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Consulting Engineers Limited

Lostock Sustainable Energy Plant

Lostock Sustainable Energy Plant Ltd

CHP-Ready Assessment

ENGINEERING + CONSULTING

Document approval

	Name	Signature	Position	Date
Prepared by:	Vildan Taylor	V. Taylor	Associate Senior Consultant	08/11/2021
Checked by:	James Sturman		Lead Consultant	08/11/2021

Document revision record

Revision no	Date	Details of revisions	Prepared by	Checked by
00	15/06/2021	First draft to the Client	VBT	JRS
01	08/11/2021	Updated for most recent turbine design	VBT	JRS

1 Introduction

1.1 Background

Lostock Sustainable Energy Plant Limited (LSEP Ltd) was granted an Environmental Permit (EP) on 16 December 2013 for a waste incineration facility (referred to as the 'Facility') at Lostock Gralam, Northwich (Ref: EPR/WP3934AK).

LSEP Ltd is now applying to vary the EP, to increase the capacity of the Facility and amend the arrangements stated within the EP for heat export, allowing for the evolution of the project since the EP was granted. Taking the proposed changes to the design and the heat export opportunities into consideration, a CHP ready assessment has been produced to support the application for the EP variation.

This CHP-Ready Assessment should be read in parallel with the Heat Demand Investigation which is provided in Appendix C of the EP application.

1.2 Objective

The principal objectives of the assessment are as follows.

1. Based on the heat loads anticipated for the outline solution identified in the Heat Demand Investigation (refer to Appendix C of the EP application), calculation of the relevant energy efficiency measures and demonstration of compliance with relevant legislative requirements.
2. Produce a CHP-Ready Assessment in accordance with the EA's guidance titled '*CHP Ready Guidance for Combustion and Energy from Waste Power Plants*' (herein referred to as the CHP-ready Guidance[1]), including a clear statement on best available techniques (BAT), combined heat and power (CHP) envelope and the CHP-Ready Assessment form.

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/296450/LIT_7978_e06fa0.pdf

2 Legislative Requirements

2.1 CHP-Ready Guidance

The EA published the CHP ready Guidance in February 2013. The guidance applies to new EfW plants with a throughput of more than 3 tonnes per hour of non-hazardous waste or 10 tonnes per day of hazardous waste. Whilst the Facility is not considered to be 'new' as it was granted an EP before the guidance was published, it is a waste incineration facility with a throughput of more than 3 tonnes per hour. When the application for the original EP was submitted, the Facility would have been classified as a CHP Plant with heat export to the adjacent Tata Chemical Europe (TCE) facility. However, due to the subsequent changes in TCE's heat demand, it will no longer be classified as a CHP facility. Therefore, the requirements of the CHP-ready Guidance will apply.

The EA requires developers to demonstrate BAT for a number of criteria, including energy efficiency. One of the principal ways of improving energy efficiency is through the use of CHP, for which three BAT tests exist. The first involves considering and identifying opportunities for the immediate use of heat off-site. Where this is not technically or economically possible, the second test involves ensuring that the plant is built to be CHP-ready. The third test involves carrying out periodic reviews to determine whether the situation has changed and if there are opportunities for heat use off site.

