Determination of an Application for an Environmental Permit under the Environmental Permitting (England & Wales) Regulations 2010

The Permit Number is:	EPR/XP3336NN
The Applicant / Operator is:	Air Products Renewable Energy Limited
The Installation is located at:	Tees Valley 2 Renewable Energy Facility Huntsman Drive Port Clarence Middlesbrough Cleveland TS2 1TT

What this document is about

It explains how we have considered the Applicant's Application, and why we have included the specific conditions in the draft permit we are proposing to issue to the Applicant. It is our record of our decision-making process, to show how we have taken into account all relevant factors in reaching our position. Unless the document explains otherwise, we have accepted the Applicant's proposals.

We believe we have covered all the relevant issues and reached a reasonable conclusion and we are issuing the Permit in its current form.

We try to explain our decision as accurately, comprehensively and plainly as possible. Achieving all three objectives is not always easy, and we would welcome any feedback as to how we might improve our decision documents in future. A lot of technical terms and acronyms are inevitable in a document of this nature: we provide a glossary of acronyms near the front of the document, for ease of reference.

Preliminary information and use of terms

We gave the application the reference number EPR/XP3336NN/A001. We refer to the application as "the **Application**" in this document in order to be consistent.

The number we propose to give to the permit is EPR/XP3336NN. We refer to the proposed permit as "the **Permit**" in this document.

The Application was duly made on 19 August 2013.

The Applicant is Air Products Renewable Energy Limited. We refer to Air Products Renewable Energy Limited as “the **Applicant**” in this document. Where we are talking about what would happen after the Permit is granted (if that is our final decision), we call Air Products Renewable Energy Limited “the **Operator**”.

Air Products Renewable Energy’s proposed facility is located at Tees Valley 2 Renewable Energy Facility. Reclamation Pond, Huntsman Drive, Stockton-on-Tees. TS2 1TT. We refer to this as “the **Installation**” in this document.

How this document is structured

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Glossary of acronyms used in this document

(Please note that this glossary is standard for our decision documents and therefore not all these acronyms are necessarily used in this document.)

AOD	Above Ordnance Datum
APC	Air Pollution Control
BAT	Best Available Technique(s)
BAT-AEL	BAT Associated Emission Level
BREF	BAT Reference Note
CEM	Continuous emissions monitor
CFD	Computerised fluid dynamics
CHP	Combined heat and power
COMEAP	Committee on the Medical Effects of Air Pollution
CROW	Countryside and rights of way Act 2000
CV	Calorific value
DAA	Directly associated activity – Additional activities necessary to be carried out to allow the principal activity to be carried out
DD	Decision document
EAL	Environmental assessment level
EIAD	Environmental Impact Assessment Directive (85/337/EEC)
ELV	Emission limit value
EMAS	EU Eco Management and Audit Scheme
EMS	Environmental Management System
EPR	Environmental Permitting (England and Wales) Regulations 2010 (SI 2010 No. 675) as amended
EQS	Environmental quality standard
EU-EQS	European Union Environmental Quality Standard
EWC	European waste catalogue
FSA	Food Standards Agency
GWP	Global Warming Potential
HHRAP	Human Health Risk Assessment Protocol
HPA	Health Protection Agency
HRA	Human Rights Act 1998
HW	Hazardous waste
HWI	Hazardous waste incinerator
IBA	Incinerator Bottom Ash

IED	Industrial Emissions Directive (2010/75/EU)
IPPCD	Integrated Pollution Prevention and Control Directive (2008/1/EC)
I-TEF	Toxic Equivalent Factors set out in Annex I of WID
I-TEQ	Toxic Equivalent Quotient calculated using I-TEF
LCPD	Large Combustion Plant Directive (2001/80/EC)
LCV	Lower calorific value – also termed net calorific value
LfD	Landfill Directive (1999/31/EC)
LHB	Local Health Board
LOI	Loss on Ignition
MBT	Mechanical biological treatment
MSW	Municipal Solid Waste
MWI	Municipal waste incinerator
NOx	Oxides of nitrogen (NO plus NO_2 expressed as NO_2)
Opra	Operator Performance Risk Appraisal
PAH	Polycyclic aromatic hydrocarbons
PC	Process Contribution
PCB	Polychlorinated biphenyls
PCT	Primary Care Trust
PEC	Predicted Environmental Concentration
POP(s)	Persistent organic pollutant(s)
PPS	Public participation statement
PR	Public register
PXDD	Poly-halogenated di-benzo-p-dioxins
PXB	Poly-halogenated biphenyl
PXDF	Poly-halogenated di-benzo furans
RDF	Refuse derived fuel
RGS	Regulatory Guidance Series
SAC	Special Area of Conservation
SED	Solvent Emissions Directive (1999/13/EC)
SCR	Selective catalytic reduction
SGN	Sector guidance note
SNCR	Selective non-catalytic reduction
SPA(s)	Special Protection Area(s)

SS	Sewage sludge
SSSI(s)	Site(s) of Special Scientific Interest
SWMA	Specified waste management activity
TDI	Tolerable daily intake
TEF	Toxic Equivalent Factors
TGN	Technical guidance note
TOC	Total Organic Carbon
UHV	Upper heating value –also termed gross calorific value
UN_ECE	United Nations Environmental Commission for Europe
US EPA	United States Environmental Protection Agency
WFD	Waste Framework Directive (2008/98/EC)
WHO	World Health Organisation

1 Our decision

We have decided to grant the Permit to the Applicant. This will allow it to operate the Installation, subject to the conditions in the Permit.

We consider that, in reaching that decision, we have taken into account all relevant considerations and legal requirements and that the permit will ensure that a high level of protection is provided for the environment and human health.

This Application is to operate an installation which is subject principally to the Industrial Emissions Directive (IED).

The Permit contains many conditions taken from our standard Environmental Permit template including the relevant Annexes. We developed these conditions in consultation with industry, having regard to the legal requirements of the Environmental Permitting Regulations and other relevant legislation. This document does not therefore include an explanation for these standard conditions. Where they are included in the permit, we have considered the Application and accepted the details are sufficient and satisfactory to make the standard condition appropriate. This document does, however, provide an explanation of our use of “tailor-made” or installation-specific conditions, or where our Permit template provides two or more options.

2 How we reached our decision

The Application was duly made on 19 August 2013. This means we considered it was in the correct form and contained sufficient information for us to begin our determination but not that it necessarily contained all the information we would need to complete that determination: see below.

The Applicant made no claim for commercial confidentiality. We have not received any information in relation to the Application that appears to be confidential in relation to any party.

We advertised the Application by a notice placed on our website, which contained all the information required by the IED, including telling people where and when they could see a copy of the Application.

We placed a paper copy of the Application and all other documents relevant to our determination (see below) on our Public Register at Environment Agency Offices, Tyneside House, Skinnerburn Road, Newcastle Business Park, Newcastle upon Tyne. NE4 7AR and also sent a copy to Stockton-on-Tees Borough Council, 16 Church Road, Stockton-on-Tees. TS18 1XD for its own Public Register. Anyone wishing to see these documents could do so and arrange for copies to be made. The Applicant also provided a number of copies of the Application on CD which were also made accessible from the Public Registers.

We sent copies of the Application to the following bodies, including those with whom we have “Working Together Agreements”:

Local Authority - Environmental Protection Department

Food Standards Agency

Health and Safety Executive

Local Primary Care Trust

Sewage Undertaker

National Grid

Natural England

These are bodies whose expertise, democratic accountability and/or local knowledge make it appropriate for us to seek their views directly.

Further details along with a summary of consultation comments and our response to the representations we received can be found in Annex 4. We have taken all relevant representations into consideration in reaching our determination.

3 The legal framework

The Permit will be granted, under Regulation 13 of the EPR. The Environmental Permitting regime is a legal vehicle which delivers most of the relevant legal requirements for activities falling within its scope. In particular, the Installation is:

- a waste *incineration* plant as described by the IED
- an *operation* covered by the WFD, and
- subject to aspects of other relevant legislation which also have to be addressed.

We address some of the major legal requirements directly where relevant in the body of this document. Other requirements are covered in a section towards the end of this document.

We consider that, in granting the Permit, it will ensure that the operation of the Installation complies with all relevant legal requirements and that a high level of protection will be delivered for the environment and human health.

We explain how we have addressed specific statutory requirements more fully in the rest of this document.

4 The Installation

4.1 Description of the Installation and related issues

4.1.1 The permitted activities

The Installation is subject to the EPR because it carries out an activity listed in Part 1 of Schedule 1 to the EPR:

- Section 5.1 Part A(1)(b) – The incineration of non-hazardous waste in an incineration plant or waste co-incineration plant with a capacity exceeding 3 tonnes per hour.
- Section 5.4 Part A(1)(a) Disposal of non-hazardous waste with a capacity exceeding 50 tonnes per day involving one of the following activities.
  (ii) physico-chemical treatment;

The definition of an "incineration plant" defined in Article 42 of the IED includes:

> *"all incineration lines (in this case gasification), waste reception, storage, on-site pre-treatment facilities, waste-fuel and air-supply systems, boiler, facilities for the treatment of exhaust gases, on-site facilities for treatment or storage of residues and waste water, stack, devices and systems for controlling incineration operations, recording and monitoring incineration conditions."*

Many activities which would normally be categorised as "directly associated activities" for EPR purposes (see below), such as air pollution control plant, and the ash (slag) storage bunker, are therefore included in the listed activity description.

An installation may also comprise "directly associated activities", which at this Installation includes the generation of electricity using two combustion gas turbines and a steam turbine. These activities comprise one installation, because the gasification plant and the turbines are successive steps in an integrated activity. The onsite Effluent Treatment Plant in considered to be a separate activity and, not therefore either part of the incineration process or a Directly Associated Activity (DAA) to it.

Together, these listed and directly associated activities comprise the Installation.

4.1.2 The Site

The site is located approximately 2.0 km to the north of South Bank, 2.5 km east of Port Clarence and 4.5 km to the east of Billingham on the Reclamation Pond Site. It is situated in the Seal Sands Area on the north bank of the Tees Estuary in Stockton, Teesside, England and there is vehicular access from the A178 via Huntsman Drive. The National Grid Reference for the site is NZ 51915 22792.

The Reclamation Pond site boundary is defined by a services corridor to the north, Tees valley REF to the east, the Impetus MRF to the west and Huntsman Drive to the south.

The site has been partially in-filled to form an undulating surface with an elevation of approximately 6 m AOD. The site has some scrub vegetation but no mature trees are currently present. The site has planning approval to reclaim the site for industrial (B2) uses, utilising soils from the site and adjoining land, as well as imported fill. The site is located in an area which is dominated by industrial uses. The north bank of the Tees is occupied by a variety of operations including petrochemical facilities storage and heavy engineering. Tees Valley REF and the North Tees Works are to the east of the site. The North Tees works is a petrochemical facility which is occupied by SABIC. To the south of the site beyond Huntsman Drive is the Port Clarence Landfill Site; this is a hazardous waste disposal site operated by Augean.

The site is located near to Ramsar site and SPA Teesmouth and Cleveland Coast and SSSI Tees and Hartlepool Foreshore and Wetlands.

The nearest residential areas are at Port Clarence which is located 2.0 km to the south west and Cowpen Bewley which is located 3.5 km to the north west of the site.

The Applicant submitted a plan which we consider is satisfactory, showing the site of the Installation and its extent. A plan is included in Schedule 7 to the Permit, and the Operator is required to carry on the permitted activities within the site boundary.

Further information on the site is addressed below at 4.3.

4.1.3 What the Installation does

The Applicant has described the facility as a Renewable Energy Facility – Plasma Gasification Plant. Our view is that for the purposes of IED and EPR, the installation is an incinerator because the plant does not produce a material output, energy is recovered from the waste being thermally treated in the form of electrical power which is exported to the National Grid, waste is the principal source of fuel.

The facility will produce approximately 49.9 MWe through oxygen-assisted plasma gasification of approximately 385,000 tonnes per year of processed

MSW supplied from an adjacent recycling facility, owned and operated by others. Whilst a significant volume of the waste processed by this materials recycling facility is destined for both Tees Valley I and Tees Valley II Renewable Energy Facilities, they also process waste materials for other, unrelated, customers. Therefore, this facility is not considered as a DAA to the REFs. It is operated and permitted separately.

This feedstock is supplied by conveyor directly from the adjacent materials recycling facility (MRF) where raw MSW will be processed off site by the Recycler to remove recyclable materials, such as ferrous and non-ferrous metals, glass, and some plastics, and will then be shredded to approximately 300 mm (12 inch) average size and delivered to the Facility. The MSW will be further processed to reduce its size to approximately 50mm (2 inch) average size and increase its density, mixed with metallurgical coke and limestone fluxant, and then introduced into the top of a vertical cylindrical gasifier.

As the material moves downward in the atmospheric pressure gasifier, it is heated by electric plasma torches to bulk temperatures in excess of 1,200ºC. Most of the carbon in the waste reacts with controlled amounts of oxygen introduced immediately above the plasma torches to produce carbon monoxide. Some of the carbon reacts with water present in the waste or steam introduced into the gasifier to produce hydrogen. The resultant syngas is partially quenched by a water spray as it exits from the top of the gasifier vessel. Inorganic and inert materials exit the bottom of the gasifier as slag, which will be quenched in a water bath, and conveyed onto trucks for offsite use by a recycler.

The syngas produced will undergo a series of process operations to further quench, scrub, cool, compress, and remove particulates, HCl, ammonia, sulphur, and mercury to make it suitable as fuel for two combustion gas turbines and an auxiliary boiler to drive a steam turbine. The syngas cleanup train includes; syngas quench and particulate removal by a dual venturi quench scrubber, separator, direct contact syngas cooler, wet electrostatic precipitator. Particulate and filter cake are recycled back to the gasifier feed for further processing; Syngas compression by multi-stage centrifugal syngas compressor including intercoolers and controls; Hydrolysis reactor consisting of a catalytic reactor to convert COS to H_2S including downstream gas cooling and condensate removal; Mercury removal using sulphur-impregnated activated carbon fixed bed polishing filters and sulphur removal by LO-CAT redox/absorption system to remove H_2S from the syngas.

The gas turbine generators will produce electricity, and the heat from each turbine‘s exhaust will be recovered as steam in heat recovery steam generators. The steam produced will be delivered to a steam turbine generator to produce additional electric power. The electric power will be transformed to 132kV and delivered to the National Grid.

The exhaust gas will be catalytically treated to remove CO and NOx. Each of the three turbine packages will exhaust to atmosphere via individual 26m high exhaust stacks. Each of these exhaust stacks will be fitted with dedicated

Continuous Emission Monitors (CEMs) to sample, analyse and record emissions of NOx, CO, O_2 (dry), SO_2, total hydrocarbons as carbon (TOC) and total dust (particulate).

The facility will also include a 46m high flare stack which will only be operated during periods of plant start up, shutdown and certain periods of short duration abnormal operating conditions.

Filter cake and particulates separated from the scrubbing water and wastewater will be recycled back to the gasifier feed.

Process wastewater will be collected, treated, and re-used as far as possible. The on-site process effluent treatment plant pre-treats the syngas scrubber blowdown, WESP blowdown, flare knockout drum blowdown, condensate from the fuel gas knockout drum and any other wastewater streams that are potentially in direct contact with the syngas before routing the final effluent to the Northumbrian Water wastewater treatment plant at Bran Sands via emission point S1 (as shown on the Site Plan). All of the streams are pumped from their respective units to the wastewater treatment block. A gravity sewer is provided for equipment and other drains where contact with syngas is possible. The anticipated breakdown of process wastewater into the treatment plant is as follows.

