Dublin City Council
Dublin Waste to Energy Project

Report on Performance Demonstration Test

May 2018

CDM Smith

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Glossary

AER	Annual Environmental Report
As	Arsenic
Cd	Cadmium
CEM	Continuous Emissions Monitoring
CEMS	Continuous Emissions Monitoring System
Co	Cobalt
CO	Carbon monoxide
Cr	Chromium
CR	Client's Representative
CT	Current Transformer
DCS	Distributed Control System
dB	Decibel
DSO	Distribution System Operator
DWTE	Dublin Waste to Energy
DWTEL	Dublin Waste to Energy Limited
ELV	Emission Limit Value
EPA	Environmental Protection Agency
ESB	Electricity Supply Board
EU	European Union
GCRP	Grid Code Review Panel
GJ/t	Gigajoules/tonne
HCl	Hydrogen Chloride
HF	Hydrogen Fluoride
Hg	Mercury
hr	Hour
HV CB	High-Voltage Circuit Breaker
HZI	Hitachi Zosen Inova
IE	Industrial Emissions
kg	Kilogram
kV	Kilo volt
kW	Kilowatt
kWh	Kilowatt hour
LA_{eq}	Equivalent Continuous Sound Level (A-weighted)
LHV	Lower Heating Value
LOI	Loss on Ignition
mg	Milligram
mg/l	Milligrams per Litre
mg/m^3	Milligrams per Cubic Meter
MJ/kg	Megajoules per Kilogram
Mn	Manganese
MU	Measurement Uncertainty
MW	Megawatts

NCV	Net Calorific Value
ng/m^3	Nanograms per Cubic Meter
Ni	Nickel
NIC	Nominal Input Capacity
Nm^3	Normal Cubic Meter
N_2O	Nitrous Oxide
NO_2	Oxides of Nitrogen
PA	Project Agreement
PAC	Powdered Activated Carbon
PAT	Performance Acceptance Test
Pb	Lead
PDT	Performance Demonstration Test
$PM_{2.5}$	Particulate Matter Less than 2.5 Microns
PM_{10}	Particulate Matter Less than 10 Microns
PPP	Public Private Partnership
QAL2	Quality Assurance Level 2
RoCoF	Reserve and Rate of Change of Frequency
Sb	Antimony
SO_2	Sulphur Dioxide
TEQ	Toxic Equivalent
t/h	Tonne per hour
TG	Turbine-Generator
TGN	Technical Guidance Note
Tl	Thallium
TOC	Total Organic Carbon
V	Vanadium
VT	Voltage Transformer

Section 1 Introduction

The Dublin Waste to Energy (DWTE) project is a Public Private Partnership (PPP) between Dublin City Council **'the Authority'** (acting on behalf of the four Dublin Local Authorities) and Dublin Waste to Energy Limited (DWTEL) **'the PPP Co.'**

The Project Agreement (PA) between the Authority and PPP Co. provides for the design, construction, operation, maintenance and financing of a waste to energy facility by the PPP Co., which is capable of thermally treating 600,000 tonnes per annum of non-hazardous municipal and industrial waste.

The construction schedule provided by PPP Co. for the delivery of the works envisaged a 33-month construction and initial commissioning programme, beginning in October 2014 (month 1) and ending June 2017 (month 33). Ultimately, the construction and initial commissioning activities took slightly longer, being completed in October 2017 (month 37), closely aligning with the schedule provided in the PA.

During the commissioning phase of the Project, the PPP Co. is required to conduct a number of tests to demonstrate to the Authority that the DWTE Facility is capable of operating at its design capacity and in accordance with the contractual and statutory requirements, namely the Waste Licence, now referenced as the Industrial Emissions (IE) Licence.

The Authority appointed CDM Smith as Client's Representative (CR) for the construction and commissioning stages of the DWTE Project on 1 December 2014. A key scope of the appointment was the monitoring and reporting on the commissioning of the DWTE Facility and to evaluate if the DWTE Facility was operated under normal and representative conditions during the testing and that the DWTE Facility's performance was at or above the contractual and statutory requirements.

1.1 Purpose of this Document

As part of their contractual requirements, the PPP Co. is tasked with conducting a series of tests to demonstrate the operational capacity of the DWTE Facility pursuant to Schedule 08 of the PA. These tests include:

- Pre-Commissioning Tests;
- Performance Demonstration Tests (PDT); and
- Performance Acceptance Tests (PAT).

The Pre-Commissioning Tests to determine readiness for the PDT were conducted in early September 2017 and the PDT was conducted from 08 September through 08 October 2017. The PAT is expected to be conducted in mid-2018 following 4,000 hours of operation per the requirements of Schedule 08 of the PA and following the completion of all construction and Commissioning works. This report discusses the PDT. The results of the Pre-Commissioning Test are contained in the report titled "Report on Pre-Commissioning Tests" dated May 2018. The results of PAT will be included in a separate report once the Facility has reached Completion and these tests are complete.

Following successful completion of the PDT, the PPP Co. is required to submit the Performance Demonstration Test Confirmation Certificate to the Authority certifying that the test procedures comply with the PA and the tests are in accordance with any requirements of the PA, manufacturers' recommendations and any Licences compulsory to the operations. If the Authority concurs that the DWTE Facility has passed the PDT, they are required to issue the Performance Demonstration Certificate to the PPP Co.

The CR is responsible for monitoring and review of DWTE Facility performance during the PDT and advising the Authority on the issuance of the Performance Demonstration Certificate. This Report documents the actions taken and observations made by the CR during the PDT, our review of the test results, and recommendation relative to issuance of the Performance Demonstration Certificate by the Authority.

Section 2 Detailed Requirements of the PDT

2.1 Project Agreement

The PA, Schedule 08, Section 3 discusses the two Performance Warranty Tests:

- The Performance Demonstration Test, which is being discussed in this Report, and
- The Performance Acceptance Test, which is scheduled to occur after the DWTE Facility has run for approximately 4,000 hours to allow for seasoning of the boilers, and associated equipment.

This Report does not discuss the Performance Acceptance Test. A future report will address the Performance Acceptance Test, once it is completed.

Section 3.2 of Schedule 08 of the PA details the requirements of the PDT.

> *(a) The Performance Demonstration Tests shall be such tests as will properly and sufficiently demonstrate the Facility's capability to operate continuously at the Nominal Input Capacity[1] and in accordance with Law.*
>
> *(b) The main tests to be carried out during the Performance Demonstration Tests shall comprise, for each individual Thermal Treatment line, a 720 (seven hundred and twenty) hours continuous operation test, during which period all Process Plant, and its auxiliary equipment shall be operated in the range of 80% (eighty per cent) to 100% (one-hundred per cent) of Nominal Input Capacity.*
>
> *(c) The 720 (seven hundred and twenty) hours continuous operation shall include safe and stable operation of the entire Facility at or above 90% (ninety per cent) of the Nominal Input Capacity with the turbine in operation with no bypass for a continuous period of not less than 14 (fourteen) days while in compliance with the environmental warranties[2] set out in paragraphs 3.1 to 3.5 of Annex 1 to this Part 1 of Schedule 08 and in accordance with Law.*
>
> *(d) "**Nominal Input Capacity**" is the thermal input capacity in megawatts (MW) equivalent to the thermal input capacity of 32 tonne/hour (t/h) at 11.5 gigajoules (GJ)/tonne, in the range from 9 to 15 GJ/tonne[3].*
>
> *(e) 720 hours continuous operation test:*
>
> > *(i) The 720 hours test period shall be rolling, meaning that the test period is prolonged with acceptable Stoppages. Once the total number and/or period of acceptable Stoppages have been exceeded, the full 720 hours continuous operation test shall be recommenced.*

[1] The Nominal Input Capacity is a measure of the heat input to the furnaces. The NIC is calculated as the product of the waste feed rate and the heating value of the waste. The NIC is automatically calculated by the Distributive Control System (DCS) from the feed rates measured by the waste crane load cells and waste heating value estimated based on various inputs including steam flow, steam pressure and temperature, steam losses, flue gas flows, flue gas temperatures, etc.

[2] See Section 2.2 for summary of Environmental Warranties in PA.

[3] This equates to a heat input of 102.2 MW/combustion line, which is roughly equivalent to 125 tonnes steam/hour/line.

*(ii) A "**Stoppage**" is defined as any period during which either:*

(A) the processed thermal input capacity is below line "ABC" in the capacity diagram contained in Appendix C (Bid Proposals); or

(B) the Operations are not complying with the Environmental Warranty; or

(C) the thermal input capacity falls below 80% (eighty percent) of the Nominal Input Capacity[4] for more than 1 (one) hour, except that a Stoppage shall not be considered to have occurred if the power grid becomes unavailable or if there are insufficient Waste deliveries due to no fault of the PPP Co[5].

(iii) The duration of a Stoppage shall be measured from the earliest of:

(A) the time the plant drops below line "ABC" until the time it again rises above line "ABC" of the capacity diagram contained in Appendix C (Bid Proposals); or

(B) the time when the plant is not complying with the Environmental Warranties; or

(C) The time when the plant in any period is operating below 80% (eighty percent) of the Nominal Input Capacity for more than 1 (one) hour.

