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LCP REGULATION 61 ENVIRONMENTAL PERMIT REVIEW

BAGLAN BAY

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BAGLAN BAY

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CONTENTS

LIST OF ABBREVIATIONS

BAT	Best Available Techniques
BAT-AEEL	BAT Associated Energy Efficiency Level
BAT-AEL	BAT Associated Emission Level
BRef	BAT Reference
CCGT	combined cycle gas turbine
CEMS	continuous emissions monitoring system
CHP	combined heat and power
CO	carbon monoxide
DLN	dry low-NO_x
EMS	Environmental Management System
FGD	flue gas desulphurisation
HP	high pressure
HRSG	heat recovery steam generator
IC	Improvement Condition
IP	intermediate pressure
IED	Industrial Emissions Directive
LCP	Large Combustion Plant
LNBs	low-NO_x burners
LP	low pressure
MSDL	Minimum Shut-Down Load
MSUL	Minimum Start-Up Load
NMP	Noise Management Plan
NO_x	nitrogen oxides
OEM	Original Equipment Manufacturer
OTNOC	Other Than Normal Operating Conditions
PM_{10}	particulate matter
PRF	Pipeline Reception Facility
SO_2	sulphur dioxide

1 INTRODUCTION

1.1 Background

1.1.1 Baglan Bay Power Station

Baglan Bay is a combined cycle gas turbine (CCGT) generating station, comprising:

- Two gas turbines (a GE MS9001H (9H) turbine and a GE LM2500 (LM2500) turbine), each with associated heat recovery steam generator (HRSG);
- One common steam turbine; and,
- One gas-fired auxiliary boiler; together with,
- Other ancillary plant and equipment.

Baglan Bay is located on the Baglan Energy Park, approximately 4 km north west of Port Talbot and 7.5 km east of Swansea in South Wales.

Baglan Bay operates under an Environmental Permit (EPR/BJ7891IT) issued by Natural Resources Wales, with the current version (V009) dated 23 December 2015.

The Environmental Permit covers the operation of the two gas turbines (the 9H and LM2500) and the gas-fired auxiliary boiler as:

- Large Combustion Plant (LCP) 15.

Baglan Bay (the 9H, the LM2500 and the auxiliary boiler) was originally designed and installed as a CCGT combined heat and power (CHP) installation, with the 9H generating electrical power for export to the National Grid, the LM2500 generating heat and power for export to the adjacent Baglan Bay Chemical Works (BP Chemicals Isopropanol Projection Plant) and the auxiliary boiler generating power to start the gas turbines in addition to providing back-up to the LM2500 to ensure continuity of heat and power to the adjacent Baglan Bay Chemical Works. In 2004, upon closure of the Baglan Bay Chemical Works, the system was modified to allow the LM2500 to operate both in combined cycle mode and in open cycle mode. In combined cycle mode, steam generated by the LM2500 is connected to the 9H steam cycle to supplement the steam supply to the 9H steam turbine.

Baglan Bay predominately operates with the 9H, it's associated HRSG and the steam turbine in a 1 + 1 configuration. Infrequently, Baglan Bay also operates with the LM2500 in combined cycle mode, supplementing the steam supply to the 9H steam turbine, in a 2 + 1 configuration. Infrequent operation is also undertaken with the LM2500 in open cycle mode, where the LM2500 operates with gas bypass (with no associated HRSG / steam turbine).

1.1.2 Environmental Permit Reviews

The Industrial Emissions Directive[1] (IED) is the main EU instrument regulating pollutant emissions from industrial installations. The IED aims to achieve a high level of protection of human health and the environment taken as a whole by reducing harmful industrial emissions across the EU, in particular through the application of Best Available Techniques (BAT).

BAT is generally established at an EU level and, following an exchange of information between Member States, BAT Reference (BRef) documents are drawn up for a wide range of industrial sectors and include a description of the techniques to be considered in the determination of BAT and provide associated BAT Conclusions.

[1] Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control). Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0075&from=EN

To take account of developments in available techniques, the IED, at Article 13, requires the review and, where necessary, update of BRef documents and, thus, associated BAT Conclusions.

To ensure the application of the BRef documents and associated BAT Conclusions, the IED, at Article 14(3), requires that BAT Conclusions are used as the reference point for setting conditions within Environmental Permits.

Following a review and update of the LCP BRef, the recent update of the LCP BAT Conclusions was published on 31 July 2017[2] (the LCP BAT Conclusions 2017).

To ensure the LCP BAT Conclusions 2017 are used as the reference point for setting conditions within existing Environmental Permits, Natural Resources Wales has issued Regulation 61 Notices under the Environmental Permitting (England and Wales) Regulations 2016 to initiate an Environmental Permit review process.

In particular, for LCPs, the Regulation 61 Notices require completion of an 'LCP BATC Returns Spreadsheet'.

In addition, where applicable, the Regulation 61 Notices request details on:

- Non-LCP fixed combustion plant (i.e. medium combustion plants with thermal inputs >1 MW and <50 MW);
- Where there is a need to install a new / substantially refurbish an existing combustion plant with a total thermal input >20 MW as a result of the Environmental Permit review process, consideration of the requirements under Article 14(5) of the Energy Efficiency Directive[3];
- Discharges of priority hazardous substances and any other relevant substances to surface water and / or sewer; and,
- Where activities involve the use, production or release of relevant hazardous substances (as defined in Article 3(18) of the IED), the risk assessment undertaken to consider the possibility of soil and / or groundwater contamination due to the relevant hazardous substances.

1.2 Purpose and Structure of this Report

This Report provides the completed 'LCP BATC Returns Spreadsheet', and additional supporting information, for LCP 15. In addition, where applicable, this Report provides the additional requested details.

This Report comprises:

- ***Section 1:*** This brief **Introduction**.
- ***Section 2:*** The **completed 'LCP BATC Returns Spreadsheet'** for LCP 324 and LCP 325.
- ***Section 3:*** **'LCP BATC Returns Spreadsheet' supporting information** for LCP 324 and LCP 325.
- ***Section 4:*** The **additional requested details**.

Supporting information is provided as Attachments.

[2] Commission Implementing Decision 2017/1442 establishing Best Available Technique (BAT) conclusions, under Directive 2010/75/EU, for large combustion plants. Available at:
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017D1442&from=EN
[3] Directive 2012/27/EU on energy efficiency. Available at:
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0027&from=EN

2 COMPLETED 'LCP BATC RETURNS SPREADSHEET'

This Section contains the completed 'LCP BATC Returns Spreadsheet'.

Table 2.1 provides the LCPs in the Baglan Bay Environmental Permit within the review scope.

TABLE 2.1: LCPs WITHIN THE REVIEW SCOPE

LCP Number	Plant Type	Fuel	Proposed Operating Hours
LCP 15	9H Combined Cycle	Natural Gas	>1500 hours
	LM2500 Combined Cycle	Natural Gas	<1500 hours
	LM2500 Open Cycle		
	Auxiliary Boiler	Natural Gas	As per the Environmental Permit (EPR/BJ7891IT)

With regards to the LM2500 operating hours, Condition 2.3.6 of the Environmental Permit states: *"For the following activities* […] *LCP 15 LM2500 [operating in open and combined cycle mode], the activities shall not be operated more than 1,500 hours per year as a rolling average over a period of 5 years, with a maximum of 2,500 hours in any calendar year for the first five years of entry in to the derogation and, if operation has reached 2,250 hours in one year then the operation across any other year should not exceed 1,650 hours".* In addition, Condition 2.3.4 of the Environmental Permit states: *"For the following activities* […] *LCP 15 LM2500 [operating in open cycle mode], the activities shall not operate more than 1,128 hours per year"*.

Under the requirements of the Environmental Permit, information on operating hours is reported every 12 months to Natural Resources Wales (Form IED HR1: Operating Hours). For LCP 15, Table 2.2 provides a summary of the reported operating hours for 2016 and 2017, confirming the assumptions for the completed 'LCP BATC Returns Spreadsheet'.

TABLE 2.2: LCP 15 SUMMARY OF REPORTED OPERATING HOURS

LCP Number	Plant Type	Proposed Operating Hours	Reported Operating Hours
LCP 15	9H Combined Cycle	>1500 hours	2016: 5,990 2017: 3,412
	LM2500 Combined Cycle	<1500 hours	2016: 6 2017: 56
	LM2500 Open Cycle		2016: 48 2017: 133
	Auxiliary Boiler	As per the Environmental Permit (EPR/BJ7891IT)	2016: 49 2017: 35

Therefore, with regards to the actual LM2500 operating hours, Table 2.2 demonstrates that the activities are currently operated <500 hours per year (cumulative of both the combined cycle mode and open cycle mode).

Permit number: EPR/BJ7891IT **Operator: Baglan Operations Limited** **Facility name: Baglan Bay Power Station (Baglan Energy Park)**

This table should be read and used to make reference to your Regulation 61 submission. Reference will need to be made to BAT Conclusions for Large Combustion Plants published on the 17th August 2017 and the supporting interpretation document (date and version).
You should also note the specific considerations you may need to consider when making responses to the Regulation 61 notice.

	LCP BREF BAT conclusions decision:	http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1503383091262&uri=CELEX:32017D1442
	Full LCP BREF document including BAT conclusions:	http://eippcb.jrc.ec.europa.eu/reference/BREF/LCP/JRC107769_LCP_bref2017.pdf

BAT No.	Topic	Brief Description	BAT	Applicable BAT - AEL	Specific considerations for the Regulation 61 response	Operating to BAT?	BAT-AEL derogation needed?	Provide reference to the section in the Regulation 61 Response demonstrating how compliance with BAT is met or confirmation of action that will be taken to ensure compliance with BAT by 17/08/2021
General BAT Conclusions								
1	EMS	Improve overall performance	Implement and adhere to an EMS that incorporates key features identified			Yes - compliant now		Please see Table 3.1 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
2	Efficiency	Determine net electrical efficiency and/or net total fuel utilisation and/or net mechanical efficiency	Carry out a performance test at full load.			Yes - compliant now		Please see Table 3.1 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
3	Monitoring of process parameters	Monitor key process parameters for emissions to air and water specified in the corresponding table.	Monitoring of specified process parameters.			Yes - compliant now		Please see Table 3.1 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
4	Monitoring of emissions to air	Monitor emissions to air with at least the frequency in the corresponding table and in accordance with the EN standards.	Monitor emissions to air with at least the frequency in the corresponding table and in accordance with the EN standards.		**Information on monthly mercury (Hg), chlorine (Cl) and fluorine (F) content in fuels required if seeking to use provisions in relation to "sufficiently stable emission levels".**	Yes - compliant now		Please see Table 3.1 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
5	Monitoring of emissions to water from flue-gas treatment	Monitor emissions to water with at least the frequency in the corresponding table and in accordance with the EN standards.	Monitor emissions to water with at least the frequency in the corresponding table and in accordance with the EN standards.					**Not Applicable.** No flue gas treatment systems are required / installed.
6	Environmental performance	Improve general environmental performance	A variety of techniques			Yes - compliant now		Please see Table 3.1 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
7	Reduce emissions of ammonia to air	Reduction of ammonia emissions where SCR or SNCR is used.	BAT is to optimise the design and/or operation and to meet associated AELs.	**Not Applicable**				**Not Applicable.** No SCR / SNCR is required / installed.
8	Prevent or reduce emissions to air	Prevent or reduce emissions to air during normal operating conditions.	Ensure, by appropriate design, operation and maintenance, that the emission abatement systems are used at optimal capacity and availability.					**Not Applicable.** All emissions to air are controlled at source, and no emissions abatement systems are required / installed.
9	Environmental performance and reduce emissions to air	Inclusion of a number of elements in the quality assurance/quality control programmes for all the fuels used, as part of the EMS.	Techniques (i), (ii) and (iii).					**Not Applicable.** The characteristics and quality of natural gas is controlled by National Grid, through the National Gas Transmission System (and therefore at a national level). As such, the quality and characteristics of natural gas arriving at the Baglan Bay site is within agreed tolerances. As such, no specific fuel quality assurance / fuel quality control programme is required. Nevertheless, a system is in place to monitor certain characteristics of the natural gas for use in overall performance monitoring.
10	Reduce emissions to air and/or water	Prevent or reduce emissions to air during other than normal operating conditions (OTNOC).	A variety of techniques.			Yes - compliant now		Please see Table 3.1 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
11	Monitoring of emissions to air and/or to water	Monitoring of emissions to air and/or to water during OTNOC.	Appropriately monitor emissions to air and/or to water during OTNOC.			Yes - compliant now		Please see Table 3.1 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
12	Energy efficiency	Increase the energy efficiency for units operated ≥1500 h/yr	A variety of techniques			Yes - compliant now		**Not Applicable to the LM2500 or the Auxiliary Boiler.** For informationon the 9H, please see Table 3.1 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')

13	Reduce water usage and the volume of contaminated waste water discharged	Reduce water usage and the volume of contaminated waste water discharged	Use of one or both of the techniques specified in the associated table.					**Not Applicable.**
								For (a) water recycling: Due to the quality requirements and water balance of the plant, Baglan Bay does not include water recycling. However, Baglan Bay does implement a number of water efficiency measures to reduce water usage.
								For (b) dry bottom ash handling: noted to be applicable to combustion of solid fuels.