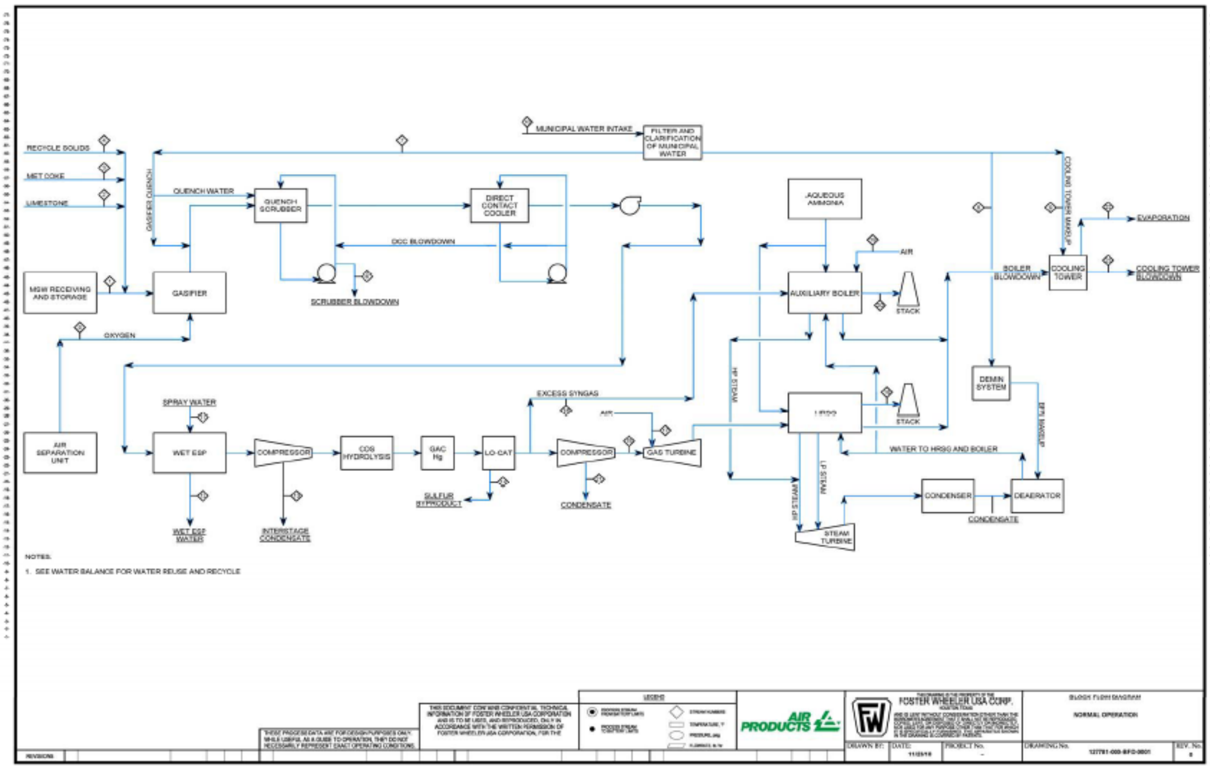
Source	Contribution m^3/hour
Syngas cleaning blowdown	52.2
WESP blowdown	15.9
Flare knockout drum	11.4
Fuel gas knockout drum	1.1
Miscellaneous sources	11.4
Gravity PWW lift station	11.4

The onsite wastewater treatment plant will have a capacity of $102m^3$/hour, and will consist of a primary clarifier to settle out the suspended solids, which can be up to 10%. Coagulant and flocculent are added to the solids contact clarifier to assist in the settlement of suspended solids. The primary clarifier is designed to achieve two-fold thickening of the inlet stream (i.e. clarifier inlet contains 2.5wt% suspended solids; the clarifier bottom outlet contains 5wt% suspended solids). Any floating solids are removed by a scum removal system. The primary clarifier effluent is then passed through a secondary clarifier, lamella style, to further remove suspended solids. The water then flows to a holding tank to equalise discharge flows. The sludge and scum from the clarifier bottom are sent to sludge thickening equipment. The clarified water is pumped to the Bran Sands wastewater connector to be sent for further treatment. This effluent will then be treated and discharged into the River Tees under the permits and discharge consents already in place at Bran Sands, as regulated by the Environment Agency. Note that the foul process effluent from the facility arises from the cleaning of synthesis gas that is subsequently used in an energy generation process in the power block. This effluent does therefore not originate from the cleaning of exhaust gases, and therefore those requirements of Part 5 of Annex VI of the IED do not apply.

To comply with Article 46(5), hardstanding, secondary and tertiary containment at the facility will act to ensure prevention of unauthorised accidental releases of any polluting substances to soil, surface water and groundwater. These measures also provide containment for contaminated rainwater run-off and firewater.

The sludge from the solids contact clarifier bottoms is sent to a gravity sludge thickener and belt filter presses. The sludge thickener uses coagulant and/or flocculent to assist in dewatering. The thickened sludge is pumped directly to three 50% capacity belt filter presses. Additional flocculent and/or coagulant is added inline to ensure at least a 35wt% solids filter cake. The water from the filter press is recycled to the primary clarifier for further treatment. The filter cake is recycled to the gasifier to be reclaimed as reprocessed feed material via the filter cake conveying system.

Process Flow Diagram.



The key features of the Installation can be summarised in the table below.

Waste throughput,	385,000 tonnes/annum	40 tonnes/hour Average
Waste processed	MSW and C&I	
Number of lines	1	
Furnace technology	Plasma-torch Gasification	
Auxiliary Fuel	Natural Gas (10,700 kg per pre-heat period)	
Acid gas abatement	Wet	Caustic NaOH
NOx abatement	SCR	Ammonia
Reagent consumption	Emergency backup fuel oil – Diesel 260 l/h Ammonia: 6,650 te/annum Met Coke: 12,450 te/annum Lime (flux agent) : 33,450 te/annum Activated carbon: 15 te/annum Process water: 364,000 te/annum	
Flue gas recirculation	No	
Dioxin abatement	Activated carbon	
Stack (Gas Turbines)	Height, 26.0 m	Diameter, 2.5m
Flue gas (Gas Turbines)	Flow, 74.7Am^3/s@96^{0}C	Velocity, 15.2m/s
Stack (Steam Turbine)	Height, 26.0 m	Diameter, 1.5 m
Flue gas (Steam Turbine)	Flow 31.9Am^3/s@110^{0}C	Velocity, 18.1m/s
Electricity generated	49.8 MWe	414,400 MWh (at 95% availability)
Waste heat use	The facility is CHP ready – low grade heat will be exported if a user can be found as the locality develops.	

4.1.4 Key Issues in the Determination

The key issues arising during this determination were the potential for emissions to air and the possibility of in combination effects with Tees Valley REF having impacts upon habitats and we therefore describe how we determined these issues in most detail in this document.

4.2 The site and its protection

4.2.1 Site setting, layout and history

Location and Current Land Use
Tees Valley 2 Renewable Energy Facility is proposed to be sited approximately 4.5km to the east of Billingham and 6km to the west of the Tees Bay. The Site is located on the Reclamation Ponds which is in the Seal Sands Area on the north bank of the River Tees, accessed from the A178 via Huntsman Drive (to be re-named North Tees Access Road).

Surrounding Land Use
The Site is bounded to the north by a culverted waterway with open land of Phase 4 beyond to the northwest and open water of Phase 4 (Reclamation Pond) beyond to the northeast. Tees Valley REF (TV1) is adjacent to the east

with the North Tees Works petrochemical facility (operated by SABIC) approximately 300m to the east and Sabic North Tees Logistics approximately 400m to the southeast. Huntsman Drive is adjacent to the south with Port Clarence Landfill, a hazardous waste landfill operated by Augean approximately 200m beyond to the south. A 4m high screening bund is adjacent to the west with Dorman's Pool approximately 350m to the west. This is part of the Tees and Hartlepool Foreshore and Wetlands Site of Special Scientific Interest (SSSI).

Geology

British Geological Survey (BGS) sheet number 33 of Stockton shows the Site to be underlain by Holocene Tidal Flats (Superficial Deposits) resting on Mercia Mudstone. However, the Site was reclaimed from the River Tees and information indicates that the Site is underlain by Made Ground comprising colliery spoil and blast furnace slag.

Site-specific information indicates that the Site is likely to be underlain by approximately 0.6m of ashy, silt topsoil resting on up to 10m of slag, ash and clinker. The Made Ground is underlain by Superficial Deposits including Clayey Sand and Sand/Silt/ Clay between 6.4 and 35m below ground level, resting on Sand between 24 and 40m below ground level, underlain by Clay between 28 and 35m below ground level. Bedrock (Mercia Mudstone) has been encountered between 32.3 and 50m below ground level.

Hydrogeology

The Site is underlain by a Secondary B Aquifer (Mercia Mudstone). Secondary B Aquifers consist of predominantly lower permeability layers which may store and yield limited amounts of groundwater because of localised features such as fissures, thin permeable horizons and weathering (generally the water-bearing parts of the former non-aquifers).
Overlying Superficial Deposits are considered a Secondary Undifferentiated Aquifer. This classification is assigned where it has not been possible to attribute either category A or B to a rock type and in most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations because of the variable characteristics of the rock type.

Site-specific information indicates that perched water is present in Made Ground and Mott MacDonald's Site Investigation to the north of the Site in 2008 show water levels between 4 and 6m below ground level in the Made Ground. These levels were similar to surface water levels in the Reclamation Pond and surrounding water bodies. It could be inferred that water flow In Made Ground underlying the Site would be in a northerly direction towards the Reclamation Pond with groundwater in hydraulic continuity with the River Tees.

The Site is not located within a groundwater Source Protection Zone (SPZ) but there are five licensed, groundwater abstractions within 1km, the closest being approximately 150m to the northeast and licensed to Impetus

Reclamation Ltd associated with the North Tees Oil Refinery. The abstraction is taken from the Mercia Mudstone for General use.

Hydrology
A number of surface water bodies are present within the vicinity of the Site. The nearest is the Reclamation Pond adjacent to the northeast. Previous investigations of the Tees Valley REF to the east suggest that the water quality within Reclamation Pond is poor. Dorman's Pool is approximately 200m to the west and connected to Reclamation Pond via an outfall system located on the boundary between Phase 1 and Phase 2 areas of the Reclamation Pond development. The River Tees is approximately 400m to the southeast and connected to the Reclamation Pond via an outfall in the southwest corner of the Tees Valley REF to the east of the Site. No river quality data exists for the River Tees downstream of the Tees Barrage.
No current, licensed surface water abstractions have been identified within 500m of the Site. No current discharge consents have been identified within 500m of the Site.
Much of the Site is currently located within Flood Zone 1 and part in the north in Flood Zone 3. Following reclamation, the Site will be raised above the 1 in 200 year flood level (4.13mAOD) and will have a low risk of fluvial flooding.

Ecology
Statutory and non-statutory conservation designations have been identified within 1km of the Site, including the Tees and Cleveland Coast Ramsar and Special Protection Areas (SPA) and Tees and Hartlepool Foreshore and Wetlands Site of SSSI, both within 500 m.

Pollution History
The Reclamation Pond was created by the incomplete backfilling of cells created by the historical placement of slag fingers. This is the process of depositing slag in lines spanning out from a central point and then infilling between these lines.
Anecdotal evidence suggests that the pond was subject to a hydrocarbon spill from the ICI chemical plant in the 1980s. The pond was subsequently remediated and it is understood surface water sampling has continued since that time.
Anecdotal evidence suggests that the Reclamation Pond was historically used for discharge of runoff and effluent from the North Tees refinery.

Evidence of Historic Contamination
The Site was reclaimed from the River Tees in the early 20th century (1899 to 1916) by placement of blast furnace slag and colliery spoil. The site owner has planning approval (01/2203/P) to reclaim the Reclamation Pond development site for industrial (class B2) uses achieved through cut and fill earthworks using site-won and imported material. It is assumed that the remediation works will be completed in accordance with the Remediation Strategy, to the satisfaction of the relevant regulatory bodies and will render the Site suitable for the proposed end-use.

4.2.2 Proposed site design: potentially polluting substances and prevention measures

There will be no subsurface bulk storage or process materials pipework. All waste will be processed in an enclosed building or the enclosed gasifier structure. The process will not involve the use of bulk hazardous liquids. All process areas where spillages may occur will be covered with an impermeable surface. The main process area will be made of high quality concrete hardstanding with sealed construction joints where appropriate. Process and non-process areas are separate, with potentially contaminated surface water (i.e. from operational areas) being treated prior to discharge. All external roadways, turning areas and parking areas will be sealed concrete or tarmac with concrete kerbs. Such areas will be laid with falls towards the drainage system so that all runoff is directed towards the dedicated drains, which are fitted with oil interceptors, rather than escape onto surrounding soft ground.

The only above ground bulk liquid storage tank will be for light fuel oil for the firewater pump backup generator. This will be within a workshop, with bunding provided with 110% of the tank capacity. Silos containing powered materials will be vented through bag filters.

The plant has been designed for low water usage. The main use of fresh water is within the demineralisation plant supplying cooling and top-up water to the boiler and to top up the process water tank. Process waste water is collected, settled and neutralised for re-use.

The firewater system is designed to store and distribute firewater to users. The system will consist of a firewater storage tank and pumps. It is designed for the largest expected fire water requirements in the areas to be protected. The demand includes the use of any fixed system and hand held equipment and is estimated at 340m^3/hr. Two fire pumps, each capable of supplying 100% of the maximum fire water demand, will be supplied, one electrically driven main duty pump and one diesel driven back-up pump which allows for full delivery during a power failure.

The Installation process areas will be covered by impermeable surfaces, whether by buildings or hardstanding. In the event of an accidental spillage in the outside area there is the ability to block any drains and contain any spillage. The building itself will act as a bund. This would also act as a detention basin for firewaters in the event of a fire at the Installation.

The thermal treatment plant is protected by high efficiency misting sprinklers from the main water tank. These are designed to minimise water use, and hence firewater generation, and are likely to extinguish any internal fires before the emergency services arrive. The waste handling areas are covered by a deluge fire water system.

All storage tanks, used for holding additive liquid products and auxiliary fuel will be mounted on impermeable surfaces and bunded with a containment capacity greater than 110% of the capacity of the tanks or greater than 25% of the total tankage whichever is the greater.

The primary source of odour from the facility would be from the incoming waste. Under normal operation, the facility will use totally enclosed waste feedstock storage, handling and conveyance systems, and will minimise on site waste storage through 24 hour 7 day per week deliveries. There will be control of ventilation exhaust with activated carbon beds for odour abatement.

4.2.3 Closure and decommissioning

Having considered the information submitted in the Application, we are satisfied that the appropriate measures will be in place for the closure and decommissioning of the Installation, as referred to in Section 2.11 of the Application. Pre-operational condition PO1 requires the Operator to have an Environmental Management System in place before the Installation is operational, which would include a site closure plan.

The Operator has to satisfy us, if it wants to surrender the Permit, that the necessary measures have been taken, both to avoid any pollution risk resulting from the operation of the Installation, and to return the site to a satisfactory state, having regard to the state of the site before the Installation was put into operation. To do this, the Operator has to apply to us for surrender, which we will not grant unless and until we are satisfied that these requirements have been complied with.

4.3 Operation of the Installation – general issues

4.3.1 Administrative issues

The Applicant is the sole Operator of the Installation.

We are satisfied that the Applicant is the person who will have control over the operation of the Installation after the granting of the Permit; and that the Applicant will be able to operate the Installation so as to comply with the conditions included in the Permit.

The incineration of waste is not a specified waste management activity (SWMA). The Environment Agency has considered whether any of the other activities taking place at the Installation are SWMAs and is satisfied that none are taking place.

We are satisfied that the Applicant's submitted Opra profile is accurate.
The OPRA score will be used as the basis for subsistence and other charging, in accordance with our Charging Scheme. Opra is the Environment Agency's method of ensuring application and subsistence fees are appropriate and proportionate for the level of regulation required.

4.3.2 Management

The Applicant has stated in the Application that they will implement an Environmental Management System (EMS). A pre-operational condition (PO1) is included requiring the Operator to provide a summary of the EMS prior to commissioning of the plant and to make available for inspection all EMS documentation. The Environment Agency recognises that certification of the EMS cannot take place until the Installation is operational. An improvement condition (IC1) is included requiring the Operator to report progress towards gaining accreditation of its EMS.

We are satisfied that appropriate management systems and management structures will be in place for this Installation, and that sufficient resources are available to the Operator to ensure compliance with all the Permit conditions.

4.3.3 Site security

Having considered the information submitted in the Application, we are satisfied that appropriate infrastructure and procedures will be in place to ensure that the site remains secure.

4.3.4 Accident management

The Applicant has submitted an Accident Management Plan. Having considered the Plan and other information submitted in the Application, we are satisfied that appropriate measures will be in place to ensure that accidents that may cause pollution are prevented but that, if they should occur, their consequences are minimised. An Accident Management Plan will form part of the Environmental Management System and must be in place prior to commissioning as required by a pre-operational condition (PO1).

4.3.5 Off-site conditions

We do not consider that any off-site conditions are necessary.

4.3.6 Operating techniques

We have specified that the Applicant must operate the Installation in accordance with the following documents contained in the Application:

Description	**Parts Included**	**Justification**
The Application	1.2. Non-technical summary, 2. Techniques for Pollution Control.	These sections describe the plant and equipment as well as management processes employed.

The details set out above describe the techniques that will be used for the operation of the Installation that have been assessed by the Environment Agency as BAT; they form part of the Permit through Permit condition 2.3.1 and Table S1.2 in the Permit Schedules.

We have also specified the following limits and controls on the use of raw materials and fuels:

Raw Material or Fuel	Specifications	Justification
Gas Oil – used to fuel backup generator.	< 0.1% sulphur content	As required by Sulphur Content of Liquid Fuels Regulations.

The fuel basis is 100% pre-treated MSW. The waste will be pre-processed to remove recyclables (specifically ferrous and non-ferrous metals, glass and some plastics, non-combustible construction debris and large bulky materials. Waste composition will be subject to contractual control to a defined specification. Waste codes to be accepted will be those relating to pre-treated and sorted MSW, arriving from waste transfer stations, notably the adjacent Impetus MRF and potentially others in the area. The Permit must list explicitly the categories of waste which may be treated. This will be done in Table S2.2 of the Permit. The Application contains a list of those wastes coded by the List of Wastes Regulations 2005, which the Applicant will accept in the waste streams entering the plant and which the plant is capable of thermally treating in an environmentally acceptable way. These wastes are listed in the table below.

Waste Code	Description
19	WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARA-TION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE
19 10	Wastes from shredding of metal-containing wastes
19 10 04	Fluff light fraction, dust and other materials not mentioned in 19 10 03
19 10 06	Other material fractions not mentioned in 19 10 05
19 12	Wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified
19 12 01	Paper and cardboard material fractions
19 12 04	Plastic and rubber material fractions
19 12 07	Wood, other than mentioned in 19 12 06
19 12 08	Textile material fractions
19 12 10	Combustible waste (such as refuse derived fuels)
19 12 12	Other waste from mechanical separation process, other than mentioned in 19 12 11
20	20 MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS
20 01	Separately collected fractions (except 15 01)
20 01 38	Wood other than that mentioned in 20 01 37

The nominal MSW flow rate will be 950 t/day with atypical Calorific Value (CV) of 13.0 MJ/kg and a Lower Heating Value (LHV) of 11.6 MJ/kg (dry basis).

