702,475	$ 2,775,265	$ 2,874,585	$ 2,981,511	$ 3,068,995	$ 3,139,139	$ 3,238,825	$ 3,349,256
Merchant Power																
Merchant Power Sales	27,630,458	27,630,458	27,630,458	27,630,458	27,630,458	27,630,458	27,630,458	27,630,458	27,630,458	27,630,458	27,630,458	27,630,458	27,630,458	27,630,458	27,630,458	27,630,458
Merchant Power Fuel	641,496	641,496	641,496	641,496	641,496	641,496	641,496	641,496	641,496	641,496	641,496	641,496	641,496	641,496	641,496	641,496
Merchant Power Water	1,135 kgal	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
Fuel Expense	$ 1,214,219	$ 1,238,504	$ 1,263,274	$ 1,288,539	$ 1,314,310	$ 1,340,596	$ 1,367,408	$ 1,394,756	$ 1,422,651	$ 1,451,104	$ 1,480,127	$ 1,509,729	$ 1,539,924	$ 1,570,722	$ 1,602,137	$ 1,634,179
Water Expense	$ 1,703	$ 1,737	$ 1,772	$ 1,807	$ 1,844	$ 1,880	$ 1,918	$ 1,956	$ 1,996	$ 2,035	$ 2,076	$ 2,118	$ 2,160	$ 2,203	$ 2,247	$ 2,292
Power Sales Operating Revenue	$ 2,072,284	$ 2,086,664	$ 2,106,072	$ 2,134,753	$ 2,150,032	$ 2,187,719	$ 2,253,592	$ 2,321,622	$ 2,388,286	$ 2,410,364	$ 2,451,705	$ 2,509,985	$ 2,561,608	$ 2,588,778	$ 2,645,144	$ 2,706,863
Power Sales Operating Income	$ 856,362	$ 846,423	$ 841,026	$ 844,406	$ 833,879	$ 845,243	$ 884,266	$ 924,910	$ 963,639	$ 957,224	$ 969,502	$ 998,139	$ 1,019,524	$ 1,015,852	$ 1,040,760	$ 1,070,391
Avoided Expense and Power Sales	$ 2,573,311	$ 2,866,105	$ 3,041,062	$ 3,145,557	$ 3,165,067	$ 3,229,682	$ 3,388,727	$ 3,523,105	$ 3,666,114	$ 3,732,489	$ 3,844,087	$ 3,979,649	$ 4,088,519	$ 4,154,992	$ 4,279,586	$ 4,419,647
NPV, Avoided Expense Cogeneration	$ 30,434,912			**NPV, Power Sales Operating Income**	$ 10,774,449											

Detailed Economics for Scenario 3.1

Salary Inflation	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%
Natural Gas	1.0%	1.2%	1.4%	1.0%
Electricity	0.4%	0.0%	0.4%	0.1%
Merchant Power Sales	2.4%	2.0%	2.4%	2.1%
Biomass				

Year	17	18	19	20
Unit Expenses				
Residual Retail Electric Service				
Demand	$ 7.73	$ 7.89	$ 8.08	$ 8.24
Energy	$ 0.04	$ 0.04	$ 0.04	$ 0.05
Blended Retail	$ 0.06	$ 0.06	$ 0.06	$ 0.06
Natural Gas	$ 7.62	$ 7.86	$ 8.13	$ 8.37
Biomass	$ 2.60	$ 2.65	$ 2.70	$ 2.76
Merchantg Power	$ 0.10	$ 0.10	$ 0.10	$ 0.11
Water	$ 2.06	$ 2.10	$ 2.14	$ 2.19
Conventional Operation				
Electricity	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921	564,921	564,921	564,921
Electric Charges	$ 3,788,055	$ 3,865,029	$ 3,956,687	$ 4,038,378
Natural Gas Expense	$ 4,303,630	$ 4,439,696	$ 4,590,573	$ 4,729,657
Subtotal, Electricity & Natural Gas	$ 8,091,685	$ 8,304,725	$ 8,547,260	$ 8,768,035
Annual Cogeneration Production				
Electricity	62,926,168	62,926,168	62,926,168	62,926,168
Thermal Cogen, Heat Recovered	587,432	587,432	587,432	587,432
Thermal Supplemental, Fuel	-	-	-	-
Residual Electric Load				
Electricity				
Demand, monthly average	-	-	-	-
Energy	-	-	-	-
Water	2,586	2,586	2,586	2,586
Cogeneration Fuel	1,460,957	1,460,957	1,460,957	1,460,957
Fuel Mix				
Natural Gas	0%	0%	0%	0%
Biomass	100%	100%	100%	100%
Supplemental Fuel	-	-	-	-
Fuel Mix				
Natural Gas	100%	100%	100%	100%
Biomass	0%	0%	0%	0%
Expenses				
Fuel, Cogeneration System	$ 3,796,148	$ 3,872,070	$ 3,949,512	$ 4,028,502
Supplemental Fuel				
Biomass	$ -	$ -	$ -	$ -
Natural Gas	$ -	$ -	$ -	$ -
Water	$ 5,325	$ 5,431	$ 5,540	$ 5,651
Maintenance-Cogen	$ 388,729	$ 396,504	$ 404,434	$ 412,522
Residual Electric Service	$ -	$ -	$ -	$ -
Stand-by Service Charges	$ 430,860	$ 439,615	$ 450,041	$ 459,332
Sub-total Expenses with Cogeneration	$ 4,621,062	$ 4,713,620	$ 4,809,526	$ 4,906,007
Avoided Expense, Cogeneration	$ 3,470,623	$ 3,591,105	$ 3,737,734	$ 3,862,028
Merchant Power				
Merchant Power Sales	27,630,458	27,630,458	27,630,458	27,630,458
Merchant Power Fuel	641,496	641,496	641,496	641,496
Merchant Power Water	1,135	1,135	1,135	1,135
Fuel Expense	$ 1,666,863	$ 1,700,200	$ 1,734,204	$ 1,768,888
Water Expense	$ 2,338	$ 2,385	$ 2,433	$ 2,481
Power Sales Operating Revenue	$ 2,772,182	$ 2,828,514	$ 2,895,591	$ 2,955,375
Power Sales Operating Income	$ 1,102,981	$ 1,125,929	$ 1,158,954	$ 1,184,005
Avoided Expense and Power Sales	$ 4,573,604	$ 4,717,034	$ 4,896,688	$ 5,046,033
NPV, Avoided Expense Cogeneration				

Detailed Economics for Scenario 4.0

Salary Inflation	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas	13.3%	6.4%	2.6%	0.6%	0.4%	1.5%	0.5%	0.8%	1.5%	1.5%
Electricity	-1.3%	-1.1%	-0.6%	-1.3%	-0.2%	1.0%	1.0%	0.9%	-1.1%	-0.3%
Biomass										

