Emissions

Introduction

The TEGCO Immingham Ltd Installation at Netherlands Way, Stallingborough, Grimsby, DN41 8DF is an Energy from Waste (EfW) process. The installation is designed to consume 320,000 Te/yr of Refuse Derived Fuel (RDF) based on 10 MJ/kg (LHV), producing: -

- 12 MW electrical export,
- 51 MW thermal export (60 Te/hr) as steam (no condensate return).

The installation is a Combined Heat & Power (CHP) plant sized and is designed to replace the steam and electricity currently generated by an existing CHP plant on an adjacent industrial plant. The existing CHP plant is reaching the end of its operational life and will be decommissioned when the installation is operational.

The need to continue to take waste in the event that steam and/or electricity cannot be exported (e.g. customer is shutdown), the installation is designed such that all steam generated at normal waste feed can pass through the turbine and condenser resulting in 24 MW electrical export.

A proportion of the RDF is sourced from local waste management companies and transported to the installation by road. The remaining is sourced from further afield and transported by rail to 1 of 2 local railheads and the final transfer from the railhead to the installation is by road.

The installation will operate continuously (24 hr/day & 7 day/week) for >8,000 hr/yr.

The installation consists of 2 off 20Te/hr incineration lines (combustor, boiler & feed-water system) and a single turbine and air cooled condenser.

The installation is designed not to generate any waste water from the process during normal operation.

The installation is designed to be fully compliant with the 2019 European BREF for Waste Incineration (JRC 118637) and the associated BAT Conclusions published in the Official Journal of the European Union on 3rd December 2019.

Point Source Emissions to air

The point source emissions to air and proposed Emission Limit Values (ELVs) are listed (in black) in the table: -

	Continuous		Periodic (P) or Long Term (LT)[11]	Units
	Daily Average	½ Hour		
Source(s)	Incineration Line Stacks 1 & 2			
References on Plan in Appendix 1	A1 & A2			
Particulate Matter	5	30	-	mg/Nm^3
Oxides of nitrogen (NO & NO_2 expressed as NO_2)[8]	100 120[3]	400	-	mg/Nm^3
Dinitrogen Oxide (N_2O)[6]	-	-	-	mg/Nm^3
Sulphur Dioxide (SO_2)	30	200	-	mg/Nm^3
VOCs as Total Organic Carbon (TOC)	10	20	-	mg/Nm^3

	Continuous		Periodic (P) or Long Term (LT)[11]	Units
	Daily Average	½ Hour		
Source(s)	Incineration Line Stacks 1 & 2			
References on Plan in Appendix 1	A1 & A2			
Hydrogen Chloride (HCl)	6	-	-	mg/Nm^3
Hydrogen Fluoride (HF)[7]	-	-	P 1[1][3]	mg/Nm^3
Carbon Monoxide (CO)	50	100	-	mg/Nm^3
Carbon Dioxide (CO_2)[9]	-	-	-	%
Ammonia (NH_3)	10	-	-	mg/Nm^3
For correction purposes: -[10] Oxygen (O_2) Moisture (H_2O)	 - -	 - -	 - -	 % %
Mercury and its compounds[5] (Periodic Proposed)	20[3]	35[3]	P 20[1] LT 10[2][3]	$\mu g/Nm^3$
Cadmium & Thallium and their compounds (total)	-	-	0.02	mg/Nm^3
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total)	-	-	0.3	mg/Nm^3
Dioxins & Furans (PCDD/F)[4] (Periodic Proposed)	-	-	P 0.04[1] LT 0.06[2] [3]	ng/Nm^3 I-TEQ
PCBs[4] (Periodic Proposed)	-	-	-	ng/Nm^3 WHO TEF
Poly Aromatic Hydrocarbons (PAH)	-	-	-	As Benzo(a)pyrene
Brominated Dioxins (PBDD/F)[7]	-	-	-	ng/Nm^3 I-TEQ
Source	Fly Ash Silo			
Reference on Plan in Appendix 1	A3			
Particulate Matter	-	-	P 5[1]	mg/Nm^3
Source	FGCr Silo			
References on Plan in Appendix 1	A4 & A5			
Particulate Matter	-	-	P 5[1]	mg/Nm^3
Source	Lime Silos			
References on Plan in Appendix 1	A6 & A7			
Particulate Matter	-	-	P 5[1]	mg/Nm^3
Source	Powdered Activated Carbon Silo			
Reference on Plan in Appendix 1	A8			
Particulate Matter	-	-	P 5[1]	mg/Nm^3

	Continuous		Periodic (P) or Long Term (LT)[11]	Units
	Daily Average	½ Hour		
Source(s)	Incineration Line Stacks 1 & 2			
References on Plan in Appendix 1	A1 & A2			

Notes: -

1. Average over sample period.
2. Average over long term sampling.
3. BAT AEL from BREF/BAT Conclusions documents.
4. Periodic monitoring proposed subject to demonstration of performance as required by relevant Environment Agency Protocols (Potential alternative ELV values included for completeness).
5. EA Protocol (for Hg) indicates an ELV of 10 µg/m^3 when compliance is based on periodic monitoring. The BAT AEL range is ≤ 20 µg/Nm^3.
6. EA requires continuous monitoring for N_2O (for new plants) although no ELVs to be set at the present time. "Virtual ELV" of 20 mg/Nm^3 to be used for calibration of CEMS.
7. EA requires periodic monitoring for PBDD/F for all incinerators burning "municipal solid waste (MSW) or similar including RDF or SRF" although no ELVs to be set at the present time.
8. EA "default" NO_X 24 hr ELV for new plants. Up to 120 mg/Nm^3 (max i.e. BREF) if it can be justified basis of BAT assessment including a cost-benefit assessment and consideration of any other relevant factors, such as increased ammonia emissions which could impact on a habitats site.
9. "Virtual ELV" of 10% to be used for calibration of CEMS.
10. Continuously measured to allow "normalisation" of results. "Virtual limits" of 21% (O_2) & 30% (H_2O) to be used for calibration of instruments.
11. Periodic (P) is 6 monthly (3 monthly in first year), Long (L) is sampling over period of 2-4 weeks in a defined period (usually 1 month).