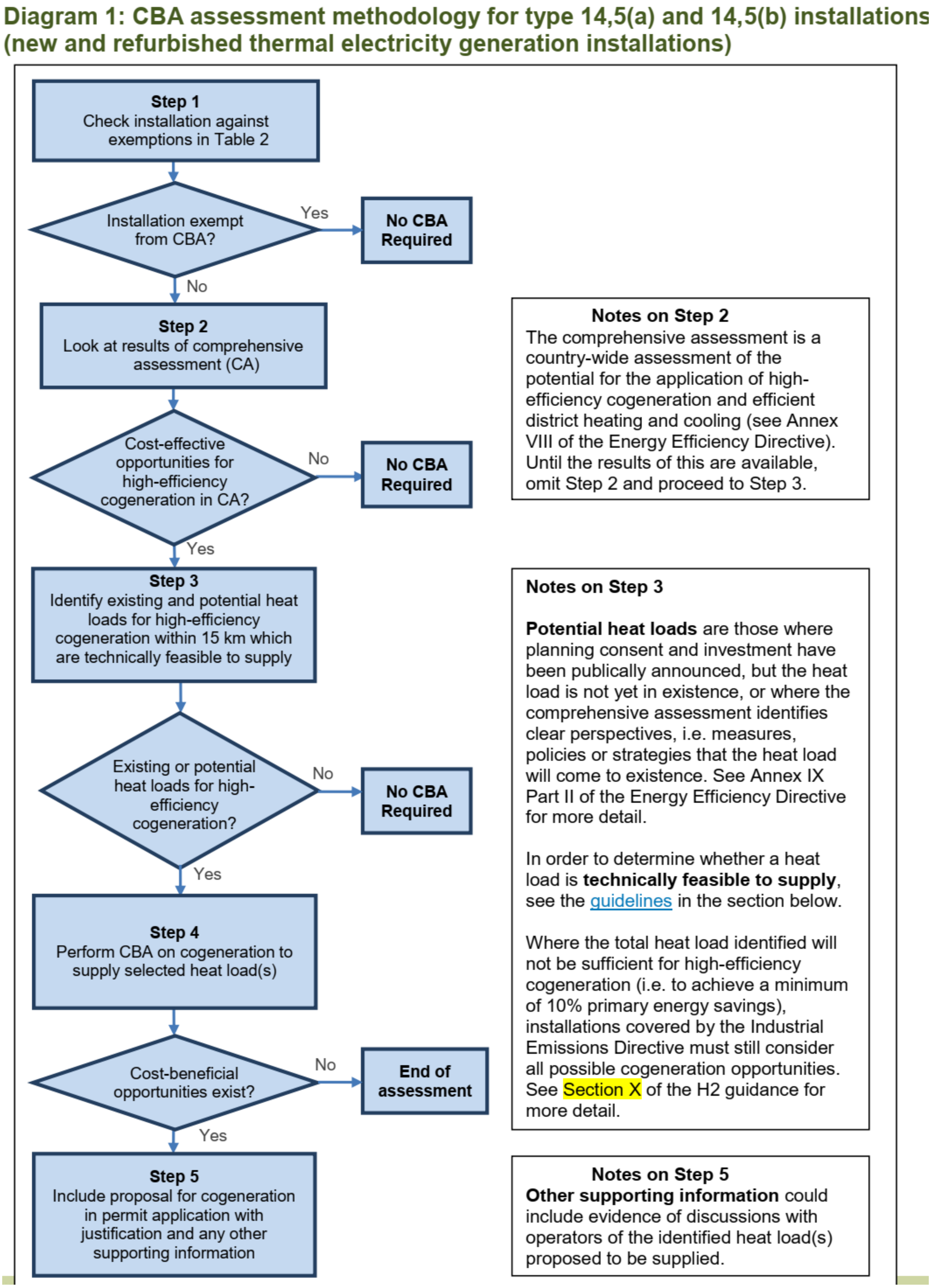
2.2 Energy Efficiency Directive

From 21 March 2015, operators of certain types of combustion installations are required to carry out a Cost Benefit Analysis (CBA) of opportunities for CHP when applying for an EP. This is a requirement under Article 14 of the Energy Efficiency Directive and applies to a number of combustion installation types. As a new electricity generation installation with a total aggregated net thermal input of more than 20 MWth, the Facility will be classified as an installation type 14.5(a).

In April 2015, the EA issued draft guidance on completing the CBA, entitled '*Draft guidance on completing cost-benefit assessments for installations under Article 14 of the Energy Efficiency Directive*'[2]. Figure 1 describes the process that must be followed for type 14.5(a) and 14.5(b) installations.

[2] Draft guidance on completing cost-benefit assessments for installations under Article 14 of the Energy Efficiency Directive, V9.0 April 2015

Figure 1: CBA methodology for type 14.5(a) and 14.5(b) installations



3 Energy Efficiency Calculations

3.1 Heat and Power Export

The Z ratio, which is the ratio of reduction in power export for a given increase in heat export, can be used to calculate the effect of variations in heat export on the electrical output of the Facility. A Z-ratio of 3.65 was obtained following the approach set out in CHPQA Guidance Note 28[3], assuming steam extraction at a pressure of 27.4 bar(a). This extraction pressure is considered sufficient to meet the requirements of the consumers that comprise the proposed heat network. The heat and power export has been modelled across a range of load cases and the results are presented in Table 1. If additional heat demand is identified in the future, the turbine could be changed if commercially and economically viable, to allow steam to be extracted at a lower pressure and maximise the Z ratio.