Year	1	2	3	4	5	6	7	8	9	10	11
Unit Expenses											
Residual Retail Electric Service											
Demand	$ 5.78 /kW	$ 5.82	$ 5.87	$ 5.95	$ 6.00	$ 6.10	$ 6.29	$ 6.48	$ 6.66	$ 6.72	$ 6.84
Energy	$ 0.0322 /kWh	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.03	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04
Blended Retail	$ 0.0450 /kWh	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05	$ 0.05
Natural Gas	$ 4.00 /MMBTU	$ 4.61	$ 5.00	$ 5.23	$ 5.37	$ 5.50	$ 5.69	$ 5.83	$ 5.99	$ 6.20	$ 6.42
Biomass	$ 1.89 /MMBTU	$ 1.93	$ 1.97	$ 2.01	$ 2.05	$ 2.09	$ 2.13	$ 2.17	$ 2.22	$ 2.26	$ 2.31
Water	$ 1.50 /kgal	$ 1.53	$ 1.56	$ 1.59	$ 1.62	$ 1.66	$ 1.69	$ 1.72	$ 1.76	$ 1.79	$ 1.83
Conventional Operation											
Electricity	62,926,168 kWh	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921 MMBTU	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 2,831,678	$ 2,851,327	$ 2,877,847	$ 2,917,038	$ 2,937,917	$ 2,989,414	$ 3,079,426	$ 3,172,386	$ 3,263,479	$ 3,293,647	$ 3,350,137
Natural Gas Expense	$ 2,259,686	$ 2,606,051	$ 2,825,169	$ 2,955,064	$ 3,031,380	$ 3,105,071	$ 3,212,719	$ 3,292,815	$ 3,386,486	$ 3,504,066	$ 3,626,277
Subtotal, Electricity & Natural Gas	$ 5,091,364	$ 5,457,378	$ 5,703,016	$ 5,872,102	$ 5,969,297	$ 6,094,485	$ 6,292,145	$ 6,465,201	$ 6,649,965	$ 6,797,713	$ 6,976,414
Annual Cogeneration Production											
Electricity	41,113,224 kWh	41,113,224	41,113,224	41,113,224	41,113,224	41,113,224	41,113,224	41,113,224	41,113,224	41,113,224	41,113,224
Thermal Cogen, Heat Recovered	123,305 MMBTU	123,305	123,305	123,305	123,305	123,305	123,305	123,305	123,305	123,305	123,305
Thermal Supplemental, Fuel	433,301 MMBTU	433,301	433,301	433,301	433,301	433,301	433,301	433,301	433,301	433,301	433,301
Residual Electric Load											
Electricity											
Demand, monthly average	5,357 kW	5,357	5,357	5,357	5,357	5,357	5,357	5,357	5,357	5,357	5,357
Energy	21,812,945 kWh	21,812,945	21,812,945	21,812,945	21,812,945	21,812,945	21,812,945	21,812,945	21,812,945	21,812,945	21,812,945
Water	2,900 kgal	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900
Fuel, Turbine Cycle & HRSG	876,123 MMBTU	876,123	876,123	876,123	876,123	876,123	876,123	876,123	876,123	876,123	876,123
Fuel Mix											
Natural Gas	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Supplemental Fuel	433,301 MMBTU	433,301	433,301	433,301	433,301	433,301	433,301	433,301	433,301	433,301	433,301
Fuel Mix											
Natural Gas	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Expenses											
Fuel, Cogeneration System	$ 1,658,318	$ 1,691,485	$ 1,725,314	$ 1,759,821	$ 1,795,017	$ 1,830,918	$ 1,867,536	$ 1,904,887	$ 1,942,984	$ 1,981,844	$ 2,021,481
Supplemental Fuel											
Biomass	$ 820,149	$ 836,552	$ 853,283	$ 870,348	$ 887,755	$ 905,511	$ 923,621	$ 942,093	$ 960,935	$ 980,154	$ 999,757
Natural Gas	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Water	$ 4,350	$ 4,437	$ 4,526	$ 4,616	$ 4,709	$ 4,803	$ 4,899	$ 4,997	$ 5,097	$ 5,199	$ 5,303
Maintenance-Cogen	$ 185,010	$ 188,710	$ 192,484	$ 196,334	$ 200,261	$ 204,266	$ 208,351	$ 212,518	$ 216,769	$ 221,104	$ 225,526
Residual Electric Service	$ 1,073,915	$ 1,081,367	$ 1,091,425	$ 1,106,288	$ 1,114,206	$ 1,133,737	$ 1,167,874	$ 1,203,129	$ 1,237,676	$ 1,249,118	$ 1,270,541
Stand-by Service Charges	$ 82,368	$ 82,940	$ 83,711	$ 84,851	$ 85,458	$ 86,956	$ 89,575	$ 92,279	$ 94,928	$ 95,806	$ 97,449
Sub-total Expenses with Cogeneration	$ 3,824,110	$ 3,885,491	$ 3,950,743	$ 4,022,258	$ 4,087,406	$ 4,166,191	$ 4,261,856	$ 4,359,903	$ 4,458,389	$ 4,533,224	$ 4,620,057
Avoided Expense, Cogeneration	$ 1,267,254	$ 1,571,887	$ 1,752,273	$ 1,849,844	$ 1,881,891	$ 1,928,294	$ 2,030,289	$ 2,105,298	$ 2,191,576	$ 2,264,489	$ 2,356,357
NPV, Avoided Expense	**$ 24,689,328**										

Detailed Economics for Scenario 4.0

Salary Inflation	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%	3.20%
Non-salary Inflation	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Natural Gas	1.1%	0.7%	1.0%	0.8%	0.9%	1.0%	1.2%	1.4%	1.0%
Electricity	0.4%	0.1%	-0.9%	0.2%	0.3%	0.4%	0.0%	0.4%	0.1%
Biomass									