The following table shows the annual mass emissions for the following: -

- Plant Operating at permit ELVs for 8760 hrs per (and reflects the impact assessment below),
- Expected actual operating conditions (i.e. At design point & each line operating for 8,000 hrs/yr with reality check against long term emissions data from BREF Note (2019)).

Substance Emitted	At Permitted ELVs (As impact assessment)	Expected Actual	Units
Particulate Matter[3]	10.177	3.718	Te/yr
Oxides of nitrogen (NO & NO_2 expressed as NO_2)	203.533	157.994	Te/yr
Dinitrogen Oxide (N_2O)	40.707	37.175	Te/yr
Sulphur Dioxide (SO_2)	61.060	37.175	Te/yr
VOCs as Total Organic Carbon (TOC)	20.353	3.718	Te/yr
Hydrogen Chloride (HCl)	12.212	7.435	Te/yr
Hydrogen Fluoride (HF)	2.035	1.115	Te/yr
Carbon Monoxide (CO)	101.767	46.469	Te/yr
Carbon Dioxide (CO_2)[4]	439,259	366,529	Te/yr
Ammonia (NH_3)	20.353	9.294	Te/yr
Mercury and its compounds[1]	0.041	0.019	Te/yr
Cadmium & Thallium and their compounds (total)	0.041	0.022	Te/yr
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total)	0.611	0.186	Te/yr
Dioxins & Furans (PCDD/F)[2] (Periodic Proposed)	122.120	37.175	mg I-TEQ/yr
PCBs (Periodic Proposed)	7.429	6.784	g WHO TEF/yr

Poly Aromatic Hydrocarbons (PAH)	183.180	167.288	mg I-TEQ/yr

Notes: -

1. Subject to demonstrating acceptable performance as defined by relevant EA protocol,
2. Assessment completed at BAT_{AEL} ELV of 0.06 ng I-TEQ/Nm^3, expected actual emissions based on 0.04 ng I-TEQ/Nm^3 ELV requested,
3. Dust emissions from silos <4 kg/yr,
4. Total CO2 = CO2 from waste (ELV x Gas Flow x Hours/yr.) + CO2 from support/start-up fuel.

As the TEGCO development will replace the CHP plant currently operated by the off-taker, some emissions will be avoided. The following table summarises these and the resultant nett emissions based on the expected performance (above).

Substance Emitted	Emissions Avoided	Expected Actual Nett Emission	Units
Particulate Matter(3)	1.42	2.30	Te/yr
Oxides of nitrogen (NO & NO_2 expressed as NO_2)	58.91	99.08	Te/yr
Dinitrogen Oxide (N_2O)	N/A	37.175	Te/yr
Sulphur Dioxide (SO_2)	1.11	36.07	Te/yr
VOCs as Total Organic Carbon (TOC)	N/A	3.718	Te/yr
Hydrogen Chloride (HCl)	N/A	7.435	Te/yr
Hydrogen Fluoride (HF)	N/A	1.115	Te/yr
Carbon Monoxide (CO)	44.27	2.20	Te/yr
Carbon Dioxide (CO_2)	88,646	277,613	Te/yr
Ammonia (NH_3)	N/A	9.294	Te/yr
Mercury and its compounds(1)	N/A	0.019	Te/yr
Cadmium & Thallium and their compounds (total)	N/A	0.022	Te/yr
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total)	N/A	0.186	Te/yr
Dioxins & Furans (PCDD/F)(2) (Periodic Proposed)	N/A	37.175	mg I-TEQ/yr
PCBs (Periodic Proposed)	N/A	6.784	g WHO TEF/yr
Poly Aromatic Hydrocarbons (PAH)	N/A	167.288	mg I-TEQ/yr

Notes: -

1. Subject to demonstrating acceptable performance as defined by relevant EA protocol,
2. Assessment completed at BAT_{AEL} ELV of 0.06 ng I-TEQ/Nm^3, expected actual emissions based on 0.04 ng I-TEQ/Nm^3 ELV requested,
3. Dust emissions from silos <4 kg/yr.

Emissions to Air: Impact Assessment (Human Health)

Emissions to air (Operating under normal conditions)

The ground level air quality impacts have been assessed (as per Environment Agency guidance) and the results are summarised below.

This assessment is precautionary as: -

- The model using the "worst" year (2015) from 5 year data set (2015-2019),

- The model assumes that emissions from all emission points are at the permit emission limits (ELVs) for the entire year, in reality this is impossible while complying with the permit (i.e. actual emissions will be lower),
- The model assumes both lines are operating at design capacity for every hour of the year (8760 hrs) while actual expected operation is circa 8,000 hrs.

Further details of the following impact assessment can be found in the report in Appendix 2.