(iv) During the test period, no more than five Stoppages will be accepted, none of them individually exceeding 10 hours. For the avoidance of doubt, if more than one of the events set out in 3.2(e) (iii) above occurs simultaneously this will constitute one Stoppage, commencing with the first to occur and concluding with the last to be rectified. During the test period the SCADA System shall be fully operative and in control of the associated plant. During the test period, no more than eight faults in the SCADA System will be accepted.

(v) The total Stoppage during the 720 hours continuous operation test, must not exceed 48 hours.

(vi) In the event of unavailability of the power grid the full 720 hours continuous operations test shall continue at whatever load possible, and this shall not constitute a Stoppage. In the event of insufficient Waste delivery within an hourly average Lower Heating Value (LHV) 9-15 GJ/tonne during the Performance Demonstration test, the full 720 hours continuous operation test shall continue at whatever load possible if due to the Authority's failure to fulfil its obligations under paragraph 1.8 above. If the PPP Co fails to fulfil its obligations under paragraph 1.8, this shall constitute a Stoppage.

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[4] The capacity diagram presents the envelope within which the combustion units are designed to operate. The diagram includes minimum and maximum values for heat input capacity and waste heating value. The "ABC" line on the capacity diagram represents the lower limits of operation of each combustion line. Line segment AB represents 60% NIC and line segment BC represents a heating value of 7 MJ/kg.

[5] 80% of the NIC is 81.8 MW/combustion line or 100 tonnes steam/hour/line.

(f) 14 (fourteen) day continuous test to demonstrate the safe and stable operation of the entire facility at 90% capacity

(i) The 90% Nominal Input Capacity referred to in paragraph 3.2(c) above shall be an average of the input capacities demonstrated during the associated 14 (fourteen) day continuous test[6].

(ii) The 14 (fourteen) day test referred to in paragraph 3.2(c) above shall be rolling, meaning that the test period is prolonged with acceptable Stoppages, but where acceptable Stoppages may be up to a total of 24 hours, none of them exceeding 10 (ten) hours, with a maximum of 3 (three) Stoppages. Once the total number and/or period of acceptable Stoppages has been exceeded, the full 14 (fourteen) day continuous test shall be recommenced.

(iii) At PPP Co's option, the 14 (fourteen) day test referred to in paragraph 3.2(c) above may be replaced with Performance Acceptance Tests, provided that the Performance Acceptance Certificate is issued prior to or simultaneously with the Authority's issuance of the Performance Demonstration Certificate, which will be issued following the successful completion of the 720 hours continuous operations test.

The Authority and PPP Co. agreed on a detailed test protocol prior to the start of the PDT consistent with the requirements of Schedule 08. This protocol defined the specific activities that were to be conducted, the data to be collected and the general schedule for undertaking the test program. Independent test firms and laboratories were engaged by the PPP Co. for air emission testing, bottom ash testing and noise emission testing.

2.2 Summary of Environmental Warranties

This section summarises the environmental warranties included in Schedule 08 of the PA.

Air Quality Warranty

The requirements of the Air Quality Warranty are set out in Table 1, Table 2 and Table 3. All of the air emission limit values in Schedule 08 are 10% less than the IE License except for carbon monoxide which is the same as the IE License.

Table 1: Air emissions guarantee values - daily and half-hourly average values.

Values shall be adjusted to standard conditions of: T=273, P=101.3 kPa, 11% O2 Dry Gas.

Pollutant	Unit	Daily Average Value	Half-hour Average Value (100%)	Half-hour Average Value (97%)
Total Dust	mg/Nm3	9	27	9
Gaseous and vaporous organic substances expressed as total organic carbon	mg/Nm3	9	18	9
Hydrogen Chloride (HCl)	mg/Nm3	9	54	9
Hydrogen Fluoride (HF)	mg/Nm3	0.9	3.6	1.8

[6] 90% of the NIC is 92.0 MW/combustion line or 112.5 tonnes steam/hour/line.

Pollutant	Unit	Daily Average Value	Half-hour Average Value (100%)	Half-hour Average Value (97%)
Sulphur dioxide (SO_2)	mg/Nm3	45	180	45
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2) expressed as nitrogen dioxide	mg/Nm3	180	360	180

The half-hourly average emission limit values in Table 1 shall be complied with if either none of the half-hourly average values exceeds any of the emission limit values set out in "Half-hour Average Value (100%)" or 97% of the half-hourly average values over the year do not exceed any of the emission limit values set in "Half-hour Average Value (97%)".

The following emission limit values of carbon monoxide (CO) concentrations shall not be exceeded in the combustion gases (excluding the start-up and shut-down phase):

1. 50 milligrams/m^3 of combustion gas determined as daily average value;
2. 150 milligrams/m^3 of combustion gas of at least 95% of all measurements determined as 10-minute average values or 100 milligrams/m^3 of combustion gas of all measurements determined as half-hourly average values taken in any 24-hour period.

Table 2: Air emission guarantee values - average values over the sample period of a minimum of 30 minutes and a maximum of 8 hours

Values shall be adjusted to standard conditions of: T=273, P=101.3 kPa, 11% O2 Dry Gas.

Pollutant	Unit	Average Value
Cadmium and its compounds, expressed as cadmium (Cd); Thallium and its compounds, expressed as thallium (Tl)	mg/Nm3	total 0.045
Mercury and its compounds, expressed as mercury (Hg)	mg/Nm3	0.045
Antimony and its compounds, expressed as antimony (Sb)	mg/Nm3	total 0.45
Arsenic and its compounds, expressed as arsenic (As)		
Lead and its compounds, expressed as lead (Pb)		
Chromium and its compounds, expressed as chromium (Cr)		
Cobalt and its compounds, expressed as cobalt (Co)		
Copper and its compounds, expressed as copper (Cu)		
Manganese and its compounds, expressed as manganese (Mn)		
Nickel and its compounds, expressed as nickel (Ni)		
Vanadium and its compounds, expressed as vanadium (V)		

Table 3: Air emission guarantee values - Average values over the sample period of a minimum of 6 hours and a maximum of 8 hours

Values shall be adjusted to standard conditions of: T=273, P=101.3 kPa, 11% O2 Dry Gas.

Pollutant	Unit	Average Value
Dioxins and Furans	ng/Nm3	0.09

Residue Quality Warranty

a) The Thermal Treatment process provided for re-use shall comply, as a minimum, with the requirements set out in Appendix 1 of Schedule 07.

b) Bottom ash shall contain less than 3% by weight of Total Organic Carbon (TOC), or their loss on ignition shall be less than 5% of the dry weight of the material.

Waste Water Quality Warranty

a) The waste water released into the sewerage system or to a recipient shall comply with Law and with all conditions and requirements pertaining to the environmental protection stipulated in permits, licenses, approvals and authorisations granted by Relevant Authorities with respect to the Project.

Noise Warranty

a) The noise levels at the Facility shall comply with Law; and sporadic episodes of high noise levels shall as far as possible be avoided.

General Operations and Maintenance Warranty

a) The Facility shall be operated and maintained according to the requirements of the O&M Manuals; and the Facility will be in a state characterised as Good Industry Practice. The Facility over its lifetime will meet the warranted emissions levels as specified the Agreement.

Section 3 Operational Performance of the DWTE Facility during the PDT

3.1 Introduction

The PDT took place over the 720-hour period between 08 September through 08 October 2017.

The CR had at least two engineers present on Site during every day of the 30-day PDT period. CR staff were generally present from approximately 07:00 hours to 19:00 hours each day.

Data from the DCS and the Continuous Emissions Monitoring System (CEMS) were received in electronic format from the PPP Co. on a daily basis. Typically, data for the preceding day was received by mid-afternoon.

The CR monitored operations of the DWTE Facility via walk down inspections, reviewed operating data in real time from the DCS in the Control Room, interfaced daily with PPP Co. testing staff, and reviewed 24-hour operating data from the DCS and CEMS for the previous day in order to assess compliance with the operating performance requirements established in Schedule 08 and the approved PDT protocol. The findings from our operational performance review are summarized below.

3.2 Performance Demonstration Test Periods

The PDT was preceded by a 48-hour pre-commissioning test pursuant to Section 2.2(b) of Part 1 to Schedule 08. The 48-hour pre-commissioning test was held from 16:33 hours on 03 September 2017 until 16:36 hours on 05 September 2017 (see separate Pre-Commissioning Test Report). The 720-hour PDT initially commenced on 06 September 2017 but was subsequently stopped the same day following a TG trip that also affected boiler operation.

The PDT was re-started on 08 September 2017 at 20:37 hours and concluded on 08 October 2017 at 23:30 hours. The PDT test period was extended by three hours to account for three hours of total Stoppage time during the 30-day period.