Year	12	13	14	15	16	17	18	19	20
Unit Expenses									
Residual Retail Electric Service									
Demand	$ 7.00	$ 7.14	$ 7.22	$ 7.38	$ 7.55	$ 7.73	$ 7.89	$ 8.08	$ 8.24
Energy	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.04	$ 0.05
Blended Retail	$ 0.05	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06	$ 0.06
Natural Gas	$ 6.62	$ 6.79	$ 7.00	$ 7.19	$ 7.40	$ 7.62	$ 7.86	$ 8.13	$ 8.37
Biomass	$ 2.35	$ 2.40	$ 2.45	$ 2.50	$ 2.55	$ 2.60	$ 2.65	$ 2.70	$ 2.76
Water	$ 1.87	$ 1.90	$ 1.94	$ 1.98	$ 2.02	$ 2.06	$ 2.10	$ 2.14	$ 2.19
Conventional Operation									
Electricity	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168	62,926,168
Natural Gas	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921	564,921
Electric Charges	$ 3,429,775	$ 3,500,315	$ 3,537,441	$ 3,614,463	$ 3,698,799	$ 3,788,055	$ 3,865,029	$ 3,956,687	$ 4,038,378
Natural Gas Expense	$ 3,737,039	$ 3,837,911	$ 3,952,574	$ 4,062,969	$ 4,179,205	$ 4,303,630	$ 4,439,696	$ 4,590,573	$ 4,729,657
Subtotal, Electricity & Natural Gas	$ 7,166,814	$ 7,338,226	$ 7,490,015	$ 7,677,432	$ 7,878,004	$ 8,091,685	$ 8,304,725	$ 8,547,260	$ 8,768,035
Annual Cogeneration Production									
Electricity	41,113,224	41,113,224	41,113,224	41,113,224	41,113,224	41,113,224	41,113,224	41,113,224	41,113,224
Thermal Cogen, Heat Recovered	123,305	123,305	123,305	123,305	123,305	123,305	123,305	123,305	123,305
Thermal Supplemental, Fuel	433,301	433,301	433,301	433,301	433,301	433,301	433,301	433,301	433,301
Residual Electric Load									
Electricity									
Demand, monthly average	5,357	5,357	5,357	5,357	5,357	5,357	5,357	5,357	5,357
Energy	21,812,945	21,812,945	21,812,945	21,812,945	21,812,945	21,812,945	21,812,945	21,812,945	21,812,945
Water	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900
Fuel, Turbine Cycle & HRSG	876,123	876,123	876,123	876,123	876,123	876,123	876,123	876,123	876,123
Fuel Mix									
Natural Gas	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%	100%	100%	100%
Supplemental Fuel	433,301	433,301	433,301	433,301	433,301	433,301	433,301	433,301	433,301
Fuel Mix									
Natural Gas	0%	0%	0%	0%	0%	0%	0%	0%	0%
Biomass	100%	100%	100%	100%	100%	100%	100%	100%	100%
Expenses									
Fuel, Cogeneration System	$ 2,061,911	$ 2,103,149	$ 2,145,212	$ 2,188,116	$ 2,231,878	$ 2,276,516	$ 2,322,046	$ 2,368,487	$ 2,415,857
Supplemental Fuel									
Biomass	$ 1,019,752	$ 1,040,147	$ 1,060,950	$ 1,082,169	$ 1,103,812	$ 1,125,889	$ 1,148,406	$ 1,171,374	$ 1,194,802
Natural Gas	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Water	$ 5,409	$ 5,517	$ 5,627	$ 5,740	$ 5,854	$ 5,972	$ 6,091	$ 6,213	$ 6,337
Maintenance-Cogen	$ 230,037	$ 234,637	$ 239,330	$ 244,117	$ 248,999	$ 253,979	$ 259,059	$ 264,240	$ 269,525
Residual Electric Service	$ 1,300,744	$ 1,327,496	$ 1,341,576	$ 1,370,787	$ 1,402,771	$ 1,436,622	$ 1,465,814	$ 1,500,576	$ 1,531,557
Stand-by Service Charges	$ 99,765	$ 101,817	$ 102,897	$ 105,138	$ 107,591	$ 110,187	$ 112,426	$ 115,092	$ 117,469
Sub-total Expenses with Cogeneration	$ 4,717,618	$ 4,812,764	$ 4,895,593	$ 4,996,066	$ 5,100,905	$ 5,209,165	$ 5,313,842	$ 5,425,982	$ 5,535,546
Avoided Expense, Cogeneration	$ 2,449,196	$ 2,525,462	$ 2,594,422	$ 2,681,366	$ 2,777,099	$ 2,882,520	$ 2,990,883	$ 3,121,278	$ 3,232,489
NPV, Avoided Expense									

Appendix J: Turbine and Engine Set Manufacturers Specifications

The following pages contain engineering drawings and specification sheets for the turbine and engine set.

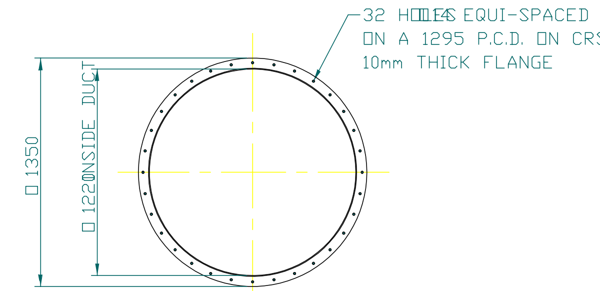
IF IN DOUBT,ASK

ALSTOM Power UK Ltd.

NOTE:-

1. SITE ACCESS WILL BE REQUIRED FOR TURBINE PACKAGE MAINTENANCE.
2. UNLESS A CRANE IS AVAILABLE, CLEAR ACCESS IS REQUIRED FOR THE ENGINE TRANSPORTATION TROLLEY, FROM ONE SIDE OF THE PACKAGE TO THE WORKSHOP.
3. CRANE ACCESS REQUIRED FOR ALTERNATOR REMOVAL FROM SIDE OF PACKAGE.
4. FOR FOUNDATION REQUIREMENTS AND LOADINGS REFER TO DRG NUMBER RM01040.
5. THE LCV MODULE REQUIRES A VENTILATION SYSTEM WHICH IS BY ALSTOM POWER AND OMITTED FOR CLARITY.