This material will be pre-shredded off-site to a maximum single dimension of 300mm and screened in a trammel screen to remove fines less than 40mm.

We are satisfied that the Applicant can accept the wastes contained in Table S2.2 of the Permit because: -

(i) these wastes are categorised as municipal waste or are non-hazardous wastes similar in character to municipal waste;
(ii) the wastes are all categorised as non-hazardous and are capable of being safely burnt at the installation.
(iii) these wastes are likely to be within the design calorific value (CV) range for the plant;
(iv) these wastes are unlikely to contain harmful components that cannot be safely processed at the Installation.

The Installation will take residual waste i.e. that which is not separately collected or otherwise recovered, recycled or composted. Waste codes for separately collected fractions of waste (with the exception of waste wood classified under EWC code 20 01 38) are not included in the list of permitted wastes, except that separately collected fractions which prove to be unsuitable for recovery may be included.

We have limited the capacity of the Installation to 385,000 tonnes per annum. The installation will operate 8,300 hours per year at a nominal average capacity of 40 tonnes per hour. The limiting capacity of the 385,000 tonnes per annum is based on the lower heating value expected in the incoming waste of 11.6 MJ/kg compared with the average expected value of 13.0MJ/kg.

The Installation will be designed, constructed and operated using BAT for the incineration of the permitted wastes. We are satisfied that the operating and abatement techniques are BAT for incinerating these types of waste. Our assessment of BAT is set out later in this document.

4.3.7 Energy efficiency

(i) Consideration of energy efficiency

We have considered the issue of energy efficiency in the following ways:

1. The use of energy within, and generated by, the Installation which are normal aspects of all EPR permit determinations. This issue is dealt with in this section.

2. The extent to which the Installation meets the requirements of Article 44(b) of the IED, which requires that "the heat generated during the process is recovered as far as practicable through the generation of heat, steam and power". This issue is covered in this section.

3. The combustion efficiency and energy utilisation of different design options for the Installation are relevant considerations in the determination of BAT for the Installation, including the Global Warming

Potential of the different options. This aspect is covered in the BAT assessment in section 6 of this Decision Document.

(ii) Use of energy within the Installation

Having considered the information submitted in the Application we are satisfied that appropriate measures will be in place to ensure that energy is used efficiently within the Installation.

The Application details a number of measures that will be implemented at the Installation in order to increase its energy efficiency, these include recycling of water through the various cooling and quench steps to reduce incoming makeup flow and reduce wastewater leaving the plant, incorporating a heat recovery steam generator to recover heat from the gas turbines exhaust streams which recover this heat as steam to feed the steam turbine and employing an auxiliary boiler to address the variability of the incoming fuel and thus allowing the gas turbines to operate at peak efficiency. Additionally, the techniques used to minimise energy consumption include equipment maintenance and monitoring as part of the preventive maintenance programme, for example: periodic water washing of the gas turbines to maintain peak efficiency; optimising cooling tower performance/chemistry to allow increased cycles of concentration and minimise thermal and water wastes; monitoring of gasifier syngas exit concentration, specifically, carbon and oxygen to control gasifier performance; and periodic replacement of torch electrodes to maximise performance. Thermal heat efficiency has a significant impact on power generation. To reduce heat loss, all plant and equipment will be insulated, particularly all main plant (gasification plant, gas clean up plant, gas turbine and steam turbine) and interconnecting lines including the steam lines.

Data from the BREF for Municipal Waste Incinerators shows that the range of specific energy consumptions is as in the table below.

MSWI plant size range (t/yr)	**Process energy demand (kWh/t waste input)**
Up to 150,000	300 – 700
150,000 – 250,000	150 – 500
More than 250,000	60 – 200

The BREF says that it is BAT to reduce the average installation electrical demand to generally below 150 kWh/tonne of waste with an LCV of 10.4 MJ/kg. The LCV in this case is expected to be 11.60 MJ/kg.
Taking account of the difference in LCV, the specific energy consumption in the Application is significantly higher than that set out above. However, the BREF does not take account of the use of Plasma technology and the higher conversion efficiencies achieved, therefore the higher parasitic load is easily compensated by the higher generation of electricity per tonne of waste processed. Therefore, we are satisfied that the facility energy efficiency is BAT.

(iii) Generation of energy within the Installation - Compliance with Article 44(b) of the IED

Article 44(b) of the IED requires that heat "*shall be recovered as far as practicable*". The following hierarchy of heat recovery options, with (e) as the least preferred option and the optimum being a combination of the other four options:

a) use of waste heat from boiler water cooling system
b) use of a boiler for steam generation or electricity generation
c) use of exhaust steam for process heating or CHP schemes
d) internal heat exchange for primary air heating and/or flue gas reheating
e) no heat recovery.

The BREF says that where a plant generates electricity only, it is BAT to recover 0.4 – 0.65 MWh/ tonne of waste (based on LCV of 11.6MJ/kg). Our technical guidance note, SGN EPR S5.01, states that where electricity only is generated, 5-9 MW of electricity should be recoverable per 100,000 tonnes/annum of waste (which equates to 0.4 – 0.72 MWh/tonne of waste).

The Installation will generate electricity only and has been specified to maximise electrical output with the use of heat from the exhaust gases of the two Gas Combustion Turbines being recovered through a Heat Recovery Steam Generation (HRSG) system to drive a Steam Turbine. The Sankey diagram in section 2.7 of the Application shows 49.9 MW of electricity produced for an annual burn of 385,000 tonnes, which represents 12.96 MW per 100,000 tonnes/yr of waste burned (1.04 MWh/tonne of waste). However not all of the electrical energy generated is being recovered from the waste feedstock a proportion of this is being recovered from the met coke, also the parasitic energy is not taken from the generated figure. Therefore, the adjusted net power output would be 31.8 MW, which represents 8.26 MW per 100,000 tonnes/yr of waste burned (0.665 MWh/tonne of waste) The Installation is therefore in the upper half in the indicative BAT range.

The SGN and the IED both require that, as well as maximising the primary use of heat to generate electricity, waste heat should be recovered as far as practicable, i.e. by identifying and utilising opportunities for Combined Heat and Power (CHP) and district heating. The location of the Installation largely determines the extent to which waste heat can be utilised, and this is a matter for the planning authority. The Applicant carried out a feasibility study, which showed there was potential to provide district heating to local businesses; suitable opportunities are being explored, though there are no firm commitments at this stage. There is provision within the design of the steam turbine to extract low-grade steam for a district heating scheme. Establishing a district heating network to supply local users would involve significant technical, financial and planning challenges such that this is not seen as a practicable proposition at present. Opportunities to maximise the potential for heat recovery should be considered at the early planning stage, when sites are being identified for incineration facilities. In our role as a statutory consultee on the planning application , we ensure that the issue of energy utilisation was bought to the attention of the planning authority.

We consider that, within the constraints of the location of the Installation explained above, the Installation will recover heat as far as practicable, and therefore that the requirements of Article 44 of the IED are met.

(iv) Permit conditions concerning energy efficiency

Pre-operational condition PO2 requires the Operator to carry out a comprehensive review of the available heat recovery options prior to commissioning, in order to ensure that waste heat from the plant is recovered as far as possible.

Conditions 1.2.2 and 1.2.3 have also been included in the Permit, which requires the Operator to review the options available for heat recovery on an ongoing basis.

The Operator is required to report energy usage and energy generated under condition 4.2 and Schedule 5. The following parameters are required to be reported: total electrical energy generated; electrical energy exported; total energy usage and energy exported as heat (if any). Together with the total MSW burned per year, this will enable the Environment Agency to monitor energy recovery efficiency at the Installation and take action if at any stage the energy recovery efficiency is less than proposed.

There are no site-specific considerations that require the imposition of standards beyond indicative BAT, and so the Environment Agency accepts that the Applicant's proposals represent BAT for this Installation.

4.3.8 Efficient use of raw materials

Having considered the information submitted in the Application, we are satisfied that the appropriate measures will be in place to ensure the efficient use of raw materials and water.

The Operator is required to report with respect to raw material usage under condition 4.2. and Schedule 5 of the Permit, including consumption of metallurgical coke, limestone, activated carbon and ammonia as well as process water used per tonne of waste burned. This will enable the Environment Agency to assess whether there have been any changes in the efficiency of the air pollution control plant, and the operation of the SCR to abate NO_x. These are the most significant raw materials that will be used at the Installation, other than the waste feed itself (addressed elsewhere). The efficiency of the use of auxiliary fuel will be tracked separately as part of the energy reporting requirement under condition 4.2.1. Optimising reagent dosage for air abatement systems and minimising the use of auxiliary fuels is further considered in the section on BAT.

4.3.9 Avoidance, recovery or disposal with minimal environmental impact of wastes produced by the activities

This requirement addresses wastes produced at the Installation and does not apply to the waste being treated there. The principal waste streams the Installation will produce are vitrified slag and recovered ferrous and non-ferrous metals.

The first objective is to avoid producing waste at all. Waste production will be avoided by achieving a high degree of destruction of the waste in the gasifier, which results in a material that is both reduced in volume and in chemical reactivity. Condition 3.1.3 and associated Table S3.5 specify limits for total organic carbon (TOC) of <3% in the slag. Compliance with this limit will demonstrate that good gasification control and waste conversion to syngas is being achieved in the gasifier and waste generation is being avoided where practicable.

Most incinerator bottom ash (IBA) – in this case vitrified slag, is likely to be classified as non-hazardous waste. However, IBA is classified on the List of Wastes Regulations as a "mirror entry", which means IBA is a hazardous waste if it possesses a hazardous property relating to the content of dangerous substances. Classification of IBA for its subsequent use or disposal is controlled by other legislation and so is not duplicated within the permit.

Air pollution control (APC) residues from syngas clean-up plant are reclaimed and returned to the Gasifier as part of the waste feedstock. The amount of APC residues is minimised through optimising the performance of the air emissions abatement plant.

In order to ensure that the Vitrified Slag residues are adequately characterised, pre-operational condition PO3 requires the Operator to provide a written plan for approval detailing the ash sampling protocols. Table S3.5 requires the Operator to carry out an ongoing programme of monitoring.

The Application proposes that, where possible, vitrified slag (approximately 238 tonnes/day) will be transported to a suitable recycling facility, from where it could be re-used in the construction industry as an aggregate. The Applicant is currently investigating options for the use of vitrified slag in road construction.

Having considered the information submitted in the Application, we are satisfied that the waste hierarchy referred to in Article 4 of the WFD will be applied to the generation of waste and that any waste generated will be treated in accordance with this Article.

We are satisfied that waste from the Installation that cannot be recovered will be disposed of using a method that minimises any impact on the environment. Standard condition 1.4.1 will ensure that this position is maintained.

5. Minimising the Installation's environmental impact

Regulated activities can present different types of risk to the environment, including: odour, noise and vibration, accidents, fugitive emissions to air and water, releases to air, discharges to ground or groundwater, global warming potential and generation of waste. Consideration may also have to be given to Photochemical Ozone Creation Potential (POCP) and the effect of emissions being deposited onto land (where there are ecological receptors). All these factors are discussed in this and other sections of this document.

For an installation of this kind, the principal emissions are those to air, although we also consider those to land and water.

This section of the document explains how we have approached the critical issue of assessing the likely impact of the emissions to air from the Installation on human health and the environment and what measures we are requiring to ensure a high level of protection.

5.1 Assessment Methodology

5.1.1 Application of Environment Agency H1 Guidance

A methodology for risk assessment of point source emissions to air, which we use to assess the risk of applications we receive for permits, is set out in our Horizontal Guidance Note H1 and has the following steps:

- Describe emissions and receptors
- Calculate process contributions
- Screen out insignificant emissions that do not warrant further investigation
- Decide if detailed air modelling is needed
- Assess emissions against relevant standards
- Summarise the effects of your emissions

The H1 methodology uses a concept of "process contribution (PC)", which is the estimated concentration of emitted substances after dispersion into the receiving environmental media at the point where the magnitude of the concentration is greatest. The guidance provides a simple method of calculating PC primarily for screening purposes and for estimating process contributions where environmental consequences are relatively low. It is based on using dispersion factors. These factors assume worst case dispersion conditions with no allowance made for thermal or momentum plume rise and so the process contributions calculated are likely to be an overestimate of the actual maximum concentrations. More accurate calculation of process contributions can be achieved by mathematical dispersion models, which take into account relevant parameters of the release and surrounding conditions, including local meteorology – these techniques are expensive but normally lead to a lower prediction of PC. The Applicant has the choice to use either method.

Screen Out Insignificant Emissions

Once short-term and long-term PCs have been calculated (either by dispersion factors or modelling), they are compared with Environmental Quality Standards (EQS) referred to as “benchmarks” in the H1 Guidance.

Where an EU EQS exists, the relevant standard is the EU EQS. Where an EU EQS does not exist, our guidance sets out a National EQS (also referred to as Environmental Assessment Level - EAL) which has been derived to provide a similar level of protection to Human Health and the Environment as the EU EQS levels.

PCs are considered **Insignificant** if:

- the **long-term** process contribution is less than **1%** of the relevant EQS; and
- the **short-term** process contribution is less than **10%** of the relevant EQS.

The **long term** 1% process contribution insignificance threshold is based on the judgements that:

- It is unlikely that an emission at this level will make a significant contribution to air quality;
- The threshold provides a substantial safety margin to protect health and the environment.

The **short term** 10% process contribution insignificance threshold is based on the judgements that:

- spatial and temporal conditions mean that short term process contributions are transient and limited in comparison with long term process contributions;
- the proposed threshold provides a substantial safety margin to protect health and the environment.

Decide Whether Detailed Modelling is Needed

Where an emission cannot be screened out as insignificant as a PC through applying the first stage of our H1 Guidance, it does not mean it will necessarily be significant.

In these circumstances, the H1 Guidance justifies the need for detailed modelling of emissions, long-term, short-term or both, taking into account the state of the environment before the Installation operates, where:

- local receptors may be sensitive to emissions;
- released substances fall under an Air Quality Management Plan;
- the long term Predicted Environmental Concentration (PEC) exceeds 70% of the appropriate long term standard, (where the PEC is equal to the sum of the background concentration in the absence of the Installation and the process contribution);

- the short term Process Contribution exceeds 20% of the headroom, (where the headroom is the appropriate short term standard minus twice the long term background concentration).

5.1.2 Applying the Guidance to the Application

We review the Applicant's detailed impact assessment to confirm whether or not we agree with the Applicant's conclusions with respect to H1 screening against the above criteria.

For those pollutants where the $PEC_{\text{long term}}$ exceeds 70% of an EQS or the $PC_{\text{short term}}$ exceeds 20% of the headroom between an EQS and the background concentration, we determine whether exceedences of EQS are likely. This is done through detailed audit and review of the Applicant's impact assessment taking headroom and modelling uncertainties into account. Where an exceedence of an EQS is identified, we may require the Applicant to go beyond what would normally be considered BAT for the Installation or refuse the application. Whether or not exceedences are considered likely, the application is subject to the requirement to operate in accordance with BAT.

National EQSs do not have the same legal status as EU EQSs, and there is no explicit requirement to impose stricter conditions than BAT in order to comply with a national EQS. However, national EQSs are a standard for harm and any significant contribution to a breach is likely to be unacceptable.

This is not the end of the risk assessment, because we also take into account local factors (for example, particularly sensitive receptors nearby such as a SSSIs, SACs or SPAs). These additional factors may also lead us to include more stringent conditions than BAT.

If, as a result of reviewing of the risk assessment and taking account of any additional techniques that could be applied to limit emissions, we consider that emissions **would** cause significant pollution, we would refuse the Application.

5.1.3 Estimating total impact of emissions

In this Application, the Applicant has carried out detailed air dispersion modelling. We are satisfied that the model proposed reflects the likely impact of the emissions from the activity. We have applied the H1 criteria above to the model outputs, and this is described in the following sections.

5.2 Air Quality Assessment

5.2.1 Assessment of Air Dispersion Modelling Outputs

The Applicant assessed the Installation's potential emissions to air against the relevant air quality standards, and potential impact upon local habitat sites and human health. These assessments predicted the potential effects on local air quality from the Installation's stack emissions using AERMOD dispersion models, which are commonly used computer models for regulatory dispersion modelling. The models used 5 years of meteorological data for the period 2005 to 2009 collected from Teesside Airport. The impact of the terrain surrounding the site upon plume dispersion was considered in the dispersion modelling. The concentrations reported in the assessments were the maximum ground level concentrations predicted by the dispersion modelling packages over the 5 years of meteorological data.

The air impact assessments, and the dispersion modelling upon which they were based, employed the following assumptions.

- First, they assumed that the ELVs in the Permit would be those in the IED.
- Second, and conservatively, they assumed that the Installation operates continuously at the short-term and long-term IED emission limit values, i.e. the maximum permitted emissions under the IED.

The way in which the Applicant used dispersion models, its selection of input data, and the assumptions it made have been reviewed by the Environment Agency's modelling specialists to establish the robustness of the Applicant's air impact assessment. Our review of the Applicant's assessment leads us to agree with the Applicant's conclusions. We have also audited the air quality and human health impact assessment and similarly agree that the conclusions drawn in the reports were acceptable.