Table 1: Heat and power export

Load case	Heat export at turbine (MW_{th})	Gross power generated (MWe)	Net power exported (MW_e)	Z ratio
1. No heat export	0.0	76.9	69.9	N/A
2. Proposed network heat load	1.97	76.4	69.4	3.65
3. Maximum heat export capacity	18.02	72.0	65.0	3.65

The results indicate that for the heat consumers identified in the Heat Demand Investigation, route 2 corresponding to an average heat export of 1.97 MW_{th} will result in a net power export of 69.4 MW_e. Route 2 is identified as the most economically potential network.

3.2 CHPQA Quality Index

CHPQA is an energy efficiency best practice programme initiative by the UK Government. CHPQA aims to monitor, assess and improve the quality of CHP in the UK. In order to prove that a plant is a 'Good Quality' CHP plant, a QI of at least 105 must be at the design, specification, tendering and approval stages. Under normal operating conditions (i.e. when the scheme is operational) the QI threshold drops to 100. The QI for CHP schemes is a function of their heat efficiency and power efficiency according to the following formula:

$$QI = X\eta_{power} + Y\eta_{heat}$$

where: η_{power} = power efficiency; and

η_{heat} = heat efficiency.

The power efficiency within the formula is calculated using the gross electrical output and is based on the gross calorific value of the input fuel. The heat efficiency is also based on the gross calorific

[3] CHPQA Guidance Note 28, 2007

value of the input fuel. The coefficients X and Y are defined by CHPQA based on the total gross electrical capacity of the scheme and the fuel / technology type used.

In December 2018, the Government released a revised CHPQA Standard Issue 7. The document sets out revisions to the design and implementation of the CHPQA scheme. These revisions are intended to ensure schemes which receive Government support are supplying significant quantities of heat and delivering intended energy savings. The following X and Y coefficients apply to the Facility:

- X value = 221; and
- Y value = 120.

The QI and efficiency values (based on a gross calorific value of 11.1 MJ/kg) have been calculated in accordance with CHPQA methodology for various load cases and the results are presented in Table 2.

Table 2: QI and efficiency calculations

Load case	Gross power efficiency (%)	Heat efficiency (%)	Overall efficiency (%)	CHPQA QI
1. No heat export	27.41	0.00	27.41	60.3
2. Proposed network heat load	27.21	0.70	27.92	60.7
3. Maximum heat export capacity	25.65	6.42	32.07	64.1

The results indicate that the Facility will not achieve a QI score in excess of the 'Good Quality' CHP threshold (QI of 105 at the design stage) for the average heat load exported to the proposed heat network. The highly onerous efficiency criteria set out in the latest CHPQA guidance, most notably the underpinning requirement to achieve an overall efficiency (NCV basis) of at least 70%, means that none of the load cases considered will enable heat export from the Facility to be considered Good Quality.

For reference, assuming the same Z ratio as set out in the preceding section, an average heat export of 210 MW_{th}, i.e. 75% of the thermal input would be required for a heat network to achieve Good Quality status. Therefore, based on the local heat export opportunities, the Facility is not able to achieve Good Quality status.

3.3 Primary energy savings

To be considered high-efficiency cogeneration, the scheme must achieve at least 10 % savings in primary energy usage compared to the separate generation of heat and power. The PES has been calculated in accordance with European Commission Delegated Regulation (EU) 2015/2402 of 12 October 2015 Annex II part (b), using the following assumptions.

1. Annual nominal throughput capacity of 728,000 tonnes per annum based on an NCV of 9.5 MJ/kg with an annual design availability of 8,000 hours.
2. Nominal gross electrical output (expected capacity in fully condensing mode) of 76.9 MW_e.
3. Parasitic load of 7.0 MW_e.
4. Z ratio of 3.65.

5. Efficiency reference values for the separate production of heat and electricity have been taken as 80 % and 25 % respectively as defined in Commission Delegated Regulation (EU) 2015/2402 of 12 October 2015[4].

When operating in fully condensing mode (i.e. without heat export) the Facility will achieve a PES of 21.93 %. The inclusion of the average annual heat export of 1.97 MW_{th} at the design case level anticipated for the proposed heat network increases PES to 22.01 %. On this basis, the Facility will qualify as a high-efficiency cogeneration operation when operating in CHP mode.