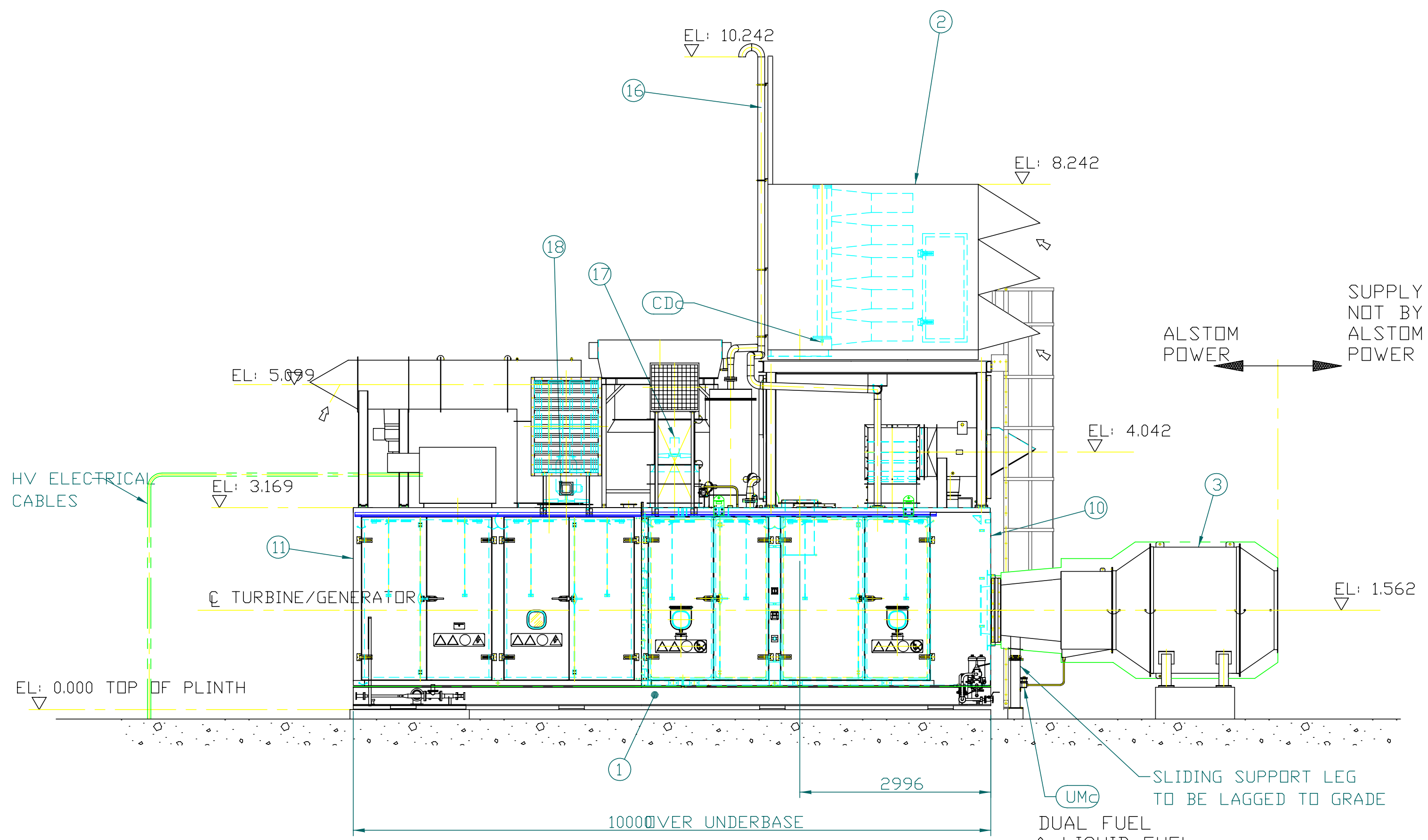
KEY TO EQUIPMENT	
1	TURBINE PACKAGE
2	COMBUSTION AIR INTAKE FILTER
3	COMB. AIR EXHAUST SILENCER
4	GAS TURBINE VENT AIR INTAKE
5	GAS TURBINE VENT AIR EXHAUST
6	GENERATOR AIR INTAKE
7	GENERATOR AIR EXHAUST
8	AIR BLAST LUB OIL COOLER
9	H.V. TERMINAL BOX
10	GAS TURBINE ENCLOSURE
11	GENERATOR ENCLOSURE
12	LUBE OIL COALESCER
13	FIRE EXTINGUISHANT CABINET
14	RETRACTABLE WEATHER HOOD
15	CONTROL EQUIPMENT
16	BREATHER DUCTING
17	GAS TURBINE VENT AIR EXHAUST FAN
18	GENERATOR AIR EXHAUST ASSIST FAN
19	LCV MODULE
20	LIQUID FUEL BLOCK / THERMAL RELIEF VALVE



DETAILS OF EXHAUST FLANGE (COLD)
SCALE 1 : 20

	CUSTOMER CONNECTIONS		X	Y	Z
UMc	AXIAL EXHAUST LIQUID FUEL DRAIN	3/4 NPT	[illegible]	-1209	0
CDc	COMB. FILTER PNUEMATIC AIR SUPPLY	1 BSP	[illegible]	4207	1270

FOR OTHER CUSTOMER CONNECTIONS REFER TO G.A. TYPHOON GENERATOR SET RM01010



VIEW ON ELEVATION

(FIRE EXTINGUISHANT CABINET AND LIQUID FUEL FILTER REMOVED FOR CLARITY)

NOTE :-
THIS DRAWING IS SUBJECT TO DISCUSSION THEREFORE DETAILS AND DIMENSIONS MAY CHANGE.

SHT ISS	DATE	INITIAL	A.C OR G FORM	DESCRIPTION	SHEET REVISED AT DRAWING ISSUE
5					
4					
3					
2					
1	19.11.01	G.D.	A.G	DRAWING ISSUED	1