The Applicant's modelling predictions are summarised in the tables below:

Predicted Maximum Process Contributions at Long-Term Emission Limits

Pollutant	EAL	Back-ground Conc.	Process Contribution (PC)	PC as % of EAL	Predicted Environmental Concentration (PEC)	PEC as % EAL
NO_2	40	26	1.40	3.5	27.4	68
SO_2	50	3	0.27	0.5	-	-
PM_{10}	40	17	0.16	0.4	-	-
$PM_{2.5}$	25	10	0.16	0.6	-	-
HF	16	n/a	0.01	0.0	-	-
Cd	0.005	$1.1x10^{-4}$	$4.8x10^{-4}$	9.6	$5.9x10^{-4}$	12
Tl	n/a	n/a	$4.8x10^{-4}$	n/a	n/a	n/a
Hg	0.25	-	$4.8x10^{-4}$	0.2	-	-
Sb	5	-	$1.1x10^{-3}$	<0.1	-	-
As	0.003	$5.3x10^{-4}$	$1.1x10^{-3}$	35.0	$1.6x10^{-3}$	53
Pb	0.25	-	$1.1x10^{-3}$	0.2	-	-
Cr, Cr(II) & Cr(III)	5	-	$1.1x10^{-3}$	<0.1	-	-
Cr(VI)	0.0002	-	$6.7x10^{-7}$	0.3	-	-
Co	n/a	n/a	$1.1x10^{-3}$	n/a	n/a	n/a
Cu	10	-	$1.1x10^{-3}$	<0.1	-	-
Mn	0.150	-	$1.1x10^{-3}$	<0.1	-	-
Ni	0.02	$1.7x10^{-3}$	$1.1x10^{-3}$	5.3	$2.8x10^{-3}$	14
V	5	-	$1.1x10^{-3}$	<0.1	-	-
VOC	5	1.9	0.2	3.9	2.1	42

Note 1 All the above concentration figures are in $\mu g/m^3$

Predicted Maximum Process Contributions at Short-Term Emission Limits

Pollutant	EAL	Back-ground Conc.	Process Contribution (PC)	PC as % of EAL	Predicted Environmental Concentration (PEC)	PEC as % EAL
NO_2	200	52	39.9	19.9	91.9	46
$SO_{2\ 15min}$	266	6	37.3	14.0	43.3	16
$SO_{2\ 1\ hour}$	350	6	27.9	7.9	33.8	10
$SO_{2\ 24\ hr}$	125	6	18.7	14.9	24.7	20
CO	30,000	500	28.5	0.1	-	-
PM_{10}	50	34	3.72	7.4	-	-
HCl	750	0.44	5.54	0.7	-	-
HF	160	n/a	0.56	0.3	-	-
Cd	n/a	n/a	$1.4x10^{-2}$	n/a	n/a	n/a
Tl	30	-	$1.4x10^{-2}$	<0.1	-	-
Hg	7.5	-	$2.7x10^{-2}$	0.36	-	-
Sb	150	n/a	$3.2x10^{-2}$	<0.1	n/a	n/a
As	15	-	$3.2x10^{-2}$	0.21	-	-
Pb	n/a	n/a	$3.2x10^{-2}$	n/a	n/a	n/a
Cr, Cr(II) & Cr(III)	150	-	$3.2x10^{-2}$	<0.1	-	-
Cr(VI)	n/a	n/a	$1.9x10^{-5}$	n/a	n/a	n/a
Co	n/a	n/a	$3.2x10^{-2}$	n/a	n/a	n/a
Cu	200	-	$3.2x10^{-2}$	<0.1	-	-
Mn	1500	-	$3.2x10^{-2}$	<0.1	-	-
Ni	n/a	$3.4x10^{-3}$	$3.2x10^{-2}$	n/a	$3.5x10^{-2}$	n/a
V	1	$2.4x10^{-3}$	$3.2x10^{-2}$	3.2	$3.4x10^{-2}$	3.4

Note 1 All the above concentration figures are in $\mu g/m^3$
Note 2 For the assessment of short term impacts the PEC is determined by adding twice the long term background concentration to the short tem process contribution.

From the tables above the following emissions can be screened out as insignificant in that the process contribution is < 1% of the long term EAL and <10% of the short term EAL: PM_{10}, $PM_{2.5}$, HF, Tl, Hg, Sb, Cr, Cr(II), Cr(III), Cr(VI), Co, Cu, Mn and V.

Therefore, generally, we consider the Applicant's proposals for preventing and minimising the emissions of these substances to be BAT for the Installation subject to the detailed audit referred to below.

Also from the table above the following emissions (which were not screened out as insignificant) cannot be considered to have the potential to give rise to significant pollution in that the predicted environmental concentration is less than 70% of the long term EAL and that the Process Contribution is less than 20% of the short term EAL headroom: NOx, SO_2, As, VOC, Cd and Ni.

For these emissions, we have carefully scrutinised the Applicant's proposals to ensure that they are applying the Best Available Techniques to prevent and minimise emissions of these substances. This is reported in section 6 of this document.

We have carefully scrutinised the Applicant's proposals to ensure that they are applying the Best Available Techniques to prevent and minimise emissions of these substances. This is reported in section 6 of this document.

5.2.2 Assessment of emissions of PM_{10} and $PM_{2.5}$

The impact on air quality from particulate emissions has been assessed against EQS for PM_{10} (particles of 10 microns and smaller) and $PM_{2.5}$ (particles of 2.5 microns and smaller). For PM_{10}, the EU EQS are a long term annual average of 40 $\mu g/m^3$ and a short term daily average of 50 $\mu g/m^3$. For $PM_{2.5}$ the EU EQS of 25 $\mu g/m^3$ as a long-term annual average to be achieved by 2010 as a Target Value and by 2015 as a Limit Value.

The Applicant's predicted impact of the Installation against these EQS is shown in the table below – all concentrations are shown as $\mu g/m^3$. The assessment assumes that **all** particulate emissions are present as PM_{10} for the PM_{10} assessment and as $PM_{2.5}$ for the $PM_{2.5}$ assessment.

Pollutant	EQS / EAL	Back-ground Conc	Process Contribution (PC)	PC as % of EQS / EAL	Predicted Environmental Concentration (PEC)	PEC as % EQS / EAL
PM_{10}	40 (Annual)	17	0.16	0.4	17.16	42.9
	50 (24 hour)	34	3.72	7.4	37.72	75.4
$PM_{2.5}$	25 (Annual)	10	0.16	0.6	10.6	42.4

The above assessment is considered to represent a worst case assessment in that: -

- It assumes that the plant emits particulates continuously at the IED limit for total dust.
- It assumes all particulates emitted are below either 10 microns (PM_{10}) or 2.5 microns ($PM_{2.5}$), when some are expected to be larger.

We have reviewed the Applicant's particulate matter impact assessment and are satisfied in the robustness of the Applicant's conclusions.

The above assessment shows that the predicted process contribution for emissions of PM_{10} is below 1% of the long term EQS and below 10% of the short term EQS and so can be considered insignificant.

The above assessment shows that the predicted process contribution for emissions of $PM_{2.5}$ is also below 1% of the EQS. Therefore the Environment Agency concludes that particulate emissions from the installation, including emissions of PM_{10} or $PM_{2.5}$, will not give rise to significant pollution.

There is currently no emission limit prescribed nor any continuous emissions monitor for particulate matter specifically in the PM_{10} or $PM_{2.5}$ fraction. Whilst the Environment Agency is confident that current monitoring techniques will capture the fine particle fraction ($PM_{2.5}$) for inclusion in the measurement of total particulate matter, an improvement condition has been included that will require a full analysis of particle size distribution in the flue gas, and hence determine the ratio of fine to coarse particles. In the light of current knowledge and available data however the Environment Agency is satisfied that the health of the public would not be put at risk by such emissions.

5.2.3 Assessment of Emission of Metals

The Applicant has assessed the impact of metal emissions to air. As for other substances, the Applicant has made the conservative assumption that emissions occur continuously at the IED limits and then used air dispersion modelling comparing the impacts against the relevant EQS / EAL in the H1 guidance.

IED sets three limits for metal emissions:

- An emission limit value of 0.05 mg/m^3 for mercury and its compounds.
- An aggregate emission limit value of 0.05 mg/m^3 for cadmium and thallium and their compounds.
- An aggregate emission limit of 0.5 mg/m^3 for antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel and vanadium and their compounds.

In addition the UK is a Party to the Heavy Metals Protocol within the framework of the UN-ECE Convention on long-range trans-boundary air pollution. Compliance with the WID emission limits for metals along with the Application of BAT also ensures that these requirements are met.

Where IED sets an aggregate limit, the Applicant's assessment assumes that for cadmium and thallium each metal is emitted individually at the aggregate limit value and for the other metals that each metal is emitted as the proportion of metals in its group (i.e. one ninth of the limit for each of the group 3 metals).

The Applicant's assessment finds that emissions of Tl, Hg, Sb, Cr, Co, Cu, Mn and V would have a PC of less than 1% of the relevant EAL and so can be considered insignificant. For those metals not insignificant by this test, the Applicant's assessment finds that the PEC of Cd, As and Ni would be below 70% of the relevant EAL.

From this assessment the Applicant has concluded that exceedences of the EAL for all metals are not likely to occur. The installation has been assessed as meeting BAT for control of metal emissions to air. See section 6 of this document. The Environment Agency's experience of regulating incineration plant is that emissions of metals are in any event below the limits set in IED, and that the above assessment is an over prediction of the likely impact. We therefore agree with the Applicant's conclusions.

The 2009 report of the Expert Panel on Air Quality Standards (EPAQS) – "Guidelines for Metal and Metalloids in Ambient Air for the Protection of Human Health", sets new ambient air quality guidelines for Arsenic, Nickel and Chromium (VI). These guidelines have been incorporated as EALs in the revised H1 Guidance issued by the Agency in 2010.

Measurement of Chromium (VI) at the levels anticipated at the stack emission points is expected to be difficult, with the likely levels being below the level of detection by the most advanced methods. We have considered the concentration of total chromium and chromium (VI) in the APC residues collected upstream of the emission point for existing Municipal Waste incinerators and have assumed these to be similar to the particulate matter released from the emission point. This data shows:

- The mean proportion of Cr (VI) to total Cr is less than 1%. There are two outliers at 2%.
- The mean total Cr emission from these plants is 0.006 mg/m^3 (max 0.03 mg/m^3).
- The mean Cr (VI) emission concentration (based on the bag dust ratio) is $3.5 * 10^{-5}$ mg/m^3 (max $1.3 * 10^{-4}$).

The highest modelled PC for Cr (VI) at a human health receptor was $1.8x10^{-6}$ $\mu g/m^3$. This value was calculated assuming 2.1% of modelled Cr to be as Cr VI, in line with AQMAU advice. This concentration is equivalent to 0.9% of the EAL. On this basis the result can be considered insignificant and no further calculation of PEC is required.

This assessment shows that emissions of Chromium (VI) are likely to be insignificant.

5.3 Human health risk assessment

5.3.1 Our role in preventing harm to human health

The Environment Agency has a statutory role to protect the environment and human health from all processes and activities it regulates. We assessed the effects on human health for this application in the following ways:

i) Applying Statutory Controls

The plant will be regulated under EPR. These regulations include the requirements of relevant EU Directives, notably, the Industrial Emissions Directive (IED), the waste framework directive (WFD) and air quality directive (AQD).

The main conditions in an EfW permit are based on the requirements of the IED. The aim of IED is to prevent or to limit as far as practicable negative effects on the environment, in particular pollution by emissions into air, soil, surface water and groundwater, and the resulting risks to human health, from the incineration and co-incineration of waste. The IED achieves this aim by "setting stringent operational conditions, technical requirements and emission limit values". The requirements of the IED include the use of BAT, which may in some circumstances dictate tighter emission limits and controls than those specified in the IED. The assessment of BAT for this installation is detailed in section 6 of this document.

ii) Environmental Impact Assessment

Industrial activities can give rise to odour, noise and vibration, accidents, fugitive emissions to air and water, releases to air (including the impact on Photochemical Ozone Creation Potential (POCP)), discharges to ground or groundwater, global warming potential and generation of waste. For an installation of this kind, the principal environmental effects are through emissions to air, although we also consider all of the other impacts listed. Section 5.1 and 5.2 above explain how we have approached the critical issue of assessing the likely impact of the emissions to air from the Installation on human health and the environment and any measures we are requiring to ensure a high level of protection.

iii) Expert Scientific Opinion

We take account of the views of national and international expert bodies. Following is a summary of some of the publications which we have considered (in no particular order).

An independent review of evidence on the health effects of municipal waste incinerators was published by **DEFRA** in 2004. It concluded that there was no convincing link between the emissions from MSW incinerators and adverse effects on public health in terms of cancer, respiratory disease or birth defects. On air quality effects, the report concluded "Waste incinerators contribute to local air pollution. This contribution, however, is usually a small proportion of existing background levels which is not detectable through environmental monitoring (for example, by comparing upwind and downwind levels of airborne pollutants or substances deposited to land). In some cases, waste incinerator facilities may make a more detectable contribution to air pollution. Because current MSW incinerators are located predominantly in urban areas, effects on air quality are likely to be so small as to be undetectable in practice."

A Position Statement issued by the **HPA** in 2009 states that "The Health Protection Agency has reviewed research undertaken to examine the suggested links between emissions from municipal waste incinerators and effects on health. While it is not possible to rule out adverse health effects from modern, well regulated municipal waste incinerators with complete certainty, any potential damage to the health of those living close-by is likely to be very small, if detectable".

Policy Advice from Government also points out that the minimal risk from modern incinerators. Paragraph 22 (Chapter 5) of WS2007 says that "research carried out to date has revealed no credible evidence of adverse health outcomes for those living near incinerators." It points out that "the relevant health effects, mainly cancers, have long incubation times. But the research that is available shows an absence of symptoms relating to exposures twenty or more years ago when emissions from incinerators were much greater than is now the case." **Paragraph 30 of PPS10** explains that "modern, appropriately located, well run and well regulated waste management facilities should pose little risk to public health."

The **Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (CoC) issued** a statement in 2000 which said that "any potential risk of cancer due to residency (for periods in excess of 10 years) near to municipal solid waste incinerators was exceedingly low and probably not measurable by the most modern epidemiological techniques." In 2009, CoC considered six further relevant epidemiological papers that had been published since the 2000 statement, and concluded that "there is no need to change the advice given in the previous statement in 2000 but that the situation should be kept under review".

Republic of Ireland Health Research Board report stated that "It is hard to separate the influences of other sources of pollutants, and other causes of cancer and, as a result, the evidence for a link between cancer and proximity to an incinerator is not conclusive".

The **Food Safety Authority of Ireland (FSAI) (2003)** investigated possible implications on health associated with food contamination from waste incineration and concluded: "In relation to the possible impact of introduction of waste incineration in Ireland, as part of a national waste management strategy, on this currently largely satisfactory situation, the FSAI considers that such incineration facilities, if properly managed, will not contribute to dioxin levels in the food supply to any significant extent. The risks to health and sustainable development presented by the continued dependency on landfill as a method of waste disposal far outweigh any possible effects on food safety and quality."

Health Protection Scotland (2009) considered scientific studies on health effects associated with the incineration of waste particularly those published after the Defra review discussed earlier. The main conclusions of this report were: "(a) For waste incineration as a whole topic, the body of evidence for an association with (non-occupational) adverse health effects is both inconsistent and inconclusive. However, more recent work suggests, more strongly, that there may have been an association between emissions (particularly dioxins) in the past from industrial, clinical and municipal waste incinerators and some forms of cancer, before more stringent regulatory requirements were implemented. (b) For individual waste streams, the evidence for an association with (non-occupational) adverse health effects is inconclusive. (c) The magnitude of any past health effects on residential populations living near incinerators that did occur is likely to have been small. (d) Levels of airborne emissions from individual incinerators should be lower now than in the past, due to stricter legislative controls and improved technology. Hence, any risk to the health of a local population living near an incinerator, associated with its emissions, should also now be lower."

The **US National Research Council Committee on Health Effects of Waste Incineration (NRC) (NRC 2000)** reviewed evidence as part of a wide ranging report. The Committee view of the published evidence was summarised in a key conclusion: "Few epidemiological studies have attempted to assess whether adverse health effects have actually occurred near individual incinerators, and most of them have been unable to detect any effects. The studies of which the committee is aware that did report finding health effects had shortcomings and failed to provide convincing evidence. That result is not surprising given the small populations typically available for study and the fact that such effects, if any, might occur only infrequently or take many years to appear. Also, factors such as emissions from other pollution sources and variations in human activity patterns often decrease the likelihood of determining a relationship between small contributions of pollutants from incinerators and observed health effects. Lack of evidence of such relationships might mean that adverse health effects did not occur, but it could mean that such relationships might not be detectable using available methods and sources."

The **British Society for Ecological Medicine (BSEM) published a report in 2005** on the health effects associated with incineration and concluded that "Large studies have shown higher rates of adult and childhood cancer and also birth defects around municipal waste incinerators: the results are consistent with the associations being causal. A number of smaller epidemiological studies support this interpretation and suggest that the range of illnesses produced by incinerators may be much wider. Incinerator emissions are a major source of fine particulates, of toxic metals and of more than 200 organic chemicals, including known carcinogens, mutagens, and hormone disrupters. Emissions also contain other unidentified compounds whose potential for harm is as yet unknown, as was once the case with dioxins. Abatement equipment in modern incinerators merely transfers the toxic load, notably that of dioxins and heavy metals, from airborne emissions to the fly ash. This fly ash is light, readily windborne and mostly of low particle size. It represents a considerable and poorly understood health hazard."