Considering species for which the monitored emission is directly comparable to an assessment standard (excluding metals), the potential impact at point of greatest ground level concentration and the worst impacted human health receptor are: -

Pollutant	Avg. Period	Max. Ground Level Conc.[1]		Receptor Max. Ground Level Conc.[1]	
		PC[2]	PEC[3][4]	PC[2]	PEC[3][4]
NO_2	99.8th %ile 1 hr	4.1	-	1.5	-
	Annual	4.6	38.4	0.5	-
CO	1 hr	0.1	-	<0.1	-
	Running 8 hr	0.3	-	<0.1	-
PM_{10}	90.4th %ile 24 hr	0.8	-	0.1	-
	Annual	0.3	-	<0.1	-
$PM_{2.5}$	Annual	0.7	-	<0.1	-
SO_2	99.9th %ile 15 min	2.9	-	1.0	-
	99.7th %ile 1 hr	2.0	-	0.7	-
	99.2th %ile 24 hr	3.8	-	0.9	-
HCl	1 hr	0.2	-	<0.1	-
HF	1 hr	0.2	-	<0.1	-
	Monthly(Weekly)	0.6	-	0.1	-
PAHs	Annual	0.2	-	<0.1	-
PCBs	1 hr	<0.1	-	<0.1	-
	Annual	<0.1	-	<0.1	-
NH_3	1 hr	0.1	-	<0.1	-
	Annual	0.1	-	<0.1	-

Notes:

1. Expressed as % of standard,
2. Process Concentration (PC) is the concentration resulting from the emission alone, figures in green indicate impact is screened out (i.e. "not significant") and no further assessment is required (1st test): -
   a. Annual average standards: PC ≤ 1% of standard.
   b. Other standards: PC ≤ 10% of standard.
3. Predicted Environmental Concentration (PEC) is the sum of the PC and the existing background, figures in green indicate (assuming PC is not "not significant") that no further assessment is required (2nd test): -
   a. Annual average standards: PEC ≤ 70% of standard,
4. PEC not quoted if screened out on PC (1st test).

The maximum ground level concentration occurs to the north-east of the installation (between the installation and the railway) and is remote to sensitive receptors location (human or environmental habitat).

The impact has been assessed at the 7 off human health receptor locations (5 off residential, 1 off leisure & 1 off commercial) closest to the installation. The Receptor results quoted are for the receptor (the commercial receptor on Queens Road & for all species/standards) that experiences the greatest impact from the installation.

Total Organic Carbon (TOC)

This is a measure of the organic carbon present in the emission but does not identify the organic species present. In this assessment it has been assumed that TOC is all: -

- 1,3 Butadiene when assessing long term (Annual) impacts,
- Benzene when assessing short term (in this case 24hr) impacts.

These species can be generated during combustion but are not expected to be present in the emissions at significant levels. However they have the most demanding environmental assessment standards and therefore their use is precautionary. The potential impact at point of greatest ground level concentration and the worst impacted human health receptor are: -

Pollutant	Avg. Period	Max. Ground Level Conc.(1)		Receptor Max. Ground Level Conc.(1)	
		PC(2)	PEC(3)(4)	PC(2)	PEC(3)(4)
TOC	Annual (1,3-Butadiene)	11.8	16.7	1.4	6.3
	24hr (Benzene)	6.4		1.6	-

Notes:

1. Expressed as % of standard,
2. Process Concentration (PC) is the concentration resulting from the emission alone, figures in green indicate impact is screened out (i.e. "not significant") and no further assessment is required (1st test): -
   a. Annual average standards: PC ≤ 1% of standard.
   b. Other standards: PC ≤ 10% of standard.
3. Predicted Environmental Concentration (PEC) is the sum of the PC and the existing background, figures in green indicate (assuming PC is not "not significant") that no further assessment is required (2nd test): -
   a. Annual average standards: PEC ≤ 70% of standard,
4. PEC not quoted if screened out on PC (1st test).

Trace Metals

The Environment Agency has specific guidance for the assessment of metals emitted from incineration processes and this: -

- Is based on historical emissions data obtained from existing operating plant,
- Includes conservative assumptions for the relative fractions of $Cr_{(III)}$ and $Cr_{(VI)}$ present in the emission and background concentrations,
- A multistep assessment approach starting with an extremely conservative screen.

This assessment has been completed at the location of maximum ground level concentration, impacts at all other receptors will be significantly lower, in this case at least an order of magnitude at human health receptors.

Step 1

This assumes that for combined limits, each metal is assessed at the ELV concentration for the group. The guidance also defines how data for chromium is to be proportioned to Chromium VI compounds. The results are: -

Pollutant	Long Term Ground Level Conc.[1]		Short Term Ground Level Conc.[1]	
	PC[2]	PEC[3][4]	PC[2]	PEC[3][4]
Hg	0.2	-	0.1	-
Cd[5]	10.6	26.8	-	-
Tl[5]	0.1	-	-	-
Sb[6]	0.2	-	0.1	-
As[6]	132	145	0.5	-
Cr[6]	0.2	-	-	-
$Cr_{(III)}$[6]	-	-	0.1	-
$Cr_{(VI)}$[7]	795	1145	-	-
Co[6]	0.8	-	-	-
Cu[6]	0.1	-	<0.1	-
Mn[6]	5.3	59.9	0.1	-
Ni[6]	39.7	47.2	-	-
Pb[6]	3.2	11.6	-	-
V	0.2	-	5.8	-

Notes:

1. Expressed as % of standard,
2. Process Concentration (PC) is the concentration resulting from the emission alone, figures in green indicate impact is screened out (i.e. "not significant") and no further assessment is required (1st test): -
   a. Annual average standards: PC ≤ 1% of standard.
   b. Other standards: PC ≤ 10% of standard.
3. Predicted Environmental Concentration (PEC) is the sum of the PC and the existing background, figures in green indicate (assuming PC is not "not significant") that no further assessment is required (2nd test): -
   a. Hg, Cd & Tl: PEC ≤ 70% of standard,
   b. Group III Metals: PEC ≤ 100% of standard,
4. PEC not quoted if screened out on PC (1st test),
5. ELV applies to sum of metals ("Group II Metals"),
6. ELV applies to sum of metals ("Group III Metals"),
7. $Cr_{(VI)}$ apportioned as per EA guidance

From the table, there is requirement for further assessment of As and $Cr_{(VI)}$

Step 2

EA guidance requires that that the impacts of these metals are assessed assuming that they are emitted at the maximum metal concentrations in Appendix A of the guidance.

