CAD 21 Ltd
Unit 12, Berrymoor Court,
Northumberland Business Park
Newcastle upon Tyne
NE23 7RZ
Tel: 0191 250 2211

South Tyneside NHS
NHS Foundation Trust

South Shields General Hospital – New Energy Centre

PLANNING SUBMISSION – Chimney Height

Rev C1

24th July 2018

1.0 INTRODUCTION

This document has been produced in collaboration with Malones to assist with gaining approval of the proposed Chimney height which forms a planning requirement for the new Energy Centre currently being built on the grounds of South Tyneside General Hospital.

The Chimney height requires approval from an Environmental Health Officer (EHO) before an order can be placed and as such this element is time sensitive to the project.

The pre-fabricated multi-core Chimney comprises; external windshield, 6No. individual flue liners, Y-spar ladder with fall arrest system, 2No. internal platforms for inspection of the flue liners and windshield, internal LED lighting, lightning protection earth bosses and external steeple jack access bosses at 1.5m intervals up the full height of the chimney.

Each internal flue liner is also provided with a clean out door.

The windshield (the outer sheath of the chimney) is to be shot blasted to a RAL 7035 (grey) with the top 2 meters to be finished in an acid resistant black resin.

2.0 METHODOLOGY

The chimney height has been based on D1 calculation.

The nearest building is Ward 17 and it is 15meter high.

The thermal plant comprises;

- 4MW LTHW Boiler – dual fuel
- 4MW LTHW Boiler – dual fuel
- 7 tonne Steam Boiler – dual fuel
- 3.5 tonne Steam Boiler – dual fuel
- 3.5 tonne Steam Boiler – dual fuel
- 532kWe Combined Heat and Power Unit – gas only

All boilers are dual fuel, capable of burning either natural gas or 35 second gas oil; therefore, 2 scenarios have been evaluated;

- Normal operation – all duty/priming* gas fired plant in operation
- Back-up operation – all duty/priming* fuel oil fired plant in operation

*The 7tonne steam boiler provides resilience to both the LTHW (by means of a steam to LTHW plate heat exchanger) and Steam Systems i.e. this boiler is only active if one other boiler is down for maintenance; therefore, the worst case is if one of the 3.5tonne steam boilers is down for maintenance. For clarity see table below for details;

PLANT	NATURAL GAS SCENARIO	FUEL OIL SCENARIO	COMMENT
4MW LTHW Boiler	On	On	-
4MW LTHW Boiler	On	On	-
7 tonne Steam Boiler	On	On	Providing the back up to the 3.5tonne steam boiler
3.5 tonne Steam Boiler	On	On	-
3.5 tonne Steam Boiler	Off	Off	Down for maintenance
532kWe CHP Unit	On	Off	Gas only

3.0 RESULTS

The D1 calculation provided the following results;

Scenario 1 Natural Gas: 17meters
Scenario 2 Fuel Oil: 20 meters

Refer to the appendix for the detailed calculations including supporting evidence and Chimney drawings.

4.0 CONCLUSION

To protect against any event the current proposal shall be based on scenario 2 i.e. Chimney height of 20 meters.

To guarantee the performance and payback of the Combined Heating and Power Unit the thermal plant shall be run on natural gas whenever possible. The back-up fuel source, 35 second gas oil, will only be used in an emergency during a gas outage.

5.0 APPENDIX

- D1 calculation Natural Gas
- D1 calculation Fuel Oil
- STGH DM4000LN data – LTHW Boiler performance data
- STGH YSXALN7000IE data – 7tonne Steam Boiler performance data
- STGH YSXALN3500IE data – 3.5tonne Steam Boiler performance data
- E530M (250NOx) Technical Datasheet – CHP performance data
- Flue Fabrication Drawing
- Flue Design Drawing

Exhaust Discharge Height Calculation To D1

Project:- **STDH Energy Centre**
Customer:-
Engineer:-
Cal.Ref.:- **Gas Blrs - Scenario 1**
Quote.Ref.:-
Date.:- **20/07/2018** **Page 1**