The 14-day continuous run of the turbine generator and boiler operation greater than 90% of NIC, initially commenced on 09 September 2017 but was subsequently suspended following a TG trip caused by ongoing problems with the condensate bleed tank pumps. The second attempt was stopped on 12 September at 06:20 hours due to another TG trip followed by a third attempt that was suspended at 01:07 hours on 18 September 2017, again due to a TG trip caused by problems with the condensate bleed tank pumps. A fourth attempt began on 18 September 2017 but this attempt lasted only one day as the TG tripped on 19 September 2017 at 01:49 hours due to a brief interruption in the cooling water flow to the main transformer. The fifth attempt at the 14-day segment of the PDT began at 04:36 hours on 19 September 2017 and successfully concluded at 16:36 hours on 03 October 2017. The 14-day test was extended by 12 hours to account for the period of time in excess of the 17.5 hours agreed for bypassing steam during concurrent EirGrid compliance testing. Schedule 08 allowed for bypassing of steam during periods when the grid was not available, or grid code testing was on going.

3.3 Boiler Nominal Input Capacity (NIC)

Per Section 3.2(d) of Part 1 to Schedule 08, NIC is defined as the thermal input capacity in megawatts (MW) equivalent to the thermal input capacity of 32 tonnes/hour at 11.5 GJ/tonne. This equates to 102.22 MW. The CR monitored the NIC on each combustion line during the PDT. A summary of the NIC data for the 30-day and 14-day test periods is provided in Table 4. Dropping below 60% of the NIC (lower limit of combustion firing diagram or "ABC" line) at any point or dropping below 80% NIC for more than one hour are considered Stoppages under Section 3.2(e)(ii) of Part 1 to Schedule 08. There were no instances during the PDT where the NIC dropped below 60% and only one instance when the NIC dropped below 80% for more than one hour. This occurred on 09 September 2017 between 20:38 and 22:48 hours on combustion line 1 and between 20:46 and 22:45 hours on combustion line 2. Since the combustion line 2 event occurred simultaneously with and within the combustion line 1 event, there was only one official Stoppage pursuant to Section 3.2(e)(iv), which equated to one hour and 11 minutes after deducting the first hour. The DWTE Facility averaged approximately 103.6 MW NIC during the 30-day test period and approximately 104.5 MW NIC during the 14-day test period, both slightly above the design point of 102.22 MW. NIC was consistent between the two combustion lines during the PDT.

Table 4: Summary of Nominal Input Capacity During the Performance Demonstration Test

Parameter	Stoppage Criteria	Performance Demonstration Test			
		30-Day Test Period		14-Day Test Period	
		Line 1	Line 2	Line 1	Line 2
Minimum 1-Minute NIC (MW)	IF ≤ 61.33 MW (60%)	**77.19**	**78.67**	**87.94**	**87.26**
	IF ≤ 81.78 MW (80%)				
Average Daily NIC (MW)	-	**103.54**	**103.67**	**104.46**	**104.48**
Maximum 1-Minute NIC (MW)	IF ≥ 112.44 MW (110%)	**108.70**	**111.32**	**108.70**	**111.32**
Time below 60% NIC (minutes)	IF ≥ 1 minutes	**0**	**0**	**0**	**0**
Time below 80% NIC (minutes)	IF ≥ 60 continuous minutes	**148**	**121**	**0**	**0**

3.4 Boiler Steam Flow

Boiler steam flow is also a good indicator of boiler operating load and, during the PDT, was used by the CR to validate the NIC being calculated by the DCS, as steam flow data is directly measured and is available in real time. Per Schedule 08, steam flow does not constitute pass/fail criteria, but does give a good representation as to what load the boilers are running at. The design steam flow at maximum load (100% NIC) is 125 tonnes of steam/hour/combustion line. The CR monitored the steam flow on each combustion line during the PDT. A summary of the steam flow data for the 30-day and 14-day test periods is provided in Table 5. The DWTE Facility averaged approximately 122.0 tonne/hour/unit steam flow during the 30-day test period and

approximately 122.4 tonne/hour/unit steam flow during the 14-day test period, both slightly below the 100% design point of 125 tonnes of steam/hour/unit, but well above the requirements of the PDT. Steam flow was consistent between the two combustion lines during the PDT and correlated reasonably well with the calculated NIC for each combustion line.

Table 5: Summary of Boiler Steam Flow During the Performance Demonstration Test

Parameter	Performance Demonstration Test			
	30-Day Test Period		14-Day Test Period	
	Line 1	Line 2	Line 1	Line 2
Minimum 1-Minute Steam Flow (tonne/hour)	**72.06**	**76.24**	**72.06**	**80.26**
Average Daily Steam Flow (tonne/hour)	**121.57**	**122.51**	**122.21**	**122.79**
Maximum 1-Minute Steam Flow (tonne/hour)	**142.47**	**146.77**	**142.47**	**142.72**
Time below 80% Steam Flow (minutes)	**661**	**460**	**326**	**203**

3.5 Waste Net Calorific Value (NCV)

The NCV of the waste was calculated automatically by the DCS on a three-hour rolling average, based on a heat balance around the boiler and the waste feed rate measured by the waste crane load cells. The details of this calculation are contained in Hitachi Zosen Inova (HZI) Document No. 90057099-2.0 titled “Functional Design Specification (FDS): Waste NCV Calculation”. The CR monitored the waste NCV on each combustion line during the PDT. A summary of the waste NCV data for the 30-day and 14-day test periods is provided in Table 6. Waste NCV below 7 MJ/kg (lower limit of combustion firing diagram) or above 15 MJ/kg (upper limit of combustion firing diagram) are considered Stoppages under Section 3.2(e) of Part 1 to Schedule 08. There were no instances during the PDT where the waste NCV dropped below 7 MJ/kg or was above 15 MJ/kg. The average waste NCV during the 30-day test period was approximately 10.10 MJ/kg and 9.95 MJ/kg during the 14-day test period. These are both below the design point of 11.5 MJ/kg but within the design range of 7-15 MJ/kg meaning that greater than 32 tonne/hour/unit of waste could be processed.

Table 6: Summary of Waste Net Calorific Value During the Performance Demonstration Test

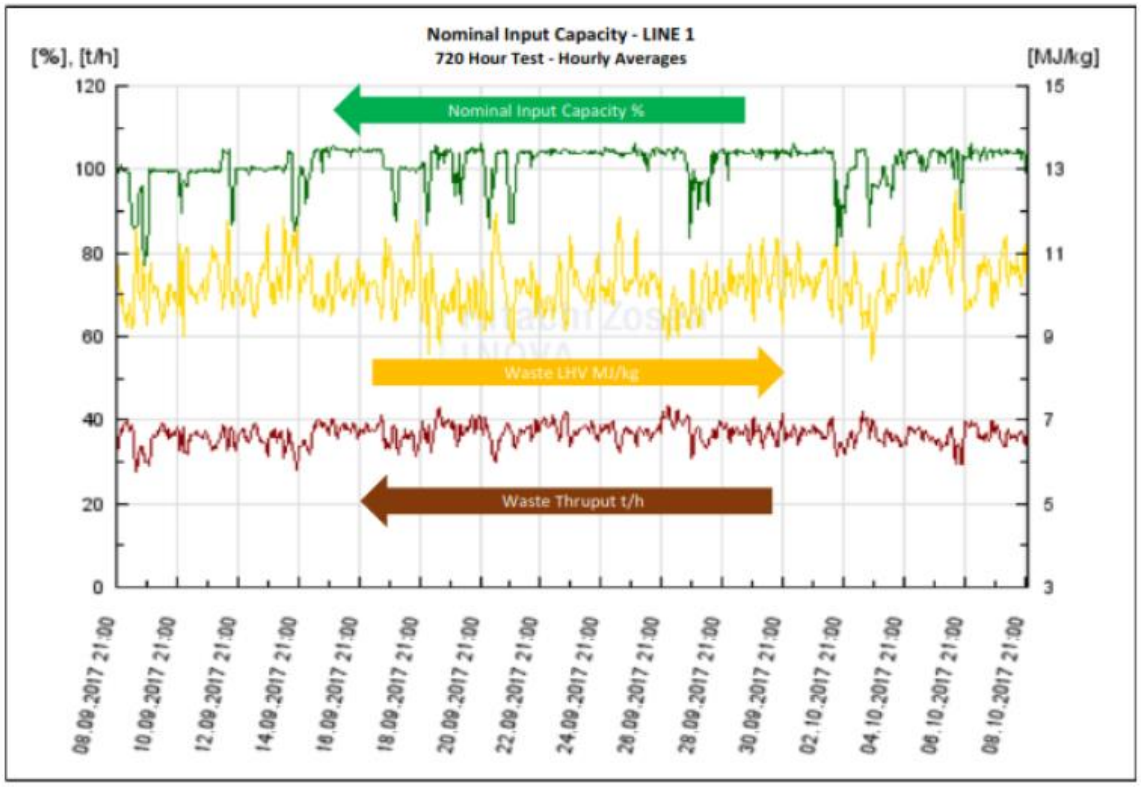
Parameter	Stoppage Criteria	Performance Demonstration Test			
		30-Day Test Period		14-Day Test Period	
		Line 1	Line 2	Line 1	Line 2
Minimum 1-Minute NCV (MJ/kg)	IF ≤ 7	**8.15**	**8.02**	**8.15**	**8.02**
Average Daily NCV (MJ/kg)	-	**10.29**	**9.92**	**10.11**	**9.79**
Maximum 1-Minute NCV (MJ/kg)	IF ≥ 15	**12.94**	**12.67**	**12.32**	**12.52**