Pollutant	Long Term Ground Level Conc.[1]		Short Term Ground Level Conc.[1]	
	PC[2]	PEC[3][4]	PC[2]	PEC[3][4]
As	11.0	23.2	-	-
$Cr_{(VI)}$[5]	1.7	352	-	-

Notes:

1. Expressed as % of standard,
2. Process Concentration (PC) is the concentration resulting from the emission alone, figures in green indicate impact is screened out (i.e. "not significant") and no further assessment is required (1st test): -
   a. Annual average standards: PC ≤ 1% of standard.
   b. Other standards: PC ≤ 10% of standard.
3. Predicted Environmental Concentration (PEC) is the sum of the PC and the existing background,

figures in green indicate (assuming PC is not "not significant") that no further assessment is required (2^{nd} test): -
   a. Annual average standards: PEC ≤ 100% of standard,
4. PEC not quoted if screened out on PC (1^{st} test),
5. $Cr_{(VI)}$ apportioned as per EA guidance.

From the table, there is requirement for further assessment of $Cr_{(VI)}$.

Further assessment of $Cr_{(VI)}$ is required is because the assumed background level is 3.5 times the assessment level and the default assumed 20% as $Cr_{(VI)}$. The nearest data set for background trace metal concentrations is at Scunthorpe (Low Santon) some 28 km west of the installation where the concentrations are likely to be significantly higher (due to the steelworks at Scunthorpe and other metal processing industries) than in the vicinity of the site.

Step 3

The point of greatest impact is north east of the site where there is no significant public exposure. Therefore using the same criteria as Step 2 the impact is considered at the most impacted sensitive receptors

Pollutant	Max. Ground Level Conc.(1)		Receptor Max. Ground Level Conc.(1)	
	PC(2)	PEC(3)(4)	PC(2)	PEC(3)(4)
$Cr_{(VI)}$(5)	1.7	352	0.2	-

Notes:
1. Expressed as % of standard (Annual),
2. Process Concentration (PC) is the concentration resulting from the emission alone, figures in green indicate impact is screened out (i.e. "not significant") and no further assessment is required (1^{st} test): -
   a. Annual average standards: PC ≤ 1% of standard.
3. Predicted Environmental Concentration (PEC) is the sum of the PC and the existing background, figures in green indicate (assuming PC is not "not significant") that no further assessment is required (2^{nd} test): -
   a. Annual average standards: PEC ≤ 100% of standard,
4. PEC not quoted if screened out on PC (1^{st} test),
5. $Cr_{(VI)}$ apportioned as per EA guidance.

In this assessment the most impacted receptor is the same as for the initial screening (i.e. R2 Queens Road) at the start of this section and is well below the 1% threshold. The impact is therefore considered "not significant." Impacts at other human receptors are significantly lower still.

The impact of $Cr_{(VI)}$ is very close to the screening threshold of the 1^{st} Test (1.7% viz. 1%) at the point of maximum ground level concentration and is therefore considered "not significant."

Dioxins & Furans

There are no assessment standards for Dioxins & Furans as the health impacts can arise via inhalation and ingestion exposure. The modelled concentrations at the point of maximum impact and the human health receptors are listed below.

Receptor	Annual PC		
	Predicted (fg TEQ/m^3)	% Rural Background(1)	% Urban Background(2)
Maximum Predicted	1.6	106	21.9
R1 Queens Road	0.19	12.7	2.6

Receptor	Annual PC		
	Predicted (fg TEQ/m^3)	% Rural Background[(1)]	% Urban Background[(2)]
R2 Queens Road	0.049	3.3	0.7
R3 Mauxhall Farm	0.084	5.6	1.1
R4 Immingham	0.117	7.8	1.6
R5 Recreation Ground	0.086	5.7	1.2
R6 Kings Road	0.058	3.9	0.8
R7 Grassmere	0.051	3.4	0.7

Notes:
1. Average for 2013-2015: 1.5 fg TEQ/m^3,
2. Average for 2013-2015, 7.3 fg TEQ/m^3.

A Human Health Risk Assessment (HHRA) has been completed based on hypothetical farmers (adult and child) who: -

- Live, work, etc. at the point of maximum impact,
- All their fruit, vegetables and cereals are grown at the point of maximum impact,
- All their meat, milk and eggs are raised at the point of maximum impact.

The dispersion modelling and HHRA are based on the BATAEL of 0.06 ng WHO-TEQ/Nm^3 while TEGCO expect to demonstrate compliance with the lower ELV (using relevant EA protocol) of 0.04 ng WHO-TEQ/Nm^3 adding an additional precautionary factor of 1.5.

The Human Health Risk Assessment is included as Appendix 3 and concludes: -

"The risk assessment methodology used in this assessment has been structured so as to create worst case estimates of risk. A number of features in the methodology give rise to this degree of conservatism. It has been demonstrated that for the maximally exposed individual, exposure to dioxins, furans and dioxin-like PCBs is not significant."

<u>Emissions to air (Operating at maximum ½ hr ELVs)</u>

This assessment is precautionary as: -

- The model using the "worst" year (2015) from 5 year data set (2015-2019),
- The model assumes that emissions from all emission points are at the permit ½ hr ELVs) for the entire year, to identify the highest impact,
- The model assumes both lines are operating at design capacity for every hour of the year (8760 hrs).

Further details of the following impact assessment can be found in the report in Appendix 2.

The table below shows the maximum results obtained for the worst case year: -

Pollutant	Avg. Period	Max. Ground Level Conc.[1]	
		PC[2]	
NO_2	Max 1 hr	18.2	
SO_2	Max 15 min	26.1	
	Max 1 hr	14.8	
	Max 24 hr	30.9	
PM_{10}	Max 24 hr	11.6	
HCl	Max 1 hr	2.1	
HF	Max 1 hr	0.6	
CO	Max 1 hr	0.1	
	Max 8 hr	0.2	

Notes:

1. Expressed as % of standard,
2. Process Concentration (PC) is the concentration resulting from the emission alone, figures in green indicate impact is screened out (i.e. "not significant") and no further assessment is required (1st test): -
    a. Short term standards: PC ≤ 10% of standard.