Jeremias UK Ltd, Unit 2-4 Long Stoop Way
Crown Farm Industrial Estate, Mansfield
Nottinghamshire, NG19 0FQ
Tel:01623 8899219 Fax:423733
sales@jeremias-fluesystems.co.uk
www.jeremias-fluesystems.co.uk

Exhaust Ref.:-	**1**	**2**	**3**	**4**	**5**	**6**
Input Details:-						
Appliance Type.	CHP	Boiler	Boiler	Boiler	Boiler	Boiler
Make.	CHP	Byworth	Byworth	Byworth	Byworth	Byworth
Model.		DM4000LN	DM4000LN	YSXALN7000I	YSXALN3500I	YSXALN3500I
Fuel Type.	N.Gas	N.Gas	N.Gas	N.Gas	N.Gas	N.Gas
Fuel Su%.	0.0	0.0	0.0	0.0	0.0	0.0
Exh.Gas Flow.	2924.0	7668.0	7668.0	7776.0	3960.0	3960.0
Exh.Gas Units.	kg/hr	m3/hr	m3/hr	m3/hr	m3/hr	m3/hr
Exh.Gas Temp(in).(C)	120	154	154	122	129	129
Exh.Gas Temp(exit).(C)	110	141	141	110	110	110
Exh.Exit Dia.(mm)	300	550	500	700	600	600
Exh.Gas Emm. NO	225	95	95	95	95	95
Exh.NO Units	mg/Nm3(dry) @5%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2
Exh.Gas Emm. NO2	25	5	5	5	5	5
Exh.NO2 Units	mg/Nm3(dry) @5%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2
Exh.Gas %H2O	11.0	16.0	16.0	16.0	16.0	16.0
Exh.Gas %O2	10.0	4.0	4.0	4.0	4.0	4.0
Appliance Input	1512.0	4761.0	4761.0	5141.0	2580.0	2580.0
App.Input Units	kw(gross.Cv)	kw(gross.Cv)	kw(gross.Cv)	kw(gross.Cv)	kw(gross.Cv)	kw(gross.Cv)

Location:- Major city center / Heavy industrial area.

	SO2	NO	NO2	CO	SPM
Guideline Con.s(mg/m3)	0.44	1.0	0.2	57.0	0.3
Background Con.s(mg/m3)	0.16	0.4	0.17		0.4

Exhaust Discharge Height Calculation To D1

jeremias CHIMNEY SYSTEMS

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Crown Farm Industrial Estate, Mansfield
Nottinghamshire, NG19 0FQ
Tel:01623 8899219 Fax:423733
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Project:- **STDH Energy Centre**
Customer:-
Engineer:-
Cal.Ref.:- **Gas Blrs - Scenario 1**
Quote.Ref.:-
Date.:- **20/07/2018** **Page 1**

Exhaust Ref.:-	**1**	**2**	**3**	**4**	**5**	**6**
Results:-						
Appliance Status	ON	ON	ON	ON	ON	OFF
Exh.Gas Vol. @ Exit(M3/s)	0.93	2.07	2.07	2.09	1.05	0.0
Exh.Gas Vel. @ Exit(m/s)	13.16	8.69	10.52	5.44	3.71	0.0
Exh.Gas Emm. NO(g/s)	0.091	0.1026	0.1026	0.1125	0.0563	0.0
Exh.Gas Emm. NO2(g/s)	0.0101	0.0054	0.0054	0.0059	0.003	0.0
Exh.Gas Emm. CO(g/s)	0.3034	0.0676	0.0406	0.0445	0.0371	0.0
Pollution Index NO	152	171	171	187	94	
Pollution Index NO2	337	180	180	197	99	
Pollution Index CO	5	1	1	1	1	
Heat Release Q(MW)	0.08	0.23	0.23	0.19	0.09	0.0
Exit Momentum M(m^4/s)	9.04	12.27	14.85	8.42	2.87	0.0
Um(m)	2.33	1.83	1.94	1.62	1.43	0.0
Um/2(m)	1.17	0.91	0.97	0.81	0.72	0.0
5Um(m)	11.65	9.15	9.72	8.11	7.17	0.0
Method of Calculation	Single Source					
Pollution Index	993					
Total Q(MW)	0.82					
Total M(m^4/s)	47.45					
Ub(m)	2.37					
Um(m)	2.82					
5Um(m)	14.1					
No of Buildings	1					
No. 1Height / Width	15.0x >Ht					
Hm	15.0					
Tm						
Calculated Height C(m)	17.0					
Adj.for Min. Requirements(m)	0.0					
Final Discharge Height(m)	**17.0**					
(Above ground level.)						