ALTERATION ISSUE NO. SHOWN ENCIRCLED THUS △ LATEST ISSUE CANCELS ALL PREVIOUS ISSUES

DRAWN
CHECKED
DATE

ORDER NO. TUL02/635

APPROVED:
DRAUGHTING
DESIGN
ENGINEER
EXAMINED

CUSTOMER'S REFERENCE
BIOMASS POWER PLANT LIMITED

SOLID EDGE

THIRD ANGLE PROJECTION

UNLESS OTHERWISE STATED ALL DIMENSIONS IN MILLIMETRES

SCALE 1 : 50 0 1 2 METRES

ALSTOM

TITLE :-
PROPOSED LAYOUT OF ALSTOM SUPPLIED EQUIPMENT
TYPHOON GENERATOR SET

DRG. No. TUL-B02-018 SHT No. 1

COMPRISES SHEETS AT ISSUE 1 1 | DATE | APPROVED | A.C OR G FORM G | DRAWING ISSUE 1

03584-01-001-01

DRG. No. TUL-B02-018 SHT No. 2 IF IN DOUBT,ASK

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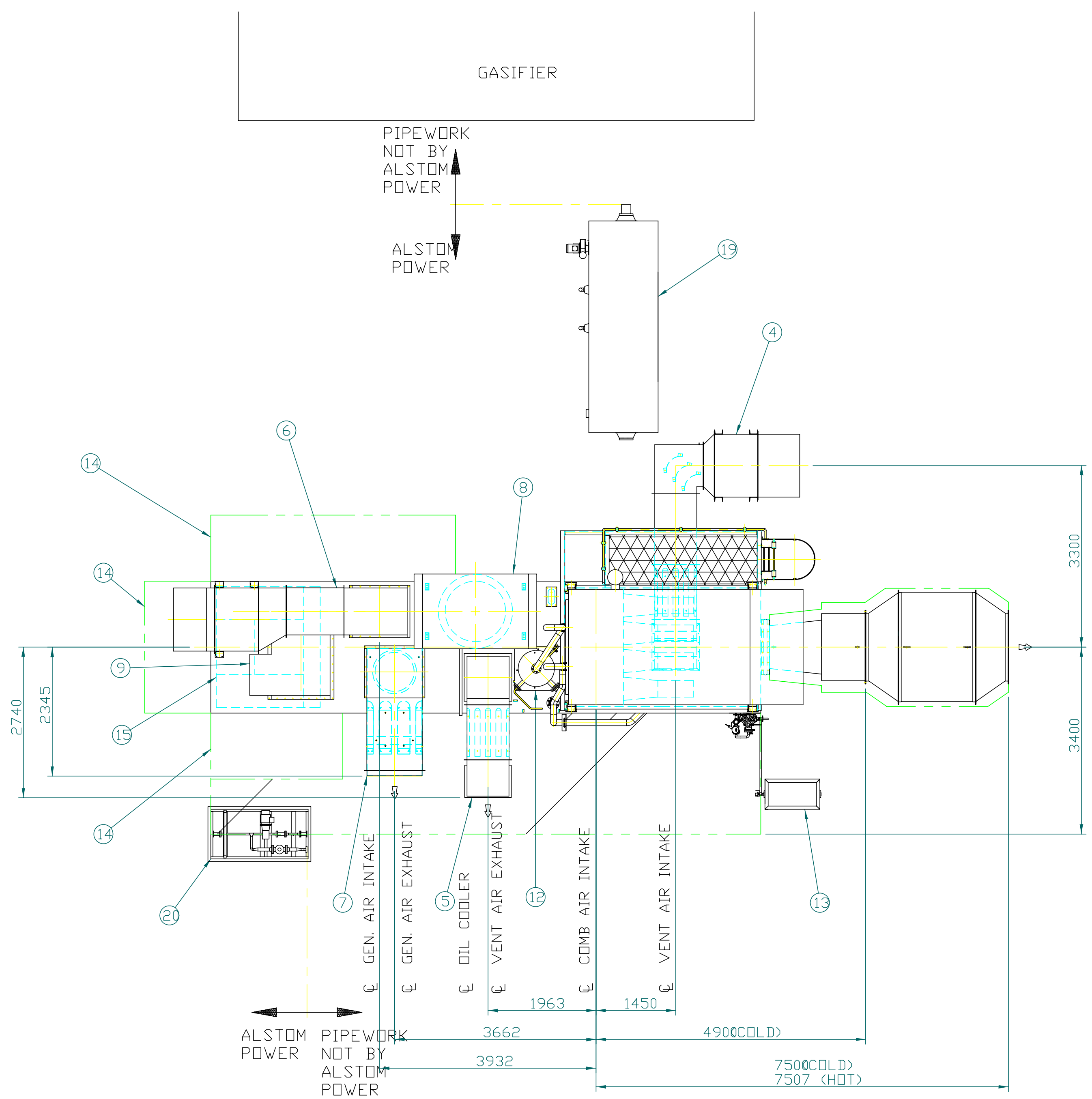
ALSTOM Power UK Ltd.

FOR DRAWING ISSUE SEE SHEET 1



NOTE :-
THIS DRAWING IS SUBJECT TO DISCUSSION THEREFORE DETAILS AND DIMENSIONS MAY CHANGE

SHT ISS	DATE	INITIAL	A.C OR G FORM	DESCRIPTION	SHEET REVISED AT DRAWING ISSUE
5					
4					
3					
2					
1	19.11.01	G.D.	A.G	DRAWING ISSUED	1

ALTERATION ISSUE NO. SHOWN ENCIRCLED THUS △ LATEST ISSUE CANCELS ALL PREVIOUS ISSUES

DRAWN
CHECKED
DATE

ORDER NO. TUL02/635

APPROVED:
DRAUGHTING
DESIGN
ENGINEER
EXAMINED

CUSTOMER'S REFERENCE
BIOMASS POWER PLANT LIMITED

SOLID EDGE

THIRD ANGLE PROJECTION

UNLESS OTHERWISE STATED ALL DIMENSIONS IN MILLIMETRES

SCALE 1 : 50 0 1 2 METRES

ALSTOM

TITLE PROPOSED LAYOUT OF ALSTOM SUPPLIED EQUIPMENT TYPHOON GENERATOR SET

03584-01-001-02

DRG. No. TUL-B02-018 SHT No. 2

A1 MODEL:-

JENBACHER ENERGIE

JMS 620 GS-N.L

NATURAL GAS

ENGINE DATA:			GEARBOX & ALTERNATOR:		
Engine type		J 620 GS-E01	**GEARBOX:**		EICKHOFF
Configuration		V 60°	Efficiency	*%*	98.67
No. of cylinders		20	Gearbox ratio		1:1.2
Bore	*in*	7.48			
Stroke	*in*	8.66	**ALTERNATOR:**		
Piston displacement	*cu.in*	7,613	Efficiency at p.f.= 1.0	*%*	96.9%
Nominal speed	*rpm*	1,500	Efficiency at p.f.= 0.8	*%*	
Mean piston speed	*in/s*	433	Ratings at p.f.= 1.0	*kW*	1,500
Mean effe. press. at stand. power and nom. s	*psi*	260	Ratings at p.f.= 0.8	*kW*	
Compression ratio	*Epsilon*	11.0	Frequency	*Hz*	60
ISO standard fuel stop power ICFN	*bhp*	3756	Voltage	*kV*	12.47
Specific fuel consumption of engine	*BTU/bhp.hr*	5,804	Protection Class		IP 23
Specific lube oil consumption	*g/bhp.hr*	0.22	Insulation class		F
Weight dry	*lbs*	26,455	Speed	*rpm*	1,800
Filling capacity lube oil	*gal*	177	Mass	*lbs*	20,000
Based on methane number	*MN d)*	70			

TECHNICAL REQUIREMENTS:

APPLICABLE STANDARDS:	Based on DIN-ISO 3046	
	Based on VDE 0530 REM with specified tolerance	
STANDARD CONDITIONS:	Barometic pressure:	14.50 psi or 328ft above sea level
	Air temperature:	77°F or 298 K
	Relative Humidity:	30%
ENGINE OUTPUT DERATING:	Height:	0.7% for any further 328ft over 1640ft
	Temperature:	0.28% for any further 1°F over 77°F
GAS QUALITY:	according to TA 1000-0300	
	Gas flow pressure:	1.2 - 2.9 (psi)
		(Lower gas pressures upon inquiry)
	Prechamber gas pressure:	NATURAL GAS, SEWAGE GAS > 44 psi
	Max. variation in gas pressure: ±10%	

All data are based on engine full load at specified media temperatures and are subject to change.

The technical Instruction TA 1100-0110 "PARAMETER FOR JENBACHER GAS ENGINES" must be strictly observed.