When considering these results, the following factors need to be considered: -

- The standards for NO_2, SO_2 & PM_{10} all allow a number of exceedances of the assessment value in each year,
- The process cannot emit at the permit ½ hr ELVs for 24 hrs and comply with the daily ELVs therefore modelled 24 hr values for SO_2 & PM_{10} cannot be achieved in practice,
- The directive states that daily ELV can only be exceeded for a total of 3% of the year (11 days),
- The model assumes both lines are operating at design capacity for every hour of the year (8760 hrs) while actual expected operation is circa 8,000 hrs,
- The period(s) at the ½ hr ELV(s) have to occur at the same time as the worst case meteorological conditions to result in the predicted impacts.
- In reality, the use of BAT_{AEL}'s for daily ELVs (considerably lower than the daily ELVs listed in the original directive) further significantly restrict the period the plant can operate at an ½ hr ELV and still comply with the relevant daily ELV.

As the PC values for all species are considerably below the relevant assessment standard value (≤ 31%) it is very unlikely that the assessment standard would be exceeded. Therefore, it is concluded that emissions at the half hourly limits would not have a significant impact on air quality even assuming worst case dispersion conditions occurring during periods of elevated emissions.

<u>Emissions to air (Abnormal Operating Conditions)</u>

This assessment is precautionary as: -

- The model using the "worst" year (2015) from 5 year data set (2015-2019),
- The model assumes that emissions from all emission points are at the "plausible abnormal emission concentration" for the entire year, to identify the highest impact,
- The model assumes both lines are operating at design capacity for every hour of the year (8760 hrs).

The calculation of the "plausible abnormal emission concentration" for each species is based on the assumption that the primary abatement fails completely and consideration of other information as indicated below: -

- The directive places specific restrictions on maximum CO, TOC and dust emissions,
- Assessment standards based on >4 hr periods assume maximum emission for 4 hrs and daily ELV for the remaining time,
- Fuel specification (e.g. SO_2, HCl & HF),
- Highest unabated emission recorded in BREF (e.g. NO_2),
- Some emissions increased by a factor of 100 (e.g. Hg, PCBs),
- Other metals assumed to increase as per dust,
- Relevant long term emissions based on factor of 100 and 60 hrs/ yr.

Full details of how these values are obtained are included in the report in Appendix 2

Pollutant	Plausible Abnormal Emission	Max. Ground Level Conc.(1)	
	mg/Nm^3	Period	PC(2)
NO_2	500	Max 1 hr	22.7
CO	100	Max 1 hr	0.2
	75	Max 8 hr	0.1
PM_{10}	29.2	Max 24 hr	11.3
SO_2	258	Max 15 min	33.7
	258	Max 1 hr	19.1
	68	Max 24 hr	10.5
HCl	398	Max 24 hr	13.8
HF	3.4	Max 1 hr	0.6
Tl	0.6	Max 1 hr	0.5
Hg	2	Max 1 hr	6.9
	0.89	Annual	0.4
Sb	9	Max 1 hr	1.6
As	9	Max 1 hr	15.6
Cr	9	Max 1 hr	1.6
Co	9	Max 1 hr	7.8
Cu	9	Max 1 hr	1.2
Mn	9	Max 1 hr	1.6
V	1.8	Max 24 hr	33.8
PCBs	3.6×10^{-9}	Max 1 hr	< 0.1
	6.04×10^{-9}	Annual	< 0.1

Notes:

1. Expressed as % of standard,
2. Process Concentration (PC) is the concentration resulting from the emission alone, figures in green indicate impact is screened out (i.e. "not significant") and no further assessment is required (1st test): -
   a. Annual average standards: PC ≤ 1% of standard.
   b. Other standards: PC ≤ 10% of standard.

When considering these results, the following factors need to be considered: -

- The standards for NO_2, SO_2 & PM_{10} all allow a number of exceedances of the assessment value in each year,

- The model assumes both lines are operating at design capacity for every hour of the year (8760 hrs) while actual expected operation is circa 8,000 hrs,
- The period(s) of abnormal operation have to be at the same time as the worst case meteorological conditions to result in the predicted impacts.

As the PC values for all species are considerably below the relevant assessment standard value (≤ 34%) it is very unlikely that the assessment standard would be exceeded. Therefore, it is concluded that emissions due to abnormal operation would not have short term adverse impacts even assuming worst case dispersion conditions occurring during periods of elevated emissions.

Conclusion

The assessment concludes that the air quality impacts, are considered: -

- "Not significant" at all residential and leisure receptors,
- "Not significant" or "well below the relevant air quality standards" at the point of maximum impact (i.e. not requiring further assessment).

Emissions to Air: Impact Assessment (Environmental Receptors)

The air quality impacts on designated sites within 2km of the installation have been (as per Environment Agency guidance). The impact has been assessed at the following designated sites: -

- "Habitats": Humber Estuary (H1); designated as SAC, SPA/RAMSAR,
- "SSSI": Humber Estuary (H1),
- "SNCI": North Moss Lane Meadow (H2), Immingham Dock Reedbeds (H3),
- "LWS": Laporte Road Brownfield Site (H4).

Assessment of such site requires assessment of the following: -

- "Critical Level": an assessment of airborne concentrations at the receptors,
- "Critical Load": an assessment of eutrophication and acidification as a result of deposition & washout of pollutants.