14	Prevent contaminated of uncontaminated waste water and to reduce emissions to water	Prevent contaminated of uncontaminated waste water and to reduce emissions to water	Segregate waste water streams and to treat them separately, depending on the pollutant content.			Yes - compliant now		Please see Table 3.1 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
15	Reduce emissions to water	Reduce emissions to water from flue-gas treatment	A variety of techniques	**Not Applicable**				**Not Applicable.**
16	Reduce waste sent for disposal	To reduce the quantity of waste sent for disposal	A variety of techniques			Yes - compliant now		Please see Table 3.1 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
17	Reduce noise emissions	To reduce noise emissions	A variety of techniques			Yes - compliant now		Please see Table 3.1 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
Combustion of Solid Fuels (Coal and/or Lignite)								
18	Environmental performance	Improve overall performance	Techniques in associated table.					Not Applicable
19	Efficiency	Increase efficiency	Techniques in associated table.	**Not Applicable**				Not Applicable
20	Prevent or reduce emissions of NOx	Prevent or reduce emissions of NOx emissions to air while limiting CO and N_2O emissions to air from the combustion of coal and/or lignite.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
21	Prevent or reduce emissions of SOx, HCl and HF	Prevent or reduce emissions of SOx, HCl and HF emissions to air from the combustion of coal and/or lignite.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
22	Reduce dust and particulate-bound metal emissions	Reduce emissions of dust and particulate-bound metal emissions to air from the combustion of coal and/or lignite.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable

23	Prevent or reduce emissions of mercury	Prevent or reduce emissions of mercury emissions to air from the combustion of coal and/or lignite.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
Combustion of Solid Fuels (Solid Biomass and/or Peat)								
AEELs	Energy efficiency	BAT-associated energy efficiency levels (BAT-AEELs)	Associated AEELs.	**Not Applicable**				Not Applicable
24	Prevent or reduce emissions of NOx	Prevent or reduce emissions of NOx emissions to air while limiting CO and N_2O emissions to air from the combustion of solid biomass and/or peat.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
25	Prevent or reduce emissions of SOx, HCl and HF	Prevent or reduce emissions of SOx, HCl and HF emissions to air from the combustion of solid biomass and/or peat.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
26	Reduce dust and particulate-bound metal emissions	Reduce emissions of dust and particulate-bound metal emissions to air from the combustion of solid biomass and/or peat.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
27	Prevent or reduce emissions of mercury	Prevent or reduce emissions of mercury emissions to air from the combustion of solid biomass and/or peat.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
Combustion of Liquid Fuels (HFO and/or Gas-Oil-Fired Boilers)								
AEELs	Energy efficiency	BAT-associated energy efficiency levels (BAT-AEELs)	Associated AEELs.	**Not Applicable**				Not Applicable
28	Prevent or reduce emissions of NOx	Prevent or reduce emissions of NOx emissions to air while limiting CO and N_2O emissions to air from the combustion of HFO and/or gas oil in boilers.	A variety of techniques and associated AELs.	**Not Applicable**				Not Applicable
29	Prevent or reduce emissions of SOx, HCl and HF	Prevent or reduce emissions of SOx, HCl and HF emissions to air from the combustion of HFO and/or gas oil in boilers.	A variety of techniques and associated AELs.	**Not Applicable**				Not Applicable
30	Reduce dust and particulate-bound metal emissions	Reduce emissions of dust and particulate-bound metal emissions to air from the combustion of HFO and/or gas oil in boilers.	A variety of techniques and associated AELs.	**Not Applicable**				Not Applicable
Combustion of Liquid Fuels (HFO and/or Gas-Oil-Fired Engines)								
31	Energy efficiency	BAT-associated energy efficiency levels (BAT-AEELs)	Specified techniques and associated AEELs.	**Not Applicable**				Not Applicable
32	Prevent or reduce emissions of NOx	Prevent or reduce emissions of NOx emissions to air from the combustion of HFO and/or gas oil in reciprocating engines.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
33	Prevent or reduce emissions of CO	Prevent or reduce emissions of CO and volatile organic compounds from the combustion of HFO and/or gas oil in reciprocating engines.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
34	Prevent or reduce emissions of SOx, HCl and HF	Prevent or reduce emissions of SOx, HCl and HF emissions to air from the combustion of HFO and/or gas oil in reciprocating engines.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
35	Reduce dust and particulate-bound metal emissions	Reduce emissions of dust and particulate-bound metal emissions to air from the combustion of HFO and/or gas oil in reciprocating engines.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
Combustion of Liquid Fuels (Gas-Oil-Fired Turbines)								
36	Energy efficiency	BAT-associated energy efficiency levels (BAT-AEELs)	Specified techniques and associated AEELs.	**Not Applicable**				Not Applicable
37	Prevent or reduce emissions of NOx	Prevent or reduce emissions of NOx emissions to air from the combustion of gas oil in gas turbines.	A variety of techniques					Not Applicable
38	Prevent or reduce emissions of CO	Prevent or reduce emissions of CO from the combustion of gas oil in gas turbines.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
39	Prevent or reduce emissions of SOx and dust	Prevent or reduce emissions of SOx and dust emissions to air from the combustion of gas oil in gas turbines.	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable
Combustion of Gaseous Fuels (Natural Gas)								
40	Energy efficiency	BAT-associated energy efficiency levels (BAT-AEELs)	Specified techniques and associated AEELs	**For the 9H:** **50 - 60%**		Yes - compliant now	No	**Not Applicable to the LM2500 or the Auxiliary Boiler.** For informationon the 9H, please see Table 3.2 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
41	Prevent or reduce emissions of NOx	Prevent or reduce emissions of NOx emissions to air from the combustion of natural gas in boilers	A variety of techniques	**For the Auxiliary Boiler:** ***Yearly:*** **Not Applicable** ***Daily:*** **85 - 110 mg/Nm^3**		Yes - compliant now	No	For information on the Auxiliary Boiler, please see Table 3.2 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
42	Prevent or reduce emissions of NOx	Prevent or reduce emissions of NOx emissions to air from the combustion of natural gas in gas turbines	A variety of techniques. Please also define effective dry low NOx load where applicable.	**For the 9H:** ***Yearly:*** **10 - 40 mg/Nm^3** ***Daily:*** **18 - 50 mg/Nm^3**	**Define the load at which DLN is effective for each unit within the LCP in terms of:** **i. The output load (i.e. electricity, heat or power generated) (MW); and** **ii. This output load as a percentage of the rated thermal output of the combustion plant (%).**	Yes - compliant now	No	For information on the 9H, please see Table 3.2 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')

				For the LM2500: **Not Applicable**	**Where dry low NOx (DLN) is utilised, you should provide information on the NOx emission profile from the load that DLN is effective through to 70% load and to 100% load.**			For information on the LM2500, please see Table 3.2 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
43	Prevent or reduce emissions of NOx	Prevent or reduce emissions of NOx emissions to air from the combustion of natural gas in engines.	A variety of techniques	**Not Applicable**				Not Applicable (concerns combustion of natural gas in **engines**)
44	Prevent or reduce emissions of CO	Prevent or reduce emissions of CO emissions to air from the combustion of natural gas	A variety of techniques and associated AELs	**For the 9H:** ***Indicative:*** **<5 - 30 mg/Nm^3**	**Where the indicative BAT-AEL for CO cannot be achieved, a BAT justification will be required as set out in the supporting interpretational document.**	Yes - compliant now	No	**Not Applicable to the LM2500 or the Auxiliary Boiler.** For informationon the 9H, please see Table 3.2 in the Report ('LCP Regulation 61 Environmental Permit Review: Baglan Bay')
45	Prevent or reduce emissions of non-methane volatile organic compounds (NMVOC) and methane emissions	Prevent or reduce emissions of non-methane volatile organic compounds (NMVOC) and methane emissions to air from the combustion of natural gas in spark-ignited lean-burn gas engines	A variety of techniques and associated AELs	**Not Applicable**				Not Applicable (concerns combustion of natural gas in **spark-ignitd lean-burn gas engines**)

BAT Conclusions for iron and steel process gases (BAT 46 - 51), offshore platforms (BAT 52 - 54) and chemical process gases (BAT 55 - 59), co-incineration (BAT 60 - 71) and gasification (72 - 75) have not been replicated in this table. If you consider these BAT Conclusions applicable to your application please list and provide the required information and append to this table when responding to the Regulation 61 notice.

Derogation
Yes
No

Compliance
Yes - compliant now
Yes - compliant by 31/07/2021
No - will not be compliant

3 'LCP BATC RETURNS SPREADSHEET' SUPPORTING INFORMATION

3.1 Introduction

Where not already provided in the 'LCP BATC Returns Spreadsheet', this Section presents additional supporting information.

Based on the LCP in the Baglan Bay Environmental Permit within the review scope, the supporting information covers: the general BAT Conclusions (BAT No.: 1 to 17); and, the BAT Conclusions for the combustion of gaseous fuels (natural gas) (BAT No.: 40 to 45).

3.2 General BAT Conclusions

Table 3.1 provides the additional supporting information covering the general BAT Conclusions.

3.3 BAT Conclusions for the Combustion of Gaseous Fuels (Natural Gas)

Table 3.2 provides the additional supporting information covering the BAT Conclusions for the combustion of gaseous fuels (natural gas).

TABLE 3.1: SUPPORTING INFORMATION COVERING THE GENERAL BAT CONCLUSIONS

BAT No.	*BAT Conclusion*	*Explanation of Compliance*
1	In order to improve the overall environmental performance, BAT is to implement and adhere to an Environmental Management System (EMS).	Baglan Bay operates under the requirements of GE Energy's EMS, which is certified in accordance with ISO 14001:2015 and is subject to annual audits and reviews with improvement opportunities continuously applied. In accordance with requirements (i) to (xvi) of BAT 1, the EMS includes: • The commitment of senior management; • An environmental policy, including a commitment to the continuous improvement of the environmental performance of Baglan Bay; • A commitment to follow the development of cleaner technologies; • Objectives and targets (corresponding with financial planning and investment); • An approach to sectoral benchmarking; • An approach to the review of the EMS, including determination of its continuing suitability, adequacy and effectiveness; • An approach to auditing of the EMS; and, • An approach to the future consideration of environmental impacts from the decommissioning and closure of Baglan Bay. The EMS includes specific site-operational plans / procedures related to: • Uncontrolled / unintended emissions; • 'Emergency Response / Accident Management'; • Waste management; and, • The reduction of emissions to air and / or water during 'Other Than Normal Operating Conditions' (OTNOC) (including start-up and shut-down periods). Each of these plans / procedures includes: • An approach for implementation, covering: - Organisational structure and responsibilities; - Recruitment, training, awareness and competence; - Communication; - Employee involvement; - Documentation; - Effective process control; - Planned regular maintenance programmes; and, - Safeguarding compliance with environmental legislation. • An approach to checking performance, including: - Monitoring and measurement; - Preventative and corrective action; and, - Maintenance of records.