SCOPE OF SUPPLY GENSET
JGS 620 GS-N.L

BASIC ENGINE EQUIPMENT:
*Exhaust gas turbocharger, Intercooler
*Motorized carburator for LEANOX control
*Electronic contactless high performance ignition system
*Lubricating oil pump (gear driven)
*Lubricating oil filters in main circuit
*Oil trip pan; Lubricating oil heat exchanger
*Jacket water pump
*Fuel-, lubricating oil and jacket water pipe work on engine
*Flywheel for alternator operation; Exhaust gas manifold
*Viscous damper
*Knock sensors

Engine accessories:
*Electric starter motor
*Electronic speed governor
*Electronic speed monitoring device including starting and overspeed control
*Transducers and switches for oil pressure, jacket water temp., jacket water pressure, charge pressure and mixture temperature
*One thermocouple per cylinder

SUPPLIED LOOSE:
Gas train according to DIN-DVGW consisting of:
*Manual stop valve, fuel gas filter, two solenoid valves, Leakage control device, gas pressure regulator
Prechamber Gas Train

Documentation:
*Operating and maintenance manual
*Spare parts manual
*Drawings

EQUIPMENT:
*Base frame for gas engine, alternator and heat exchangers
*Internal pole alternator with excitation alternator and with automatic voltage regulator; p.f. 0.8 lagging to 1.0
*Flexible coupling, bell housing
*Anti-vibration mounts
*Air filter
*Automatic lube oil replenishing with level control
*Wiring of components to module interface panel
*Crankcase breather
*Jacket water electric preheating

ENGINE CONTROL PANEL:
*Totally enclosed , single door cubicle, wired to terminals and ready to operate, protection IP 41 outside, IP 10 inside, according to VDE-standards
CONTROL EQUIPMENT:
*Engine-Management-System dia.ne (Dialog Network)
**Visualisation (industry PC-10" color graphics display): Operation controller display,Exh. gas temp.,Generator electr. connection,et
**Central engine- and module control: Speed-, Power output-, LEANOX-Control and knock control, etc.
*Multi-transducer
*Lockable operation mode selector switch
Positions: "OFF", "MANUAL", "AUTOMATIC"
*Demand switch

ASSEMBLY, PAINTING, TESTING   in Jenbach/Austria

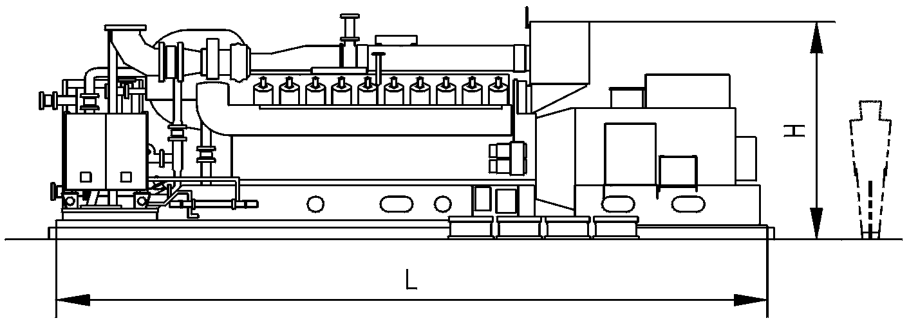
SCOPE OF SUPPLY MODULE
JMS 620 GS-N.L

Identical to Genset except that heat recovery is included.
*jacket water heat exchanger mounted on module frame
*exhaust gas heat exchanger mounted as separate heat recovery module
*all heat exchangers with complete pipework
*Heat exchangers and all inherent auxiliaries

Scope of Supply & Design Subject to Local Regulations and product development

DIMENSIONS

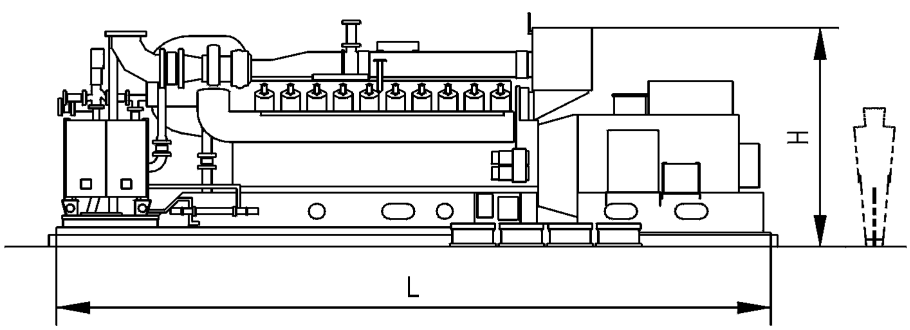
GENSET



Main dimensions and weights (approximate value)		
Length L	*in*	410
Width B	*in*	100
Height H	*in*	110
Weight empty	*lbs*	65,210
Weight filled	*lbs*	67,420

Connections (at genset)		
Jacket water inlet and outlet	*in/lbs*	4"/232
Exhaust gas outlet	*in/lbs*	25"/145
Fuel gas (at gas train)	*in/lbs*	3"/232
Intercooler water connection:		
Low Temperature Circuit	*in/lbs*	2½"/232

MODULE



Main dimensions and weights (approximate value)		
Length L	*in*	410
Width B	*in*	100
Height H	*in*	110
Weight empty	*lbs*	66,530
Weight filled	*lbs*	68,740

Connections (at module)		
Hot water inlet and outlet	*in/lbs*	4"/232
Exhaust gas outlet	*in/lbs*	25"/145
Fuel gas (at gas train)	*in/lbs*	3"/232
Intercooler water connection:		
Intercooler water-Inlet/Outlet 2nd stage	*in/lbs*	2½"/232

FUEL GAS QUALITY

1. General :

The analysis of the fuel gas shall be made known to the engine manufacturer prior to the contract settlement.
The analysis values must constitute a representative result.
When it is recognized and/or possible that in the course of time changes of analysis values could occur this factor should be referred to specifically.
Exceeding or remaining under fuel gas connected limit values according to table (page 2) must be declared during single measurements.

The engine is fully suitable only for the kind of fuel gas, for which it was delivered.

Because engine equipment and engine adjustment are optimized only for the indicated fuel gas it has to be guaranteed that the methane quantity will not fall below the min. methane quantity of the technical specification (e.g. addition of a liquified gas air mixture). This matter shall be clarified with the respective gas utility.

Lubricating oil can loose its anti-corrosion characteristics by soiling of the fuel gas. The results of periodical lubricating oil analysis also refer to fuel gas soiling (for this matter see TI-No. 1000-0112).

Particular prescriptions regarding the use of engine lube oils (vide technical instructions TI-No.1000-0125, TI-No.1000-0099 B and 1000-0099 C) shall be obeyed in case of existence of Halogen and sulphur bonds in the fuel gas.

2. Required characteristics of the fuel gas 4-stroke spark ignited gas egines :

a) maximum admissible variating speed of calorific value : 0,5% / 30 sec.

b) maximum admissible gas-pressure change : 10 mbar/sec. **[0,145 psi/sec].**
(provided a pre-pressure controller is mounted).

c) Gas pre-pressure :
(constant dynamic gas pressure at interface of JENBACHER's scope of supply)

- Turbocharged gas engines : 80 – 200 mbar **[1,16 psi - 2,9 psi]**

- Br.6 Pre-combustion chamber
  gas pressure 612-616 : 2500 – 4000 mbar **[36,25 psi - 58 psi]**
  620 : 3000 - 4000 mbar **[43,5 psi - 58 psi]**

d) Fuel gas quality : the limiting values for the fuel gas, which have to be obeyed resp. underpassed at the interface of JENBACHER scope of supply, are enlisted in the table below.