Comments:

1. The final chimney height of all chimneys must be approved by the Local Environmental Health Department who may specify a further adjustment in overall height in light of particular local circumstances.

CE HETAS Constructionline SafeContractor APPROVED CHAS BFCMA BRITISH FLUE & CHIMNEY MANUFACTURERS ASSOCIATION

Exhaust Discharge Height Calculation To D1

Project:- **STDH Energy Centre**
Customer:-
Engineer:-
Cal.Ref.:- **Oil Blrs Scenario 2_1**
Quote.Ref.:-
Date.:- **20/07/2018** **Page 1**

Jeremias UK Ltd, Unit 2-4 Long Stoop Way
Crown Farm Industrial Estate, Mansfield
Nottinghamshire, NG19 0FQ
Tel:01623 8899219 Fax:423733
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Exhaust Ref.:-	**1**	**2**	**3**	**4**	**5**	**6**
Input Details:-						
Appliance Type.	CHP	Boiler	Boiler	Boiler	Boiler	Boiler
Make.	CHP	Byworth	Byworth	Byworth	Byworth	Byworth
Model.		DM4000LN	DM4000LN	YSXALN7000I	YSXALN3500I	YSXALN3500I
Fuel Type.	N.Gas	Gas Oil	Gas Oil	Gas Oil	Gas Oil	Gas Oil
Fuel Su%.	0.0	0.1	0.1	0.1	0.1	0.1
Exh.Gas Flow.	2924.0	4979.0	4979.0	7776.0	3960.0	3960.0
Exh.Gas Units.	kg/hr	Nm3/hr	Nm3/hr	m3/hr	m3/hr	m3/hr
Exh.Gas Temp(in).(C)	120	148	148	121	127	127
Exh.Gas Temp(exit).(C)	110	141	141	110	110	110
Exh.Exit Dia.(mm)	300	550	550	700	600	600
Exh.Gas Emm. NO	225	190	190	190	190	190
Exh.NO Units	mg/Nm3(dry) @5%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2
Exh.Gas Emm. NO2	25	10	10	10	10	10
Exh.NO2 Units	mg/Nm3(dry) @5%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2	mg/Nm3(dry) @3%O2
Exh.Gas %H2O	11.0	10.0	10.0	10.0	10.0	10.0
Exh.Gas %O2	10.0	5.0	5.0	5.0	5.0	5.0
Appliance Input	1512.0	4558.0	4558.0	4931.0	2473.0	2473.0
App.Input Units	kw(gross.Cv)	kw(gross.Cv)	kw(gross.Cv)	kw(gross.Cv)	kw(gross.Cv)	kw(gross.Cv)

Location:- Major city center / Heavy industrial area.

	SO2	NO	NO2	CO	SPM
Guideline Con.s(mg/m3)	0.44	1.0	0.2	57.0	0.3
Background Con.s(mg/m3)	0.16	0.4	0.17		0.4

Exhaust Discharge Height Calculation To D1

Project:- **STDH Energy Centre**
Customer:-
Engineer:-
Cal.Ref.:- **Oil Blrs Scenario 2_1**
Quote.Ref.:-
Date.:- **20/07/2018** **Page 1**