Parameter	Stoppage Criteria	Performance Demonstration Test			
		30-Day Test Period		14-Day Test Period	
		Line 1	Line 2	Line 1	Line 2
Time Below 7 MJ/kg (minutes)	IF ≥ 1 minutes	**0**	**0**	**0**	**0**
Time Above 15 MJ/kg (minutes)	IF ≥ 1 minutes	**0**	**0**	**0**	**0**

3.6 DCS Data Trends

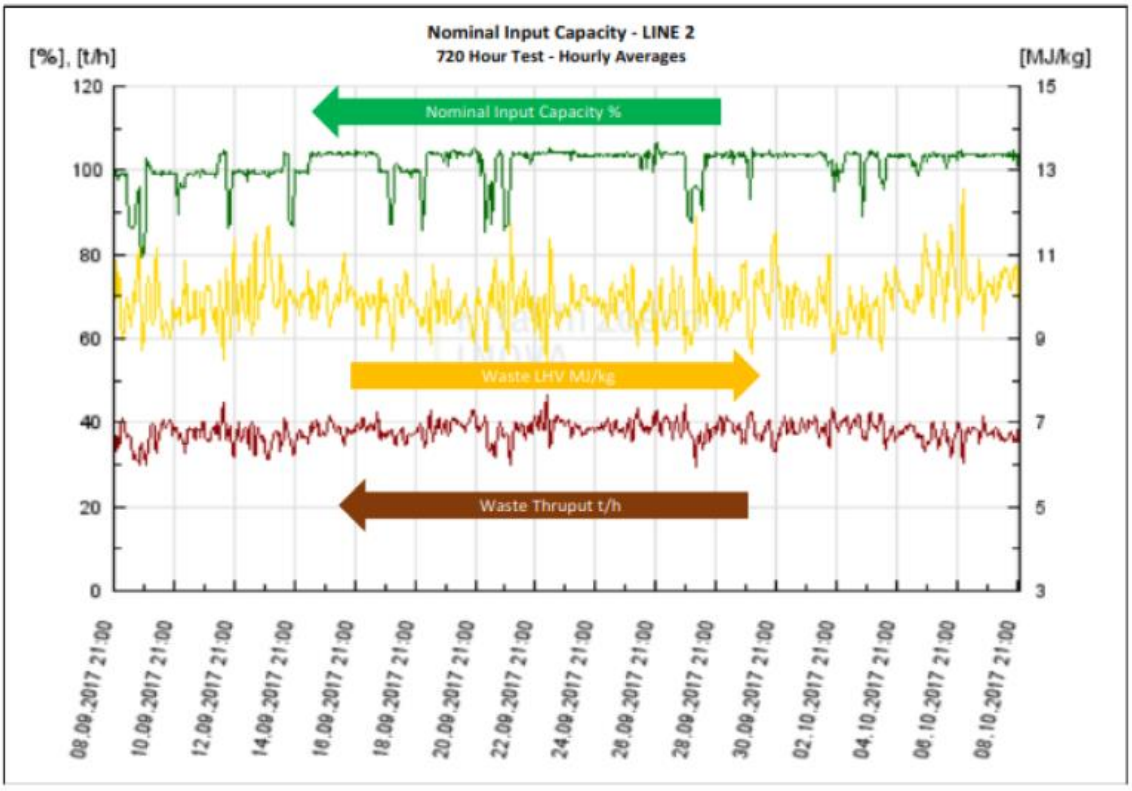
Figure 1 and Figure 2, prepared by the PPP Co. and their subcontractor, HZI, from the 1-minute data collected by the DCS, show hourly average boiler NIC, waste NCV (i.e., lower heating value or LHV) and waste throughput for combustion lines 1 and 2, respectively, during the PDT. The total estimated amount of waste processed during the PDT was 26,340 tonnes for combustion line 1 and 27,130 tonnes for combustion line 2. This equates to approximately 36.6 tonne/hour and 37.7 tonne/hour, respectively, which is consistent with the estimated NCV that was lower than design.

Additionally, the CR team monitored steam flow from both combustion lines during the PDT as a comparison to NIC values. As discussed above, NIC values are automatically calculated by the DCS and were presented at approximately 3 to 4 hour delayed intervals. This was a function of the time period taking into account drops of waste from the waste cranes. Steam flows were a measured value coming from calibrated instrumentation and gave real time indication of the load the boilers were operating at. The 100%/full load of each boiler is rated at 125,000 tonnes of steam per hour. Using this as a basis, the CR team was able to determine, if the boilers were running close to full load at any given moment.



Signal		#values	mean	stdev	Min	Max
Waste throughtput m B 3 Hour Average, 1EYA10EB001ZJ59, &fm_Wst_L1	[t/h]	723	36.59	2.42	27.53	43.22
Percent of MCR Waste Heat Input, &P_Thrm_L1_pct	[%]	723	101.27	4.67	77.27	106.33
Waste NCV Hu,B 3 Hour Average, 1EYA10EB001ZJ57	[MJ/kg]	723	10.23	0.58	8.45	12.52

Figure 1: Hourly Average Boiler NIC, Waste NCV and Waste Throughput for Combustion Line 1 (Source: Hitachi Zosen Inova)



Signal		#values	mean	stdev	Min	Max
Waste throughtput m B 3 Hour Average, 2EYA10EB001ZJ59, &fm_Wst_L2	[t/h]	723	37.87	2.45	29.54	46.57
Percent of MCR Waste Heat Input, &P_Thrm_L2_pct	[%]	723	101.45	4.22	79.30	106.65
Waste NCV Hu,B 3 Hour Average, 2EYA10EB001ZJ57	[MJ/kg]	723	9.90	0.56	8.22	12.55

Figure 2: Hourly Boiler NIC, Waste NCV and Waste Throughput for Combustion Line 2 (Source: Hitachi Zosen Inova)

3.7 Bottom Ash Test Results

Bottom ash samples were collected at 6-hour intervals during the 720-hour PDT to demonstrate compliance with the requirements of the PA which are the same as the IE Licence. These samples where then mixed and screened to produce a weekly composite sample. Four weekly composite samples were sent to an independent laboratory to determine the total organic carbon (TOC) and loss on ignition (LOI) percentages by dry weight. These parameters are indicative of the degree of burnout of the combustible matter in the waste with low numbers indicating good burnout. The laboratory results are shown in Table 7 and demonstrate compliance with the maximum TOC and LOI percentages allowed under the IE Licence and PA.

Table 7: Summary of Bottom Ash Test Results

Bottom Ash Sample	Percent Moisture	TOC (% by dry weight)	TOC Limit [1] (% by dry weight)	LOI (% by dry weight)	LOI Limit [1] (% by dry weight)	Pass/Fail TOC/LOI Limits
Week 1	10.4	<1.0	<3	3.1	<5	Pass
Week 2	11.2	<1.0		2.2		Pass
Week 3	13.7	<1.0		2.5		Pass
Week 4	13.3	<1.0		2.1		Pass

[1]Per Condition 3.18.4 of IE Licence and Section 3.3 of Annex 1 to Part 1 of Schedule 08 to PA.

Section 4 Environmental Performance of the DWTE Facility during the PDT

4.1 Introduction

The CR monitored the environmental performance of the DWTE Facility during the 30-day PDT for compliance with the requirements of the IE Licence and the Environmental Warranties in Schedule 08. The CR monitored environmental compliance via walk down inspections, reviewed air and water emissions data in real time from the DCS in the Control Room, reviewed 24-hour environmental data from the DCS and CEMS for the previous day and reviewed various test reports prepared by independent testing companies and laboratories. The findings from our environmental performance review are summarised in the following sections.

4.2 Combustion Line Stack Emission Test Results

Table C.1.2 of the IE Licence and Schedule 08 of the PA requires periodic (quarterly) monitoring for the following parameters via manual stack tests:

- Particulate Matter Less than 10 Microns (PM_{10});
- Particulate Matter Less than 2.5 Microns ($PM_{2.5}$);
- Hydrogen Fluoride (HF);
- Cadmium (Cd) and Thallium (Tl);
- Mercury (Hg);
- Metals (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V); and
- Dioxin/Furans.

Exova Catalyst Ireland (Exova) conducted manual stack tests to demonstrate compliance with the Emission Limit Values (ELVs) for each of the above parameters during the PDT (13-18 September 2017). The IE Licence also requires periodic monitoring of nitrous oxide (N_2O). Three test runs were made on each combustion line for each pollutant while the line operated at or close to the 100% NIC, or maximum load. An instrument method was used to measure N_2O emissions during Quality Assurance Level 2 (QAL2) testing of the CEMS (29-31 August). Note there is no ELV for N_2O emissions, just a requirement in the IE Licence to periodically measure.