The assessments are precautionary as: -

- The model using the "worst" year (2015) from 5 year data set (2015-2019),
- The model assumes that emissions from all emission points are at the permit emission limits (ELVs) for the entire year, in reality this is impossible while complying with the permit (i.e. actual emissions will be lower),
- The model assumes both lines are operating at design capacity for every hour of the year (8760 hrs) while actual expected operation is circa 8,000 hrs.

Critical Levels

The relevant Critical Levels are identified in the report in Appendix XX.

The assessment of the Critical Levels at the most impacted part of the identified receptors is summarised in the table: -

Pollutant	Avg. Period	H1[1]		H2[1]		H3[1]		H4[1]	
		PC[2]	PEC[3][4]	PC[5]	PEC[4]	PC[5]	PEC[4]	PC[5]	PEC[4]
NO_2	24 hr	6.0	-	3.1	-	5.5	-	7.2	-
	Annual	3.0	74.1	0.3	-	1.3	-	2.5	-
SO_2	Annual	1.4	18.8	0.1	-	0.6	-	1.1	-
HF	24 hr	1.5	-	0.8	-	1.4	-	1.8	-
	Weekly	5.4	-	1.1	-	3.2	-	5.5	-
NH_3	Annual	3.0	68.4	0.3	-	1.3	-	2.5	-

Notes:

1. Expressed as % of Critical Level,
2. H1 Only: Process Concentration (PC) is the concentration resulting from the emission alone, figures in green indicate impact is screened out (i.e. "not significant") and no further assessment is required (1st test): -
    a. Annual average standards: PC ≤ 1% of standard.
    b. Other standards: PC ≤ 10% of standard.
3. H1 Only: Predicted Environmental Concentration (PEC) is the sum of the PC and the existing background, figures in green indicate (assuming PC is not "not significant") that no further assessment is required (2nd test): -
    a. Annual average standards: PEC ≤ 70% of standard,
4. PEC not quoted if screened out on PC (1st test).
5. H2, H3 & H4 Process Concentration (PC) is the concentration resulting from the emission alone, figures in green indicate impact is screened out (i.e. "not significant") and no further assessment is required (1st test): -
    a. Annual average standards: PC ≤ 100% of standard.
    b. Other standards: PC ≤ 100% of standard.

With the exception of the annual assessment standard (Critical Level) for annual NO_2 at the Humber Estuary (H1) the table shows that all other impacts are screened out as "not significant."

However, the PEC for annual NO_2 is only just above the 70% screening value, considering the conservative nature of the assessment it is considered that there would be sufficient headroom such that an exceedance of the critical level would be unlikely.

The Critical Levels are derived for rural locations away from agglomerations, other built up areas, industrial installations, motorways and major roads. The receptors identified not meet the criteria of "rural", however the Critical Levels are assessed inline with EA H1 guidance that states: -

"the critical levels should be applied at all locations as a matter of policy, as they represent a standard against which to judge ecological harm".

Critical Loads

Generally there are 2 off Critical Loads to be considered when assessing environmental receptors, these are: -

- Deposition of nutrient Nitrogen,
- Acidification (Nitrogen & Sulphur).

The relevant Critical Loads are identified in the report in Appendix 2. The lowest Critical Load listed for the receptor has been used.

The assessment of the Critical Loads at the most impacted part of the identified receptors is summarised in the table: -

Pollutant	Avg. Period	H1[1][6]		H2[1]		H3[1]		H4[1]	
		PC[2]	PEC[3][4]	PC[5]	PEC[4]	PC[5]	PEC[4]	PC[5]	PEC[4]
Nutrient Deposition		3.0	98.2	0.3	-	1.7	-	6.2	-
Acidification		Not Sensitive		0.2	-	Not Sensitive		1.7	-

Notes:

1. Expressed as % of Critical Load,
2. H1 Only: Process Concentration (PC) is the concentration resulting from the emission alone, figures in green indicate impact is screened out (i.e. "not significant") and no further assessment is required (1st test): -
    a. Annual average standards: PC ≤ 1% of standard.
3. H1 Only: Predicted Environmental Concentration (PEC) is the sum of the PC and the existing background, figures in green indicate (assuming PC is not "not significant") that no further assessment is required (2nd test): -
    a. Annual average standards: PEC ≤ 70% of standard,
4. PEC not quoted if screened out on PC (1st test).
5. H2, H3 & H4 Process Concentration (PC) is the concentration resulting from the emission alone, figures in green indicate impact is screened out (i.e. "not significant") and no further assessment is required (1st test): -
    a. Annual average standards: PC ≤ 100% of standard.
6. Humber Estuary SSSI is considered "Not Sensitive" to Nutrient Deposition.

From the table it is clear that there is a risk that the critical load for nutrient deposition could be exceeded for the Humber Estuary and this needs further consideration.

The Critical Loads used for the assessment of the impacts on the Humber Estuary (above) are listed below: -

Habitat Site	Critical Load Class	Lowest Critical Load (kg N/ha/a)	Background Nitrogen Deposition (kg N/ha/a)
H1. Humber Estuary SAC	Atlantic salt meadows	20	19.04
H1. Humber Estuary SPA/RAMSAR	Pioneer, low-mid, mid-upper saltmarshes	20	19.04
H1. Humber Estuary SSSI	Intertidal mudflats	Not sensitive	19.04

The boundary of the Humber Estuary designated sites (SAC, SPA/RAMSAR and SSSI) in the area of maximum impact consists of: -

- Concrete sea wall protecting major commercial & industrial assets,
- A narrow strip of stony foreshore along the base of the sea wall (that is routinely submerged),
- A relatively narrow strip of intertidal mudflats,

The Humber Estuary is an extremely large designated site that with widely varying characteristics.

The stony foreshore is not considered to provide a significant contribution to the areas of "Atlantic salt meadows" or "Pioneer, low-mid, mid-upper saltmarshes" present within the Estuary.