BAT No.	***BAT Conclusion***	***Explanation of Compliance***
		Under Improvement Condition (IC) 9.2 of the Environmental Permit, now completed, information on the EMS has previously been provided to Natural Resources Wales. In addition, as part of a rolling 36 month condition of the EMS and under IC 9.6 of the Environmental Permit, a report considering potential environmental improvements is provided to Natural Resources Wales.
2	BAT is to determine the net electrical efficiency of the combustion units by carrying out a performance test at full load, according to EN Standards, after the commissioning of the unit (and after any relevant modification). If EN Standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	The latest 9H performance tests were conducted on 16 December 2009 and 9 May 2010, immediately prior to shut-down and after restart from the April 2010 Outage. The performance tests were conducted in accordance with ASME PTC 24-1996 'Performance Test Code on Overall Plant Performance'. During the Outage, the instrumented combustion cans were removed, and an offline water wash was conducted. Attachment BAT 2.1 provides the 9H combined cycle performance test results (dated 9 July 2010).
3	BAT is to monitor key process parameters relevant for emissions to air, including: flow; oxygen content; temperature; pressure; and, water vapour content.	<u>For the 9H and LM2500, as required by the Environmental Permit:</u> • For stack gas volume flow, continuous monitoring is undertaken in accordance with BS EN 16911-2:2013 ('Stationary Source Emissions – Manual and Automatic Determination of Velocity and Volume Flow Rate in Ducts: Automated Measuring Systems') and TGN M2 ('Monitoring of Stack Emissions to Air'). • For oxygen and water vapour content, continuous (as appropriate to reference) monitoring is undertaken in accordance with BS EN 14181:2014 ('Stationary Source Emissions: Quality Assurance of Automated Measuring Systems'). • For stack gas temperature and stack gas pressure, continuous (as appropriate to reference) monitoring is traceable to national standards. The 9H and LM2500 are equipped with a Continuous Emissions Monitoring System (CEMS). Under the requirements of the Environmental Permit, information on operation of the CEMS is reported every 12 months to Natural Resources Wales (Form IED CEM 1: 'Continuous Measurement System Invalidation Log'). <u>For the Auxiliary Boiler, as required by the Environmental Permit:</u> • For oxygen, periodic (as appropriate to reference) monitoring is undertaken in accordance with BS EN 14789: 2017 ('Stationary Source Emissions. Determination of Volume Concentration of Oxygen. Standard Reference Method: Paramagnetism'). • For water vapour content, periodic (as appropriate to reference) monitoring is undertaken in accordance with BS EN 14790: 2017 ('Stationary Source Emissions. Determination of Water Vapour in Ducts. Standard Reference Method).

BAT No.	***BAT Conclusion***	***Explanation of Compliance***
4	BAT is to monitor emissions to air in accordance with EN Standards. If EN Standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	<u>For the 9H and LM2500:</u> Monitoring and reporting is undertaken in accordance with Part 3 (Emission Monitoring) of Annex V of the IED and under the requirements of the Environmental Permit. With regards to natural gas-fired turbines (e.g. the 9H and LM2500[4]), BAT is to monitor the following emissions to air: • Nitrogen oxides (NO_x) (on a continuous basis and in accordance with EN Standards); and, • Carbon monoxide (CO) (on a continuous basis, and in accordance with EN Standards). For NO_x and CO, monitoring is undertaken in accordance with BS EN 14181:2014 ('Stationary Source Emissions: Quality Assurance of Automated Measuring Systems'). Under the requirements of the Environmental Permit, information on the NO_x and CO emissions to air is reported every 3 months to Natural Resources Wales (Form IED CON 2: 'Quarterly Return of Monthly Mean, Monthly Maximum Daily Mean and Annual Return of Hourly Concentration Percentiles').
		<u>For the Auxiliary Boiler:</u> Monitoring and reporting is undertaken in accordance with the requirements of the Environmental Permit. With regards to natural gas-fired boilers (e.g. the auxiliary boiler) which have a rated thermal input <100 MW and are operated <1500 hours/year, BAT is to monitor the following emissions to air: • NO_x (at least once every six months and in accordance with EN Standards); and, • CO (at least once every six months and in accordance with EN Standards). For NO_x and CO, monitoring is undertaken in accordance with an agreed procedure (between Baglan Operations Limited and Natural Resources Wales) and reported as a "*concentration by calculation, every 4380 operational hours or 2 years, whichever is sooner*". Under the requirements of the Environmental Permit, information on the NO_x and CO emissions to air is reported every 6 months to Natural Resources Wales.
5	Not Applicable	
6	In order to improve the general environmental performance of combustion plants, and to reduce emissions of CO and unburnt substances, BAT is to ensure optimised combustion and to use an appropriate combination of:	
	(a) Fuel blending and mixing.	Not applicable to natural gas-fired turbines or natural gas-fired boilers.

[4] The LM2500 could qualify for a derogation from the 'minimum monitoring frequency', which notes that rather than continuous monitoring, "*in the case of plant with a rated thermal input of <100 MW operated <1,500 hours/year, the minimum monitoring frequency may be at least once every six months*".

BAT No.	***BAT Conclusion***		***Explanation of Compliance***
	(b)	Maintenance of the combustion system.	Baglan Bay is subject to regular and planned maintenance of the combustion system in accordance with the Original Equipment Manufacturer (OEM) recommendations. In particular: • For the 9H, in addition to the April 2010 Outage, in 2016 an inspection of the combustors was performed. • For the LM2500, in 2018 an Outage, including an inspection of the combustors, was performed. Baglan Operations Limited have advised that the associated inspection reports are available, should Natural Resources Wales wish to review.
	(c)	Advanced control system.	Baglan Bay implements computer-based advanced control systems to automatically control and optimise combustion efficiency, and support the prevention and reduction of emissions. In particular: • The 9H and LM2500 are controlled by an MKVI integrated control system. The system includes associated high-performance monitoring. • The auxiliary boiler is controlled by a PLC control system.
	(d)	Good design of the combustion system.	Baglan Bay represents a well-designed combustion system.
	(e)	Fuel choice.	Originally, both natural gas and by-products from the Baglan Bay Chemical Works (from the isopropanol process, including a mixture of gaseous propane and propene and liquid di-isopropyl ether) were used as fuel in LCP 15. In 2004, upon closure of the Baglan Bay Chemical Works, a variation to the Environmental Permit (Variation BX8823IF, determined 3 August 2004) allowed for (amongst other variations) *"changes in fuels available for use on the turbines".* As such, currently natural gas only is used as fuel in LCP 15 (the 9H, the LM2500 and the auxiliary boiler), both when the LCP is run as normal and is started-up and shut-down. Natural gas is an inherently clean fuel, and does not produce the emissions of particulate matter (PM_{10}) and sulphur dioxide (SO_2) normally associated with the combustion of other fossil fuels. As a result, emissions of PM_{10} and SO_2 will be negligible.
7	Not Applicable		
8	Not Applicable		
9	Not Applicable		
10	In order to reduce emissions during OTNOC, BAT is to include the following elements in a Management Plan (commensurate with the relevant of potential pollutant releases):		
	–	Appropriate design of the systems relevant in causing OTNOC that may have an impact on emissions to air, water and / or land.	Baglan Bay implements computer-based advanced control systems to automatically control and optimise combustion efficiency, and support the prevention and reduction of emissions. In particular: • The 9H and LM2500 are controlled by an MKVI integrated control system. The system includes associated high-performance monitoring. • The auxiliary boiler is controlled by a PLC control system.

BAT No.	***BAT Conclusion***		***Explanation of Compliance***
	–	A specific preventative maintenance plan.	Baglan Bay operates under the requirements of GE Energy's EMS, which is certified in accordance with ISO 14001:2015. As part of the EMS, a specific site-operational plan / procedure is included related to the reduction of emissions to air and / or water during OTNOC (including start-up and shut-down periods).
	–	Review and recording of emissions caused by OTNOC (and associated circumstances) and, if necessary, implementation of corrective actions.	The plan / procedure related to the reduction of emissions to air and / or water during OTNOC (including start-up and shut-down periods) also includes an approach to checking performance, including: • Monitoring and measurement; • Preventative and corrective action; and, • Maintenance of records.
	–	Periodic assessment of the overall emissions during OTNOC and, if necessary, implementation of corrective actions.	
11	BAT is to appropriately monitor emissions to air and / or to water during OTNOC.		Monitoring is undertaken in accordance with Part 3 (Emission Monitoring) of Annex V of the IED and under the requirements of the Environmental Permit. As appropriate, monitoring is undertaken in accordance with BS EN 14181:2014 ('Stationary Source Emissions: Quality Assurance of Automated Measuring Systems') or in accordance with an agreed procedure (between Baglan Operations Limited and Natural Resources Wales). The 9H and LM2500 are equipped with a CEMS. Under the requirements of the Environmental Permit, information on operation of the CEMS is reported every 12 months to the Environment Agency (Form IED CEM 1: 'Continuous Measurement System Invalidation Log').
12	**BAT No. 12 is not applicable to the LM2500 or auxiliary boiler as these are operated <1,500 hours/year.** **Accordingly, the following information is provided mainly for the 9H, with additional information for the LM2500 and auxiliary boiler only when operated in combination with the 9H.**		
	In order to increase the energy efficiency of combustion plants operated ≥1500 hours per year, BAT is to use an appropriate combination of:		
	(a)	Combustion optimisation.	The 9H incorporates measures to ensure combustion optimisation. These measures include: a well-designed combustion system; optimisation of the temperature and residence time in the combustion zone; and, the use of an advanced control system. In particular, the 9H is controlled by an MKVI integrated control system which includes associated high-performance monitoring.
	(b)	Optimisation of the working medium conditions.	The 9H includes a computer-based advanced control system to automatically control and optimise the working medium (natural gas and steam) conditions.
	(c)	Optimisation of the steam cycle.	During the design, installation and modifications to the 9H, the steam cycle was optimised.
	(d)	Minimisation of energy consumption.	Baglan Bay incorporates measures to minimise internal energy consumption, and many aspects of the site's operation have been targeted to ensure the minimisation of energy consumption.