[4] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015R2402

4 CHP-Ready BAT Assessment

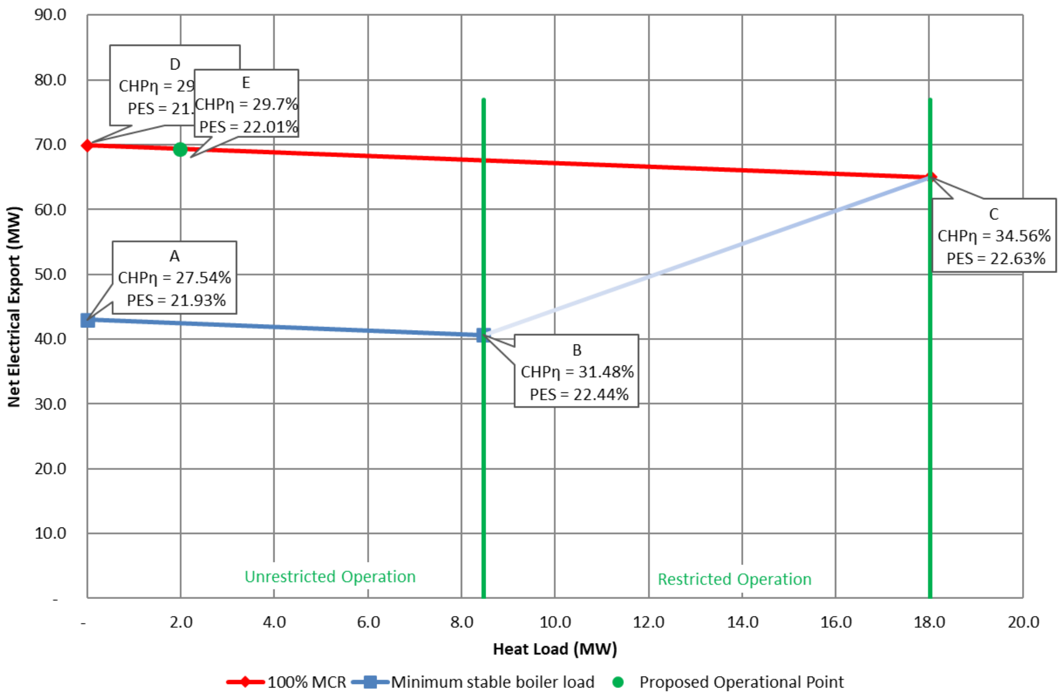
A CHP-Ready Assessment which considers the requirements of the CHP-ready Guidance has been completed and is provided in Appendix A.

The 'CHP envelope', as outlined under requirement 2 of the CHP-ready Guidance, identifies the potential operational range of a new plant where it could be technically feasible to operate electrical power generation with heat generation. The 'CHP envelope' for the Facility is provided in Figure 2.

The points defining the extent of the CHP envelope are as follows:

- A: minimum stable load (with no heat extraction).
- B: minimum stable load (with maximum heat extraction).
- Line A to B: minimum electrical power output for any given heat load (corresponds to the minimum stable plant load).
- C: 100 % load (with maximum heat extraction).
- D: 100 % load (with no heat extraction).
- Line D to C: maximum electrical power output for any given heat load (corresponds to 100 % plant load).
- E: proposed operational point of the Facility, based on the proposed heat network.
- Unrestricted operation: if a selected heat load is located in this region, the Facility will have the ability to operate at any load between minimum stable plant load and 100 % plant load whilst maintaining the selected heat load.
- Restricted operation: if a selected heat load is located in this region, the Facility will not have the ability to operate over its full operational range without a reduction in heat load.

Figure 2: Graphical representation of CHP envelope for proposed heat network



The proposed operational point (point E) represents the annual average heat demand of 1.97 MW_{th} exported to the Route 2 heat network as identified in the Heat Demand Investigation as the most economically feasible network, refer to Appendix C of the EP application. It considers the heat losses and pressure drop in the pipe network; therefore, it corresponds to the annual average heat demand predicted at the installation boundary. The operational range for the Facility will ultimately be subject to the required hot water flow temperature and final steam turbine selection.