The location is close to Immingham Dock meaning that the access channels to the dock and associated terminal has to be maintained preventing further potential build-up of the mudflats and therefore scope for development of "Atlantic salt meadows" or "Pioneer, low-mid, mid-upper saltmarshes."

The fixed concrete sea wall, combined with sea level rise/land tip means that this area of the estuary is subject to "coastal squeeze." This means that features such as salt meadows and salt marsh cannot advance inland in response to the effective rise in sea level as the intertidal distance between high water (fixed sea wall) and low water decreases.

The background nitrogen deposition is already 95.2% of the critical load.

Considering these factors it is considered unlikely that the emissions from the installation will have an adverse impact on the integrity of these features within the Humber Estuary designated sites.

Conclusions

Considering the worst-case assumptions adopted for the assessment, the predicted process contributions would not result in significant harm to habitat sites compared with the critical levels for NO_X, SO_2, NH_3 and HF and critical loads for acidification. However, predicted nutrient nitrogen deposition at the Humber Estuary indicates there is a risk that the facility could result in an exceedance of the critical load. Further assessment concludes that the sensitive habitats considered are not present in the impacted area and therefore that the impacts on environmental receptors is "not significant."

Emissions to Air: Impact Assessment (Global Warming Potential, GWP)

The following table shows the global warming potential of the emissions from the process for the following: -

- Plant Operating at permit ELVs for 8760 hrs per (as calculated using the EA H1 tool),
- Expected actual operating conditions (i.e. At design point & each line operating for 8,000 hrs/yr.)

Substance Emitted	At Permitted ELVs (As impact assessment)	Expected Actual	Units
Carbon Dioxide (CO_2) from Waste	438,159	365,429	GWP
Dinitrogen Oxide (N_2O)	12,619	11,524	GWP
Carbon Dioxide (CO_2) from Gas	1,100	1,100	GWP
Carbon Dioxide (CO_2) from Electricity	10	10	GWP
Total	451,888	378,063	GWP
Notes: -			

The BREF Note indicates that for MSW, the portion of CO_2 "which is considered relevant to climate change (i.e. from fossil fuel carbon such as plastics etc.) is generally in the range of 33 % to 50 %." Taking a conservative approach, i.e. assuming 50% of the CO_2 from the RDF is relevant to climate change, the GWPs (i.e. from fossil fuel carbon such as plastics etc.) for the 2 scenarios considered above are circa 232,809 & 195,349 respectively.

As the TEGCO development will replace the gas fired CHP plant currently operated by the off-taker, the fossil fuel (natural gas) CO_2 emissions from the CHP plant will be avoided.

Substance Emitted	At Permitted ELVs (As impact assessment)	Expected Actual	Units
Total Emitted	451,888	378,063	GWP
Carbon Dioxide (CO_2) avoided[(1)]	-88,646	-88,646	GWP
Nett Total	363,242	289,417	GWP
Notes: - 1. Based on 2022 data, assumed no N_2O emitted from displaced CHP plant.			

Taking a conservative approach, i.e. assuming 50% of the CO_2 from the RDF is relevant to climate change, the GWPs (i.e. from fossil fuel carbon such as plastics etc.) for the 2 scenarios considered above are circa 144,163 & 106,703 respectively.

Emissions to Air: Impact Assessment (Petrochemical Ozone Creation Potential, POCP)

The EA H1 tool also calculates POCP and has screened out POCP for all relevant substances as insignificant.

Diffuse Emissions to air

Good housekeeping procedures (e.g. all potentially dusty materials delivered to/exported from the site are in suitable containers, stored within buildings or silos & roadways swept) mean that defuse dust emissions are prevented.

RDF is delivered in closed vehicles/containers and processed within buildings operating at reduced pressure (extracted via the combustors) mean that defuse odour emissions are prevented.

Point Source Emissions to water (other than sewer)

Emissions to water

There no emissions from the prescribed process meaning that no further assessment has been completed.

A discharge is proposed for the following: -

- Clean rainwater run-off,
- Treated foul/domestic sewerage from offices.

Rainwater Run-Off

There is currently uncontrolled rainwater run-off from site (from existing roof and yard area) via a rainwater runoff drainage system. As part of the development of the installation rainwater run-off is via a SUDs system and restricted to predicted green-field run-off rates. This is clean rainwater run-off is not from the prescribed process and TEGCO understands that this does not require further assessment.

In addition to rainwater, this system also collects wash water from the external surfaces of the air cooled condenser radiators. Demineralised water is used for washing meaning that there is no risk of contamination (other than that present in rainwater run-off) arising from this water.

The proposal includes the installation of a sampling & monitoring point (expected to be flow, pH, COD/BOB, Turbidity & Oil & Grease) on this discharge to allow ongoing demonstration that this is uncontaminated water. This is a pumped discharge and incorporates a penstock to enable the discharge to be prevented in the advent of fire or other accidental spillage leading to contamination of the rainwater run-off system.

The discharge reference is W1 on the plan in Appendix 1.

Domestic Sewage

Presently the proposed installation includes a small packaged Sewage Treatment Plant (to BS 12566) is proposed for foul/domestic sewage from the offices. This is considered to be “domestic sewage” and the discharge is a maximum of 3.5 m3 per day. TEGCO understand that this does not require further assessment and that such a discharge is not from the prescribed process.

However, TEGCO understand that the presumption is that domestic sewage should be discharged into the public sewage system where practicable and the cost is not excessive.