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Exhaust Ref.:-	**1**	**2**	**3**	**4**	**5**	**6**
Results:-						
Appliance Status	OFF	ON	ON	ON	ON	OFF
Exh.Gas Vol. @ Exit(M3/s)	0.0	2.1	2.1	2.1	1.05	0.0
Exh.Gas Vel. @ Exit(m/s)	0.0	8.83	8.83	5.46	3.73	0.0
Exh.Gas Emm. SO2(g/s)	0.0	0.1999	0.1999	0.2163	0.1085	0.0
Exh.Gas Emm. NO(g/s)	0.0	0.2101	0.2101	0.2273	0.114	0.0
Exh.Gas Emm. NO2(g/s)	0.0	0.0111	0.0111	0.012	0.006	0.0
Exh.Gas Emm. CO(g/s)	0.0	0.0692	0.0692	0.0749	0.0376	0.0
Exh.Gas Emm. g/s)	0.0	0.0	0.0	0.0	0.0	0.0
Pollution Index SO2		714	714	772	387	
Pollution Index NO		350	350	379	190	
Pollution Index NO2		369	369	399	200	
Pollution Index CO		1	1	1	1	
Heat Release Q(MW)	0.0	0.23	0.23	0.19	0.09	0.0
Exit Momentum M(m^4/s)	0.0	12.66	12.66	8.46	2.9	0.0
Um(m)	0.0	3.73	3.73	4.7	4.16	0.0
Um/2(m)	0.0	1.87	1.87	2.35	2.08	0.0
5Um(m)	0.0	18.66	18.66	23.51	20.78	0.0
Method of Calculation	Single Source					
Pollution Index	2588					
Total Q(MW)	0.74					
Total M(m^4/s)	36.68					
Ub(m)	3.84					
Um(m)	6.75					
5Um(m)	33.73					
No of Buildings	1					
No. 1Height / Width	15.0x >Ht					
Hm	15.0					
Tm						
Calculated Height C(m)	20.02					
Adj.for Min. Requirements(m)	0.0					
Final Discharge Height(m)	**20.0**					
(Above ground level.)						

Comments:

1. The final chimney height of all chimneys must be approved by the Local Environmental Health Department who may specify a further adjustment in overall height in light of particular local circumstances.

DALESMAN HOT WATER MODEL	DM	4000	LT	LN
REQUIRED BOILER MAXIMUM OUTPUT	kW	4000		
WATER FLOW TEMPERATURE FROM BOILER	DegC	95		
WATER RETURN TEMPERATURE INTO BOILER	DegC	75		
Water Flow Rate Through Boiler	kg/hr	171983		
	L/sec	47.77		
Standard Flow and Return Connection Size	mm	150		
Customer Connection Sizes if Different	mm	150		
Boiler Operating Pressure	barg	3	43.5	psig
Ambient Air Temp	degC	21		