Table C.1.2 of the IE Licence and Schedule 08 of the PA also requires continuous monitoring for the following six parameters:

- Total Dust;
- Total Organic Carbon (VOC);
- Hydrogen Chloride (HCl);
- Sulphur Dioxide (SO_2);

- Oxides of Nitrogen (expressed as NO_2); and
- Carbon monoxide (CO).

Exova conducted manual stack tests for total dust and HCl and used instrument methods for VOC, SO_2, oxides of nitrogen and CO during QAL2 testing of the CEMS (29-31 August). The PPP Co. stated post-PDT that they were using the DWTE Facility's CEMS (i.e., daily CEMS reports) to show compliance with the ELVs for these parameters during the PDT. It is the CR's opinion that this meets the intent of Schedule 08.

The average of the test runs performed during the PDT or QAL2 testing are shown in Table 8. All of the test results are significantly lower than the applicable ELVs set out in the IE Licence and PA, even when the measurement uncertainty (MU) is considered. Per the EPA's Emissions Monitoring Guidance Note (AG2), "All measurements, particularly those associated with dynamic processes such as stack emissions, are subject to an inherent doubt as to their absolute value, due to the combination of individual factors associated with the many variables involved in the sampling and analysis procedure". The MU is intended to represent the range of values within which the "true" value is likely to fall. Since the CEMS emissions recorded during the PDT were well below the respective ELVs for pollutants requiring continuous monitoring, the PPP Co. was operating in compliance with all of the ELVs during the PDT with the exception of three half hour SO_2 averages as discussed in Section 4.5.

Table 8: Summary of Combustion Line Stack Emission Test Results

Pollutant [1]	Emission Limit Value [2]			Test Results [3]				Pass/Fail
	IE Licence	PA	Units [3]	Line 1		Line 2		
				Result	MU (+/-)	Result	MU (+/-)	
Total Dust (Particulate)	10	9	mg/m^3	1.35	0.34	0.83	1.00	Pass
Total Organic Carbon (TOC)	10	9	mg/m^3	2.0	0.32	0.29	0.33	Pass
Hydrogen Chloride (HCl)	10	9	mg/m^3	0.030	0.0024	0.072	0.0057	Pass
Hydrogen Fluoride (HF)	1	0.9	mg/m^3	<0.04	0.0026	0.042	0.0031	Pass
Sulphur Dioxide (SO_2)	50	45	mg/m^3	0.062	0.005	0.068	0.0053	Pass
Oxides of Nitrogen (NO_2)	200	180	mg/m^3	103.24	4.3	106.70	4.96	Pass
Cadmium (Cd) and Thallium (Tl)	0.05	0.045	mg/m^3	<0.00071	0.00011	<0.00056	0.00009	Pass
Mercury (Hg)	0.05	0.045	mg/m^3	<0.00030	0.00004	0.00091	0.00012	Pass
Heavy Metals [4]	0.5	0.45	mg/m^3	0.1590	0.027	0.1341	0.02	Pass
Arsenic (As)	0.2	-	mg/m^3	<0.00065	0.00015	0.00060	0.00013	Pass
Dioxin/Furan	0.1	0.09	ng/m^3 TEQ [5]	0.00348	0.00072	0.00022	0.000045	Pass

Pollutant [1]	Emission Limit Value [2]			Test Results [3]				Pass/Fail
	IE Licence	PA	Units [3]	Line 1		Line 2		
				Result	MU (+/-)	Result	MU (+/-)	
Carbon Monoxide (CO)	50	50	mg/m^3	1.82	4.5	0.23	0.82	Pass
PM_{10}	-	-	mg/m^3	0.18	0.98	0.20	0.36	-
$PM_{2.5}$	-	-	mg/m^3	0.14	0.98	0.15	0.27	-
Nitrous Oxide (NO)	-	-	mg/m^3	5.7	1.66	1.83	1.51	-

[1]Total dust, TOC, HCl, SO_2, NO_2 conducted by instrument method. All others conducted by manual stack testing.

[2]Per Table B.1 of IE Licence and Table 1 of Annex 1 to Part 1 of Schedule 08 to the PA. Most stringent emission limit value (daily average) used for total dust, TOC, HCl, HF, SO_2 and NO_2 and CO

[3]Corrected to standard conditions: 273 °K, 101.3 kPa, 11% O_2 dry gas

[4]Includes antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V)

[5]Total concentration of dioxins and furans calculated using the concept of toxic equivalence in accordance with Annex I of Directive 2000/76/EC

4.3 Overview of PAC usage

The PPP Co.'s reported fresh powdered activated carbon (PAC) feed rate setpoint is 18 kg/hour/combustion line. The fresh PAC usage during the mercury and dioxin/furan test runs is summarized in Table 9. Usage is based on the change in the PAC storage silo weight during the test run period and assumes that an equal amount was distributed to each combustion line since a single PAC silo serves both lines. The recirculation feature of the semi-dry reactor introduces an additional amount of carbon back into the system as part of the recycled fly ash. The amount of recycled fly ash is not measured nor is the percent of unreacted PAC known without sampling so the amount of additional PAC contributed by the recycled system is not available on a real time basis. Average hourly fresh PAC usage during the mercury and dioxin/furan tests varied from approximately 18-42 kg/hour/line (90-210 mg/Nm^3/unit) or slightly higher than the PPP Co.'s setpoint. Since fresh PAC usage is based on the change in silo weight, usage over the six-hour dioxin/furan test run period (23.4 kg/hour/line average) is considered more reliable than the one-hour mercury test runs. The PPP Co. should routinely operate with the same fresh PAC feed rate that was used during the most recent dioxin/furan testing until a new feed rate is established during the next scheduled stack testing program.

Figure 3 includes daily average fresh PAC feed rate during the 30-day PDT. Similar to the data in Table 8, the average daily usage was calculated based on the change in PAC storage silo weight and assumes that an equal amount was distributed to each combustion line. The data in Figure 3 shows that the actual fresh PAC feed rate was highly variable over the test period and in many cases the daily average was less than the PPP Co.'s stated feed rate setpoint of 18 kg/hour/combustion line and in almost all cases well below the average feed rate of 23.4 kg/hour/line established during the dioxin/furan test runs.

The IE Licence requires a dose meter to measure the PAC and lime feed rates. The current system of using the change in the common PAC silo weight does not allow for positive verification of the amount of PAC injected into each combustion line. This approach can also not be used while a PAC delivery is in progress. Due to the importance of this parameter for mercury and dioxin/furan control, the CR and the Authority have strongly encouraged the PPP Co. to

replace the current volumetric screw feeder for each combustion line with a loss-in-weight gravimetric feeder. A loss-in-weight gravimetric feeder uses a screw feeder in combination with a platform scale and provides a direct measure of the fresh PAC weight injected into each combustion line in real time. The PPP Co. has agreed to the installation of gravimetric carbon feeders, and the works will be completed during scheduled combustion line outages in August 2018.

Table 9: Estimated Fresh Carbon Usage During Mercury and Dioxin/Furan Stack Emission Testing

Line	Pollutant	Run	Date	Sampling Time	Carbon Silo Weight (tonnes)		Carbon Usage (kg/hr/line)
					Start	End	
1	Mercury	1	13/9/17	10:28-11:32	16.73	16.69	18.8
1	Mercury	2	13/9/17	12:40-13:44	- [1]	- [1]	- [1]
1	Mercury	3	13/9/17	14:38-15:42	- [1]	- [1]	- [1]
2	Mercury	1	14/9/17	09:09-10:13	34.73	34.68	23.4
2	Mercury	2	14/9/17	10:58-12:02	34.64	34.60	18.8
2	Mercury	3	14/9/17	12:40-13:44	34.56	34.47	42.2
1	Dioxin/Furan	1	15/9/17	08:05-14:05	33.96	33.67	24.2
1	Dioxin/Furan	2	16/9/17	07:47-13:47	32.97	32.63	28.3
1	Dioxin/Furan	3	18/9/17	08:32-14:32	31.10	30.85	20.8
2	Dioxin/Furan	1	14/9/17	08:02-14:02	34.73	34.51	18.3
2	Dioxin/Furan	2	16/9/17	07:45-13:45	32.97	32.63	28.3
2	Dioxin/Furan	3	18/9/17	08:30-14:30	31.10	30.85	20.8