The BSEM report was reviewed by the HPA and they concluded that "Having considered the BSEM report the HPA maintains its position that contemporary and effectively managed and regulated waste incineration processes contribute little to the concentrations of monitored pollutants in ambient air and that the emissions from such plants have little effect on health." The BSEM report was also commented on by the consultants who produced the Defra 2004 report referred to above. They said that "It fails to consider the significance of incineration as a source of the substances of concern. It does not consider the possible significance of the dose of pollutants that could result from incinerators. It does not fairly consider the adverse effects that could be associated with alternatives to incineration. It relies on inaccurate and outdated material. In view of these shortcomings, the report's conclusions with regard to the health effects of incineration are not reliable."

A **Greenpeace** review on incineration and human health concluded that a broad range of health effects have been associated with living near to incinerators as well as with working at these installations. Such effects include cancer (among both children and adults), adverse impacts on the respiratory system, heart disease, immune system effects, increased allergies and congenital abnormalities. Some studies, particularly those on cancer, relate to old rather than modern incinerators. However, modern incinerators operating in the last few years have also been associated with adverse health effects."

The Health Protection Scotland report referred to above says that "the authors of the Greenpeace review do not explain the basis for their conclusion that there is an association between incineration and adverse effects in terms of criteria used to assess the strength of evidence. The weighting factors used to derive the assessment are not detailed. The objectivity of the conclusion cannot therefore be easily tested."

From this published body of scientific opinion, we take the view stated by the HPA that "While it is not possible to rule out adverse health effects from modern, well regulated municipal waste incinerators with complete certainty, any potential damage to the health of those living close-by is likely to be very small, if detectable". We therefore ensure that permits contain conditions which require the installation to be well-run and regulate the installation to ensure compliance with such permit conditions.

iv) Health Risk Models

Comparing the results of air dispersion modelling as part of the H1 Environmental Impact assessment against European and national air quality standards effectively makes a health risk assessment for those pollutants for which a standard has been derived. These air quality standards have been developed primarily in order to protect human health via known intake mechanisms, such as inhalation and ingestion. Some pollutants, such as dioxins and furans, have human health impacts at lower ingestion levels than lend themselves to setting an air quality standard to control against. For these pollutants, a different human health risk model is required which better reflects the level of dioxin intake.

Dioxin Intake Models: Two models are available to predict the dioxin intake for comparison with the Tolerable Daily Intake (TDI) recommended by the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment, known as COT. These are HHRAP and the HMIP model.

HHRAP has been developed by the US EPA to calculate the human body intake of a range of carcinogenic pollutants and to determine the mathematic quantitative risk in probabilistic terms. In the UK, in common with other European Countries, we consider a threshold dose below which the likelihood of an adverse effect is regarded as being very low or effectively zero. The HMIP model uses a similar approach to the HHRAP model, but does not attempt to predict probabilistic risk. Either model can however be used to make comparisons with the TDI.

The TDI is the amount of a substance that can be ingested daily over a lifetime without appreciable health risk. It is expressed in relation to bodyweight in order to allow for different body size, such as for children of different ages. In the UK, the COT has set a TDI for dioxins and furans of 2 picograms I-TEQ/Kg-body weight/day (N.B. a picogram is (10^{-12}) of a gram).

In addition to an assessment of risk from dioxins and furans, the HHRAP model enables a risk assessment from human intake of a range of heavy metals. The HMIP report does not consider metals. In principle, the respective EQS for these metals are protective of human health. It is not therefore necessary to model the human body intake.

COMEAP developed a methodology based on the results of time series epidemiological studies which allows calculation of the public health impact of exposure to the classical air pollutants (NO_2, SO_2 and particulates) in terms of the numbers of “deaths brought forward” and the “number of hospital admissions for respiratory disease brought forward or additional”. COMEAP has issued a statement expressing some reservations about the applicability of applying its methodology to small affected areas. Those concerns generally relate to the fact that the exposure-response coefficients used in the COMEAP report derive from studies of whole urban populations where the air pollution climate may differ from that around a new industrial installation. COMEAP identified a number of factors and assumptions that would contribute to the uncertainty of the estimates. These were summarised in the Defra review as below:

- Assumption that the spatial distribution of the air pollutants considered is the same in the area under study as in those areas, usually cities or large towns, in which the studies which generated the coefficients were undertaken.
- Assumption that the temporal pattern of pollutant concentrations in the area under study is similar to that in the areas in which the studies which generated the coefficients were undertaken (i.e. urban areas).
- It should be recognised that a difference in the pattern of socio-economic conditions between the areas to be studied and the reference areas could lead to inaccuracy in the predicted level of effects.
- In the same way, a difference in the pattern of personal exposures between the areas to be studied and the reference areas will affect the accuracy of the predictions of effects.

The use of the COMEAP methodology is not generally recommended for modelling the human health impacts of individual installations. However it may have limited applicability where emissions of NO_x, SO_2 and particulates cannot be screened out as insignificant in an H1 Environmental Impact assessment, there are high ambient background levels of these pollutants and we are advised that its use was appropriate by our public health consultees.

Our recommended approach is therefore the use of the H1 assessment methodology comparison for most pollutants (including metals) and dioxin intake models using either the HHRA or HMIP models as described above for dioxins and furans. Where an alternative approach is adopted for dioxins, we check the predictions ourselves using the HMIP methodology.

v) Consultations

As part of our normal procedures for the determination of a permit application, we would consult PCT, FSA and in some cases HPA. We also consult the local communities who may raise health related issues. All issues raised by these consultations are considered in determining the application as described in Annex 4 of this document.

5.3.2 Assessment of Intake of Dioxins and Furans

For dioxins and furans, the principal exposure route is through ingestion, usually through the food chain, and the main risk to health is through accumulation in the body over a period of time.

The human health risk assessment calculates the dose of dioxins and furans that would be received by local receptors if all their food and water were sourced from the locality where the deposition of dioxins and furans is predicted to be the highest. This is then assessed against the Tolerable Daily Intake (TDI) levels established by the COT of 2 picograms I-TEQ / Kg bodyweight/ day.

The results of the Applicant's assessment of dioxin intake are detailed in the table below. The results showed that the predicted daily intake of dioxins at all receptors, resulting from emissions from the proposed facility, were significantly below the recommended TDI levels.

Receptor	adult	child
High Clarence Community Farm - Farmer	0.00462	0.00667
Westlothian Street Allotments - Resident	0.00008	0.00025
Grazing land, Marsh House Lane - Farmer	0.00925	0.01330
41 Salisbury Terrace - Resident	0.00016	0.00046
Grazing land, Zinc Works Road - Farmer	0.02030	0.02930

Calculated maximum daily intake of dioxins by local receptors resulting from the operation of the proposed facility (I-TEQ/ kg-BW/day)

The FSA has reported that dietary studies have shown that estimated total dietary intakes of dioxins and dioxin-like PCBs from all sources by all age groups fell by around 50% between 1997 and 2001, and are expected to continue to fall. In 2001, the average daily intake by adults in the UK from diet was 0.9 pg WHO-TEQ/kg bodyweight. The additional daily intake predicted by the modelling as shown in the table above is substantially below this figure.

In 2010, FSA studied the levels of chlorinated, brominated and mixed (chlorinated-brominated) dioxins and dioxin-like PCBs in fish, shellfish, meat and eggs consumed in UK. It asked COT to consider the results and to advise on whether the measured levels of these PXDDs, PXDFs and PXBs indicated a health concern ('X' means a halogen). COT issued a statement in December 2010 and concluded that " The major contribution to the total dioxin toxic activity in the foods measured came from chlorinated compounds. Brominated compounds made a much smaller contribution, and mixed halogenated compounds contributed even less (1% or less of TDI). Measured levels of PXDDs, PXDFs and dioxin-like PXBs do not indicate a health concern". COT recognised the lack of quantified TEFs for these compounds but said that "even if the TEFs for PXDDs, PXDFs and dioxin-like PXBs were up to four fold higher than assumed, their contribution to the total TEQ in the diet would still be small. Thus, further research on PXDDs, PXDFs and dioxin-like PXBs is not considered a priority."

In the light of this statement, we assess the impact of chlorinated compounds as representing the impact of all chlorinated, brominated and mixed dioxins / furans and dioxin like PCBs.

5.3.3 <u>Particulates smaller than 2.5 microns</u>

The Operator will be required to monitor particulate emissions using the method set out in Table S3.1 of Schedule 3 of the Permit. This method requires that the filter efficiency must be at least 99.5 % on a test aerosol with a mean particle diameter of 0.3 μm, at the maximum flow rate anticipated. The filter efficiency for larger particles will be at least as high as this. This means that particulate monitoring data effectively captures everything above 0.3 μm and much of what is smaller. It is not expected that particles smaller than 0.3 μm will contribute significantly to the mass release rate / concentration of particulates because of their very small mass, even if present. This means that emissions monitoring data can be relied upon to measure the true mass emission rate of particulates.

Nano-particles are considered to refer to those particulates less than 0.1 μm in diameter ($PM_{0.1}$). Questions are often raised about the effect of nano-particles on human health, in particular on children's health, because of their high surface to volume ratio, making them more reactive, and their very small size, giving them the potential to penetrate cell walls of living organisms. The small size also means there will be a larger number of small particles for a given mass concentration. However the HPA statement (referenced below) says that due to the small effects of incinerators on local concentration of particles, it is highly unlikely that there will be detectable effects of any particular incinerator on local infant mortality.

The HPA addresses the issue of the health effects of particulates in their September 2009 statement 'The Impact on Health of Emissions to Air from Municipal Incinerators'. It refers to the coefficients linking PM_{10} and $PM_{2.5}$ with effects on health derived by COMEAP and goes on to say that if these coefficients are applied to small increases in concentrations produced, locally, by incinerators, the estimated effects on health are likely to be small. The HPA notes that the coefficients that allow the use of number concentrations in impact calculations have not yet been defined because the national experts have not judged that the evidence is sufficient to do so. This is an area being kept under review by COMEAP.

In December 2010, COMEAP published a report on The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom. It says that “a policy which aims to reduce the annual average concentration of $PM_{2.5}$ by 1 $\mu g/m^3$ would result in an increase in life expectancy of 20 days for people born in 2008.” However, “The Committee stresses the need for careful interpretation of these metrics to avoid incorrect inferences being drawn – they are valid representations of population aggregate or average effects, but they can be misleading when interpreted as reflecting the experience of individuals.”

The HPA also point out that in 2007 incinerators contributed 0.02% to ambient ground level PM_{10} levels compared with 18% for road traffic and 22% for industry in general. The HPA note that in a sample collected in a day at a typical urban area the proportion of $PM_{0.1}$ is around 5-10% of PM_{10}. It goes on to say that PM_{10} includes and exceeds $PM_{2.5}$ which in turn includes and exceeds $PM_{0.1}$.

This is consistent with the assessment of this application which shows emissions of PM_{10} to air to be insignificant.

We take the view, based on the foregoing evidence, that techniques which control the release of particulates to levels which will not cause harm to human health will also control the release of fine particulate matter to a level which will not cause harm to human health.

5.3.4 Assessment of Health Effects from the Installation

We have assessed the health effects from the operation of this installation in relation to the above (sections 5.3.1 to 5.3.3). We have applied the relevant requirements of the national and European legislation in imposing the permit conditions. We are satisfied that compliance with these conditions will ensure protection of the environment and human health.

Taking into account all of the expert opinion available, we agree with the conclusion reached by the HPA that “While it is not possible to rule out adverse health effects from modern, well regulated municipal waste incinerators with complete certainty, any potential damage to the health of those living close-by is likely to be very small, if detectable.”

In carrying out air dispersion modelling as part of the H1 Environmental Impact assessment and comparing the predicted environmental concentrations with European and national air quality standards, the Applicant has effectively made a health risk assessment for many pollutants. These air quality standards have been developed primarily in order to protect human health.

The Applicant's assessment of the impact from NO_2, SO_2, CO, PM_{10}, $PM_{2.5}$, HCl AND HF have all indicated that the Installation emissions screen out as insignificant.

In their Application the Applicant states that the Human Health Risk Assessment (HHRA) was undertaken for Tees Valley I and was re-calculated for Tees Valley II where dioxins exposure at receptors is "proportionate to the modelled ground level concentration" due to the facilities being immediately adjacent to each other. The Applicant concluded that assuming 100% of the IED limit for dioxins, predictions at a residential receptor for TV1 and TV2 combined is less than 0.1% of the TDI. We carried out check modelling and made dioxin, furan and PCB intake predictions using empirical calculations based on the Human Health Risk Assessment Protocol (HHRAP). We extracted PCB data from our public register and used the worst case emission concentration of 9.15×10^{-3} ng(TEQ)/Mm^3 to make conservative predictions; our checks indicate that the human intake is likely to be less than 1% of the TDI for TV2 (and also including TV1).

The Environment Agency has reviewed the methodology employed by the Applicant to carry out the health impact assessment. Our modelling confirms that the applicant's worst case emissions scenario. We do not necessarily agree with the absolute numerical predictions given in the reports but agree that exceedences are not likely at human receptors of EQS for the protection of human health. The Applicant's predictions can therefore be used as a basis for permit determination. Our predictions agree with this.

Overall, taking into account the conservative nature of the impact assessment (i.e. that it is based upon an individual exposed for a life-time to the effects of the highest predicted airborne concentrations and consuming mostly locally grown food), it was concluded that the operation of the proposed facility will not pose a significant carcinogenic or non-carcinogenic risk to human health.
The Primary Care Trust were consulted on the Application and concluded that they had no significant concerns regarding the risk to the health of humans from the installation. The Food Standards Agency was also consulted during the permit determination process and it concluded that it is unlikely that there will be any unacceptable effects on the human food chain as a result of the operations at the Installation.

The Environment Agency is therefore satisfied that the Applicant's conclusions presented above are soundly based and we conclude that the potential emissions of pollutants including dioxins, furans and metals from the proposed facility are unlikely to have an impact upon human health.

5.4 Impact on Habitats sites, SSSIs, non-statutory conservation sites etc.

5.4.1 Sites Considered

The following Habitats (i.e. Special Areas of Conservation, Special Protection Areas and Ramsar) sites are located within 10Km of the Installation:

- Teesmouth and Cleveland Coast (Ramsar) (SPA)

The following Sites of Special Scientific Interest are located within 2Km of the Installation:

- Tees and Hartlepool Foreshore and Wetlands, Seal Sands (SSSI)

There are no non-statutory local wildlife and conservation sites within 2Km of the proposed Installation.

5.4.2 Habitats Assessment

The Applicant's Habitats assessment was reviewed by the Environment Agency's technical specialists for modelling, air quality, conservation and ecology technical services, who agreed with the assessment's conclusions.

The Applicant has assessed the impact at Sites of Special Scientific Interest (SSSI) within 2km of the plant and Teesside and Cleveland Coast Special Protection Areas (SPA). There are no other European Designated ecological receptors within our distance criterion of 10km. They made predictions of annual nitrogen oxides (NOx) and sulphur dioxide (SO_2) concentrations at the ecological sites and compared them to their respective critical levels.

The Applicant predicts process contributions (PCs) that are not insignificant compared to the annual SO_2 and NOx critical level. Taking background into account, they do not predict exceedences of the SO_2 level. The background NOx concentrations quoted by the applicant (taken from the APIS website) is already in excess of the critical level. We assessed the impacts of these emissions and concluded that there was no likely significant effect and in accordance with our guidance.

Natural England were sent an Appendix 11 for information only.

Protected Species

Water Voles have been recorded about 940m to the west of the application site so we advise that any active ditches and areas of open water on the proposed site are fully surveyed for this species prior to any site preparation and construction. Water Voles can move in to new habitats at any time so this precautionary approach, if suitable habitats exist on the application site, is warranted. Opportunities should be taken within the overall landscaping plan to create new habitats for Water Voles, by association this would also result in new wetland habitats, a target for The EA and its partners as part of England Biodiversity 2020.

Otters are known to frequent and use this area so any development must take account of this via the Construction Environmental Method Statement, for example, by making sure no holes/pits are left open without access out of them for otters after work finishes each evening and that if otters are encountered during construction that any operatives on site know how to react.

Bats – Noctule bats have been recorded using this area so any existing buildings on site must be checked for this species, by a licensed bat worker, before any demolition begins and further advice sort from Natural England.
Signal Crayfish Buffer Zone – the development site falls into the Signal Crayfish Buffer Zone and therefore strict bio-security measures should be followed by all operators and their machinery to assist in reducing the spread of the North American Signal Crayfish, which can devastate our native White-clawed Crayfish by spreading crayfish plague and out competing for habitats. Any machinery and PPE needs to be Checked Cleaned and Dried before arriving on site and then before leaving to work in water on other sites
Priority Habitats – Coastal and Floodplain Grazing Marsh is present about 500m away from the development site and any opportunities to create new habitat or enhance existing habitat should be taken as this will also contribute to the England Biodiversity 2020 targets.

The Applicant also made predictions of nutrient nitrogen and acid deposition at the sites.

At ecological receptors, we agree that the predicted PCs for annual NOx and SO_2 are not likely to be insignificant. Taking background into account, SO_2 is not likely to exceed the critical level. The NOx background however is quoted by APIS as already exceeding the critical load. The Applicant's prediction of 2.1% of the NOx critical level is based on emitting at the NOx IED ELV for 100% of the time under the applicant's worst case conditions of operation. Our own modelling of the 24-hr NOx critical level indicates that like the annual predictions, the PC is not likely to be "insignificant". There is however limited data on 24-hour NOx background concentrations. Doubling the annual average concentrations could result in potential exceedences.