BAT No.	BAT Conclusion		Explanation of Compliance
	(e)	Preheating of combustion air.	Not applicable. Under normal operating conditions, the pre-heating of combustion air lowers the energy efficiency of gas turbines.
	(f)	Fuel preheating.	Prior to combustion, the 9H incorporates a fuel preheating system using HRSG economiser water. This system is a design requirement to allow for 'Premix' mode of operation to meet the emission requirements.
	(g)	Advanced control system.	The 9H includes a computer-based advanced control system to automatically control and optimise combustion efficiency, and support the prevention and reduction of emissions. In particular, the 9H is controlled by an MKVI integrated control system which includes associated high-performance monitoring.
	(h)	Feed-water preheating using recovered heat.	To increase feed-water temperature, the 9H includes a low temperature economiser (preheater) for the high pressure (HP) / intermediate pressure (IP) and low pressure (LP) sections of the HRSG.
	(i)	Heat recovery by cogeneration.	Baglan Bay (the 9H, the LM2500 and the auxiliary boiler) was originally designed and installed as a CCGT-CHP installation, with the 9H generating electrical power for export to the National Grid, the LM2500 generating heat and power for export to the adjacent Baglan Bay Chemical Works (BP Chemicals Isopropanol Projection Plant) and the auxiliary boiler generating power to start the gas turbines in addition to providing back-up to the LM2500 to ensure continuity of heat and power to the adjacent Baglan Bay Chemical Works. In 2004, upon closure of the Baglan Bay Chemical Works, the system was modified to allow the LM2500 to operate both in combined cycle mode and in open cycle mode. In combined cycle mode, steam generated by the LM2500 is connected to the 9H steam cycle to supplement the steam supply to the 9H steam turbine. With regards to future CHP opportunities, under Condition 1.2.2 of the Environmental Permit, the Operator is required to review the viability of CHP implementation every 4 years, or in response to any of the following factors: • New plans / significant developments within 15 km of the installation; • Changes to the Local Plan; • Changes to the DECC UK CHP Development Map (or similar); and, • New financial or fiscal incentives for CHP. The results of the review of the viability of CHP is reported to Natural Resources Wales within 2 months of each review, including where there are no changes to the previous review. Based on the results of the previous review, Baglan Operations Limited have advised that no current viable CHP consumer has been identified in the local vicinity.

BAT No.	***BAT Conclusion***		***Explanation of Compliance***
	(j)	CHP-Readiness.	Although only noted to be applicable to new plants / units where there is a realistic potential for the future use of heat in the vicinity of the unit, Baglan Bay was originally design and installed as a CHP installation and, under Condition 1.2.2 of the Environmental Permit, reviews the viability of CHP implementation at least every 4 years. The results of the review of the viability of CHP is reported to Natural Resources Wales within 2 months of each review, including where there are no changes to the previous review. Based on the results of the previous review, Baglan Operations Limited have advised that no current viable CHP consumer has been identified in the local vicinity.
	(k)	Flue-gas condenser.	Not applicable (noted to be applicable to CHP plants / units).
	(l)	Heat accumulation.	Not applicable (noted to be applicable to CHP plants / units).
	(m)	Wet stack.	Not applicable (noted to be applicable to plants / units fitted with flue gas desulphurisation (FGD)).
	(n)	Cooling tower discharge.	Not applicable (noted to be applicable to plants / units fitted with FGD).
	(o)	Fuel pre-drying.	Not applicable (noted to be applicable to combustion of biomass and / or peat).
	(p)	Minimisation of heat losses.	Not applicable (noted to be applicable to combustion of solid fuels, and gasification / integrated gasification combined cycle plants / units).
	(q)	Advanced materials.	Not applicable (noted to be applicable to new plants / units).
	(r)	Steam turbine upgrades.	Not applicable. No steam turbine upgrade have been installed to date.
	(s)	Supercritical and ultra-supercritical steam conditions.	Not applicable (noted to be applicable to new plants / units with a thermal input ≥600 MW).
13	Not Applicable.		
14	In order to prevent the contamination of uncontaminated waste water and to reduce emissions to water, BAT is to segregate waste water streams and to treat them separately, depending on the pollutant content.		Baglan Bay incorporates a site drainage system which segregates waste water streams appropriately to prevent the mixing of uncontaminated surface waters with process waters. These systems include: • Surface water system (Emission Point W2); and, • Process and cooing water system (Emission Point W1): comprising treated site effluent and cooling water which is discharged to the River Neath. Separately, treated sanitary effluent (from the turbine building and administration / services building) is discharged (Emission Point W3) to Dŵr Cyrmu / Welsh Water. In addition, Baglan Bay operates under the requirements of GE Energy's EMS, which is certified in accordance with ISO 14001:2015. As part of the EMS, specific site-operational plans / procedures are included to related to: uncontrolled / unintended emissions; 'Emergency Response / Accident Management'; and, the reduction of emissions to air and / or water during OTNOC (including start-up and shut-down periods).
15	Not Applicable		

BAT No.	***BAT Conclusion***		***Explanation of Compliance***
16	In order to reduce the quantity of waste sent for disposal from the combustion process (and associated abatement techniques), BAT is to organise operations so as to maximise (in order of priority and taking account of life-cycle thinking):		
	(a)	Waste prevention.	Baglan Bay operates under the requirements of GE Energy's EMS, which is certified in accordance with ISO 14001:2015. As part of the EMS, a specific site operational plan / procedure is included related to waste management. Under the certification, the plan / procedure is subject to audits and reviews with improvement opportunities continuously applied. Under IC 9.5 of the Environmental Permit, now completed, information on the plan / procedure has previously been provided to Natural Resources Wales. In addition, under Condition 1.4.1 of the Environmental Permit, Baglan Bay is required to be operated in accordance with the waste hierarchy referred to in Article 4 of the Waste Framework Directive[5].
	(b)	Waste preparation for re-use.	
	(c)	Waste recycling.	
	(d)	Other waste recovery (e.g. energy recovery).	
	And use an appropriate combination of:		
	(a)	Generation of gypsum as a by-product.	Not applicable.
	(b)	Recycling or recovery of residues in the construction sector.	Not applicable.
	(c)	Energy recovery by using waste in the fuel mix.	Not applicable.
	(d)	Preparation of spent catalyst for re-use.	Not applicable.
17	In order to reduce emissions of noise, BAT is to use an appropriate combination of:		
	(a)	Operational measures.	Baglan Bay operates under the requirements of GE Energy's EMS, which is certified in accordance with ISO 14001:2015. The EMS includes specific site-operational plans / procedures, with each of these plans / procedures including an approach for implementation covering safeguarding compliance with environmental legislation. In addition: • Under IC 9.3 of the Environmental Permit, now completed, a review of the Section 36 Noise Management Plan (NMP) was undertaken to ensure the NMP identified the significant noise sources (both in amplitude and frequency), appropriate noise control / noise minimisation measures and potential improvements. Based on the review, an updated NMP was provided to Natural Resources Wales. • Under IC 9.9 of the Environmental Permit, now completed, a review of the previous noise monitoring work was undertaken. Based on the review and the operation of Baglan Bay, proposals for a risk-based noise monitoring plan / procedure were provided to Natural Resources Wales. Based on these reviews, Baglan Operations Limited have advised that no changes have been required since original construction.

[5] Directive 2008/98/EC on waste. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0098&from=EN

BAT No.	BAT Conclusion		Explanation of Compliance
	(b)	Low-noise equipment.	During the design and consenting (via Section 36 of the Electricity Act 1989) of Baglan Bay, noise emissions were considered and a noise impact assessment was undertaken. The noise impact assessment considered the proposed location of equipment and buildings with regards to nearby Noise Sensitive Receptors. Subsequently, an appropriate combination of low-noise equipment, noise attenuation and noise-control equipment was implemented.
	(c)	Noise attenuation.	
	(d)	Noise-control equipment.	
	(e)	Appropriate location of equipment and buildings.	

TABLE 3.2: SUPPORTING INFORMATION COVERING THE BAT CONCLUSIONS FOR THE COMBUSTION OF GASEOUS FUELS (NATURAL GAS)

BAT No.	*BAT Conclusion*		*Explanation of Compliance*
40	**BAT No. 40 is not applicable to the LM2500 ('*not applicable to existing gas turbines and engines operated <1,500 hours/year*') or the auxiliary boiler ('*not applicable to boilers*').** **Accordingly, the following information is provided mainly for the 9H, with additional information for the LM2500 and auxiliary boiler only when operated in combination with the 9H.**		
	In order to increase the energy efficiency of natural gas combustion, BAT is to use an appropriate combination of BAT 12 and:		
	(a)	Combined cycle.	Baglan Bay is a CCGT generating station, with two gas turbines (the 9H and the LM2500), each with an associated HRSG, and one common steam turbine. There is also one gas-fired auxiliary boiler, together with other ancillary plant and equipment. Baglan Bay (the 9H, the LM2500 and the auxiliary boiler) was originally designed and installed as a CCGT CHP installation with the 9H generating electrical power for export to the National Grid, the LM2500 generating heat and power for export to the adjacent Baglan Bay Chemical Works and the auxiliary boiler generating power to start the gas turbines in addition to providing back-up to the LM2500 to ensure continuity of heat and power to the adjacent Baglan Bay Chemical Works. In 2004, upon closure of the Baglan Bay Chemical Works, the system was modified to allow the LM2500 to operate in both combined cycle and in open cycle mode. In combined cycle mode, steam generated by the LM2500 is connected to the 9H steam cycle to supplement the steam supply to the 9H steam turbine. Baglan Bay predominately operates with the 9H, it's associated HRSG and the steam turbine in a 1 + 1 configuration. Infrequently, Baglan Bay also operates with the LM2500 in combined cycle mode, supplementing the steam supply to the 9H steam turbine, in a 2 + 1 configuration. Infrequent operation is also undertaken with the LM2500 in open cycle mode, where the LM2500 operates with gas bypass (with no associated HRSG / steam turbine).

BAT No.	***BAT Conclusion***		***Explanation of Compliance***
BAT-AEEL	**The BAT Associated Energy Efficiency Levels (BAT-AEEL) are not applicable to the LM2500 or the auxiliary boiler (‘*BAT-AEELs for not apply to units operated <1,500 hours/year*’).** **Accordingly, the following information is provided mainly for the 9H, with additional information for the LM2500 and auxiliary boiler only when operated combination with the 9H.**		
	From Table 23, the BAT-AEEL (net electrical efficiency) for an existing CCGT unit with a thermal input ≥600 MW: 50 to 60 per cent.		The latest 9H performance tests were conducted on 16 December 2009 and 9 May 2010, immediately prior to shut-down and after restart from the April 2010 Outage. The performance tests were conducted in accordance with ASME PTC 24-1996 ‘Performance Test Code on Overall Plant Performance’. Attachment BAT 2.1 provides the 9H combined cycle performance test results (dated 9 July 2010). The results of the thermal performance test indicated that, after restart, the net electrical efficiency of Baglan Bay was approximately 56.12 per cent. This is within the BAT-AEEL range.
41	**BAT No. 41 is not applicable to the 9H or the LM2500 (these are gas turbines).** **Accordingly, the following information is provided for the auxiliary boiler.**		
	In order to prevent or reduce NO_x emissions to air from the combustion of natural gas in boilers, BAT is to use an appropriate combination of:		
	(a)	Air and / or fuel staging.	Not applicable.
	(b)	Flue-gas recirculation.	The auxiliary boiler incorporates flue-gas recirculation.
	(c)	Low-NO_x burners (LNBs).	The auxiliary boiler is equipped with LNBs. The LNBs were installed to ensure compliance with the original Environmental Permit (determined 31 December 2001). The LNB technology becomes effective above when the auxiliary boiler thermal input is >18 MW, which corresponds to approximately 20% load.
	(d)	Advanced control system.	Baglan Bay implements computer-based control systems to automatically control and optimise combustion efficiency, and support the prevention and reduction of emissions. In particular, the auxiliary boiler is controlled by a PLC control system.
	(e)	Reduction of the combustion air temperature.	Not applicable.
	(f)	Selective Non-Catalytic Reduction.	Not applicable. To meet both the ELVs of the IED and the BAT-Associated Emission Levels (BAT-AELs), a combination of primary techniques (based on (b) flue-gas recirculation, (c) LNBs and (d) advanced control system) are used. As such, no additional secondary techniques (such as (f) Selective Non-Catalytic Reduction or (g) Selective Catalytic Reduction) are required.
	(g)	Selective Catalytic Reduction.	