All quantity indications refer to the volume of fuel gas in standard condition,i.e.: a temperature of 0°C **[32°F]**, a pressure of 1,013 bar **[14,6885 psi]** and a heating value of 10 kWh/m³ **[966,68 BTU/cu ft]**.
Other heating values are to be proportionally converted directly.

FUEL GAS QUALITY

Table:

	without catalyst	**with catalyst**
maximum temperature (°C)	40 **[104 °F]**	40 **[104 °F]**
maximum relative humidity (%)	80	80
condensate	0	0
dust: maximum grade size (µm) maximum quantity (mg/10 kWh)	3 50	3 50
maximum content of sulphuric compounds calculated as H_2S (mg/10 kWh) 4)	2000	1150
maximum content of halide compounds (total Cl + 2 x sum F mg/10 kWh) 1)		
without restriction of warranty 2)	< 100	0
restricted warranty 3)	100-400	0
no warranty given against damage which is directly or indirectly due to raised halogen content	> 400	0
maximum content of silicon (mg/10 kWh)		
without restriction of warranty	5)	0
with restricted warranty (for wear on exhaust valves, cylinder liner and piston rings)	5)	0
maximum ammonia content (mg/10 kWh)	55	55
maximum oil content (mg/10 kWh)	5	5

1) A single exceeding of 30% of the mentioned limiting value out of 4 analysis per year shall be admissible.

2) TI-No. 1000-0099 B limiting values for used oil must be observed.

3) Condition : An increased oil sump with additional oil tank to achieve an oil service life of at least 250 working hours (better still 500/1000 working hours) must be provided (dimensioning of size must be carried out for each case of need depending on halogen content, type of oil, etc.). The limiting values for used oil according to TI 1000-0099B must be observed and the analytical findings obtained during the warranty period must be submitted to JENBACHER without prior request.

4) With a total sulphur content > 50 mg/10kWh a reduction of the oil service life occurs.
Attention is to be paid to this as with a defect high sulphur concentrations can arise, particularly in desulphurisation plants.

5) The silicon content in the gas is difficult to measure (depending on the sample taken, the methods of analysis and the time in between). Because, however, it was possible to establish a clear relationship between the various engines regarding wear in relation to the silicon-content increase in the oil over time, a limiting value of < 0.02 has been set. If this limit is exceeded, the warranty will be limited to some extent and allowance should be made for increased wear, especially of the piston rings.
Sample calculation for the Si-content:
e.g. J 312 GS / 600 kW
Oil filling quantity 200 litres **[52,84 gallon]**
550 oil service hours
Si-content in engine oil 280 mg/k (ppm G)

$$\text{Rel. Si-content} = \frac{\text{ppm Si x oil content}\ ^{\text{(Oil sump + additional reservoir + content)}}}{\text{Power x service time}} = \frac{280 \times 200}{600 \times 550} = 0{,}17$$

3. Special instructions regarding landfill gas :

The composition of landfill gases in general is subject to extreme variations. This may result in variations of the Wobbe no. and the required air excess number and thus to variations of the combustion air ratio.

Deviations from the nominal value of the air ratio with engine under load are corrected within a defined regulating range by the Leanox control system.

In order to secure a good starting and no-load function course it may be necessary to adapt the starting position to the mixer if the CH_4 content when compared to the time of initial operation has noticeably changed.

Gas samples :

Utilization of landfill gas in engines supposes the knowledge of composition, quantity and its periodical characteristic. Gas samples shall be taken and being analyzed by qualified laboraties already in the phase of planning. Gas well with highly pollutant contents must be connected to the flare or can utilize gas, produced here by installation of a gas purifier.

The following procedure is recommended for the recording of periodical variations :

1st sample taking
2nd sample taking one week after the 1st
3rd sample taking two weeks after the 2nd
4th sample taking four weeks after the 3rd
5th sample taking eight weeks after the 4th

FUEL GAS QUALITY

Quarteryearly analysis of the landfill gas feed to the engine shall be taken after start-up and continued over the warranty period. These analyisis shall be made available to JENBACHER without request.

When taking gas samples, make sure that no post-reactions are possible until analysis is carried out resp. that watersolluble and components condensed with the humidity of the gas (e.g. NH_3, acids etc.) are being collected together with the gas sample.
The temperature of gases during sampling must be acquired and indicated.
Suction of outer air is to be prevented. Time between sampling and analysis must be as short as possible (max. 3 days). Time of sampling and time of analysis must be indicated.

The gas sample shall be taken at the interface of JENBACHER scope of supply.

The fuel gas shall be analyzed for the following components :

methane (CH_4)

total silicone

carbon dioxide (CO_2)

nitrogen (N_2)

oxygen (O_2)

total sulphur

total chlorine

total florine

ammonia

condensate quantity at 0°**C [32°F]**

relative humidity

residual oil content

dust

Sampling and analysis are to be carried out according to VDI directives. Each applied analysis procedure is to be indicated.

LUBRICATING OILS FOR ENGINES OF STANDARD SERIES 6 IN SWEET-GAS, BIOGAS, LANDFILL-GAS OR SPECIAL-GAS OPERATION, FOR ENGINES OF STANDARD SERIES 1, 2, 3 AND 4 IN NATURAL-GAS OPERATION AND FOR LAMBDA-1-ENGINES

1. Validity :

The present Technical Instruction applies to :

- Leanox engines of standard series 6 with or without oxydation-type catalytic converter in all applications (sweet gas, biogas, landfill gas and special gas),
- Engines of standard series 1, 2,3 and 4 if oil with a low ash content is required,
- Engines which are equipped with a three-way catalytic converter.

2. Requirements concerning the lubricating oil :

- SAE40
- additives suited to spark-ignition gas operation rather than diesel or regular gas
- API "CC" or MIL-L-2104 B;
- corrosion test CRC L-38 must be able to be compridged
- Sulfate ash according to DIN 51575 smaller than 0,5 weight %
- with TBN not below 3 mg KOH/g, if possible above 4 mg KOH/g
- Phosphorus contents maximum 800 ppm.

3. Note :

The sulphate-ash content can, depending on the operational conditions of the engine, affect the service life of the lubrication oil. It is very important that you take into the account oil ageing and/or that the used-oil analyses limit values (according to TD 1000-0099B) are met.