Pollutant	EQS / EAL	Back-ground Conc	Process Contribution (PC)	PC as % of EQS / EAL	Predicted Environmental Concentration (PEC)	PEC as % EQS / EAL
NOx	30	34.6	0.63	2.1	35.2	117
SO_2	20	4	0.10	0.5	4.1	21

Note 1 All the above concentration figures are in $\mu g/m^3$

The Applicant also made predictions of nutrient nitrogen and acid deposition at the sites. The highest nitrogen deposition rate is found at Unit 7 of the Tees and Hartlepool Wetlands SSSI to the south of the site, at 0.091 kg/ha/yr; this is equivalent to between 0.2% and 0.3% of the upper and lower extents of the critical load range for saltmarsh (30 to 40 kg/ha/yr), a negligible increment.

The background rate of nitrogen deposition across the SPA is 15.5 kg N/ha/year (for the 5 km grid square TQ 525 140). The total deposition rate including background of 15.59 kg/ha/yr is approximately half the lower critical load value. The deposition rate which represents the greatest contribution to a critical load occurs at Unit 4 of the Tees and Hartlepool Wetlands SSSI, to the west of the proposed development. This site is classified as fen, marsh and swamp hence a critical load for grassland of between 10 and 30 kg/ha/yr is considered appropriate. The facility contributes between 0.2 and 0.5% to this critical load range, a negligible proportion. It is noted that at this location, the lower critical load is already exceeded by the background nitrogen deposition rate of 15.5 kg N/ha/yr. The total deposition rate of 15.55 kg N/ha/year remains, however, at approximately half the upper critical load.
The closest possible location of sand dunes, a sensitive habitat with a critical load of between 10 and 25 kg/ha/yr, is considered to be Unit 7 of Seaton Dunes SSSI. At this location, which is approximately 4 kilometres to the north east of the Reclamation Pond, the facility contribution is equivalent to 0.4% to the lower critical load for nitrogen deposition. Again at this location, the lower critical load is currently exceeded by the background deposition rate.

Acid deposition rates were calculated using the conversion rates for nitrogen and sulphur deposition specified in the Air Quality Technical Advisory Group, AQTAG06 guidance. The maximum acid deposition rate at any point within the SPA is estimated to be 0.02 keq/ha/yr or 0.5% of the critical load of 4 keq/ha/yr; the total PEC of 1.35 keq/ha/yr is equivalent to 34% of the critical load for soil. On the basis of this negligible contribution, there would be no material effect on acid deposition rates and soil quality within the SPA and the conservation objective would not be compromised.

We agree that the PC is likely to be insignificant relative to nutrient nitrogen critical loads (where relevant) at any ecological receptors. We also agree that the nitrogen and sulphur contributions are likely to be less than 1% of the lower acid critical load functions at acid sensitive sites such as the Teesmouth and Cleveland Coast SPA, Ramsar Site and associated SSSI, we therefore agree with the Applicant that there is no likely cause of significant effect on any ecological receptor.

5.5 Impact of abnormal operations

IED (Article 46(6)) requires that in the case of a breakdown, the Operator shall reduce or close down operations if a return to normal operation is not achieved within 4 hours, or to operate the plant using low polluting fuels. waste shall cease to be fed to the installation whenever any of the continuous emission monitors show that an emission limit value (ELV) is exceeded due to disturbances or failures of the purification devices. Not withstanding this, IED (Article 46(6)) allows for the continued feeding of waste under abnormal operating conditions – this is a recognition that the emissions during transient states (e.g. start-up, shut-down) are higher than during steady-state operation, and the overall environmental impact of continued operation with a limited exceedance of an ELV may be less than that of a partial shut-down and re-start. IED sets criteria for determining what an abnormal operation is and sets some limits regarding duration and extent of the abnormal operation which aim to ensure that the overall environmental impact is so minimised.

Abnormal operations are limited to no more than a period of 4 hours continuous operation and no more than 60 hours aggregated operation in any 12 month period. As such, abnormal operating conditions are not expected to have any significant long term environmental impact unless the background conditions were already close to, or exceeding, an EQS. For the most part therefore consideration of abnormal operations is limited to consideration of its impact on short term EQSs.

IED abnormal operations are defined as any technically unavoidable stoppages, disturbances, or failures of the abatement plant or the measurement devices, during which the concentrations in the discharges into air may exceed the normal emission limit values.

Combustion of the syngas produced only takes place in the two combustion gas turbines, the auxiliary boiler or the flare. The only point source emission from the process is the exhausts from these plant items. In the event of a malfunction or tripping of the turbines the plant has the capacity to operate in different modes as described below. Tripping of the turbines is not considered to be a IED abnormal operation as no syngas or fuel is combusted. Failure of any of the Continuous Emission Monitors, or any exceedence of the permitted ELVs would initiate a rapid controlled shutdown of the plant. Therefore there is no adverse impact of increased emissions from the plant in the event of abnormal operation.

100% of the syngas produced at the gasifier will be either combusted in the combustion gas turbines, auxiliary boiler or diverted to the flare. The only time syngas may be released to the atmosphere directly would occur for safety reasons during a relief scenario, which would be short term and truly an emergency situation.

Syngas combustion philosophy and flare operation.

Cold start up of the plant: The first 24 hours of operation will be from Natural Gas using the start up Low NOx Burners. A heat up rate of the refractory systems will limit firing rate. Coke will then be added and plasma torches lit over the next six hours. Municipal Solid Waste will then be slowly added to bring the plant up to a minimum load. Syngas clean up systems will be brought on line as soon as gas flow is adequate. During this phase all emissions to air are diverted to the flare. Once syngas flow is initiated, it is directed to the auxiliary boiler and then eventually to the gas turbines.

Hot start up of the plant: Feed to the gasifier could be interrupted due to various reasons, such as material blockage. The gasifier will be purged with nitrogen and gas flow diverted to the flare until syngas flow is resumed.

Turbine Trip: As much of the syngas, produced in the gasifier, as possible is diverted to the auxiliary boiler, any balance will be flared. On an unplanned single gas turbine trip, syngas is immediately flared in order to maintain the fuel header pressure. This flow is then increasingly diverted to the auxiliary boiler until the vent to the flare can be fully closed. On an unplanned double gas turbine trip, syngas will be immediately flared, then progressively diverted to the auxiliary boiler and then to each of the turbines as they can be restarted.

Emergency shutdowns: Such controlled shutdown would be in the event of the syngas cleanup train. The flare would be at maximum output, decreasing over time as gas production ceases. The aim is to consume all of the MSW bed, taking typically 1 – 2 hours. With a malfunction of any part of the plant which causes the syngas to go off specification, the plant would automatically vent to flare.

6. Application of Best Available Techniques

6.1 Scope of Consideration

In this section, we explain how we have determined whether the Applicant's proposals are the Best Available Techniques for this Installation.

- The first issue we address is the fundamental choice of incineration technology. There are a number of alternatives, and the Applicant has explained why it has chosen one particular kind for this Installation.

- We then consider in particular control measures for the emissions which were not screened out as insignificant in the previous section on minimising the installations environmental impact. These are: NO_X, SO_X with regards to habitats, also Cd, As and Ni.

- We also have to consider the combustion efficiency and energy utilisation of different design options for the Installation, which are relevant considerations in the determination of BAT for the Installation, including the Global Warming Potential of the different options.

- Finally, the prevention and minimisation of Persistent Organic Pollutants (POPs) must be considered, as we explain below.

IED on the other hand is based on setting mandatory emission limit values. Although the IED limits are designed to be stringent, and to provide a high level of environmental protection, they do not necessarily reflect what can be achieved by new plant. The IPPCD requires that emissions should be prevented or minimised, so it may be possible and desirable to achieve emissions below IED limits.

Even if the IED limits are appropriate, operational controls complement the emission limits and should generally result in emissions below the maximum allowed; whilst the limits themselves provide headroom to allow for unavoidable process fluctuations. Actual emissions are therefore almost certain to be below emission limits in practice, because any Operator who sought to operate its installation continually at the maximum permitted level would almost inevitably breach those limits regularly, simply by virtue of normal fluctuations in plant performance, resulting in enforcement action (including potentially prosecution) being taken. Assessments based on, say, IED limits is therefore a “worst-case” scenario.

Should the Installation, once in operation, emit at rates significantly below the limits included in the Permit, we will consider tightening ELVs appropriately. We are, however, satisfied that emissions at the permitted limits would ensure a high level of protection for human health and the environment in any event.

6.1.1 Consideration of Furnace Type

The prime function of the furnace is to achieve maximum combustion of the waste. The IED requires that the plant (furnace in this context) should be designed to deliver its requirements. The main requirements of the IED in relation to the choice of a furnace are compliance with air emission limits for CO and TOC and achieving a low TOC/LOI level in the bottom ash.

The Waste Incineration BREF elaborates the furnace selection criteria as:

- the use of a furnace (including secondary combustion chamber) dimensions that are large enough to provide for an effective combination of gas residence time and temperature such that combustion reactions may approach completion and result in low and stable CO and TOC emissions to air and low TOC in residues.
- use of a combination of furnace design, operation and waste throughput rate that provides sufficient agitation and residence time of the waste in the furnace at sufficiently high temperatures.
- The use of furnace design that, as far as possible, physically retain the waste within the combustion chamber (e.g. grate bar spacing) to allow its complete combustion.

The BREF also provides a comparison of combustion and thermal treatment technologies and factors affecting their applicability and operational suitability used in EU and for all types of wastes. There is also some information on the comparative costs. The table below has been extracted from the BREF tables. This table is also in line with the Guidance Note “The Incineration of Waste (EPR 5.01)). However, it should not be taken as an exhaustive list nor that all technologies listed have found equal application across Europe.

Overall, any of the furnace technologies listed below would be considered as BAT provided the Applicant has justified it in terms of:

- nature/physical state of the waste and its variability
- proposed plant throughput which may affect the number of incineration lines
- preference and experience of chosen technology including plant availability
- nature and quantity/quality of residues produced.

- emissions to air – usually NOx as the furnace choice could have an effect on the amount of unabated NOx produced
- energy consumption – whole plant, waste preparation, effect on GWP
- Need, if any, for further processing of residues to comply with TOC
- Costs

Comparison of thermal treatment technologies

Technique	Key waste characteristics and suitability	Throughput per line	Advantages	Disadvantages / Limitations of use	Bottom Ash Quality	Cost
Moving grate (air-cooled)	Low to medium heat values (LCV 5 – 16.5 GJ/t) Municipal and other heterogeneous solid wastes Can accept a proportion of sewage sludge and/or medical waste with municipal waste Applied at most modern MSW installations	1 to 50 t/h with most projects 5 to 30 t/h. Most industrial applications not below 2.5 or 3 t/h.	Widely proven at large scales. Robust Low maintenance cost Long operational history Can take heterogeneous wastes without special preparation	generally not suited to powders, liquids or materials that melt through the grate	TOC 0.5 % to 3 %	High capacity reduces specific cost per tonne of waste
Moving grate (liquid Cooled)	Same as air-cooled grates except: LCV 10 – 20 GJ/t	Same as air-cooled grates	As air-cooled grates but: higher heat value waste treatable better Combustion control possible.	As air-cooled grates but: risk of grate damaging leaks and higher complexity	TOC 0.5 % to 3 %	Slightly higher capital cost than air-cooled

Technique	Key waste characteristics and suitability	Throughput per line	Advantages	Disadvantages / Limitations of use	Bottom Ash Quality	Cost
Rotary Kiln	Can accept liquids and pastes solid feeds more limited than grate (owing to refractory damage) often applied to hazardous Wastes	<10 t/h	Very well proven with broad range of wastes and good burn out even of HW	Throughputs lower than grates	TOC <3 %	Higher specific cost due to reduced capacity
Fluid bed - bubbling	Only finely divided consistent wastes. Limited use for raw MSW ☐often applied to sludges	1 to 10 t/h	Good mixing Fly ashes of good leaching quality	Careful operation required to avoid clogging bed. Higher fly ash quantities.	TOC <3 %	FGT cost may be lower. Costs of waste preparation
Fluid bed - circulating	Only finely divided consistent wastes. Limited use for raw MSW, often applied to sludges / RDF.	1 to 20 t/h most used above 10 t/h	Greater fuel flexibility than BFB Fly ashes of good leaching quality	Cyclone required to conserve bed material Higher fly ash quantities	TOC <3 %	FGT cost may be lower. Costs of preparation.
Oscillating furnace	MSW / heterogeneous wastes	1 – 10 t/h	Robust Low maintenance Long history Low NOX level Low LOI of bottom ash	-higher thermal loss than with grate furnace - LCV under 15 GJ/t	TOC 0.5 – 3 %	Similar to other technologies

Technique	Key waste characteristics and suitability	Throughput per line	Advantages	Disadvantages / Limitations of use	Bottom Ash Quality	Cost
Pulsed hearth	Only higher CV waste (LCV >20 GJ/t) mainly used for clinical wastes	<7 t/h	can deal with liquids and powders	bed agitation may be lower	Dependent on waste type	Higher specific cost due to reduced capacity
Stepped and static hearths	Only higher CV waste (LCV >20 GJ/t) Mainly used for clinical wastes	No information	Can deal with liquids and powders	Bed agitation may be lower	Dependent on waste type	Higher specific cost due to reduced capacity
Spreader - stoker combustor	- RDF and other particle feeds poultry manure wood wastes	No information	- simple grate Construction less sensitive to particle size than FB	only for well defined mono-streams	No information	No information
Gasification - fixed bed	- mixed plastic wastes other similar consistent streams gasification less widely used/proven than incineration	1 to 20 t/h	-low leaching residue good burnout if oxygen blown syngas available -Reduced oxidation of recyclable metals	- limited waste feed - not full combustion - high skill level tar in raw gas - less widely proven	-Low leaching bottom ash good burnout with oxygen	High operation/ maintenance costs

Technique	Key waste characteristics and suitability	Throughput per line	Advantages	Disadvantages / Limitations of use	Bottom Ash Quality	Cost
Gasification - entrained flow	- mixed plastic wastes - other similar consistent streams not suited to untreated MSW gasification less widely used/proven than incineration	To 10 t/h	- low leaching slag reduced oxidation of recyclable metals	- limited waste feed not full combustion high skill level less widely proven	low leaching slag	High operation/ maintenance costs pre-treatment costs high
Gasification - fluid bed	- mixed plastic wastes shredded MSW shredder residues sludges metal rich wastes other similar consistent streams less widely used/proven than incineration	5 – 20 t/h	-temperatures e.g. for Al recovery separation of non-combustibles -can be combined with ash melting - reduced oxidation of recyclable metals	-limited waste size (<30cm) - tar in raw gas - higher UHV raw gas - less widely proven	If Combined with ash melting chamber ash is vitrified	Lower than other gasifiers
Pyrolysis	pre-treated MSW high metal inert streams shredder residues/plastics pyrolysis is less widely used/proven than incineration	~ 5 t/h (short drum) 5 – 10 t/h (medium drum)	no oxidation of metals no combustion energy for metals/inert in reactor acid neutralisation possible syngas available	- limited wastes process control and engineering critical high skill req. not widely proven need market for syngas	- dependent on process temperature - residue produced requires further processing e.g. combustion	High pre-treatment, operation and capital costs

The Applicant has carried out a review of the following candidate methods of waste treatment which are reproduced in the table below for comparison.

- Plasma Gasification
- Gasification
- Pyrolysis
- Incineration

BAT Criteria	Plasma Gasification	Gasification	Pyrolysis	Incineration
Feed Pre treatment	Pre treatment and size reduction of MSW is required for consistent feed composition. Front end sorting to remove recyclables may be incorporated. A wide range of feed wastes may be accommodated, e.g., biomass, tyres and car shredder waste	Pre treatment and size reduction of MSW is required for consistent feed composition. Front end sorting to remove recyclables may be incorporated. No data is available on treatment of other wastes.	Pre treatment and size reduction of MSW is required for consistent feed composition. Front end sorting to remove recyclables may be incorporated. No data is available on treatment of other wastes.	Pre treatment of MSW not essential except for removal of bulky items only for hearth / grate and rotary kiln type units, although front end sorting to remove recyclables may be incorporated. Particle size reduction for more homogenous feed essential for fluidised bed units.
Waste storage and handling	Waste receipts subject to pre-acceptance and acceptance procedures and systems. Enclosed storage and handling (including waste unloading) with measures for control of fugitive releases of odour, dust, litter, etc. Bunker management techniques should prevent development of anaerobic conditions.	Waste receipts subject to pre-acceptance and acceptance procedures and systems. Enclosed storage and handling (including waste unloading) with measures for control of fugitive releases of odour, dust, litter, etc. Bunker management techniques should prevent development of anaerobic conditions.	Waste receipts subject to pre-acceptance and acceptance procedures and systems. Enclosed storage and handling (including waste unloading) with measures for control of fugitive releases of odour, dust, litter, etc. Bunker management techniques should prevent development of anaerobic conditions.	Waste receipts subject to pre-acceptance and acceptance procedures and systems. Enclosed storage and handling (including waste unloading) with measures for control of fugitive releases of odour, dust, litter, etc. Bunker management techniques should prevent development of anaerobic conditions.