FUEL HEATING VALUES

GASEOUS FUEL

NATURAL GAS

GCV	52.97 *Mj/kg*	40.55 MJ/Ncu mtre
NCV	47.75 *Mj/kg*	36.55 MJ/Ncu mtre

LIQUID FUEL

CLASS A2 AND D -FUEL OIL

GCV	46.89 *Mj/kg*	40.22 Mj/litre
NCV	43.98 *Mj/kg*	37.73 Mj/litre

BOILER PERFORMANCE			CLASS A2 AND D -FUEL OIL					NATURAL GAS					
Load		%	100	75	50	25	20	100	75	50	25	15	
		kw	4000	3000	2000	1000	800	4000	3000	2000	1000	600	
Nett Furnace Heat Release		mw/m^3	**1.237**	**0.927**	**0.618**	**0.311**	**0.250**	**1.246**	**0.933**	**0.622**	**0.313**	**0.190**	
Nett Heat Input		mw	**4.295**	**3.218**	**2.145**	**1.079**	**0.868**	**4.327**	**3.241**	**2.162**	**1.088**	**0.661**	
Gross Furnace Heat Release		mw/m3	**1.312**	**0.983**	**0.655**	**0.330**	**0.265**	**1.371**	**1.027**	**0.685**	**0.345**	**0.209**	
Front Smoke BoxTemperature		deg C	327	295	256	203	190	353	319	276	218	185	
Boiler Outlet Temperature		deg C	148	138	126	112	109	154	143	130	115	107	
			Exhaust Temp at or near Dew Point					Exhaust Temp at or near Dew Point					
Combustion Products	CO2	%	12.50	12.00	11.50	11.00	10.50	10.30	9.80	9.20	8.50	8.30	
	O2	%	3.80	4.49	5.17	5.86	6.55	2.66	3.55	4.62	5.87	6.22	
Total Gas Weight		kg/h	6438	5004	3466	1814	1524	6338	4958	3493	1886	1170	
Max CO_2 Emissions		kg/hr	1100					862					
Boiler Efficiency on GCV		%	88.12	88.26	88.37	88.15	87.77	84.36	84.51	84.60	84.31	83.72	EN12953
Boiler Efficiency on NCV		%	93.90	94.04	94.15	94.00	93.59	93.50	93.66	93.75	93.52	92.84	EN12953
Total Draught Loss		inchwg	3.87	2.30	1.09	0.29	0.21	3.97	2.38	1.16	0.33	0.09	
		mbar	9.67	5.75	2.72	0.74	0.53	9.92	5.96	2.90	0.83	0.22	
Combustion air volume		Sm^3/s	1.379	1.074	0.746	0.391	0.329	1.363	1.068	0.755	0.409	0.254	
Exit Gas Volume from Boiler		Am^3/s	2.130	1.616	1.088	0.549	0.458	2.130	1.623	1.109	0.575	0.350	
		Nm^3/s	1.383	1.07475	0.7444	0.3897	0.327	1.361	1.065	0.750	0.405	0.251	
Fuel consumption		kg/h	349.93	262.20	174.77	87.89	70.76	323.56	242.42	161.66	81.38	49.44	kg/h
		litre/h	407.85	305.60	203.70	102.44	82.47	446.18	334.28	222.92	112.22	68.18	Sm^3/h
								422.75	316.73	211.21	106.32	64.60	Nm^3/h
	kWhr	Gross	4557.5	3414.9	2276.3	1144.7	921.5	4760.5	3566.6	2378.4	1197.3	727.45	kWhr Gross
HydraulicPressure Drop across Boiler for Actual Connection Sizes		mbar	122	4.1	ft head								
Duct / chimney size @ velocity of 12 m/s and 15m/s			470	420	mm I/Dia								
Actual Chimney Connection Size			493		mm I/Dia								

Dalesman Boiler Performance Data

YORKSHIREMAN LOW NOX MODEL	YSLN	7000	IE

Boiler working pressure	barg	6.9	100.05	psig
Saturation Temperature	degC	169.9		
Ambient Air Temp	degC	21		

REQUIRED BOILER DUTY 7000						
	Percentage Load	%	100	75	50	25
	Heat Output	kw	4389.5	3292.1	2194.7	1097.4
	F&A 100DegC	kg/h	7000	5250	3500	1750
		lb/h	15435	11576	7717.5	3858.8
Actual Boiler Output with Feed Water		kg/hr	6550.3	4912.7	3275.1	1637.6
Temperature of 85	degC	lb/hr	14443	10833	7221.7	3610.8

FUEL HEATING VALUES

Natural Gas			
GCV	52.97	*Mj/kg*	40.5 MJ/Ncu mtre
NCV	47.75	*Mj/kg*	36.6 MJ/Ncu mtre
ClassA2 and D-Fuel Oil			
GCV	46.89	*Mj/kg*	
NCV	43.98	*Mj/kg*	

BOILER PERFORMANCE		ClassA2 and D-Fuel Oil				Natural Gas			
Percentage Load	%	100	75	50	25	100	75	50	25
Nett Heat Release	mw/m^3	**1.12**	**0.90**	**0.60**	**0.30**	**1.13**	**0.93**	**0.63**	**0.32**
Nett Heat Input	mw	**4.65**	**3.71**	**2.48**	**1.26**	**4.67**	**3.87**	**2.59**	**1.32**
Gross Heat Release Rate	mw/m^3	**1.19**				**1.24**			
Front Smoke BoxTemperature	deg C	310	287	259	224	327	301	271	233
Boiler Outlet Temperature	deg C	187	183	178	174	190	185	180	174
ECONOMISER FITTED TO BOILER ROWS 6		Exhaust Temp approaching Acid Dew Pnt							
Economiser Gas Outlet Temperature	degC	121	119	117	117	122	120	117	117
Econ Feed Water Outlet Temperature	degC	103	103	103	103	104	104	104	104
Economiser Duty	kW	148	111	74	36	148	111	74	36
Total Gas Weight	kg/h	6964	5433	3781	1995	6945	5374	3806	2072
Max CO_2 Emissions	kg/hr	1190				944			