5 Conclusions

5.1 Energy Efficiency Measures

In order to qualify as technically feasible under the draft Article 14 guidance, the heat demand must be sufficient to achieve high efficiency cogeneration, equivalent to at least 10% savings in primary energy usage compared to the separate generation of heat and power. When operating in fully condensing mode (i.e. without heat export) the Facility will achieve a primary energy saving (PES) of 21.93 %, which is in excess of the technical feasibility threshold defined in the draft Article 14 guidance. The proposed heat network with an average heat load of 1.97 MW_{th} will result in PES of 22.01 % which is in excess of the technical feasibility threshold; and therefore, would be technically feasible to supply.

To be considered 'Good Quality' CHP under the CHPQA scheme, the quantity of heat exported to a heat network must be sufficient to achieve a Quality Index (QI) of at least 105 at the design stage (reducing to 100 at the operational stage). Recent changes to CHPQA guidance (released in December 2018) mean that the maximum QI score which could be achieved by the proposed heat network would be 60.7. On this basis, any heat network would not qualify as Good Quality CHP. The efficiency criteria set out in the latest CHPQA guidance means that it is unlikely that any 'new' energy from waste plant will achieve 'Good Quality' status.

5.2 CHP-Ready Assessment

A CHP-Ready Assessment has been carried out and the completed CHP Ready Assessment form is provided in Appendix A. The CHP-Ready assessment considers the annual average heat demand exported to the proposed heat network, Route 2 as identified in the Heat Demand Investigation as it shows the most economically potential network.

The results of the commercial modelling currently indicates an internal rate of return of 7.29 % and a net present value of -£753,608. Although the economic case for the proposed heat network is not currently considered to be viable, LSEP is committed to undertaking ongoing reviews to identify additional potential opportunities to export heat from the facility and realise CHP. Therefore, the Facility will be constructed CHP Ready as this is considered to represent BAT.

As a 'CHP-ready facility', the Facility has been designed to be ready, with minimum modification, to supply heat in the future to the identified potential heat users and also any additional future heat users.

The EA CHP Ready Guidance in February 2013 states that given the uncertainty of future heat loads, the initial electrical efficiency of a CHP-ready facility (before any opportunities for the supply of heat are realised) should be no less than that of the equivalent non-CHP-ready facility. The Facility has been designed to ensure that up to 25 tonnes per hour of steam can be extracted from the turbine in the event that suitable agreements can be reached with the potential heat users identified in the Heat Demand Investigation. In addition, sufficient space has been provided for within or close to the turbine hall to house CHP equipment for the export of up to 25 tonnes per hour of steam. Furthermore, this area has been designed for up to 100 tonnes per hour of steam to be exported with modifications to the turbine and the installation of suitably sized CHP equipment in the event that TCE was to require this quantity of steam in the future.

Appendices

A CHP-R Assessment Form

#	Description	Units	Notes / Instructions
Requirement 1: Plant, Plant location and Potential heat loads			
1.1	Plant name		Lostock Sustainable Energy Plant
1.2	Plant description		The main activities associated with the Facility will be the combustion of incoming waste to raise steam and the generation of electricity in a steam turbine/generator. The Facility includes two waste incineration lines, waste reception hall, main thermal treatment process, turbine hall, on-site facilities for the treatment or storage of residues and waste water, flue gas treatment, stack, boilers, devices and systems for controlling operation of the waste incineration plant and recording and monitoring conditions. In addition to the main elements described, the Facility will also include weighbridges, water, auxiliary fuel and air supply systems, site fencing and security barriers, external hardstanding areas for vehicle manoeuvring, internal access roads and car parking, transformers, grid connection compound, firewater storage tanks, offices, workshop, stores and staff welfare facilities. The Facility has been designed to export power to the National Grid. The Facility will generate approximately 76.9 MWe of electricity in full condensing mode. The Facility will have a parasitic load of 7.0 MWe. Therefore, the maximum export capacity of the Facility is 69.9 MWe. In addition to generating power, the Facility has been designed to be capable of exporting up to 18 MW_{th} to local heat users. This is suitable for the identified district heating network (Route 2). The maximum heat capacity will be subject to the requirements of the heat consumers and confirmed during detailed design stage. At the time of writing this report, there are no signed agreements in place for the export of heat to the identified heat users on Route 2 (identified as the most economically promise network) from the Facility. The power exported may fluctuate as fuel quality fluctuates. Furthermore, if agreement can be made for the export of heat to local users it is likely that this will reduce the overall power generation for the Facility.