[1]Carbon delivery in progress

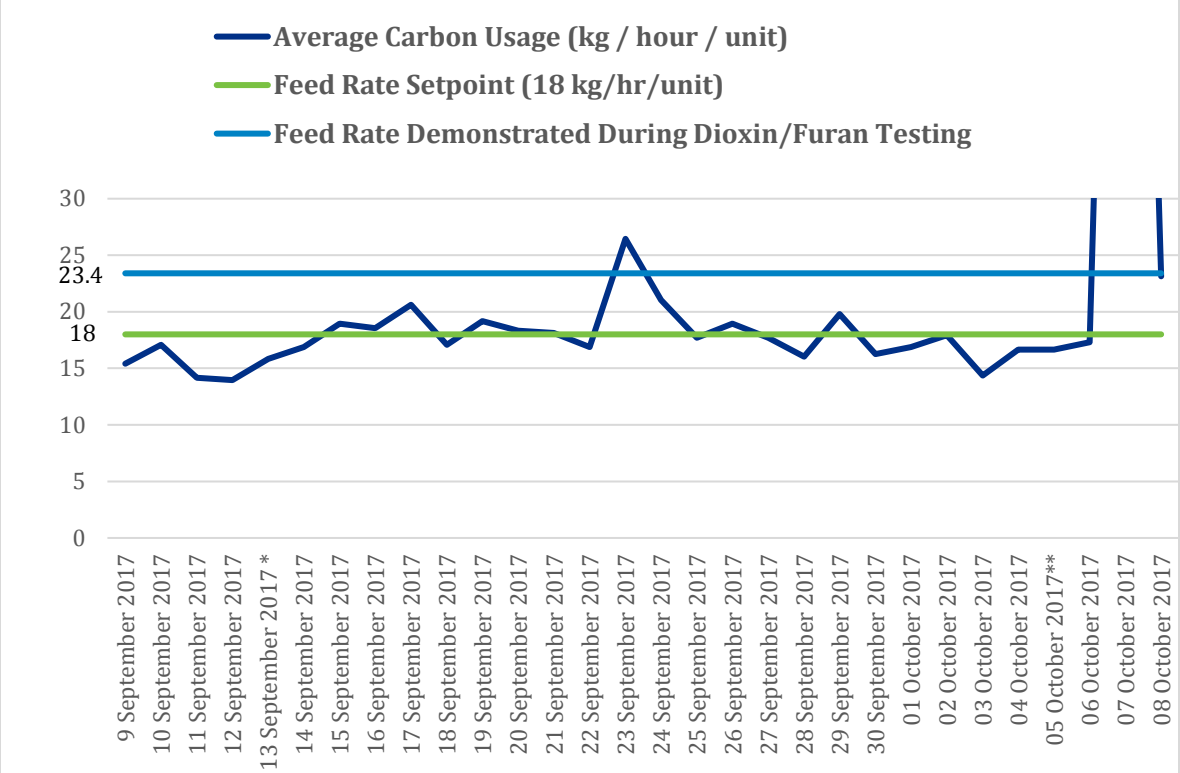


Figure 3: Average Daily Fresh Carbon Usage During 28-Day PDT

4.4 Emergency Diesel Engine Generator Stack Test Results

Stack emission tests were performed on the emergency standby diesel engine generator during the PDT as required by the IE Licence. Exova performed testing on 04 October 2017 with the diesel engine generator operating at full load. One test run was performed for each pollutant. Table C.1.2 of the IE Licence requires monitoring for particulates, TOC, oxides of nitrogen and CO but does not specify ELVs for these pollutants, nor are there any ELVs for the emergency diesel engine generator specified in the PA. Furthermore, there are no EPA or EU emission standards that currently apply to the standby diesel engine generator. New standards for generator sets greater than 560 kW will take effect on 01 January 2019. It is not clear at this time what the new regulations will require, and if DWTE will be required to comply with these new regulations.

A summary of the test results for the emergency standby diesel generator is presented in Table 10.

Table 10: Summary of Emergency Diesel Generator Stack Test Results

Pollutant	Test Results		Calculated Emission Rate g/kWh [2]
	mg/m³ [1]	g/hr	
Total Particulate	10.5	94.5	0.0385
Total VOCs (as carbon)	44.6	399.3	0.162
Oxides of Nitrogen (as NO_2)	1,886	16,893	6.88
Carbon Monoxide	220.9	1,979	0.81

[1]Corrected to reference conditions: 273 °K, 101.3 kPa, 6% O_2 dry gas
[2]Based on generator set standby rating of 2,456 kW

4.5 CEMS QAL2 Analysis

A QAL2 calibration process was performed on the two "duty" (i.e., on line) CEMS and the standby CEMS that is common to both combustion lines. Exova performed the QAL2 testing during the period 28 August - 01 September 2017. The QAL2 process involves calibrating the CEMS against the appropriate standard reference method. The standard reference method is deemed to provide the correct results within certain tolerances. The calibration process also verifies that the CEMS meets the measurement uncertainty requirements, as per the guidance document.

A summary of the QAL2 results for each CEMS is provided in Table 11. Valid calibration functions were derived for all of the pollutants except for particulate matter. Valid calibration functions could not be derived for total particulate matter on either of the three CEMS due to the particulate emissions being of a "low order" (i.e., less than the 95% confidence interval of the daily ELV which is 30%). In these situations, Section 3.5.4 of UK's Technical Guidance Note (TGN) M20 provides the following guidance with respect to this condition:

"If a test report states that a particulate monitor cannot be calibrated due to very low emissions, then the output of the CEM will be qualitative. Whilst it may be possible to intuitively set the reading of the CEM to provide an output in mg.m-3, such readings will be an approximation at best, with a strong likelihood of high levels of uncertainty. Unless it is possible to produce higher, representative emissions from the process, it is recommended that such readings should be disregarded for regulatory purposes when compared to an ELV, even if there is an apparent breach of the ELV. However, the output from the particulate monitor can demonstrate whether the process is under control or not. Such outputs should be regarded as an indicative trend that can demonstrate if there is a significant change in the process, resulting in an increase in emissions that requires immediate attention."

The CR understands that the output from the particulate monitors, as a qualitative indicator of particulate emissions, rather than as quantitative monitors, is acceptable to EPA in this case, as the flue gas cleaning equipment was performing well and removing particulate below what could be calculated for the particulate monitor.

All of the pollutants for which valid calibration functions were derived also passed the variability test and linearity check, except for the three water vapour monitors. Per TGN M20, linearity checks are not required for water vapour monitors if they pass the variability test due to the practical difficulties in introducing various moisture contents.

Table 11: Summary of CEMS Quality Assurance Level 2 (QAL2) Results

CEMS Unit	Pollutant	Valid Calibration Function Derived	Calibration Function Derived	Calibration Function R^2	Valid Calibration Range (mg/m^3)	Variability Test Outcome	Linearity Check Outcome
Duty Line 1	Particulate Matter	**No**	–	–	–	–	–
	Total VOCs	Yes	Y=0.9982x + 0.3612	0.9999	0-2	Pass	Pass
	Oxides of Nitrogen (as NO_2)	Yes	Y=0.889x – 0.6813	0.9962	0-220.7	Pass	Pass

CEMS Unit	Pollutant	Valid Calibration Function Derived	Calibration Function Derived	Calibration Function R^2	Valid Calibration Range (mg/m^3)	Variability Test Outcome	Linearity Check Outcome
	Sulphur Dioxide	Yes	Y=1.0601x – 5.1442	0.9952	0-10	Pass	Pass
	Carbon Monoxide	Yes	Y=1.016x + 2.4768	0.9975	0-10	Pass	Pass
	Hydrogen Chloride	Yes	Y=1.0094x + 0.1499	0.998	0-2	Pass	Pass
	Water Vapour	Yes	Y=1.0017x + 0	1	0-28.4	Pass	-
	Oxygen	Yes	Y=0.9592x + 0	1	0-8.3	Pass	Pass
Duty Line 2	Particulate Matter	**No**	–	–	–	–	–
	Total VOCs	Yes	Y=0.9859x + 0.5216	0.9999	0-2	Pass	Pass
	Oxides of Nitrogen (as NO_2)	Yes	Y=0.9441x – 0.1984	0.9965	0-226.8	Pass	Pass
	Sulphur Dioxide	Yes	Y=1.0738x – 5.99	0.9991	0-10	Pass	Pass
	Carbon Monoxide	Yes	Y=1.0398x – 0.6079	0.9968	0-10	Pass	Pass
	Hydrogen Chloride	Yes	Y=1.078x + 0.0445	0.9986	0-2	Pass	Pass
	Water Vapour	Yes	Y=0.9546x + 0	1	0-28	Pass	-
	Oxygen	Yes	Y=0.8947x + 0	1	0-7.1	Pass	Pass
Common Standby	Particulate Matter	**No**	–	–	–	–	–
	Total VOCs	Yes	Y=0.9958x – 0.0338	0.9999	0-2	Pass	Pass
	Oxides of Nitrogen (as NO_2)	Yes	Y=0.8596x – 1.8794	0.9986	0-219.9	Pass	Pass
	Sulphur Dioxide	Yes	Y=1.0189x – 1.0835	0.999	0-10	Pass	Pass
	Carbon Monoxide	Yes	Y=1.1291x + 2.0991	0.9985	0-10	Pass	Pass
	Hydrogen Chloride	Yes	Y=1.0842x + 0.1275	0.9995	0-2	Pass	Pass
	Water Vapour	Yes	Y=1.0671x + 0	1	0-27.1	Pass	-
	Oxygen	Yes	Y=1.0808x + 0	1	0-8.3	Pass	Pass

The CR requested confirmation from the PPP Co. as to when the valid calibration functions determined during the QAL2 testing were entered into the Data Acquisition Handling Software. The PPP Co. responded that the calibration functions were applied beginning on 23 October 2017, approximately two weeks after completion of the PDT. In the CR's opinion, these correction functions would not have had a material impact on the "raw" CEMS data reported

during the PDT and used to assess compliance with the ELVs for pollutants requiring continuous monitoring given the extremely low CEMS values measured and the relatively small adjustment provided by the derived calibration functions.