Boiler Efficiency on GCV with Econ	%	90.79	90.64	90.31	89.46	88.03	87.91	87.59	86.81	EN12953
Boiler Efficiency on NCV with Econ	%	95.40	95.19	94.80	93.71	95.30	95.08	94.64	93.46	EN12953

Total Draught Loss	inchwg	5.91	3.35	1.62	0.46	6.02	3.45	1.72	0.51
	mbar	14.77	8.39	4.05	1.14	15.07	8.64	4.29	1.27
Combustion air volume	Sm^3/s	1.49	1.17	0.81	0.43	1.49	1.16	0.82	0.45
Exit Gas Volume from Economiser	Am^3/s	2.16	1.67	1.16	0.61	2.16	1.66	1.17	0.64

Fuel consumption									
	kg/h	378.51	284.65	190.64	96.63	349.33	262.77	176.13	89.44	kg/h
	litre/h	440.88	331.55	222.05	112.56	481.71	362.35	242.87	123.33	Sm^3/h
						456.41	343.32	230.12	116.85	Nm^3/h
	kWhr Gross	4930.8	3708.1	2483.5	1258.8	5140.7	3866.9	2591.9	1316.2	kWhr Gross

Steam Release Area	m^2	9.19	Duct / chimney size @ velocity of 12 m/s	mm	478	inside diameter
Steam Release Rate	m/sec	0.0482	Duct / chimney size @ velocity of 15 m/s	mm	428	inside diameter

Yorkshireman Boiler Performance Data

YORKSHIREMAN LOW NOX MODEL			YSLN	3500	IE
Boiler working pressure	barg	6.9	100.05	psig	
Saturation Temperature	degC	169.9			
Ambient Air Temp	degC	21			

REQUIRED BOILER DUTY 3500			100	75	50	25
	Percentage Load	%				
	Heat Output	kw	2194.7	1646	1097.4	548.68
	F&A 100DegC	kg/h	3500	2625	1750	875
		lb/h	7717.5	5788.1	3858.8	1929.4
Actual Boiler Output with Feed Water Temperature of 85 degC		kg/hr	3275.1	2456.4	1637.6	818.8
		lb/hr	7221.7	5416.3	3610.8	1805.4

FUEL HEATING VALUES		
Natural Gas		
GCV	52.97 Mj/kg	40.5 MJ/Ncu mtre
NCV	47.75 Mj/kg	36.6 MJ/Ncu mtre
ClassA2 and D-Fuel Oil		
GCV	46.89 Mj/kg	
NCV	43.98 Mj/kg	

BOILER PERFORMANCE		ClassA2 and D-Fuel Oil				Natural Gas			
Percentage Load	%	100	75	50	25	100	75	50	25
Nett Heat Release	mw/m^3	**1.14**	**0.91**	**0.61**	**0.31**	**1.15**	**0.95**	**0.64**	**0.32**
Nett Heat Input	mw	**2.33**	**1.86**	**1.24**	**0.63**	**2.34**	**1.94**	**1.30**	**0.66**
Gross Heat Release Rate	mw/m^3	**1.21**				**1.27**			
Front Smoke BoxTemperature	deg C	363	334	300	253	388	355	317	267
Boiler Outlet Temperature	deg C	206	198	189	179	210	201	192	181
ECONOMISER FITTED TO BOILER ROWS 6		Exhaust Temp approaching Acid Dew Pnt							
Economiser Gas Outlet Temperature	degC	127	124	121	120	129	125	121	120
Econ Feed Water Outlet Temperature	degC	107	106	106	104	108	107	106	105
Economiser Duty	kW	87	64	41	19	87	64	41	19
Total Gas Weight	kg/h	3493	2723	1894	999	3485	2695	1907	1038
Max CO_2 Emissions	kg/hr	**597**				**474**			
Boiler Efficiency on GCV with Econ	%	90.47	90.36	90.10	89.31	87.75	87.68	87.41	86.71 EN12953
Boiler Efficiency on NCV with Econ	%	95.00	94.83	94.50	93.45	94.85	94.69	94.31	93.19 EN12953