<table>
<tr><th>BAT No.</th><th colspan="2">BAT Conclusion</th><th>Explanation of Compliance</th></tr>
<tr><td rowspan="2">BAT-AEL</td><td colspan="2">The yearly average BAT-AELs are not applicable to the auxiliary boiler (yearly average “BAT-AELs do not apply to plants operated <1,500 hours/year”).</td><td></td></tr>
<tr><td colspan="2">From Table 25, BAT-AEL for NO_x emissions to air for an existing boiler plant:
• Daily Average / Average over the Sampling Period: 85 – 110 mg/Nm^3.</td><td>As required by Table S3.1(c) of the Environmental Permit (‘Point source emissions to air from existing or new boilers ≥50 <100 MWth’), NO_x emissions to air from the auxiliary boiler are limited to 110 mg/m^3. This is within the ‘Daily Average / Average over the Sampling Period’ BAT-AEL range.
For NO_x emissions to air, monitoring is undertaken in accordance with an agreed procedure (between Baglan Operations Limited and Natural Resources Wales) and reported as a “concentration by calculation, every 4380 operational hours or 2 years, whichever is sooner”.
Baglan Operations Limited have advised that the information on the auxiliary boiler NO_x emissions to air were part of the original submissions, and that this information is due to be confirmed by independent Monitoring Certification Scheme (MCERTS) reference measurements currently planned for January 2019 and agreed with Natural Resources Wales.</td></tr>
<tr><td rowspan="4">42</td><td colspan="2">BAT No. 42 is not applicable to the auxiliary boiler.
Accordingly, the following information is provided for the 9H and LM2500.</td><td></td></tr>
<tr><td colspan="2">In order to prevent or reduce NO_x emissions to air from the combustion of natural gas in gas turbines, BAT is to use an appropriate combination of:</td><td></td></tr>
<tr><td>(a)</td><td>Advanced control system.</td><td>Baglan Bay implements computer-based advanced control systems to automatically control and optimise combustion efficiency, and support the prevention and reduction of emissions. In particular, the 9H and LM2500 are controlled by an MKVI integrated control system. This system includes associated high-performance monitoring.</td></tr>
<tr><td>(b)</td><td>Water / steam addition.</td><td>The LM2500 is equipped with a water injection NO_x abatement system.
The following Table defines the approximate electrical loads at which the NO_x abatement system becomes effective.
<table>
<tr><th></th><th>GT Output Load (MW electrical)</th><th>Output Load as a % of GT Rated Electrical Output (%)</th></tr>
<tr><td>LM2500 (Combined Cycle and Open Cycle)</td><td>11</td><td>37.8</td></tr>
</table>
These gas turbine loads correspond approximately to the Minimum Start-Up Load (MSUL) and Minimum Shut-Down Load (MSDL) thresholds reported in Table S1.4 of the Environmental Permit.</td></tr>
</table>

<table>
<tr><th>BAT No.</th><th colspan="2">BAT Conclusion</th><th>Explanation of Compliance</th></tr>
<tr><td></td><td>(c)</td><td>Dry low-NO_x burners.</td><td>The 9H is equipped with dry low-NO_x (DLN) burner technology.
The following Table defines the approximate electrical loads at which the DLN technology becomes effective. The original DLN burners have not been changed since installation.
<table><tr><th></th><th>GT Output Load (MW electrical)</th><th>Output Load as a % of GT Rated Electrical Output (%)</th></tr><tr><td>9H</td><td>200</td><td>41</td></tr></table>These gas turbine loads correspond approximately to the MSUL and MSDL thresholds reported in Table S1.4 of the Environmental Permit.</td></tr>
<tr><td></td><td>(d)</td><td>Low-load design concept.</td><td>Baglan Bay implements computer-based advanced control systems to automatically control and optimise combustion efficiency, and support the prevention and reduction of emissions. In particular, the 9H and LM2500 are controlled by an MKVI integrated control system. This system includes associated high-performance monitoring which allows for the adaption of process control and related equipment to maintain good combustion efficiency when the demand in energy varies.</td></tr>
<tr><td></td><td>(e)</td><td>LNBs.</td><td>Not applicable.</td></tr>
<tr><td></td><td>(f)</td><td>Selective Catalytic Reduction.</td><td>Not applicable.
In particular for the 9H, to meet both the ELVs of the IED and the BAT-AELs, a combination of primary techniques (based on (a) advanced control system, (c) DLN burners and (d) low-load design concept) are used. As such, no additional secondary techniques (such as (f) Selective Catalytic Reduction) are required.</td></tr>
</table>

<table>
<tr><th>BAT No.</th><th>BAT Conclusion</th><th>Explanation of Compliance</th></tr>
<tr><td>BAT-AEL</td><td>The following information is provided for the 9H.</td><td></td></tr>
<tr><td></td><td>From Table 24, BAT-AEL for NO_x emissions to air for an existing CCGT unit with a thermal input ≥600 MW and with a net total fuel utilisation of <75 per cent:
• Yearly Average: 10 – 40 mg/Nm^3; and,
• Daily Average: 18 – 50 mg/Nm^3.</td><td>The following Table summarises the information reported on NO_x emissions to air. Values are reported as mg/m^3.
<table>
<tr><th></th><th>Yearly Average[6]</th><th>Daily Average[7]</th><th>Part Load Max Daily Average[8]</th></tr>
<tr><td>9H</td><td>2016: 26.4
2017: 22.5</td><td>2016: 33.4
2017: 26.7</td><td>2016: 33.4
2017: -</td></tr>
</table>
As noted previously, the gas turbines load at which the DLN technology becomes effective corresponds approximately to the MSUL and MSDL thresholds reported in Table S1.4 of the Environmental Permit. The original DLN burners have not been changed since installation.
This information demonstrates that the 9H complies with both the yearly and daily BAT-AELs for NO_x emissions to air.
Under the requirements of the Environmental Permit, information on the NO_x emissions to air is reported every 3 months to Natural Resources Wales (Form IED CON 2: 'Quarterly Return of Monthly Mean, Monthly Maximum Daily Mean and Annual Return of Hourly Concentration Percentiles').</td></tr>
</table>

[6] Based on Form IED CON 2. Average of the reported 'Monthly Means', with zero values discounted. Values reported from 70% GT load to Baseload. For 2016, values provided by Baglan Operations Limited.
[7] Based on Form IED CON 2. Average of the reported 'Daily Means', with zero values discounted. Values reported from 70% GT load to Baseload. For 2016, values provided by Baglan Operations Limited.
[8] Based on Form IED CON 2. Average of the reported 'Part Load Daily Means', with zero values discounted. Values reported from MSUL / MSDL to Baseload. For 2016, values provided by Baglan Operations Limited.

<table>
<tr><th>BAT No.</th><th>BAT Conclusion</th><th>Explanation of Compliance</th></tr>
<tr><td></td><td>The following information is provided for the LM2500.
The yearly average BAT-AELs are not applicable to the LM2500 (yearly average “BAT-AELs do not apply to existing plants operated <1,500 hours/year”).</td><td></td></tr>
<tr><td></td><td>For the LM2500 in combined cycle mode, from Table 24, the BAT-AELs for NO_x emissions to air for:
• An existing CCGT unit, with a thermal input ≥50 to <600 MW and with a net total fuel utilisation of <75 per cent,
Daily Average: 35 – 55 mg/Nm^3.</td><td>The following Table summarises the information reported on NO_x emissions to air. Values are reported as mg/m^3.
<table>
<tr><th></th><th>Daily Average[9]</th><th>Part Load Max Daily Average[10]</th></tr>
<tr><td>LM2500
(Combined Cycle)</td><td>2016: 66.6
2017: 73.9</td><td>2016: -
2017: -</td></tr>
</table>
The NO_x emissions to air are reported above the MSUL and MSDL thresholds, when the water injection NO_x abatement system is effective.
In terms of compliance with the BAT-AELs, Footnote (5) to Table 24 notes that: “these [yearly and daily] BAT-AELs do not apply to existing turbines for mechanical drive applications or to plants operated <500 hours/year”. As noted previously, with regards to the actual LM2500 operating hours, Table 2.2 demonstrates that the activities are currently operated <500 hours per year (cumulative of both the combined cycle and open cycle mode). Therefore, it is considered that both the yearly and daily BAT-AELs are not applicable to the LM2500 in combined cycle mode.</td></tr>
</table>

[9] Based on Form IED CON 2. Average of the reported ‘Daily Means’, with zero values discounted. Values reported from 70% GT load to Baseload.
[10] Based on Form IED CON 2. Average of the reported ‘Part Load Daily Means’, with zero values discounted. Values reported from MSUL / MSDL to Baseload.

<table>
<tr><th>BAT No.</th><th>BAT Conclusion</th><th>Explanation of Compliance</th></tr>
<tr><td></td><td>For the LM2500 in open cycle mode, from Table 24, the BAT-AELs for NO_x emissions to air for:
• An existing OCGT unit (per Footnote (7) to Table 24) "put into operation no later than 27 November 2003 and are operated between 500 and 1,500 hours per year" with a thermal input ≥50 MW,
Daily Average: 25 – 80 mg/Nm^3.</td><td>The following Table summarises the information reported on NO_x emissions to air. Values are reported as mg/m^3.
<table>
<tr><th></th><th>Daily Average[11]</th><th>Part Load Max Daily Average[12]</th></tr>
<tr><td>LM2500
(Open Cycle)</td><td>2016: 66.6
2017: 70.7</td><td>2016: -
2017: -</td></tr>
</table>
The NO_x emissions to air are reported above the MSUL and MSDL thresholds, when the water injection NO_x abatement system is effective.
In terms of compliance with the BAT-AELs, Footnote (5) to Table 24 notes that: "these [yearly and daily] BAT-AELs do not apply to existing turbines for mechanical drive applications or to plants operated <500 hours/year". As noted previously, with regards to the actual LM2500 operating hours, Table 2.2 demonstrates that the activities are currently operated <500 hours per year (cumulative of both the combined cycle and open cycle mode). Therefore, (whilst the above information demonstrates that the LM2500 in open cycle mode compiles with the daily BAT-AELs for NO_x emissions to air) it is considered that both the yearly and daily BAT-AELs are not applicable to the LM2500 in open cycle mode.
Nevertheless, as required by Table S3.1(b) of the Environmental Permit ('Point source emission to air from Gas Turbines operating ≤1500 hours LHD'), NO_x emissions to air from the LM2500 are limited to 110 mg/m^3. The information above demonstrate that the LM2500 (in both combined cycle mode and in open cycle mode) complies with the requirements of the Environmental Permit.
Under the requirements of the Environmental Permit, information on the NO_x emissions to air is reported every 3 months to Natural Resources Wales (Form IED CON 2: 'Quarterly Return of Monthly Mean, Monthly Maximum Daily Mean and Annual Return of Hourly Concentration Percentiles').</td></tr>
<tr><td>43</td><td>Not Applicable</td><td></td></tr>
<tr><td>44</td><td>In order to prevent or reduce CO emissions to air from the combustion of natural gas, BAT is to ensure combustion optimisation.</td><td>Baglan Bay incorporates measures to ensure combustion optimisation. These measures include: a well-designed combustion system; optimisation of the temperature and residence time in the combustion zone; and, the use of an advanced control system. In particular:
• The 9H and LM2500 are controlled by an MKVI integrated control system. The system includes associated high-performance monitoring.
• The auxiliary boiler is controlled by a PLC control system.</td></tr>
</table>

[11] Based on Form IED CON 2. Average of the reported 'Daily Means', with zero values discounted. Values reported from 70% GT load to Baseload. For 2016, values provided by Baglan Operations Limited.
[12] Based on Form IED CON 2. Average of the reported 'Part Load Daily Means', with zero values discounted. Values reported from MSUL / MSDL to Baseload. For 2016, values provided by Baglan Operations Limited.