#	Description	Units	Notes / Instructions
			The nominal capacity of the Facility is 91 tonnes per hour of fuel with an NCV of 9.5 MJ/kg. The expected operational availability is 8,000 hours per annum (91.3 %), which is regarded as typical for an EfW plant in the UK. Therefore, the nominal capacity for the installation is 728,000 tonnes per annum, and is consistent with proposed capacity which has been applied for in the s36(c) planning application which has been submitted to BEISS.
1.3	Plant location (Postcode / Grid Ref)		The site is located within the wider Tata Chemicals Europe Lostock Works site which itself is located near Lostock Gralam, approximately 2km to the east of the centre of Northwich. The Lostock Works site is occupied by a number of independent businesses. Tata Chemicals Europe's operations form the main use of the site as the UK's only producer of soda ash (sodium carbonate) and related products. These uses occupy a total of 68 hectares, including a significant area of waste treatment lagoons. A number of other companies producing chemical and chemical related products are also clustered within the Lostock Works site. This site, and its context, is overwhelmingly characterised / dominated by very large scale, heavy industrial uses. Access to / from the Lostock Works site is via a dedicated junction off the A530 Griffiths Road. To the south of the Lostock site entrance, the A530 connects to the A556 dual-carriageway, which links to the M6 motorway at junction 19, circa 8km to the north east. To the north of the Lostock site entrance, the A530 connects to the A559 Manchester Road. The Facility will be located at an approximate National Grid Reference of SJ6831173933, with the nearest postcode listed as CW9 7TD.
1.4	Factors influencing selection of plant location		Please refer to Chapter 4 of original EIA, submitted with the original planning application.
1.5	Operation of plant		
a)	Proposed operational plant load	%	100
b)	Thermal input at proposed operational plant load	MW	240.14
c)	Net electrical output at proposed operational plant load	MW	69.90
d)	Net electrical efficiency at proposed operational plant load	%	29.11%
e)	Maximum plant load	%	100

#	Description	Units	Notes / Instructions
f)	Thermal input at maximum plant load	MW	240.14
g)	Net electrical output at maximum plant load	MW	69.90
h)	Net electrical efficiency at maximum plant load	%	29.11%
i)	minimum stable plant load	%	65%
j)	Thermal input at minimum stable plant load	MW	156.09
k)	Net electrical output at minimum stable plant load	MW	40.67
l)	Net electrical efficiency at minimum stable plant load	%	26.05%
1.6	Identified potential heat loads		
			Details of the identified heat loads identified the Heat Demand Investigation, refer to Appendix C of the EP Application. Following consumer screening and accounting for network heat losses and consumer diversity, potential consumers were identified with an average heat load of 1.97 $MW_{th.}$ and a peak load of 12.00 MW_{th} for the proposed heat network (Route 2, identified as the most economically promise network). The estimated heat use of the identified network is 17,284 MWh/year.
1.7	Selected heat load(s)		
a)	Category (e.g. industrial / district heating)		District heating
b)	Maximum heat load extraction required	MW	The average and diversified peak heat demand of the proposed heat network has been calculated to be 1.97 MW_{th} and 12.00 MW_{th} respectively.
1.8	Export and return requirements of heat load		
a)	Description of heat load extraction		Network to supply hot water at typical district heating temperatures (approximately 85 °C) via turbine steam extractions at approximately 1.6 bar(a).
b)	Description of heat load profile		The heat load profile is variable due to mixed use developments (primarily industrial and commercial). The average and diversified peak heat demand of the proposed heat network has been calculated to be 1.97 MW_{th} and 12.00 MW_{th} respectively.