Total Draught Loss	inchwg	4.29	2.37	1.14	0.32	4.34	2.44	1.21	0.35	
	mbar	10.74	5.93	2.84	0.79	10.86	6.11	3.02	0.88	
Combustion air volume	Sm^3/s	0.75	0.58	0.41	0.22	0.75	0.58	0.41	0.22	
Exit Gas Volume from Economiser	Am^3/s	1.10	0.85	0.59	0.31	1.10	0.84	0.59	0.32	
Fuel consumption	kg/h	189.84	142.69	95.50	48.37	175.29	131.78	88.26	44.78	**kg/h**
	litre/h	221.12	166.20	111.24	56.34	241.72	181.72	121.71	61.75	Sm^3/h
						229.02	172.18	115.32	58.51	Nm^3/h
	kWhr Gross	2473.0	1858.8	1244.1	630.1	2579.5	1939.3	1298.9	659.0	kWhr Gross

Steam Release Area	m^2	5.58	Duct / chimney size @ velocity of 12 m/s	mm	342	inside diameter
Steam Release Rate	m/sec	0.0397	Duct / chimney size @ velocity of 15 m/s	mm	306	inside diameter

Yorkshireman Boiler Performance Data

Technical Datasheet

E530M 250NOx Natural Gas CHP Unit

Energy Balance and Load Data at Power Factor 1		Units	100%	75%***	50%***
Electrical Output	(+/-3%)	kW	520	390	260
Electrical Efficiency (Net)	(+/-5%)	%	38.0%	37.3%	35.9%
Heat Output	(+/-10%)	kW	687	534	374
Thermal Efficiency (Net)	(+/-8%)	%	50.3%	51.1%	51.7%
Fuel Input (Net / Gross)*	(+/-5%)	kW	1367 / 1512	1045 / 1156	724 / 801
Total Efficiency (Net)	(+/-8%)	%	88.3%	88.4%	87.6%
Heat Output from Jacket Water	(+/-7%)	kW	358	267	181
Heat Output from Exhaust Gas @ Outlet Temp.	(+/-7%)	kW	329	267	193
Aftercooler Heat Output	(+/-7%)	kW	38	29	19
Radiated Heat Output	(+/-7%)	kW	55	32	20
Combustion Air Flow (30 °C, 100 kPa, 30% RH)**	(+/-5%)	m^3/h	2426	1833	1239
Fuel Mass Flow (ρ = 0.75kg/Nm³)	(+/-5%)	kg/h	102.5	78.4	54.3
Fuel Volume Flow (LHV = 10kWh/Nm³)	(+/-5%)	Nm3/h	136.7	104.5	72.4
Exhaust Mass Flow (Wet)	(+/-5%)	kg/h	2924	2210	1495
Exhaust Volume Flow @ Outlet Temp.	(+/-5%)	m^3/h	3257	2461	1665

*Natural gas Net and Gross fuel input figures are based on 36MJ/Nm3 and 39.8MJ/Nm3 respectively. The Gross figure is used when establishing UK fuel costs. Net figures are provided for ease of performance comparison with other technologies. Fuel must comply with engine manufacturer's fuel quality guide, supplied seperately.

**Engine technical data is based on Standard Conditions according to DIN ISO 3046-1 but engine de-rate applies when Combustion Air Temperature is >25°C.

*** If operating at part load for long periods of time, the unit should be run at full load for at least 5 hours in a given 24 hour period.