<table>
<tr><th>BAT No.</th><th>BAT Conclusion</th><th>Explanation of Compliance</th></tr>
<tr><td>BAT-AEL</td><td>The indicative BAT-AELs for CO are not applicable to the LM2500 or auxiliary boiler as these are operated <1,500 hours/year.
Accordingly, the following information is provided for the 9H.</td><td></td></tr>
<tr><td></td><td>Indicative BAT-AEL for CO emissions to air for an existing CCGT with a thermal input ≥50 MWth:
• Yearly Average: <5 – 30 mg/Nm^3.</td><td>The following Table summarises the information reported on CO emissions to air. Values are reported as mg/m^3.
<table><tr><th></th><th>Yearly Average[13]</th></tr><tr><td>9H</td><td>2016: 0.4
2017: 0.8</td></tr></table>As noted previously, the gas turbines load at which the DLN technology becomes effective corresponds approximately to the MSUL and MSDL thresholds reported in Table S1.4 of the Environmental Permit. The original DLN burners have not been changed since installation.
This information demonstrates that the 9H complies with the indicative yearly BAT-AELs for CO emissions to air.
Under the requirements of the Environmental Permit, information on the CO emissions to air is reported every 3 months to the Environment Agency (Form IED CON 2: ‘Quarterly Return of Monthly Mean, Monthly Maximum Daily Mean and Annual Return of Hourly Concentration Percentiles’).</td></tr>
<tr><td>45</td><td>Not Applicable</td><td></td></tr>
</table>

[13] Based on Form IED CON 2. Average of the reported ‘Monthly Means’, corresponding to NO_x averaged values. Values reported from 70% GT load to Baseload. For 2016, values provided by Baglan Operations Limited.

4 ADDITIONAL REQUESTED DETAILS

4.1 Introduction

This Section contains additional requested details on:

- Non-LCP fixed combustion plant;
- Consideration of the requirements under the Energy Efficiency Directive;
- Discharges of priority hazardous substances and any other relevant substances to surface water and / or sewer; and,
- The possibility of soil and / or groundwater contamination due to the relevant hazardous substances.

4.2 Non-LCP Fixed Combustion Plant

The Regulation 61 Notice requests details on non-LCP fixed combustion plant (i.e. medium combustion plants with thermal inputs >1 MW and <50 MW), stating that: *"this is a data collection exercise which will feed into future work on BAT for smaller combustion plant"*.

Table 4.1 provides details on the non-LCP fixed combustion plant in the Baglan Bay Environmental Permit out of the review scope. No electricity is exported off-site from these non-LCP fixed combustion plant. Baglan Operations Limited would welcome the opportunity to support Natural Resources Wales's future work on BAT for these smaller combustion plant.

TABLE 4.1: NON-LCP FIXED COMBUSTION PLANT OUT OF THE REVIEW SCOPE

Plant Type	Fuel	Use
Safe Shut-down Diesel Generator: *Designed for infrequent use to maintain essential supplies in the event of total site power loss.*	Diesel Fuel Oil	The Environmental Permit contains no associated emission limit values or reporting requirements. Each unit is tested routinely for reliability, with estimated run times between 20 to 50 hours per annum per unit.
LM2500 Start-up Diesel Generator: *Designed to allow LM2500 start-up in black-start mode in the event of total site power loss.*		
Pipeline Reception Facility (PRF) Back-Up Diesel Generator: *Designed to maintain essential supplies to the PRF in the event of total site power loss.*		
Diesel Fire-Fighting Pump: *For use in emergency fire-fighting situations.*		

4.3 Consideration of the Requirements under the Energy Efficiency Directive

Based on the information provided in the completed 'LCP BATC Returns Spreadsheet', there is no need to install a new / substantially refurbish an existing combustion plant with a total rated thermal input >20 MW.

Accordingly, no additional details are required.

4.4 Discharges of Priority Hazardous Substances and any Other Relevant Substances to Surface Water and / or Sewer

With regards to discharges of priority hazardous substances and any other relevant substances to surface water and / or sewer:

- As part of the original application for the Environmental Permit (duly made: 30/01/2001) information on discharges to surface water and / or sewer was prepared and submitted to the Environment Agency / Natural Resources Wales. Within this information, assessment was made

of the discharges of priority hazardous substances and any other relevant substances to the River Neath.

- Baglan Operations Limited have confirmed there have been no changes to the discharges from that noted within these submissions. Baglan Operations Limited have advised that the original application reports are available, should Natural Resources Wales with to review.
- As noted within these submissions and the current Environmental Permit, the process and cooling water system (Emission Point W1) comprises treated site effluent and cooling water which is discharged to the River Neath. Based on Table S3.2 of the Environmental Permit ('Point source emissions to water (other than sewer) – emissions limits and monitoring requirements'), the following substances are monitored at Emission Point W1:

EMISSION POINT W1: EMISSIONS LIMITS AND MONITORING REQUIREMENTS*

Parameter	***Limit***	***Monitoring Frequency***
Temperature (°C)	30	Continuous
Total Suspended Solids (mg/l)	350	Continuous
pH max	9	Continuous
pH min	6	Continuous
Ammonia (as N) (mg/l)	2	Continuous
Copper (total) (µg/l)	80	Monthly
Zinc (total) (µg/l)	290	Monthly
Iron (total) (mg/l)	12	Monthly
Phosphate (mg/l)	9	Monthly
Sodium Bisulphite max (mg/l)	20	Continuous
Sodium Bisulphite min (mg/l)	0.05**	Continuous
Oil and Grease	None Visible	Continuous
Non-Oxidising Biocide (as total methylene bisthiocyanate) (mg/l)	7.5	Monthly
Filter Aid Polymer (MDC 150) (mg/l)	12	Monthly
Dispersant Polymer (AEC 3153) (mg/l)	12	Monthly
Maximum Discharge Rate (l/s)	190	Continuous
Discharge Window	±3 hrs of High Water	Continuous

* No reference periods are given, and the monitoring standard / method is noted as '*as agreed in writing with* [Natural Resources Wales] *NRW*'
** Minimum concentration to be achieved during batch wastewater treatment process.

- Under the requirements of the Environmental Permit, information on Emissions Point W1 (oil and grease; and, pH) is reported to Natural Resources Wales every 12 months.
- To date, there have been no breaches or non-compliances with the emissions limits or monitoring requirements.

Accordingly, no additional details are required.

4.5 Possibility of Soil and / or Groundwater Contamination due to Relevant Hazardous Substances

With regards to the site condition:

- As part of the original application for the Environmental Permit (duly made: 30/01/2001), a Site Condition Report was prepared and submitted to the Environment Agency / Natural Resources Wales.
- Baglan Operations Limited have confirmed that there have been no changes to the site condition from that noted within the Site Condition Report. Baglan Operations Limited have advised that the original application Site Condition Report is available, should Natural Resources Wales with to review.
- In addition, under Condition 3.1.4 of the Environmental Permit, Baglan Bay is required to carry out periodic monitoring at least every 5 years for groundwater and 10 years for soil, unless such monitoring is based on a systematic appraisal of the risk of contamination.
- With regards to groundwater, Baglan Operations Limited have advised that annual groundwater testing is undertaken.
- With regards to soil, Baglan Operations Limited have advised that they do not carry out any routine activities which cause soil contamination, and any accidental spill would be recorded and reported to Natural Resources Wales as part of the normal site reporting procedures. Therefore, period soil monitoring is not required.

Accordingly, no additional details are required.

ATTACHMENTS

Supporting information is provided in the following attachments:

- Attachment BAT 2.1: 9H Combined Cycle Performance Test Results (dated 9 July 2010).

GE Energy

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Kelvin Hood
Baglan Bay Operations Manager
Baglan Energy Park
Port Talbot, South Wales SA12 7GE
United Kingdom

Subject: Baglan Bay Power Station – Combined Cycle Performance Results

July 9, 2010

Dear Sir:

Baglan Bay Power Station 109H combined cycle performance test program was conducted on December 16, 2009 and May 9, 2010. The tests were conducted by Baglan Bay O&M team immediately prior to shutdown and after restart from the April 2010 outage. During this outage the instrumented combustion cans were removed and an offline water wash was conducted.

The baseload performance results are summarized in the following tables. Plant gross results are shown in Table 1, as plant net output was not recorded during the pre-outage test. Plant net results are shown in Table 2.

Table 1: Baseload Plant Performance Results

	Units	**Pre TR01**	**Pre TR02**	**Average**	**Post TR10**	**Post TR11**	**Average**	**Delta**
		Baseload	*Baseload*		*Baseload*	*Baseload*		
Date	*mm/dd/yy*	12/16/09	12/16/09		05/09/10	05/09/10		
Time	*hh:mm*	13:00 - 14:00	14:00 - 15:00		11:00 - 12:00	12:00 – 13:00		
Fired Hours	#	33,343	33,344		36,768	36,769		
Corrected Gross Plant Output	*kW*	489,529	488,172	488,850	491,927	492,889	492,408	0.73%
Corrected Gross Plant Efficiency	*%*	57.01	57.04	57.03	57.47	57.46	57.46	0.44
Corrected Gross Plant Heat Rate	*BTU/kWh*	5,985.0	5,981.8	5,983.4	5,937.4	5,938.7	5,938.1	-0.76%

Table 2: Baseload Net Plant Combined Cycle Performance

	Units	**Post TR10**	**Post TR11**	**Average**
		Baseload	*Baseload*	
Date	*mm/dd/yy*	05/09/10	05/09/10	
Time	*hh:mm*	11:00 - 12:00	12:00 – 13:00	
Fired Hours	#	36,768	36,769	
Corrected Net Plant Output	*kW*	480,479	481,371	480,925
Corrected Net Plant Efficiency	*%*	56.13	56.11	56.12
Corrected Net Plant Heat Rate	*BTU/kWh*	6,078.8	6,080.8	6,079.8

These results are based on the DCS on-line gas chromatograph fuel analysis and the MKVI watthour meter for the Pre-Outage test. The Post-Outage test results are based on SGS laboratory analysis of fuel samples that were collected during the test and on the precision load meter. The results have been corrected to the following rated conditions that are also listed in the test procedure.

Table 3: Conditions in Basis for Performance

Steady-State Load Condition	Base
Ambient air temperature at Gas Turbine Inlet	50.0 °F
Ambient air relative humidity	75.0 %
Barometric pressure	14.7 psia
Cooling tower wet bulb temperature	46.12 °F
Gas turbine shaft speed	3000 rpm
Generator power factor	0.85 (lagging)
Fuel Composition	% volume
Nitrogen (N_2)	0.96
Carbon Dioxide (CO_2)	1.20
Methane (CH_4)	91.10
Ethane (C_2H_6)	4.80
Propane (C_3H_8)	1.30
N-Butane (C_4H_{10})*	0.64
Gas turbine cleanliness	See Section 5.1
Fuel	Natural Gas
Fuel supply temperature	26.7 °C
Fuel supply pressure	44.0 barg
Auxiliary loads	10,870 kW

*The C_4H_{10} N-Butane constituent represents the sum of the C_4H_{10} N-Butane, C_4H_{10} i-Butane, C_5H_{12} i-pentane, C_6H_{14}, C_7H_{16}, and C_8H_{18}.

The results were calculated based on the average of the individual parameters for each test run. Please note that an offline water wash was not conducted prior to the Pre-Outage test.

See Attachment 1 for details of data results and calculations. I will be following up with a full test report concerning this test.

Please contact me if you have any questions.