#	Description	Units	Notes / Instructions
			The consumer heat load and profile is subject to verification.
c)	Export pressure	bar a	10
d)	Export temperature	°C	85
e)	Export flow	t/h	67.78 (nominal case)
f)	Return pressure	bar a	3
g)	Return temperature	°C	60
h)	Return flow	t/h	67.78 (nominal case)
Requirement 2: Identification of CHP Envelope			
2.0	Comparative efficiency of a standalone boiler for supplying the heat load	% LHV	80 % - updated in accordance with CHPQA Stakeholder Engagement Document, April 2016, Table 1.
2.1	Heat extraction at 100% plant load		
a)	Maximum heat load extraction at 100% plant load	MW	18.02
b)	Maximum heat extraction export flow at 100% plant load	t/h	Assuming steam extraction at 13.5 bar(a), export flow rate would be: 25.00 t/hr
c)	CHP mode net electrical output at 100% plant load	MW	64.97
d)	CHP mode net electrical efficiency at 100% plant load	%	27.05%
e)	CHP mode net CHP efficiency at 100% plant load	%	34.56%
f)	Reduction in primary energy usage for CHP mode at 100% plant load	%	22.63%
2.2	Heat extraction at minimum stable plant load		
a)	Maximum heat load extraction at minimum stable plant load	MW	8.47
b)	Maximum heat extraction export flow at minimum stable plant load	t/h	Assuming steam extraction at 13.51 bar(a), export flow rate would be: 11.75 t/hr
c)	CHP mode net electrical output at minimum stable plant load	MW	40.67
d)	CHP mode net electrical efficiency at minimum stable plant load	%	26.05%
e)	CHP mode net CHP efficiency at minimum stable plant load	%	31.48%
f)	Reduction in primary energy usage for CHP mode at minimum stable plant load	%	22.44%

#	Description	Units	Notes / Instructions
2.3	Can the plant supply the selected identified potential heat load (i.e.is the identified potential heat load within the 'CHP envelope')?		Yes, but not deemed 'Good Quality' CHP as identified in section 3.2.
Requirement 3: Operation of the Plant with the Selected Identified Heat Load			
3.1	Proposed operation of plant with CHP		
a)	CHP mode net electrical output at proposed operational plant load	MW	69.36
b)	CHP mode net electrical efficiency at proposed operational plant load	%	28.88%
c)	CHP mode net CHP efficiency at proposed operational plant load	%	29.70%
d)	Reduction in net electrical output for CHP mode at proposed operational plant load	MW	0.54
e)	Reduction in net electrical efficiency for CHP mode at proposed operational plant load	%	0.22%
f)	Reduction in primary energy usage for CHP mode at proposed operational plant load	%	22.01%
g)	Z ratio		3.65
Requirement 4: Technical provisions and space requirements			
4.1	Description of likely suitable extraction points		Steam for the district heating system could be supplied from the high pressure turbine bleed at approximately 27.4 bar(a) and desuperheated to 13.51 bara. Full details are presented in section 3.
4.2	Description of potential options which could be incorporated in the plant, should a CHP opportunity be realised outside the 'CHP envelope'		The CHP opportunity lies within the CHP envelope.
4.3	Description of how the future costs and burdens associated with supplying the identified heat load / potential CHP opportunity have been minimised through the implementation of an appropriate CHP-R design		If the CHP opportunities were to be implemented, space will be allocated for the CHP equipment within the buildings envelope to avoid the cost of building a dedicated heat station at a later date. The turbine design will be selected to maximise electrical efficiency while allowing for the option of heat export to be implemented in the future. This is in line with the EA CHP-Ready Guidance which states that the initial electrical efficiency of a CHP-R plant (before any opportunities for the supply of heat are realised) should be no less than that of the equivalent non-CHP-R plant.

#	Description	Units	Notes / Instructions
4.4	Provision of site layout of the plant, indicating available space which could be made available for CHP-R		Space has been made available within the buildings envelope to house all required equipment for heat export infrastructure. Please see the site layout in Appendix A of the EP application. The heat network will need to include steam extraction piping, control and shutoff valves, heat exchangers, district heating supply and return lines, district heating circulation pumps, condensate return piping (to the condensate tank), control and instrumentation / electrical connections, an expansion tank for pressurisation of the district heating pipe network and heat metering. If necessary, a back-up boiler will be located at a suitable location for ease of connection to the primary hot water circuit.
Requirement 5: Integration of CHP and carbon capture			
5.1	Is the plant required to be CCR?		No
5.2	Export and return requirements identified for carbon capture		
	100% plant load		
a)	Heat load extraction for carbon capture at 100% plant load	MW	N/A
b)	Description of heat export (e.g. steam / hot water)		N/A
c)	Export pressure	bar a	N/A
d)	Export temperature	°C	N/A
e)	Export flow	t/h	N/A
f)	Return pressure	bar a	N/A
g)	Return temperature	°C	N/A
h)	Return flow	t/h	N/A
i)	Likely suitable extraction points		N/A
	Minimum stable plant load		
j)	Heat load extraction for carbon capture at minimum stable plant load	MW	N/A
k)	Description of heat export (e.g. steam / hot water)		N/A
l)	Export pressure	bar a	N/A
m)	Export temperature	°C	N/A
n)	Export flow	t/h	N/A
o)	Return pressure	bar a	N/A
p)	Return temperature	°C	N/A