The detailed costs associated with connection to public sewer are being reviewed however initial investigations have revealed that: -

- The nearest sewer connection point is approximately 250 m from the site,
- The direct route to this connection point is not practicable due to the need to obtain easements etc. across land subject to 3rd party ownership and with proposals for railway development,
- Only practicable available route is approximately 650 m (following local private roads) and involves obtaining easements etc. to allow installation within these roads,
- Initial costings indicate that the packaged plant costs circa £20,000 while connect to the public sewer costs circa £250,000. TEGCO currently believe that this cost is excessive,

The current proposal has the discharge from the packaged sewage plant discharging into the final detention basin of the surface water system with a common discharge into the adjacent beck. This includes the installation of a sampling & monitoring point at the discharge from the packaged sewage treatment plant into the rainwater run-off system to allow monitoring of sewage treatment plant performance and aid investigation of unusual discharge from the rainwater run-off system.

The discharge reference is W2 on the plan in Appendix 1.

Point Source Emissions to sewer, effluent treatment plants or other transfers off site

There are no point source emissions to sewer effluent treatment plants or transfers off site in normal operation.

Any transfers off site will arise from maintenance activities (e.g. boiler drain down) or other non-routine operations and be subject to appropriate waste management procedures (characterisation, transfer/consignment notes and exported to licensed installations). This point is shown as W3 on the plan in Appendix 1.

Diffuse Emissions to water (other than sewer)

There are no diffuse emissions to water with rainwater run-off being collected and discharged in a single monitored penstock controlled discharge point (W1).

Point Source Emissions to land

There are no point source emissions to land in normal operation.

Diffuse Emissions to land

There are no diffuse emissions to land in normal operation. A waterproof membrane is incorporated into the rainwater run-off detention basins preventing rainwater from seeping into the ground under the site.

Noise Emissions

A study of the potential impacts of noise emission from the installation has been completed. This is based on the installation operating 24hrs/day with the following operational assumptions: -

- 06:00 – 22:00: EfW Plant running at full capacity with HGV movements (Scenario 1),
- 22:00 to 06:00: EfW Plant running at full capacity with no HGV movements (Scenario 2).

The study includes: -

- BS4142 assessment,
- An assessment of impact on Ambient Noise Levels,
- Increase in Ambient Noise Levels due to additional traffic

The assessments are based on monitoring undertaken at the 2 closest sensitive (residential) receptors identified below

Monitoring Point	Noise Sensitive Receptor	Location	Equivalent Receptor used in Air dispersion Modelling.
MP1	NSR1	Queens Road, Immingham 670m North West of installation	R2
MP2	NSR2	Kendal Road Immingham 1.4 km West of installation	R4

The BS4142 and Ambient Noise Level assessments at the receptors are summarised in the table: -

Receptor	BS4142[(1)]		Ambient Noise Level[(2)]	
	Day (Scenario 1)	Night (Scenario 2)	Day (Scenario 1)	Night (Scenario 2)
NSR1	-5	-6	+0.0	+0.0
NSR2	-11	-11	+0.0	+0.0
Notes: - 1. Excess of Rating over Background Sound Level (in dB), 2. Increase in Noise Level (in dB),				

The report concludes: -

- The BS4142 assessment concludes that the installation will have a “low impact” on the surrounding NSRs.
- The Ambient Noise Level Assessment concludes that impact of noise from the installation is “Not Significant.”
- The increase in noise level due to the percentage increase in road traffic from the plant shows “negligible” impact with noise levels increasing less than 1dB.

The assessment report is included in Appendix 4.

Odour Emissions

There are potential odour emissions from the site, these are related to the receipt, handling and storage of the RDF.

The installation has been design to reflect BAT and includes the following design features that will minimise odour emissions: -

- RDF deliveries are in closed containers,
- RDF containers are emptied within a closed building maintained under reduced pressure,
- RDF containers are discharged directly into the Receiving Pits (walking floor or tipped) preventing the need for further handling with mobile plant and associated spillage etc,
- RDF Receipt & Storage Hall is ventilated via the 2 off combustion lines,
- Use of 2 off combustion lines reduces the risk of complete unplanned shutdown as the Receipt & Storage Hall is still maintained under negative pressure by the remaining operational combustion line,

- Receiving Pits and Feed Bunker are emptied prior to shutdown,
- RDF deliveries are stopped or diverted to other installations during plant shutdown.

The use of Urea for NO_X abatement eliminates the odour (& H&S) issues associated with using Ammonia.

The installation is remote from odour sensitive receptors (e.g. residential).

TEGCO therefore conclude odour emissions will not have a significant impact and therefore a further specific odour management plan is not required.

SITE PLAN 1:500

TEG1_MLD_TEB292004

W 1
Main discharge point into Beck
maximum 8.1 l/s (29.16 m3/h)

W 3
Process Water
maximum 2.5 l/s (9.0 m3/h) (part of W1)

W 2
Karlgestor
(part of W1)

PRELIMINARY

A/M	ÄNDERUNG/MODIFICATION	DATUM/DATE	NAME	GEPR./CHECK	GES./APPR.
A	1st Issue	20221222	AK	RC	AD

KUNDE/PURCH.: ---
ORDER NR.: 1900100
ANLAGE/PLANT: EfW IMMINGHAM
Refer to protection notice ISO 16016
Schutzvermerk ISO 16016 beachten !
BENENNUNG/TITLE
Plot Plan
Emissions to water
= &MLD
+N1
MASSSTAB/SCALE
approx 1:500

TEGCO
THE ENERGY GENERATION COMPANY GMBH
COMBUSTION
GASIFICATION

	DATUM/DATE	NAME
GEZ./DRAWN	20221222	Kraft
GEPR./CHECK		RC
GES./APPR.	Engg	AD

ISO / R 128
EUROPA

KKS	DAS/DCC	ZEICHN/NUSNR./DRAWING No.	REV.	BL./SH.	VON/OF
	1N & MLD	TEG1 TEB 292001 A			002/003

FILE DATE: 2022-03-24 FILE NAME: TEG1_MLD_TEB292001

Emissions

Appendix 1

1. **Site Emissions to Air Location Plan**
2. **Site Emissions to Water Location Plan**