S E L E C T I O N C H A R T

Mobil	Pegasus 705	CALTEX	Geostar Low Ash SAE 40	REPSOL	Motor Gas SAE 40
Agip	GEUM BG 40	CEPSA	Troncoil Gas 40	Shell	Mysella LA 40
ARAL	Degasol LA 40	DEA FUCHS	Dea Ectan LA40 Titan Ganymet LA40	T	Texaco Geotex LA 40
AVIA	Gasmotorenöl LA 40	Esso	Mineralöl: ESTOR PC 40 Synthetisch: ESTOR SPC	TOTAL	OMG 40
BP	Energol IC-DG 40 S	FINA	405		

US REFERENCE LIST 2001 JENBACHER					
Project	**Fuel Type**	**Year of Installation**	**Application**	**Engine Configuration**	**Location**
WWTP-Annacis Island	Sewer and Natural Gas	1997	Cogen	4 JMS320GS-B.L 807 kW each **3228 kW** gross output	Vancouver, BC Canada
Alpha Industries	Natural Gas	1999	Cogen	2 JMS612GS-N.LC 1334 kW each **2668 kW** gross output	Newark, NJ USA
WWTP-Eugene	Biogas	1997	Cogen	1 JMS316GS-B.L 800 kW **800 kW** gross output	Eugene, OR USA
Catawba County	Landfill gas	1998	Container Genset	3 JMS 320GS-L.L 987 kW each **2961 kW** gross output	Hickory, NC USA
Fermic	Natural gas	2000	Genset	2 JMS 620GS-L.L 2085 kW each **4170 kW** gross output	Mexico City, Mexico
GE-SECCO	Well head gas	2001	Gensets	3 JGS 616 GS-B.L 1677 kW each **5031 kW** gross output	Buenos Aires, Argentina
GE-Spartech	Natural gas	2001	Gensets	2 JGS 616 GS-N.L 1912 kW each **3824 kW** gross output	California USA
GEER-Clark Public Utility	Natural gas	2001	Container Gensets	50 JGC 320 GS-N.L 1060 kW each **53000 kW** gross output	Vancouver, WA USA
GEER-Cowlitz	Natural gas	2001	Container Gensets	6 JGC 320 GS-N.L 1060 kW each **6360 kW** gross output	Long View, WA USA
GE-Tesoro	Natural gas	2001	Container Gensets	18 JGC 320 GS-N.L 1060 kW each **19080 kW** gross output	Anacortes, WA USA
GE-Springfield	Natural gas	2001	Gensets	5 JGS 616 GS-N.L 1912 kW each **9560 kW** gross output	Springfield, OR USA
GE-El Cap	Natural gas	2001	Gensets	10 JGS 616 GS-N.L 1912 kW each	Washington USA

				19120 kW gross output	
GE-ITT Canon	Natural gas	2001	Gensets	3 JGS 616 GS-N.L 1912 kW each **5736 kW** gross output	Santa Ana, California USA
WWTP-Littelton Englewood	Sewer gas	1999	Cogen	2 JMS320GS-B.L 907 kW each **1814 kW** gross output	Denver, CO USA
WWTP-El Paso	Natural Gas	1998	Direct Drive Blowers	2 JCS316GS-N.LC 650 kW each **1300 kW** gross output	El Paso, TX USA
WWTP-Liverpool	Natural Gas	2001	Cogen	2 JMS 320 GS N.L 1023 kW each **2046 kW** gross output	Liverpool, OH USA
Loctite Corp.	Natural Gas	1993	Cogen	2 JMS316GS-N.LC 650 kW each **1300 kW** gross output	Rocky Hill, CT USA
Marina Landfill 1 + 2	Landfill gas	1996/1998	Genset	2 JMS 320 GS-L.L 987 kW each **1974 kW** gross output	Marina, CA USA
Marina Landfill 3	Landfill gas	2001	Genset	1 JMS 320 GS-L.L 1060 kW **1060 kW** gross output	Marina, CA USA
Maxim Energy	Natural gas	2001	Container Gensets	25 JGC 320 GS-N.L 1060 kW each **26500 kW** gross output	Calgary, Alberta Canada
RTC Lyons / Shelton/Pontiac Biodyne	Landfill gas	1996	Container Genset	5 JGC320GS-L.L 987 kW each **4935 kW** gross output	Chicago, IL USA
RTC 31st Street Biodyne	Landfill gas	2001	Genset	4 JGS 616 GS-L.L 1677 kW each **6708 kW** gross output	Chicago, IL USA
RTC Des Plaines Biodyne	Landfill gas	2001	Genset	4 JGS 616 GS-L.L 1677 kW each **6708 kW** gross output	Chicago, IL USA
Santee Cooper	Landfill Gas	2001	Container Gensets	2 JGS 320 GS-L.L 1060 kW each **2120 kW** gross output	Monks Corner, SC USA
Valley Medical Ctr	Natural Gas	1997	Gensets	4 JGS320 NG 907 kW each	Renton, WA USA

				3628 kW gross output	
Winnebago Landfill	Landfill Gas	1999	Container Gensets	3 JGS 320 GS-L.L 987 kW each **2961 kW** gross output	Oshkosh, WI USA
Wellesley College I	Natural Gas	1993	Cogen	4 JMS 616 GS-N.LC 1400 kW each **5600 kW** gross output	Wellesley, MA USA
Wellesley College II	Natural Gas	1998	Cogen	1 JMS 616 GS-N.LC 1941 kW **1941 kW** gross output	Wellesley, MA USA
ZAPCO 1 Romeoville	Landfill Gas	1997	Container Gensets	1 JGC 320GS-L.L 987 kW **987 kW** gross output	Romeoville, IL USA
ZAPCO 1 122nd Street	Landfill Gas	1997	Container Gensets	4 JGC 320GS-L.L 987 kW each **3948 kW** gross output	Chicago, IL USA
ZAPCO 2 Dixon Zapco Allied-Lee Landfill	Landfill Gas	1998	Container Gensets	3 JGC 320GS-L.L 987 kW each **2961 kW** gross output	Dixon, IL USA
ZAPCO 3 Brickyard	Landfill Gas	1998	Container Gensets	3 JGC 320GS-L.L 987 kW each **2961 kW** gross output	Danville, IL USA
ZAPCO 4/1 Roxanna	Landfill Gas	1999	Container Gensets	4 JGC 320GS-L.L 987 kW each **3948 kW** gross output	Roxanna, IL USA
ZAPCO 3/2 Streator	Landfill Gas	1999	Container Gensets	2 JGC 320GS-L.L 987 kW each **1974 kW** gross output	Streator, IL USA
Zapco 4/2 Upper Rock	Landfill Gas	1999	Container Gensets	3 JGC 320GS-L.L 987 kW each **2961 kW** gross output	Upper Rock, IL USA
Zapco – Dolton	Landfill Gas	2001	Gensets	5 JGS 320 GS-L.L 1060 kW each **5300 kW** gross output	Dolton, IL USA
				Total kW 231173 **Total engines 197**	