BAT Criteria	Plasma Gasification	Gasification	Pyrolysis	Incineration
Emissions	Emissions of metals in flue gas are likely to be lower than conventional incineration as these are either retained in solid residues (slag) at the gasification stage or separately tapped off as molten metal for recycle. Potentially polluting contaminants are removed from the syngas in the clean-up train prior to the power generation combustion stage, eliminating the need for pollutant removal by secondary abatement post syngas combustion. Emissions are lower than conventional incineration with secondary abatement techniques (e.g., SCR) only required in combination with primary techniques at the power train combustion stage for the reduction of NOx. The potential for generation of dioxins and furans is controlled and minimised to very low levels at the gasification stage (the primary technique) rather than abated post incineration stage. The very high bulk gas temperature (~18500C – although localized temperature may reach this level, bulk gas temperatures are usually ~ 1200°C or less) in the gasification stage ensures the destruction and conversion of complex hydrocarbons and tars. The plasma arc gasification technique allows very tight control of process parameters for minimisation of emissions.	No large scale UK operational plants. Largest capacity plant treating MSW is 80,000 tepa (Sweden). Limited operational data available. Emissions of metals in flue gas are likely to be lower than conventional incineration as these are retained in solid residues at the gasification stage. Potentially polluting contaminants are removed from the syngas in the clean-up train prior to the power generation combustion stage, eliminating the need for pollutant removal by secondary abatement post syngas combustion. Emissions performance data is limited, although it is reported that lower releases than conventional incineration are achievable with secondary abatement techniques (e.g., SCR) at the power train combustion stage for the reduction of NOx.	No large scale UK operational plants. Large commercial scale plant operational in Europe, Japan and North America. Some operational data available. Emissions of metals in flue gas are likely be lower than conventional incineration as these are retained in solid residues at the pyrolysis stage. Potentially polluting contaminants are removed from the syngas in the clean-up train prior to the power generation combustion stage, eliminating the need for pollutant removal by secondary abatement post syngas combustion. Emissions performance data is limited, although it is reported that lower releases than conventional incineration are achievable with secondary abatement techniques (e.g., SCR) at the power train combustion stage for the reduction of NOx. Pyrolysis produces a liquid oil by-product that must be further processed to produce useful products. Also, due to the lower treatment temperatures vs. gasification, tars are more likely to be formed.	Primary combustion technique alone cannot meet necessary emission standards for combustion gases, although fluidised beds generate lower NOx than other techniques. Application of in-combination secondary abatement technique can reduce emissions to meet WID. Emissions lower than WID criteria are reported by many plants.

BAT Criteria	Plasma Gasification	Gasification	Pyrolysis	Incineration
Design and construction	Complex process engineering design and operation. Gas tight plant required but complete exclusion of air is difficult and some oxidation will occur. Selection of plant materials of construction is critical owing to corrosive nature of syngas.	Complex process engineering design and operation. Gas tight plant required but complete exclusion of air is difficult and some oxidation will occur. Selection of plant materials of construction is critical owing to corrosive nature of syngas.	Complex process engineering design and operation. Gas tight plant required but complete exclusion of air is difficult and some oxidation will occur. Selection of plant materials of construction is critical owing to corrosive nature of syngas.	Complex process engineering design and operation. Gas tight plant required but less critical than for gasification / pyrolysis. System operates under induced draught and main concern is prevention of tramp air ingress leading to combustion trim imbalance. Selection of plant materials of construction is less critical than for gasification / pyrolysis owing to the less aggressive nature of the combustion gases.
Energy recovery / CO_2 generation	Higher parasitic load than conventional incineration but operation in combined cycle mode allows much higher energy recovery efficiencies. Energy output per tonne MSW is therefore higher than conventional incineration. Significantly lower ratio of CO2 emissions per unit energy generated for the same MSW input (approximately half that of incineration and one fifth of landfill). Scope for CHP mode operation.	No large scale UK operational plants. Largest capacity plant treating MSW is 80,000 tepa (Sweden). Limited operational data available. Higher parasitic load than conventional incineration but operation in combined cycle mode allows much higher energy recovery efficiencies. Energy output per tonne MSW is therefore higher than conventional incineration with higher biogenic CO2 offset. No data available on ratio of CO2 emissions per unit energy generated for the same MSW input but may be comparable with plasma gasification. Scope for CHP mode operation.	No large scale UK operational plants. Large commercial scale plant operational in Europe, Japan and North America. Some operational data available. Higher parasitic load than conventional incineration but operation in combined cycle mode allows much higher energy recovery efficiencies. Energy output per tonne MSW is therefore higher than conventional incineration with higher biogenic CO2 offset. No data available on ratio of CO2 emissions per unit energy generated for the same MSW input but may be comparable with plasma gasification. Scope for CHP mode operation.	Parasitic load is lower than gasification / pyrolysis but energy recovery efficiencies are lower owing to inability to operate combined cycle mode. CO2 emissions per unit energy generated are approximately double those for plasma gasification. Scope for CHP mode operation.

BAT Criteria	Plasma Gasification	Gasification	Pyrolysis	Incineration
Residue generation	Solid residue is an inert by-product, comprising a vitrified granulated slag, which can be beneficially re-used in the manufacture of cement and roofing tiles, or as an asphalt filler, or for sandblasting. It is possible to recover metals in molten form via a tap-off point directly from the gasifier, further enhancing recovery.	Solid residues can vary from a low leaching ash to a low leaching slag, depending on the specific process technique.	Ash or slag arises from inert solid material present in the waste feed. Carbon char produced by the pyrolysis process may be used as a product (e.g., carbon black), burned as fuel or disposed of as a waste residue.	Furnace bottom ash, which may be recycled to use as an aggregate. Fly ash / FGT residues may be re-used in the chemicals sector as a neutralising agent, although care must be exercised to avoid re-mobilising pollutants. Control measures for the prevention of fugitive releases will be required. Metals can be recovered from the quenched bottom ash.
Odour	Odour management techniques typically prevent nuisance. Waste pre-treatment can generate additional odour potential, requiring further control measures. Syngas introduces odour potential, requiring control measures for storage and handling.	Odour management techniques typically prevent nuisance. Waste pre-treatment can generate additional odour potential, requiring further control measures. Syngas introduces odour potential, requiring control measures for storage and handling.	Odour management techniques typically prevent nuisance. Waste pre-treatment can generate additional odour potential, requiring further control measures. Syngas introduces odour potential, requiring control measures for storage and handling.	Odour management techniques typically prevent nuisance. Waste pre-treatment can generate additional odour potential, requiring further control measures.
Noise	Noise management techniques, including equipment specification, plant maintenance and noise attenuation / abatement, typically prevent nuisance. High pressure steam venting requires particular attention, although this generally only occurs in emergency / plant upset conditions.	Noise management techniques, including equipment specification, plant maintenance and noise attenuation / abatement, typically prevent nuisance. High pressure steam venting requires particular attention, although this generally only occurs in emergency / plant upset conditions.	Noise management techniques, including equipment specification, plant maintenance and noise attenuation / abatement, typically prevent nuisance. High pressure steam venting requires particular attention, although this generally only occurs in emergency / plant upset conditions.	Noise management techniques, including equipment specification, plant maintenance and noise attenuation / abatement, typically prevent nuisance. High pressure steam venting requires particular attention, although this generally only occurs in emergency / plant upset conditions.

BAT Criteria	Plasma Gasification	Gasification	Pyrolysis	Incineration
Raw materials	Dependent on selected abatement technique, principal raw materials consumption comprises flue gas treatment (FGT) chemicals and catalysts, boiler feed water treatment chemicals and supplementary fuels. In addition, the plasma arc process uses metallurgical coke and limestone.	Dependent on selected abatement technique, principal raw materials consumption comprises flue gas treatment (FGT) chemicals and catalysts, boiler feed water treatment chemicals and supplementary fuels.	Dependent on selected abatement technique, principal raw materials consumption comprises flue gas treatment (FGT) chemicals and catalysts, boiler feed water treatment chemicals and supplementary fuels.	Dependent on selected abatement technique, principal raw materials consumption comprises flue gas treatment (FGT) chemicals and catalysts, boiler feed water treatment chemicals and supplementary fuels. Fluidised bed units have greater raw materials usage owing to bed sand inventory.

The Applicant has proposed to use a thermal treatment technology comprising oxygen assisted gasification, using a plasma torch gasifier to produce a syngas to fuel gas combustion turbines and an auxiliary boiler with a steam turbine to produce electricity, all of which are identified in the tables above as being considered BAT in the BREF or TGN for this type of waste feed.

The Applicant proposes to use natural gas as support fuel for start-up, shut down and for the auxiliary burners. The choice of support fuel is based on the Applicant's design philosophy for employing low NOx burners, minimising pre-heat times and combustion of auxiliary fuel. Natural gas is considered to be a clean fuel environmentally.

Heat Recovery Steam Generation (HRSG) Plant and Auxiliary Boiler Design

In accordance with our Technical Guidance Note, S5.01, the Applicant has confirmed that the HRSG and boiler design will include the following features to minimise the potential for reformation of dioxins within the de-novo synthesis range:

- ensuring that the steam/metal heat transfer surface temperature is a minimum where the exhaust gases are within the de-novo synthesis range;
- design of the boilers using CFD to ensure no pockets of stagnant or low velocity gas;
- boiler passes are progressively decreased in volume so that the gas velocity increases through the boiler; and
- Design of boiler surfaces to prevent boundary layers of slow moving gas.

The justification for the auxiliary boiler design is presented in Section 2.1.5.5 of the application.

Temperature and residence time: Section 1.1.2.4 of the Application discusses the development of the gasifier, and the CFD modelling work undertaken to demonstrate that dioxins and furans are exposed to a temperature above 850^0C for longer than 2 seconds in the gasifier chamber.

This is somewhat irrelevant as this is not the point of combustion of the syngas produced hence the formation of dioxins and furans that could be emitted to the environment are formed later in the process described below.

The gas turbines are incapable themselves of delivering this residence time, due to the nature of turbine operation. This is common to all gasification processes which employ gas turbines or engines to combust the syngas produced. The combustion takes place at very high temperatures over very short periods of time. Therefore the Applicant has applied for a derogation of the requirements of Article 50(2) as allowed under Article 51(1) of the IED.

The Applicant states in their Application that the auxiliary boiler has been sized to provide the flexibility required for the installation to accept the syngas during the downtime of one gas turbine, and is essentially a package in nature. It is highly doubtful if it could be sized to deliver a two second residence time above 850^0C, and even if it were technically possible, the size of boiler required would be so far out of proportion to the syngas volume it would be required to combust, that the efficiency would be drastically reduced. That combined with the excessive cost of such a boiler, and the significant doubt as to whether any such boiler running on syngas could actually deliver the residence time above 850^0C required, leads to consideration of a derogation from the requirements of IED Article 50(2) concerning the residence time requirements of the last points of combustion (the gas turbines and auxiliary boiler).

We consider BAT is achieved for prevention of dioxin and furan formation, and that the proposed facility will emit concentrations of dioxin and furans orders of magnitude below the emission limit in IED. Consequently we have accepted the Applicant’s request for a derogation to the 2 second residence time required by Article 50(2) of the IED.

The auxiliary boiler is a package type boiler, which is sized for this application and provides a high efficiency at reasonable cost. The actual temperature in the auxiliary boiler is anticipated to be between $1{,}000^0$C and $1{,}300^0$C at the firebox exit. At the normal turn down rate for the auxiliary boiler of 15% of nameplate, when it is firing on the excess syngas that the gas turbines cannot normally accept, the residence time will be between 1.4s and 2.2s, depending on the calorific value of incoming waste to generate the fixed supply of syngas to the turbines. At 100% firing, in the event of a gas turbine trip, for example, the residence time could be around 0.4s.

The justification for the requirements of the Directive having been met is set out in the application. Section 2.1 demonstrates that the proposed equipment and technology meets the requirements of the Directive. Sections 3 and 4 of the application confirm that the objectives of the Directive have been met in that pollution by emissions from the installation is minimised as far as possible and that no statutory air quality objectives or standards are likely to be breached as a result of the emissions from the proposed installation.

We have considered the assessments made by the Applicant and agree that the furnace technology chosen represents BAT. We believe that, based on the information gathered by the BREF process, the chosen technology will achieve the requirements of the IED for the air emission of TOC/CO and the TOC on bottom ash.

6.2 BAT and emissions control

The prime function of the syngas treatment clean up train is to reduce the concentration of pollutants in the resultant exhaust gas as far as practicable. The techniques which are described as BAT individually are targeted to remove specific pollutants, but the BREF notes that there is benefit from considering the FGT system as a whole unit. Individual units often interact, providing a primary abatement for some pollutants and an additional effect on others.

Point source emissions to air are from the flare stack, HRSG stacks serving the gas turbines, the stack serving the auxiliary boiler and the diesel firewater pump and stand by generator. Emissions from stacks consist of NO_X, SO_2, CO, CO_2, TOC, HCl, HF, NH_3, particulate matter, heavy metals (antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel, vanadium); cadmium, mercury, thallium, dioxins and furans.

Emissions of all pollutants are minimised by the design of the installation. Emissions from the flare are minimised by ensuring that the use of the flare is designed out as far as possible by maximising the flexibility of the installation. In addition to operational control measures as primary techniques, a syngas cleanup train is in place prior to use as fuel in the power generation block to remove the remaining amounts of all these pollutants that cannot be prevented. This includes:

- quench and particulate removal including a dual venturi quench scrubber and wet electrostatic precipitator (WESP), separator, a direct contact syngas cooler, circulation pumps and particulate recycle to the gasifier to remove particulates, acids and bases;
- syngas compression including intercoolers and controls;
- hydrolysis reactor to catalytically convert COS to H_2S;
- mercury removal in a sulphur-impregnated activated carbon bed; and
- sulphur removal in a redox/absorption system to remove H_2S from the syngas.

To provide additional secondary removal of NO_X, a Selective Catalytic Reduction (SCR) unit is in place on each of the emission points from the two HRSGs and Auxiliary Boiler stacks.

The BREF lists the general factors requiring consideration when selecting flue-gas treatment (FGT) systems as:

- type of waste, its composition and variation
- type of combustion process, and its size
- flue-gas flow and temperature
- flue-gas content, size and rate of fluctuations in composition
- target emission limit values
- restrictions on discharge of aqueous effluents
- plume visibility requirements
- land and space availability
- availability and cost of outlets for residues accumulated/recovered
- compatibility with any existing process components (existing plants)
- availability and cost of water and other reagents
- energy supply possibilities (e.g. supply of heat from condensing scrubbers)
- reduction of emissions by primary methods
- release of noise.

Taking these factors into account the Technical Guidance Note points to a range of technologies being BAT subject to circumstances of the Installation.

6.2.1 Particulate Matter

Particulate matter				
Technique	**Advantages**	**Disadvantages**	**Optimisation**	**Defined as BAT in BREF or TGN for:**
Bag / Fabric filters (BF)	Reliable abatement of particulate matter to below 5mg/m^3	Max temp 250°C	Multiple compartments Bag burst detectors	Most plants
Wet scrubbing	May reduce acid gases simultaneously.	Not normally BAT. Liquid effluent produced	Require reheat to prevent visible plume and dew point problems.	Where scrubbing required for other pollutants
Ceramic filters	High temperature applications Smaller plant.	May “blind” more than fabric filters		Small plant. High temperature gas cleaning required.

Electrostatic precipitators	Low pressure gradient. Use with BF may reduce the energy consumption of the induced draft fan.	Not normally BAT.		When used with other particulate abatement plant

Due to the high operating temperatures of Plasma Torch Gasification, use of fabric filtration (with a typical temperature limit of 200 – 250^{0}C) is not appropriate. Generally, ceramic filters that can sustain high temperature up to typically 450^{0}C present potential problems with breakage and blinding having significant downtime implications. The resistance of these filters to the corrosive and erosive nature of the raw syngas at high temperatures is another significant concern with their use.

The refuse-derived syngas from a plasma gasifier carries very fine particulates: 65% of the particulates are less than 1 micron. ESPs are an effective particulate removal device for fine particles. However, ESPs are not suitable for this high temperature application. Additionally, the soft and sticky nature of the particulates at syngas production stage of the process would almost certainly cause widespread fouling and plugging of the ESP grids. The ESP is more suitable for use further downstream in the syngas cleaning process to remove the very fine particulates below 0.5 micron at near ambient temperatures, and after bulk particulates have already been removed in a venturi quench scrubber.
A wet scrubber therefore presents the option that is most appropriate for this application. There are four major categories of wet particulate scrubbers:

- spray tower scrubber;
- packed bed or tray-type scrubbers;
- mechanically aided scrubbers; and
- venturi scrubbers.

The mechanically aided scrubber is similar to a fan equipped with water sprays. Due to the high temperature and highly erosive and corrosive nature of the syngas, this type of separator is not considered suitable for the application.

The separation principle of wet scrubbers is that particulates are knocked out with water droplets by various means. Effectiveness of different devices depends on particle size, water droplet size, density of water droplets, etc. Residence time can be an important factor in determining efficiency, depending on design principles. With high particulate solid loading (30,000 mg/ Nm^3dry basis, for this process) and small particle size (65% of the particulates are less than 1 micron), spray-type, tray-type, and packed bed scrubbers are not believed to be suitable. Generally these devices are large vessels, intended to provide sufficient residence time for particle separation. However, the long residence time would allow chemical reactions in the hot syngas to take place and would likely produce undesirable chemical species by-products, such as dioxin. Additionally, tray-type and packed bed scrubbers have intricate narrow flow passages where blockage and/or fouling can easily result leading to plant shutdown for maintenance.