4.6 CEMS Data Review

Based on our review of the CEMS data, the CR concluded that the DWTE Facility exceeded the applicable half-hourly averages for SO_2 on 04 October 2017 during the period 11:00-13:00 as a result of a fuel related process upset, and that this continuous 90-minute period constituted one Stoppage, in accordance with Schedule 08 of the PA. Table 12 shows the three half-hourly exceedances of SO^2 on line 1 on 04 October 2017 between 11:30 – 13:00 (the results given are the half-hourly average of the previous half hour).

Table 12: Exceedances of SO2 on line 1 on 04 October 2017

Time	Line 1 SO2 (mg/m³)	PA half-hourly ELV (mg/m³)	IE Licence half-hourly ELV (mg/m³)	Pass/fail
12:00	509.55	180	200	Fail
12:30	431.46	180	200	Fail
13:00	236.18	180	200	Fail

The PPP Co. disagreed with this conclusion and held that compliance with the Environmental Warranty was demonstrated as the DWTE Facility operated over the 720-hour PDT within 97% of the half-hourly ELV set out in Column B of Schedule B.1 of the IE Licence and Column 5 of Table 1 to Section 3.2 of Annex 1 to Part 1 of Schedule 08. The Authority in consultation with the CR team did not concur with the conclusion reached by the PPP Co as compliance with the 97% of half-hourly ELV can only be demonstrated over a year of operation and compliance cannot be demonstrated on a pro-rata basis utilising the PDT period as the relevant timeframe. The CR thus concluded that Column A of Table B.1 of the IE Licence and Column 4 of Table 1 to Section 3.2 of Annex 1 to Part 1 of Schedule 08 were the applicable half-hour ELVs, therefore the three, 30-minute periods in question exceeded the applicable SO_2 ELV, and that since these three periods were continuous that this constituted one 90-minute Stoppage pursuant to Schedule 08.

Elevated emissions were recorded for oxides of nitrogen, total organic carbon and dust on combustion line 2 for the half hour period 10:30-11:00 on 13 September 2017 and for oxides of nitrogen on combustion line 1 for the half hour period 19:00-19:30 on 27 September 2017. In addition, the 10-minute carbon monoxide readings and half hour readings for carbon monoxide, SO_2 and oxides of nitrogen on line 1 were reported as “zero” from 12:50-17:00 on 28 September 2017. The CR requested clarification from the PPP Co. for each of these events and the PPP Co. provided two memos from the CEMS supplier, SICK, dated 20 September 2017 and 02 October 2017. These memos stated that the readings in question were erroneous readings that resulted from their technician’s failure to put the duty analyser in maintenance, calibration or fault mode before switching to the redundant analyser. As a result, data from the offline duty analyser was captured instead of data from the online analyser. The CR has recommended that the PPP Co. put clear procedures in place to avoid this problem from occurring again.

Outside of the issues described in the preceding paragraphs, the CR observed that CEMS data was in compliance with the Licence. Average daily CEMS data, and half hour maximum values during the PDT are shown in Table 13.

Table 13: Average daily CEMS data during the PDT

ELV (Daily Average Results)		Test Results												Pass/Fail
		Total Dust		TOC		HCL		SO_2		NO_2		CO		
IE Licence	Mg/m^3	10		10		10		50		200		50		
PA	Mg/m^3	9		9		9		45		180		50		
Line 1/2		1	2	1	2	1	2	1	2	1	2	1	2	
08/09/2017		1.00	1.00	0.00	0.00	0.00	0.00	4.72	7.26	156.04	152.15	1.47	1.47	Pass
09/09/2017		0.83	0.90	0.00	0.00	0.00	0.00	4.96	4.81	152.58	149.35	2.45	2.00	Pass
10/09/2017		1.00	1.00	0.00	0.00	0.00	0.00	3.77	4.77	155.29	155.94	1.85	1.58	Pass
11/09/2017		0.98	1.00	0.00	0.00	0.00	0.00	2.65	3.56	151.04	151.75	1.36	1.10	Pass
12/09/2017		1.90	1.29	0.00	0.00	0.00	0.00	2.75	4.25	143.48	145.69	1.60	1.17	Pass
13/09/2017		1.15	2.85	0.00	3.10	0.00	0.00	3.00	4.17	145.15	150.13	1.64	1.96	Pass
14/09/2017		1.00	1.42	0.00	0.00	0.00	0.00	3.44	3.98	144.96	146.00	1.91	1.29	Pass
15/09/2017		1.00	1.63	0.00	0.00	0.00	0.00	3.46	4.98	144.94	145.42	2.06	1.19	Pass
16/09/2017		1.00	2.00	0.00	0.00	0.00	0.00	3.38	4.46	145.23	145.15	1.55	1.10	Pass
17/09/2017		1.00	1.71	0.00	0.00	0.00	0.00	3.69	4.19	144.50	144.92	1.00	1.69	Pass
18/09/2017		1.00	1.00	0.00	0.00	0.00	0.00	3.98	3.77	144.98	145.42	1.26	0.67	Pass
19/09/2017		1.00	1.69	0.00	0.00	0.00	0.00	3.46	3.94	144.75	145.58	2.47	1.10	Pass
20/09/2017		1.00	1.98	0.00	0.00	0.00	0.00	3.21	3.94	143.98	145.10	3.89	1.44	Pass
21/09/2017		1.00	1.50	0.02	0.00	0.00	0.00	4.35	4.29	145.33	144.54	4.15	2.40	Pass
22/09/2017		1.00	1.90	0.00	0.00	0.00	0.00	3.56	4.54	148.02	147.08	1.89	1.17	Pass
23/09/2017		0.02	0.00	0.02	0.00	0.00	0.00	4.85	4.32	145.53	145.23	1.71	0.95	Pass
24/09/2017		1.00	2.27	0.00	0.00	0.00	0.00	4.27	4.73	145.75	145.06	1.04	0.83	Pass
25/09/2017		1.00	2.00	0.00	0.00	0.00	0.00	4.23	4.35	137.19	145.27	1.00	0.44	Pass
26/09/2017		1.00	1.85	0.02	0.00	0.00	0.00	4.29	4.25	151.81	144.98	2.11	2.19	Pass
27/09/2017		1.00	1.92	0.00	0.00	0.00	0.00	4.69	3.96	141.98	142.00	2.98	1.54	Pass
28/09/2017		0.99	1.45	0.00	0.02	0.00	0.00	3.46	3.12	151.19	148.58	2.67	2.40	Pass
29/09/2017		1.00	2.00	0.00	0.00	0.00	0.00	3.85	2.75	143.36	145.08	1.69	2.08	Pass

ELV (Daily Average Results)		Test Results												Pass/Fail
		Total Dust		TOC		HCL		SO_2		NO_2		CO		
IE Licence	Mg/m^3	10		10		10		50		200		50		
PA	Mg/m^3	9		9		9		45		180		50		
Line 1/2		1	2	1	2	1	2	1	2	1	2	1	2	
30/09/2017		0.81	2.01	0.03	0.01	0.00	0.03	4.35	4.14	145.12	145.22	2.88	3.25	Pass
01/10/2017		0.82	2.03	0.01	0.00	0.00	0.03	4.84	2.07	143.99	145.54	1.91	1.61	Pass
02/10/2017		0.77	2.14	0.03	0.02	0.00	0.10	4.24	3.70	142.91	145.18	3.60	2.08	Pass
03/10/2017		0.63	1.78	0.01	0.00	0.01	0.05	2.77	3.35	143.85	145.69	3.42	2.32	Pass
04/10/2017		1.23	1.72	0.19	0.00	0.01	0.07	33.75	4.90	149.56	145.33	5.19	2.56	Pass
05/10/2017		2.25	1.97	0.08	0.01	0.00	0.04	5.32	3.27	145.21	145.63	2.41	2.56	Pass
06/10/2017		1.43	2.02	0.08	0.09	0.01	0.04	3.98	3.56	141.70	145.00	2.77	3.73	Pass
07/10/2017		0.95	2.06	0.03	0.00	0.01	0.01	4.24	3.51	148.05	145.41	2.62	1.64	Pass
08/10/2017		0.63	1.98	0.01	0.00	0.03	0.06	3.92	3.57	143.72	142.81	1.70	1.19	Pass

4.7 Noise Test Results

Condition 6.2 of the IE Licence states; *"The licensee shall carry out a noise survey of the site operations within three months after the commencement of the Licenced activity, followed by quarterly monitoring intervals for a period of three years, and then biannually thereafter. The survey programme shall be submitted to the Agency in writing prior to the surveys being carried out. The survey programme shall be in accordance with Schedule C: Control & Monitoring, of this licence or as otherwise agreed by the Agency. A record of the survey results shall be available for inspection by any authorised persons of the agency, at all reasonable times and a summary report of this record shall be included as part of the AER".*

Schedule B: Emission Limits, Table B.4 provides details of the noise emission limits which are outlined in Table 14:

Table 14: Details of noise emission limits outlined in W0232-01

Day dB (A) LA_{eq}(30 minutes)	Night dB(A) LA_{eq} (30 minutes)
55	45

On behalf of PPP Co., noise monitoring was undertaken by AECOM Infrastructure & Environment UK Limited (AECOM) on 21, 22 and 25 September 2017 as a requirement of the above conditions outlined in the IE Licence, and as set out in the PA; Schedule 08, Environmental Warranties, Section 3.5 Noise Warranty states; *"The PPP Co. warrants and guarantees that: the noise levels at the Facility shall comply with Law; and sporadic episodes of high noise levels shall as far as possible be avoided"*.