Engine Details

Manufacturer	MAN
Model	E 3262 LE 202
Fuel Type	Natural Gas
Min. Methane Number	80
Cylinders	12
Aspiration	Turbocharged
Speed rpm	1500
Aftercooler	Yes

Hot Water Details

Max. Water In/Out Temp. °C	78/90°C
Max. Water Flow Rate* l/s	14.09
Max. Glycol Content %	30
Connection Size mm	100
Flange Type	PN16
Pressure Loss** kPa	28.9
Max. Test Pressure Bar	9.75

* Assuming Cp = 4.2 kJ/kg·K and ρ = 968.55 kg/m³

** Pressure loss figures stated are at max. water flow rate. Internal unit only.

Exhaust Details

Connection Size	mm	250
Flange Type		PN10
Outlet Temp***.	°C	120
Allowable Backpressure	Pa	1300
Allowable Backpressure with Catalyst	Pa	TBC

*** For engines with exhaust bypass, please request exhaust bypass temp. from ECPL.

Ventilation Details

Connection Size	mm	710
Ventilation Rate****	m^3/s	5.39
Max. Air Inlet Temp.	°C	30
Max. Air Outlet Temp.	°C	45
Enclosure Pressure Drop	Pa	210

**** Vent rate is stated at max. air outlet temp, 100kPa

Aftercooler Details

Max. Water Inlet Temp.	°C	42
Water Flow Rate	l/s	1.85
Connection Size	mm	40
Flange Type		PN16
Pressure Loss	kPa	200
Max. Test Pressure	Bar	6
Ethylene Glycol Content	%	45

Generator Details

Manufacturer		Stamford
Model		HCI634H-311
Type		Synchronous
Rating	kVA	940
Voltage	V	400
Phase	Ph	3
Frequency	Hz	50
Protection Class		IP23
Rated Power Factor	PF	0.8
Xd Dir. Axis Synchronous		2.7
X'd Dir. Axis Transient		0.23
X"d Dir. Axis Sub-Transient		0.16
T" Sub-Transient Time Const.		0.025
T'do O.C Field Time Const.		2.44
CHP Protection Device	A/Ph	TBC
Indicative Client Protection Device	A/Ph	TBC
Current Per Phase @ 0.8PF	A	929
Current Per Phase @ 0.95PF	A	788
Efficiency @ 0.8PF	%	95.7%
Efficiency @ 0.95PF	%	96.5%
Indicative Main Cable Size [a] †	mm^2	TBC
Indicative Earth Cable Size [b] †	mm^2	TBC

[a] 4-Core XLPE/SWA/PVC to BS5467, Max 50 meters.

[b] 1-Core 6491B to BS7211, Max 50 meters.

† Sizes and lengths based on IET 17TH Edition BS7671, Installation method 31.

Fuel Details

Connection Size	mm	65
Flange Type		PN16
Min/Max. Supply Pressure	mbar	25/50

Emissions @ 5% O2

NOx	mg/Nm^3	250
CO	mg/Nm^3	700
NOx (With Catalyst)	mg/Nm^3	<N/A
CO (With Catalyst)	mg/Nm^3	<TBC

Weight Details

Enclosure (Dry) STD/PREM.	See Sales Drawing
Container (Dry) STD/PREM.	See Sales Drawing

Noise Data

Enclosure SPL @ 1m SN/LN	dB(A)	70/64.92
Container SPL @ 1m SN/LN	dB(A)	75/65

NB: Output figures are based on operation at DIN ISO 3046-1 conditions with the exception of exhaust output, which is quoted to 120°C/180°C for Natural Gas/Biogas respectively, figures are stated from manufacturer's declared performance figures subject to the manufacturer's tolerances and subject to change without notice. Values for de-rated units are estimates only. Energy balance data assumes perfect combustion. All information detailed is for guidance only and is subject to change without notice due to our commitment to continuous improvement - all values should be confirmed with ENER-G Combined Power Ltd on a project specific basis.

T: +44 161 745 7450
F: +44 161 745 7457
www.energ.co.uk

Edison House
2 Daniel Adamson Road, Salford
Manchester, M50 1DT, UK