#	Description	Units	Notes / Instructions
q)	Return flow	t/h	N/A
r)	Likely suitable extraction points		N/A
5.3	Operation of plant with carbon capture (without CHP)		
a)	Maximum plant load with carbon capture	%	N/A
b)	Carbon capture mode thermal input at maximum plant load	MW	N/A
c)	Carbon capture mode net electrical output at maximum plant load	MW	N/A
d)	Carbon capture mode net electrical efficiency at maximum plant load	%	N/A
e)	Minimum stable plant load with CCS	%	N/A
f)	Carbon capture mode CCS thermal input at minimum stable plant load	MW	N/A
g)	Carbon capture mode net electrical output at minimum stable plant load	MW	N/A
h)	Carbon capture mode net electrical efficiency at minimum stable plant load	%	N/A
5.4	Heat extraction for CHP at 100% plant load with carbon capture		
a)	Maximum heat load extraction at 100% plant load with carbon capture [H]	MW	N/A
b)	Maximum heat extraction export flow at 100% plant load with carbon capture	t/h	N/A
c)	Carbon capture and CHP mode net electrical output at 100% plant load	MW	N/A
d)	Carbon capture and CHP mode net electrical efficiency at 100% plant load	%	N/A
e)	Carbon capture and CHP mode net CHP efficiency at 100% plant load	%	N/A
f)	Reduction in primary energy usage for carbon capture and CHP mode at 100% plant load	%	N/A
5.5	Heat extraction at minimum stable plant load with carbon capture		
a)	Maximum heat load extraction at minimum stable plant load with carbon capture	MW	N/A

#	Description	Units	Notes / Instructions
b)	Maximum heat extraction export flow at minimum stable plant load with carbon capture	t/h	N/A
c)	Carbon capture and CHP mode net electrical output at minimum stable plant load	MW	N/A
d)	Carbon capture and CHP mode net electrical efficiency at minimum stable plant load	%	N/A
e)	Carbon capture and CHP mode net CHP efficiency at minimum stable plant load	%	N/A
f)	reduction in primary energy usage for carbon capture and CHP mode at minimum stable plant load	%	N/A
5.6	Can the plant with carbon capture supply the selected identified potential heat load (i.e. is the identified potential heat load within the 'CHP and carbon capture envelope')?		N/A
5.7	Description of potential options which could be incorporated in the plant for useful integration of any realised CHP system and carbon capture system		N/A
Requirement 6: Economics of CHP-R			
6.1	Economic assessment of CHP-R		In order to assess the economic feasibility of the CHP scheme (as required under Article 14 of the Energy Efficiency Directive) a commercial modelling has been carried out in accordance with the draft Article 14 guidance. The commercial modelling for the proposed route (Route 2) is presented in the Heat Demand Investigation as identified the most economically promise network, refer to Appendix C of the EP Application . The results of the commercial modelling currently indicates an internal rate of return of 7.29 % and a net present value of -£753,608. Although the economic case for the proposed heat network is not currently considered to be viable, LSEP is committed to undertaking ongoing reviews to identify additional potential opportunities to export heat from the facility and realise CHP. Therefore, the Facility will be constructed CHP Ready as this is considered to represent BAT.

#	Description	Units	Notes / Instructions
			As a 'CHP-ready facility', the Facility will be designed to be ready, with minimum modification, to supply heat in the future to the identified potential heat users and also any additional future heat users.
BAT assessment			
	Is the new plant a CHP plant at the outset (i.e. are there economically viable CHP opportunities at the outset)?		No
	If not, is the new plant a CHP-R plant at the outset?		Yes
	Once the new plant is CHP-R, is it BAT?		Yes

ENGINEERING CONSULTING

FICHTNER
Consulting Engineers Limited

Kingsgate (Floor 3), Wellington Road North,
Stockport, Cheshire, SK4 1LW,
United Kingdom

t: +44 (0)161 476 0032
f: +44 (0)161 474 0618

www.fichtner.co.uk