Best Regards,
Christopher Erwin

CC:	Logan Yanson	GE PGS CS Service Manager
	Jagadish Nanjappa	O&P CC Project Engineer
	George Mathai	O&P GT Performance Engineer
	Matthew Michael	O&P CC Performance Engineer
	Mark Griffiths	O&M Plant Manager – Baglan Bay
	Paul Fitzsimmons	O&M Performance & Projects Specialist

Attachment 1:

Data Results Summary

		Pre-outage TR01	Pre-outage TR02	Pre-outage Average	TR10	TR11	Post-outage Average	Delta
GENERAL								
Test Type		Base Load	Base Load		Base Load	Base Load		
Test Date		12/16/09	12/16/09		5/9/10	5/9/10		
Time Start		13:00	14:00		11:00	12:00		
Time Stop		14:00	15:00		12:00	13:00		
Tfire		Cntrl Curve	Cntrl Curve		Cntrl Curve	Cntrl Curve		
VGV		Cntrl Curve	Cntrl Curve		Cntrl Curve	Cntrl Curve		
CORRECTED NET PLANT PERFORMANCE								
Commercial Performance - HY Revenue Meters								
Output (SGS)	kW	#DIV/0!	#DIV/0!		**480,479**	**481,371**	**480,925**	
Heat Rate (SGS)	BTU/kWh	-	-		**6078.8**	**6080.8**	**6,079.8**	
Efficiency (SGS)	%	-	-		**56.13**	**56.11**	**56.12**	
CORRECTED GROSS PLANT PERFORMANCE								
Generator Output Meters								
Output	kW	489,529	488,172	488,850	491,927	492,939	492,433	0.73%
Output (SGS)	kW	-	-		**491,927**	**492,889**	**492,408**	
Heat Rate	BTU/kWh	5985.0	5981.8	5,983.4	5935.0	5938.6	5,936.8	-0.78%
Efficiency	%	57.01	57.04	57.03	57.49	57.46	57.47	0.45
Heat Rate (SGS)	BTU/kWh	-	-		5937.38	5938.74	**5,938.1**	
Efficiency (SGS)	%	-	-		**57.47**	**57.46**	**57.46**	
TEST CONDITIONS								
Ambient								
Temperature - O&P	deg F	42.7	42.7		51.4	53.3		
Pressure - O&P	psia	14.6	14.6		14.7	14.7		
Relative Humidity - O&P	%	81.3	81.1		51.5	48.2		
Specific Humidity O&P - Calculated	lb/lb	0.00471	0.00469		0.00412	0.00413		
Cooling Tower Wet Bulb - O&P Calc from GT Inlet	deg F	40.3	40.2		43.4	44.4		
Output & Auxiliaries								
Generator Gross - MKVI	kW	495,069	494,929		490,543	487,987		
Power Factor - MKVI	frac	0.9876	0.9865		0.9832	0.9917		
Frequency	Hz	49.96	50.04		50.02	49.97		
Aux Xfmr Losses	kW	60	60		60	60		
Total Aux Load	kW	9,670	9,717		9,330	9,233		
AC Excitation - Reference	kW	1,004	1,009		1,011	978		
DC Excitation - Reference	kW	966	971		985	917		
U1 Remote - Reference	kW	1,941	1,943		1,923	1,904		
Step-up Xfmr Losses	kW	1,094.1	1,095.3		1,088.0	1,062.4		
Non-contractual Plant Aux Load								
Fuel Compressors	kW	42	42		44	44		
CHP Loads	kW	5	5		6	6		
Heat Consumption - On-Line GC								
Heat consumption - O&P HGF	10^6 BTU/hr	2963.9	2961.9		2905.0	2890.9		
Hot Gas Flow - O&P	lb/hr	141,108	141,009		137,869	137,182		
LHV, dry	BTU/lb	21,005	21,005		21,071	21,073		
LHV, dry	BTU/scf	944.4	944.4		943.6	944.2		
Molecular Weight, dry	lb/lbmol	17.1	17.1		17.0	17.0		
Fuel Composition								
Carbon Dioxide (CO2)	Mole Frac	0.00009	0.00009		0.00000	0.00000		
Nitrogen (N2)	Mole Frac	0.01063	0.01063		0.00905	0.00895		
Methane (CH4)	Mole Frac	0.92890	0.92890		0.93253	0.93193		
Ethane (C2H6)	Mole Frac	0.05789	0.05789		0.05715	0.05789		
Propane (C3H8)	Mole Frac	0.00224	0.00224		0.00113	0.00109		
Isobutane (C4H10)	Mole Frac	0.00012	0.00012		0.00007	0.00007		
N-Butane (C4H10)	Mole Frac	0.00011	0.00011		0.00007	0.00007		
Neo-Pentane (C5H12)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Isopentane (C5H12)	Mole Frac	0.00001	0.00001		0.00000	0.00000		
N-Pentane (C5H12)	Mole Frac	0.00001	0.00001		0.00000	0.00000		
Hexanes, Avg. (C6H14)	Mole Frac	0.00001	0.00001		0.00000	0.00000		
Heptanes, Avg. (C7H16)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Octanes (C8H18)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Nonanes (C9H20)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Decanes (C10H22)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Hydrogen Sulfide (H2S)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Helium (He)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Water (H2O)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Oxygen (O2)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Argon	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Hydrogen (H2)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Carbon Monoxide (CO)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Heat Consumption - Lab Analysis								
Heat consumption - O&P HGF	10^6 BTU/hr	#VALUE!	#VALUE!		2906.2	2891.0		
Heat consumption - MkVI HGF	10^6 BTU/hr	#VALUE!	#VALUE!		2901.9	2887.5		
Heat consumption - RGF	10^6 BTU/hr	#VALUE!	#VALUE!		#VALUE!	#VALUE!		
Hot Gas Flow - O&P	lb/hr	#VALUE!	#VALUE!		137872	137185		
Hot Gas Flow - MkVI	lb/hr	#VALUE!	#VALUE!		137671	137020		
Cold Gas Flow	lb/hr	-	-		-	-		
Rev Gas Flow	lb/hr	-	-		#VALUE!	#VALUE!		
LHV, dry	BTU/lb	#DIV/0!	#DIV/0!		21079	21074		
LHV, dry	BTU/scf	#DIV/0!	#DIV/0!		943.8	944.1		
Molecular Weight, dry	lb/lbmol	#DIV/0!	#DIV/0!		17.0	17.0		
Fuel Composition								
Carbon Dioxide (CO2)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Nitrogen (N2)	Mole Frac	#DIV/0!	#DIV/0!		0.00878	0.00891		
Methane (CH4)	Mole Frac	#DIV/0!	#DIV/0!		0.93275	0.93205		
Ethane (C2H6)	Mole Frac	#DIV/0!	#DIV/0!		0.05716	0.05780		
Propane (C3H8)	Mole Frac	#DIV/0!	#DIV/0!		0.00112	0.00106		
Isobutane (C4H10)	Mole Frac	#DIV/0!	#DIV/0!		0.00007	0.00006		
N-Butane (C4H10)	Mole Frac	#DIV/0!	#DIV/0!		0.00007	0.00007		
Neo-Pentane (C5H12)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Isopentane (C5H12)	Mole Frac	#DIV/0!	#DIV/0!		0.00001	0.00001		

		Pre-outage TR01	Pre-outage TR02	Pre-outage Average	TR10	TR11	Post-outage Average	Delta
N-Pentane (C5H12)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Hexanes, Avg. (C6H14)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Heptanes, Avg. (C7H16)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Octanes (C8H18)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Nonanes (C9H20)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Decanes (C10H22)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Hydrogen Sulfide (H2S)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Helium (He)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Water (H2O)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Oxygen (O2)	Mole Frac	#DIV/0!	#DIV/0!		0.00003	0.00003		
Argon	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Hydrogen (H2)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
Carbon Monoxide (CO)	Mole Frac	#DIV/0!	#DIV/0!		0.00000	0.00000		
REFERENCE CONDITIONS								
Ambient								
Temperature	deg F	50.0	50.0		50.0	50.0		
Pressure	psi	14.7	14.7		14.7	14.7		
Relative Humidity	%	75.0	75.0		75.0	75.0		
Specific Humidity	lb/lb	0.005701	0.005701		0.005701	0.005701		
Cooling Tower Wet Bulb	deg F	46.12	46.12		46.12	46.12		
Output								
Power Factor	ratio	0.8500	0.8500		0.8500	0.8500		
Frequency	Hz	50.0	50.0		50.0	50.0		
Heat Consumption								
Fuel LHV	BTU/lb	20375	20375		20375	20375		
LHV, dry	BTU/scf	955.5	955.5		955.5	955.5		
Molecular Weight, dry	lb/lbmol	17.8	17.8		17.8	17.8		

		Pre-outage TR01	Pre-outage TR02	Pre-outage Average	TR10	TR11	Post-outage Average	Delta
Fuel Composition								
Carbon Dioxide (CO2)	Mole Frac	0.01200	0.01200		0.01200	0.01200		
Nitrogen (N2)	Mole Frac	0.00960	0.00960		0.00960	0.00960		
Methane (CH4)	Mole Frac	0.91100	0.91100		0.91100	0.91100		
Ethane (C2H6)	Mole Frac	0.04800	0.04800		0.04800	0.04800		
Propane (C3H8)	Mole Frac	0.01300	0.01300		0.01300	0.01300		
Isobutane (C4H10)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
N-Butane (C4H10)	Mole Frac	0.00640	0.00640		0.00640	0.00640		
Neo-Pentane (C5H12)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Isopentane (C5H12)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
N-Pentane (C5H12)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Hexanes, Avg. (C6H14)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Heptanes, Avg. (C7H16)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Octanes (C8H18)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Nonanes (C9H20)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Decanes (C10H22)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Hydrogen Sulfide (H2S)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Helium (He)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Water (H2O)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Oxygen (O2)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Air (N2O2)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Hydrogen (H2)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
Carbon Monoxide (CO)	Mole Frac	0.00000	0.00000		0.00000	0.00000		
CORRECTIONS TO OUTPUT								
Correction Factors Applied								
Power Factor	P_1	626	620		590	636		
Cooling Tower Wet Bulb	P_{ST}	450	454		238	164		
Temperature	P_{IT}	1.0150	1.0151		0.9966	0.9920		
Pressure	P_{BP}	0.9957	0.9953		0.9983	0.9977		
Specific Humidity	P_{RH}	0.9999	0.9999		0.9999	0.9999		
Frequency	Pfreq	0.9986	1.0014		1.0007	0.9988		
Fuel composition	P_{FCOMPO}	1.0000	1.0000		1.0000	0.9999		
Test Correction Factors from Correction Curves								
Power Factor	kW	4536	4547		4541	4409		
Cooling Tower Wet Bulb	kW	482	486		270	196		
Temperature	frac	1.0155	1.0156		0.9971	0.9925		
Pressure	frac	0.9953	0.9949		0.9979	0.9973		
Specific Humidity <59 F	frac	0.9999	0.9999		0.9999	0.9999		
Specific Humidity >59 F	frac	0.9993	0.9993		0.9992	0.9992		
Frequency	frac	0.9988	1.0016		1.0009	0.9990		
Fuel composition	frac	0.9995	0.9995		0.9995	0.9994		
Reference Correction Factors from Correction Curves								
Power Factor	kW	5162	5167		5132	5045		
Cooling Tower Wet Bulb	kW	32	32		32	32		
Temperature	frac	1.0005	1.0005		1.0005	1.0005		
Pressure	frac	0.9996	0.9996		0.9996	0.9996		
Specific Humidity <59 F	frac	1.0000	1.0000		1.0000	1.0000		
Specific Humidity >59 F	frac	1.0000	1.0000		1.0000	1.0000		
Frequency	frac	1.0002	1.0002		1.0002	1.0002		
Fuel composition	frac	0.9995	0.9995		0.9995	0.9995		
CORRECTIONS TO HEAT RATE								
Correction Factors Applied								
Temperature	H_{IT}	1.0024	1.0025		0.9996	0.9993		
Pressure	H_{BP}	1.0001	1.0001		1.0000	1.0000		
Specific Humidity	H_{RH}	1.0000	1.0000		0.9999	0.9999		
Frequency	Hf	1.0000	1.0000		1.0000	1.0000		
Fuel composition	H_{FCOMPO}	1.0000	1.0000		1.0000	1.0000		
Test Correction Factors from Correction Curves								
Temperature	frac	1.0024	1.0025		0.9996	0.9993		
Pressure	frac	1.0001	1.0001		1.0000	1.0000		
Specific Humidity <59 F	frac	1.0000	1.0000		0.9999	0.9999		
Specific Humidity >59 F	frac	1.0000	1.0000		1.0000	0.9999		
Frequency	frac	1.0000	1.0000		1.0000	1.0000		
Fuel composition	frac	1.0001	1.0001		1.0001	1.0001		
Reference Correction Factors from Correction Curves								
Temperature	frac	1.0000	1.0000		1.0000	1.0000		
Pressure	frac	1.0000	1.0000		1.0000	1.0000		
Specific Humidity <59 F	frac	1.0000	1.0000		1.0000	1.0000		
Specific Humidity >59 F	frac	1.0000	1.0000		1.0000	1.0000		
Frequency	frac	1.0000	1.0000		1.0000	1.0000		
Fuel composition	frac	1.0001	1.0001		1.0001	1.0001		
CALCULATIONS								
Test fuel H/C ratio	ratio	3.8797	3.8797		3.8861	3.8849		
Test fuel I/HC ratio	ratio	0.0108	0.0108		0.0091	0.0090		
Reference fuel H/C ratio	ratio	3.7837	3.7837		3.7837	3.7837		
Reference fuel I/HC ratio	ratio	0.0221	0.0221		0.0221	0.0221		