Noise monitoring was carried out at four locations (N7 – N10), as shown in Figure 2.1 of AECOM the Noise Monitoring Report:

- N7 – Western Site Boundary Midway on the western site boundary;
- N8 – Northern Site Boundary Midway of the northern site boundary;
- N9 – Eastern Side Boundary Midway on the eastern site boundary; and
- N10 – Southern Site Boundary Midway on the southern site boundary.

Schedule C.6.2 Ambient Noise Monitoring in the IE Licence outlines ten noise monitoring locations (NL01 -NL10). Note 1 states; "Or as otherwise may be amended by agreement, or as necessary direction, of the Agency".

AECOM undertook a Noise Monitoring Programme at the DWTE Facility in July 2017 which outlines ten noise monitoring locations noted above in Schedule C.6.2 Ambient Noise Monitoring. Within the noise monitoring program, it was outlined that, "*measurements will be undertaken at four locations (N7 – N10) within the site boundary of the facility. The LA_{eq} values at the remaining locations* [N1-N6] *beyond the site boundary will be interpolated from the measured results".* The PPP Co. advised the above-mentioned Noise Monitoring Programme was submitted to the EPA. The CR was not informed of any additional correspondence between the PPP Co. and the EPA in relation to the number of noise monitoring locations surveyed, therefore

the CR understands the EPA has been notified and does not have issue in relation to Note 1 contained within Schedule C.6.2 Ambient Noise Monitoring of the IE Licence. Accordingly, the CR has no issue with the noise monitoring locations.

Table 15 and Table 16 include a summary of both Daytime and Night-time Sound Measurements as outlined in AECOM's Noise Monitoring Report for testing conducted during the PDT:

Table 15: Summary of Daytime Sound Measurements

Location	Time (21 Sept 2017)	L_{Aeq}, 30mins (dB)	L_{A10}, 30mins (dB)	L_{A90}, 30mins (dB)
N7	15:12	65	62	54
	17:27	60	62	51
	08:41	61	64	54
	Average	**62**	**63**	**53**
N8	14:37	64	63	57
	16:54	58	60	55
	09:14	60	63	56
	Average	**62**	**62**	**56**
N9	12:29	66	70	61
	16:20	61	62	60
	18:34	71	73	65
	Average	**68**	**68**	**62**
N10	11:55	65	68	56
	15:45	53	56	48
	18:01	53	56	48
	Average	**61**	**60**	**51**

Table 16: Summary of Night-time Sound Measurements

Location	Time (21/22 Sept 2017)	L_{Aeq}, 30mins (dB)	L_{A10}, 30mins (dB)	L_{A90}, 30mins (dB)
N7	00:59	50	50	48
	03:18	54	50	47
	Average	**53**	**50**	**48**
N8	00:22	55	56	54
	02:44	55	55	54
	Average	**55**	**55**	**53**
N9	23:47	61	61	60
	02:07	60	61	59
	Average	**60**	**61**	**60**
N10	23:14	49	49	46
	01:33	50	50	45
	Average	**49**	**49**	**46**

Within AECOM's Noise Monitoring Report, sounds from 'other' sources were noted as contributing factors to noise levels recorded during the survey. Since the DWTE Facility's

equipment is contained within a totally enclosed building, back ground noise from adjacent properties and temporary construction activities on site likely contributed to the levels being above the relevant standards. The AECOM report specifically noted noise being emitted from the following activities:

- Hammond Lane scrap metal yard (adjacent to facility on the north side of the DWTE Site;
- Sounds from a diesel engine and driving/reversing mechanical work platforms working at the DWTE Site;
- Fans & pumps from the Ringsend Waste Water Treatment Works facility adjacent to the DWTE Facility on the eastern side;
- Hum from a diesel generator powering a security hut on the DWTE Site;
- Crane working onsite during construction related works;
- Diesel pumps used for power washing outside the DWTE Facility; and
- Loading of materials using a telehandler on an adjacent Site to the south.

It is the CR's opinion that these 'other' noise sources are valid contributing factors to noise levels recorded.

AECOM state within their Noise Monitoring Report; *"The measured sound levels at the site were dominated by either ongoing construction works or offsite operations and plant from the adjacent industrial area. It was noted during the sound measurements that the operation of the Waste to Energy facility was only just audible at all locations within the site boundary. As the nearest residential receptors are located approximately 850 m from the site any sound will be significantly attenuated and will comfortably meet the specified limits."*

Based on the Noise Monitoring Survey undertaken by AECOM during September 2017, compliance with the limits specified within Condition C.6.2 of the IE Licence have been demonstrated.

4.8 Cooling Water Data Review

Part B.2 of Schedule B to the IE Licence establishes emission limits for the cooling water (seawater) returned to the Liffey Estuary. All of the limits contain a specific averaging time period with the exception of the maximum temperature rise of 9.5 ^{o}C and the total residual chlorine level of 0.5 mg/l. At the time the PDT was performed the IE Licence did not specify whether these limits were to be measured on an instantaneous basis or are to be based on a specific averaging period. Adjacent facilities owned by ESB and Dublin Port Authority use water from the River Liffey for cooling purposes and the ELVs stated in their licences are based on one-hour averages.

Following a non-compliance notice issued by EPA on 19 September 2017 for Incident Notification INCI012603 regarding an exceedance of the cooling water temperature rise of 9.5^{o}C, the PPP Co. submitted a Licence Alteration request to the EPA on 15 November 2017 (CR04506). This request requested clarification on the interpretation of Condition 4.2.1.4 and Schedule B.2

of the IE Licence to include reference to a one-hour averaging period. On 27 March 2018, EPA confirmed the alteration to the Licence granting the one-hour averaging period.

Table 17 includes a comparison of the cooling water data during the PDT to the IE Licence limits. All of the cooling water parameters were met by the PPP Co. during the PDT.

Table 17: Summary of Cooling Water (Seawater) Data During Performance Demonstration Test

Parameter	Performance Demonstration Test		
	Value	Limit	Pass/Fail
Maximum Hourly Seawater Flow (M^3/hr)	14,075 (2 mins)	14,040	Pass
Total Daily Seawater Flow (M^3/day)	332,909	570,000	Pass
Number Times Seawater Temperature Rise Above 9.5°C (Hourly Average)	0	0	Pass
Number Times Seawater Residual Chlorine Above 0.5 mg/l (Hourly Average)	0	0	Pass
Number Time Seawater Residual Chlorine Above 0.2 mg/l (24-Hour Average)	0	0	Pass

Section 5 Conclusion

The CR confirms that the 720-hour PDT took place over the period 08 September through 08 October 2017.

The CR confirms that the DWTE Facility successfully completed the PDT on 8 October 2017, with only two Stoppages, one of which involved the NIC dropping below 80% for more than one hour on 09 September 2017 and the other for an exceedance of the SO_2 ELV on 04 October 2017. The total duration of these two Stoppages was approximately three hours. The number and duration of Stoppages was within the allowable number and timeframes set out in Schedule 08.

The 14-day continuous run of boiler and steam turbine operation at greater than 90% of NIC, conducted within the 720-hour PDT test period was successfully completed during the period 19 September through 03 October 2017 with no Stoppages.

The PPP Co. submitted the Performance Demonstration Test Confirmation Certificate to the Authority on 16 November 2017 certifying that the test procedures comply with the PA and the tests are in accordance with any requirements of the PA, manufacturers' recommendations and any Licences compulsory to the operations.

Based on our on-site review of the PDT, and review of relevant test data, it is the CR's opinion that the PPP Co. successfully met all of the PDT criteria as outlined in Schedule 08 of the PA.

Therefore, with respect to Clause 15.2(e) of the PA, the CR recommends that the Authority agree that the Performance Demonstration Tests have been completed and passed, and that the Performance Demonstration Certificate can be issued.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