SGS Oil Gas & Chemicals

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ANALYTICAL REPORT No: AB10-01020.001

CLIENT: **GENERAL ELECTRIC INTERNATIONAL, INC.**
2 CENTRAL QUAY
89 HYDE PARK STREET
SCOTLAND
GLASGOW
G3 8BW

PRODUCT:	Natural Gas	**CLIENT ID:**	Sample 1 at 11:00hrs
SAMPLE SOURCE:	As Supplied	**SAMPLE RECEIVED:**	10/06/2010
SOURCE ID:		**SAMPLE ANALYSED:**	14/06/2010
VESSEL:		**SAMPLE TYPE:**	As submitted
LOCATION:	Baglan Bay	**SAMPLE BY:**	Client
		DATE SAMPLED:	09/05/2010

Cylinder No TPED#326 --- **Sample Temperature** 6.5 °C **Pressure** 4.4 Bar

Hydrocarbon Composition: ASTM D1945 / ISO 6974,75 & ISO 6976

Property	**Results % Mole**
Nitrogen	0.874
Oxygen	0.004
Methane	93.29
Carbon Dioxide	<0.0005
Ethane	5.704
Propane	0.113
Iso-Butane	0.007
N-Butane	0.007
Neo Pentane	<0.0005
Iso Pentane	0.001
N- Pentane	<0.0005
Hexanesplus	<0.0005
Total	**100.00**

Gas Calculations (ISO 6976:1995)

Property	**Units**	**RESULT**
Ideal Gross Calorific Value	MJ/m^3	39.07
Real Gross Calorific Value	MJ/m^3	39.16
Ideal Nett Calorific Value	MJ/m^3	35.23
Real Net Calorific Value	MJ/m^3	35.31
Ideal Gas Density	kg/m^3	0.7184
Real Gas Density	kg/m^3	0.7200
Ideal Relative Density	kg/m^3	0.5865
Real Relative Density	kg/m^3	0.5876
Apparent Molecular Weight	g/mol	16.99
Real Superior Primary Wobbe Index	MJ/m^3	51.08
Compressibility Factor Z at 15DegC / 1.01325 Bar	---	0.9978

Authorised Signatory

140620101157 0000022756

Gordon Jack-Laboratory Chemist

SGS United Kingdom Ltd
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Member of the SGS Group (SGS SA)

ANALYTICAL REPORT No: AB10-01020.002

CLIENT: **GENERAL ELECTRIC INTERNATIONAL, INC.**
2 CENTRAL QUAY
89 HYDE PARK STREET
SCOTLAND
GLASGOW
G3 8BW

PRODUCT:	Natural Gas	**CLIENT ID:**	Sample 2 at 11:30hrs
SAMPLE SOURCE:	As Supplied	**SAMPLE RECEIVED:**	10/06/2010
SOURCE ID:		**SAMPLE ANALYSED:**	14/06/2010
VESSEL:		**SAMPLE TYPE:**	As submitted
LOCATION:	Baglan Bay	**SAMPLE BY:**	Client
		DATE SAMPLED:	09/05/2010

Cylinder No TPED#323 --- **Sample Temperature** 6.5 °C **Pressure** 4.4 Bar

Hydrocarbon Composition: ASTM D1945 / ISO 6974,75 & ISO 6976

Property	**Results % Mole**
Nitrogen	0.878
Oxygen	0.003
Methane	93.28
Carbon Dioxide	<0.0005
Ethane	5.709
Propane	0.113
Iso-Butane	0.007
N-Butane	0.008
Neo Pentane	<0.0005
Iso Pentane	0.001
N- Pentane	<0.0005
Hexanesplus	<0.0005
Total	**100.00**

Gas Calculations (ISO 6976:1995)

Property	**Units**	**RESULT**
Ideal Gross Calorific Value	MJ/m³	39.07
Real Gross Calorific Value	MJ/m³	39.16
Ideal Nett Calorific Value	MJ/m³	35.23
Real Net Calorific Value	MJ/m³	35.31
Ideal Gas Density	kg/m³	0.7184
Real Gas Density	kg/m³	0.7201
Ideal Relative Density	kg/m³	0.5865
Real Relative Density	kg/m³	0.5876
Apparent Molecular Weight	g/mol	16.99
Real Superior Primary Wobbe Index	MJ/m³	51.08
Compressibility Factor Z at 15DegC / 1.01325 Bar	---	0.9978

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ANALYTICAL REPORT No: AB10-01020.003

CLIENT: **GENERAL ELECTRIC INTERNATIONAL, INC.**
2 CENTRAL QUAY
89 HYDE PARK STREET
SCOTLAND
GLASGOW
G3 8BW

PRODUCT:	Natural Gas	**CLIENT ID:**	Sample 3 at 12:00hrs
SAMPLE SOURCE:	As Supplied	**SAMPLE RECEIVED:**	10/06/2010
SOURCE ID:		**SAMPLE ANALYSED:**	14/06/2010
VESSEL:		**SAMPLE TYPE:**	As submitted
LOCATION:	Baglan Bay	**SAMPLE BY:**	Client
		DATE SAMPLED:	09/05/2010

Cylinder No TPED#447 --- **Sample Temperature** 6.5 °C **Pressure** 4.4 Bar

Hydrocarbon Composition: ASTM D1945 / ISO 6974,75 & ISO 6976

Property	**Results % Mole**
Nitrogen	0.882
Oxygen	0.003
Methane	93.25
Carbon Dioxide	<0.0005
Ethane	5.736
Propane	0.111
Iso-Butane	0.007
N-Butane	0.007
Neo Pentane	<0.0005
Iso Pentane	0.001
N- Pentane	<0.0005
Hexanesplus	<0.0005
Total	**100.00**

Gas Calculations (ISO 6976:1995)

Property	**Units**	**RESULT**
Ideal Gross Calorific Value	MJ/m³	39.07
Real Gross Calorific Value	MJ/m³	39.16
Ideal Nett Calorific Value	MJ/m³	35.24
Real Net Calorific Value	MJ/m³	35.32
Ideal Gas Density	kg/m³	0.7186
Real Gas Density	kg/m³	0.7202
Ideal Relative Density	kg/m³	0.5866
Real Relative Density	kg/m³	0.5877
Apparent Molecular Weight	g/mol	16.99
Real Superior Primary Wobbe Index	MJ/m³	51.08
Compressibility Factor Z at 15DegC / 1.01325 Bar	---	0.9978

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ANALYTICAL REPORT No: AB10-01020.004

CLIENT: **GENERAL ELECTRIC INTERNATIONAL, INC.**
2 CENTRAL QUAY
89 HYDE PARK STREET
SCOTLAND
GLASGOW
G3 8BW

PRODUCT:	Natural Gas	**CLIENT ID:**	Sample 4 at 12:30hrs
SAMPLE SOURCE:	As Supplied	**SAMPLE RECEIVED:**	10/06/2010
SOURCE ID:		**SAMPLE ANALYSED:**	14/06/2010
VESSEL:		**SAMPLE TYPE:**	As submitted
LOCATION:	Baglan Bay	**SAMPLE BY:**	Client
		DATE SAMPLED:	09/05/2010

Cylinder No TPED#327 --- **Sample Temperature** 6.5 °C **Pressure** 4.4 Bar

Hydrocarbon Composition: ASTM D1945 / ISO 6974,75 & ISO 6976

Property	**Results % Mole**
Nitrogen	0.900
Oxygen	0.003
Methane	93.19
Carbon Dioxide	<0.0005
Ethane	5.793
Propane	0.104
Iso-Butane	0.006
N-Butane	0.007
Neo Pentane	<0.0005
Iso Pentane	0.001
N- Pentane	<0.0005
Hexanesplus	<0.0005
Total	**100.00**

Gas Calculations (ISO 6976:1995)

Property	**Units**	**RESULT**
Ideal Gross Calorific Value	MJ/m³	39.08
Real Gross Calorific Value	MJ/m³	39.17
Ideal Nett Calorific Value	MJ/m³	35.24
Real Net Calorific Value	MJ/m³	35.32
Ideal Gas Density	kg/m³	0.7189
Real Gas Density	kg/m³	0.7205
Ideal Relative Density	kg/m³	0.5869
Real Relative Density	kg/m³	0.5880
Apparent Molecular Weight	g/mol	17.00
Real Superior Primary Wobbe Index	MJ/m³	51.08
Compressibility Factor Z at 15DegC / 1.01325 Bar	---	0.9978

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ANALYTICAL REPORT No: AB10-01020.005

CLIENT: **GENERAL ELECTRIC INTERNATIONAL, INC.**
2 CENTRAL QUAY
89 HYDE PARK STREET
SCOTLAND
GLASGOW
G3 8BW

PRODUCT:	Natural Gas	**CLIENT ID:**	Sample 5 at 13:00hrs
SAMPLE SOURCE:	As Supplied	**SAMPLE RECEIVED:**	10/06/2010
SOURCE ID:		**SAMPLE ANALYSED:**	14/06/2010
VESSEL:		**SAMPLE TYPE:**	As submitted
LOCATION:	Baglan Bay	**SAMPLE BY:**	Client
		DATE SAMPLED:	09/05/2010

Cylinder No TPED#310 --- **Sample Temperature** 6.5 °C **Pressure** 4.4 Bar

Hydrocarbon Composition: ASTM D1945 / ISO 6974,75 & ISO 6976

Property	**Results % Mole**
Nitrogen	0.892
Oxygen	0.003
Methane	93.18
Carbon Dioxide	<0.0005
Ethane	5.812
Propane	0.104
Iso-Butane	0.006
N-Butane	0.006
Neo Pentane	<0.0005
Iso Pentane	0.001
N- Pentane	<0.0005
Hexanesplus	<0.0005
Total	**100.00**

Gas Calculations (ISO 6976:1995)

Property	**Units**	**RESULT**
Ideal Gross Calorific Value	MJ/m^3	39.09
Real Gross Calorific Value	MJ/m^3	39.17
Ideal Nett Calorific Value	MJ/m^3	35.25
Real Net Calorific Value	MJ/m^3	35.33
Ideal Gas Density	kg/m^3	0.7190
Real Gas Density	kg/m^3	0.7206
Ideal Relative Density	kg/m^3	0.5870
Real Relative Density	kg/m^3	0.5880
Apparent Molecular Weight	g/mol	17.00
Real Superior Primary Wobbe Index	MJ/m^3	51.09
Compressibility Factor Z at 15DegC / 1.01325 Bar	---	0.9978

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