The venturi quench scrubber was selected by the Applicant as the best available technique to perform the multiple functions as required in this step of the process. This technology is selected because it can rapidly quench the syngas temperature, remove particulates, and scrub acids / bases simultaneously. The venturi quench scrubber is designed to reduce syngas temperature from 850^0C to ~ 85^0C. Venturi scrubbers are commonly used as particulate, ammonia and HCl removal devices. In addition to cooling the syngas to near saturation temperature, the dual venturi scrubber will also remove a high percentage of solid particulate over 5 micron in size that may be carried over from the gasifier, thereby minimising downtime. The addition of caustic (NaOH) to control the resultant water stream to a pH range of 6.5-7, in this initial scrubbing stage, will remove greater than 90% of hydrogen chloride (HCl) that may be present from any plastic constituents (such as polyvinyl chloride) that are present following the pre-sorting and acceptance checks. The captured impurities will be removed from the initial wet scrubber system as "blow down," which will be transferred to the on-site effluent treatment system before being routed to the Northumbrian Water wastewater treatment works at Bran Sands.

The Applicant’s design basis is therefore to employ venturi scrubbing in two stages with a downstream liquid / gas separator. The solid-loaded water downstream of the venturi scrubbers will be introduced tangentially along the liquid / gas separator wall to enhance the separation and to ensure that no liquid (containing solids) entrained in the gas stream exits the unit. The convergent section of the venturi is covered with a water film to eliminate particles sticking to the wall. High gas velocity in the venturi throat causes violent agitation in the water film creating numerous fine droplets to capture the particulates. Because of the close contact between the water and hot gas, a rapid temperature drop takes place over a very short distance and time and brings all chemical reactions to an abrupt stop. At pH of 7 in the outlet scrubbing water, modelling calculations, carried out by the equipment supplier, indicate greater than 99% of HCl and HF can be absorbed into the scrubbing water while two thirds of ammonia can be removed from the syngas stream. Prior to exiting the gasifier, the syngas is partially quenched with water spray to 850^0C, and is expected to contain particulates. The syngas leaving the plasma gasifier will be cooled in a dual venturi quench to about 85°C. Syngas cooling is required to lower the temperature of the syngas exiting the gasifier to allow for subsequent syngas clean-up. Rapid quench of the syngas will prevent re-combination of organic molecules into complex organics such as dioxins or furans. Both venturi stages are similar, but the first serves primarily for temperature quenching, while the second serves primarily for particulate and HCl / NH_3 removal. Make-up water will be provided when required from towns water. The water separated from the particulates-laden quench / scrubbing water will be further re-used for the slag quench pit beneath the gasifier.

A low pressure syngas blower will be used to raise the syngas pressure from sub-atmospheric level exiting the scrubber to a level high enough to maintain positive pressure through the particulate removal system.

The syngas exiting the venturi quench scrubber at 85^0C has a moisture content of up to 59%. In order to reduce the gas volume for compression, a cooler will be installed before the blower in order to condense out moisture. The cooler will be of direct contact type (DCC). The DCC is designed to cool the syngas to 46^0C and reduce the syngas volume by 57% primarily due to moisture condensation, but also due to the temperature reduction contribution. The DCC has the advantage of bringing the process gas and cooling water in direct contact such that reduces a much smaller temperature approach and greater thermal efficiency can be obtained than with a conventional non-contact heat exchanger (such as shell-and-tube type). The direct contact of the syngas with water also provides some degree additional scrubbing of particulates.

The DCC will be a packed bed column with a circulating loop of cooled water that will condense water from the syngas stream. Hot water collected at the bottom of the DCC will be pumped through the DCC heat exchanger where the circulating water is cooled before re-entering the DCC. Water is purged from the system before the DCC heat exchanger and this purged water is recirculated back to the scrubber as quench / scrubbing water.

The syngas leaving the quench scrubber will contain up to 500 mg/Nm (dry basis) particulates, largely of sub-micron size. These could be removed either by bag filters or a wet ESP. Although the syngas pressure is boosted and becomes superheated, the syngas is still moisture-laden. Collected particulates on a fabric filter may be caked up and becomes difficult to remove. In addition, the syngas is barely above the ambient pressure (0.07 Bar g) and does not have much driving force to spare for pressure drop across the bag fabric. There is very little or no demonstrable experience with fabric filtration of moist flammable gases at this scale. Therefore, an ESP has been selected for the second stage of particulate removal, following the two stage venturi scrubber.

There are two types of ESP – dry and wet. Selection of the wet ESP, by the Applicant, as the final particulate removal unit is driven by several factors. With the specified particulate loading in the syngas, the saturation environment inherent in the WESP reduces the possibility of igniting the syngas with the electric charge, and, consequently, an energy release. The high solid loading of extremely fine particulate may cause space charge in a dry ESP. WESPs can achieve up to several times the typical corona power levels of dry precipitators, greatly enhancing collection of submicron particles. In wet precipitators, re-entrainment in the last field is virtually nonexistent due to adhesion between the water and collected particulate. Also, the gas stream temperature is lowered to the saturation temperature, promoting condensation, and enhancing particulate collection. A saturator is added before the WESP to ensure the inlet syngas is at its saturation point. WESPs are highly efficient collectors of sub-micron particulate, including condensable aerosols. In the WESP, remaining or condensed particulate in the syngas will be given an electrical charge as the syngas stream is distributed to flow over and around wetted tubes with the opposite, attractive electrical charge. The electrically charged particulates are attracted to the tubes by a strong electrical field, where they become trapped in a sheet of water flowing over the surface of the tubes. Once captured, these particles are washed to the base of the unit where they are blown down to the process effluent treatment plant. WESPs are known to also capture mercury and organic aerosols that may condense from syngas at saturation temperatures. Therefore, at this facility, the syngas exiting the DCC will be routed to a tubular 2 field WESP for polishing, capture and removal of remaining fine particulates. The second field will incorporate a demisting design to limit liquid carryover to the downstream compressor. This system is a down flow tubular design with no moving parts. The top inlet design allows the flue gas to flow downward through the collection tubes. The collected liquid droplets with particulate create a self-forming falling film of liquid that flows by gravity, irrigating the inside surfaces of the tube walls, (the collecting surface) to provide continuous cleaning. Since the liquid flows co-current to the gas flow, there are no interruptions in the falling film of liquid, preventing dry spots from forming on the collection tubes.

The high voltage system for the WESP consists of a rigid high voltage frame suspended at four points by robust ceramic insulators. The insulator location is removed from the flue gas stream, thus avoiding contamination due to wetting and particle deposition. The insulator compartments are designed with large inspection / maintenance doors to provide adequate space for insulator inspection and / or removal. Insulator compartment mounting flanges are seal welded during installation to prevent air infiltration which could enhance corrosion potential and cause disruption of the gas flow distribution. The compartments are also purged with heated nitrogen to prevent process gas infiltration. This purging is more reliable than commonly used strip heaters and more effective than heat tracing. The high voltage plenum is equipped with a flushing header that provides an intermittent flushing spray to prevent build-up of particulate on the high voltage frame or collection tubes. The duration and frequency of the spray depends on the severity of the application but is typically set at 2 minutes every 6 hours. The flushing nozzles are adjusted at the start-up of the equipment and locked into place to prevent any accidental misalignment during maintenance procedures. The wash water is supplied from a local tank adjacent to the WESP. Particulates are flushed from the system and piped to the wastewater treatment system where they are fed to a clarifier and ultimately returned to the gasifier as filter cake.

Emissions of particulate matter have been previously assessed as insignificant, and so the Environment Agency agrees that the Applicant's proposed technique is BAT for the installation.

6.2.2 Oxides of Nitrogen

Oxides of Nitrogen : Primary Measures				
Technique	**Advantages**	**Disadvantages**	**Optimisation**	**Defined as BAT in BREF or TGN for:**
Low NOx burners	Reduces NOx at source		Start-up, supplementary firing.	Where auxiliary burners required.
Starved air systems	Reduce CO simultaneously.			Pyrolysis, Gasification systems.
Optimise primary and secondary air injection				All plant.
Flue Gas Recirculation (FGR)	Reduces the consumption of reagents used for secondary NOx control. May increase overall energy recovery	Some applications experience corrosion problems.		All plant unless impractical in design (needs to be demonstrated)

Oxides of Nitrogen : Secondary Measures (BAT is to apply Primary Measures first)				
Technique	**Advantages**	**Disadvantages**	**Optimisation**	**Defined as BAT in BREF or TGN for:**
Selective catalytic reduction (SCR)	NOx emissions < 70mg/ m^3 Reduces CO, VOC, dioxins	Expensive. Re-heat required – reduces plant efficiency		All plant
Selective non-catalytic reduction (SNCR)	NOx emissions typically 150 - 180mg/m^3	Relies on an optimum temperature around 900 °C, and sufficient retention time for reduction May lead to Ammonia slip	Port injection location	All plant unless lower NOx release required for local environmental protection.
Reagent Type: Ammonia	Likely to be BAT Lower nitrous oxide formation	More difficult to handle Narrower temperature window		All plant
Reagent Type: Urea	Likely to be BAT			All plant

The Plasma Torch Gasification Reactor itself is inherently low in potential for the generation of NO_X owing to the oxygen deficient atmosphere, which is subject to very tight process control in terms of temperature profile, oxidant profile and energy input. The reactor is gas tight to prevent ingress of tramp air which would disrupt the specific conditions required, therefore, generation of NO_X at the gasification stage is low.

For the syngas combustion stage, the following primary NO_X control methods will be used:

- control of combustion air for optimised combustion in the turbines and auxiliary boiler;

- premixing of fuel and air in the gas turbine injectors prior to reaching the flame front, preventing the formation of hot spots which can lead to higher thermal NO_X generation (other systems inject fuel and air simultaneously); and

- lower fuel / air ratio on the gas turbines for lean combustion, resulting in a lower flame temperature and suppression of the NO_X formation rate.

These measures are considered BAT for primary NOx control.

During preheat of the gasifier natural gas is used with auxiliary low NOx burners.

There are two recognised techniques for secondary measures to reduce NO_x. These are Selective Catalytic Reduction (SCR) and Selective Non-Catalytic Reduction (SNCR). For each technique, there is a choice of urea or ammonia reagent.

Secondary NOx removal is proposed for both the gas turbines and the auxiliary boiler, and will comprise selective catalytic reduction (SCR) systems capable of achieving up to 94% removal of NOx in the turbine exhaust and up to 90.5% removal from the auxiliary boiler exhaust. Although thermal NOx formation is minimised by the primary techniques described above, owing to the substantial concentration of ammonia in the syngas fuel (around 1,100 mg/Nm^3), generation of chemical NOx in the combustion units is relatively high. Ammonia dosage rates to the SCR units must therefore be correspondingly high to secure compliant releases of NOx. Whilst the dosage of ammonia is tightly controlled by a feedback loop referenced to the continuously monitored NOx emission level, at such high levels, the issue of ammonia slip becomes important. A detailed BAT assessment was undertaken by the Applicant to ensure that this was the most effective combination of NOx prevention techniques, bearing in mind the environmental benefits and associated costs.

Each stack from the two HRSGs and the Auxiliary Boiler will have an SCR unit. This is despite the potentially higher capital cost compared with SNCR, due to its applicability across all 3 combustion units, and the improved performance available in terms of NOx removal. Ammonia is proposed as the reagent, although this will be finalised once the SCR system has been procured. The temperature range is not a constraint on the choice or reagent. The hazard status of ammonia does not require further consideration because ammonia solution (expected concentration around 19-29%) will be used and concentrated ammonia will not be stored on site. The reagent cost is higher for ammonia, but this is offset by the reduction in N_2O emissions. N_2O is a powerful greenhouse gas (GWP = 310), and with the improved NOx removal efficiency compared with urea, this means that ammonia is considered to represent BAT as the reagent for the SCR system at this installation.

Ammonia slip from the SCR unit can be emitted along with the flue-gas to atmosphere. The ammonia slip at SCR installations increases with an increasing NH_3 / NO_X ratio, but also with decreasing catalyst activity.
The SCR units serving HRSGs attached to the gas turbines will be sourced to guarantee maximum ammonia slip of 10ppmv (6.3 mg/Nm^3) at 15% O_2, and the auxiliary boiler SCR will guarantee maximum ammonia slip of 25ppmv (19 mg/Nm^3) at 3% O_2. (Figures provided by SCR equipment supplier). By calculation we determine that these ammonia slip figures equate to 10.5 mg/Nm^3 at 11% oxygen.

Ammonia dosing will be based on a feedback loop from the continuous emissions monitoring results for NO_2. This will optimise the dosing regime and help to prevent ammonia slip. In order to further minimise ammonia slip, the SCR system will be subject to regular planned maintenance or inspection, e.g. annually, in order to prevent ammonia slip.

The amount of ammonia used for NO_x abatement will need to be optimised to maximise NO_x reduction and minimise NH_3 slip. Improvement condition IC4 requires the Operator to report to the Environment Agency on optimising the performance of the NO_x abatement system. The Operator is also required to monitor and report on NH_3 and N_2O emissions every 6 months.

6.2.3 Acid Gases, SO_x, HCl and HF

Acid gases and halogens : Primary Measures				
Technique	**Advantages**	**Disadvantages**	**Optimisation**	**Defined as BAT in BREF or TGN for:**
Low sulphur fuel, (< 0.1%S gasoil or natural gas)	Reduces SOx at source		Start-up, supplementary firing.	Where auxiliary fuel required.
Management of waste streams	Disperses sources of acid gases (e.g. PVC) through feed.	Requires closer control of waste management		All plant with heterogeneous waste feed

Acid gases and halogens : Secondary Measures (BAT is to apply Primary Measures first)				
Technique	**Advantages**	**Disadvantages**	**Optimisation**	**Defined as BAT in BREF or TGN for:**
Wet	High reaction rates Low solid residues production Reagent delivery may be optimised by concentration and flow rate	Large effluent disposal and water consumption if not fully treated for re-cycle Effluent treatment plant required May result in wet plume Energy required for effluent treatment and plume reheat		Plants with high acid gas and metal components in exhaust gas – HWIs
Dry	Low water use Reagent consumption may be reduced by recycling in plant Lower energy use	Higher solid residue production Reagent consumption controlled only by input rate		All plant

	Higher reliability			
Semi-dry	Medium reaction rates Reagent delivery may be varied by concentration and input rate	Higher solid waste residues		All plant
Reagent Type: Sodium Hydroxide	Highest removal rates Low solid waste production	Corrosive material ETP sludge for disposal		HWIs
Reagent Type: Lime	Very good removal rates Low leaching solid residue Temperature of reaction well suited to use with bag filters	Corrosive material May give greater residue volume if no in-plant recycle	Wide range of uses	MWIs, CWIs
Reagent Type: Sodium Bicarbonate	Good removal rates Easiest to handle Dry recycle systems proven	Efficient temperature range may be at upper end for use with bag filters – Leachable solid residues Bicarbonate more expensive	Not proven at large plant	CWIs

The Applicant proposes to implement the following primary measures:

- Use of natural gas will be used at start-up, The Applicant has justified its choice of gas as the support fuel and we agree with that assessment.
- Management of heterogeneous wastes – this will disperse problem wastes such as PVC by ensuring a homogeneous waste feed.

There are three recognised techniques for secondary measures to reduce acid gases. These are wet, dry and semi-dry. Wet scrubbing produces an effluent for treatment and disposal in compliance with the IED. It will also require reheat of the exhaust to avoid a visible plume. Wet scrubbing is unlikely to be BAT in most cases, however, in this case the Applicant suggests it is. The Applicant proposes to implement a wet venturi scrubber for a secondary measure for acid gases and halogens removal, the BAT explanation for this is based around the removal of particulate matter from extremely hot syngas as discussed in section 6.2.1 above.

6.2.4 Carbon monoxide and volatile organic compounds (VOCs)

The prevention and minimisation of emissions of carbon monoxide and volatile organic compounds is through the optimisation of combustion controls, where all measures will increase the oxidation of these species.

Carbon monoxide and volatile organic compounds (VOCs)				
Technique	**Advantages**	**Disadvantages**	**Optimisation**	**Defined as BAT in BREF or TGN for:**
Optimise combustion control	All measures will increase oxidation of these species.		Covered in section on furnace selection	All plants

6.2.5 Dioxins and furans (and Other POPs)

Dioxins and furans				
Technique	**Advantages**	**Disadvantages**	**Optimisation**	**Defined as BAT in BREF or TGN for:**
Optimise combustion control	All measures will increase oxidation of these species.		Covered in section on furnace selection	All plants
Avoid *de novo* synthesis			Covered in boiler design	All plant
Effective Particulate matter removal			Covered in section on particulate matter	All plant
Activated Carbon injection	Can be combined with acid gas absorber or fed separately.	Combined feed rate usually controlled by acid gas content.		All plant. Separate feed normally BAT unless feed is constant and acid gas control also controls dioxin release.

The prevention and minimisation of emissions of dioxins and furans during the gasification process and subsequent combustion of the syngas is achieved in these following ways;

- in the high temperature environment in gasification, larger molecules such as plastics are completely broken down into the components of syngas, which can be cleaned and processed before any further use;
- dioxins and furans need sufficient oxygen to form or re-form, and the oxygen-deficient atmosphere in a gasifier does not provide the environment needed for dioxins and furans to form or reform;
- dioxins need fine metal particulates in the exhaust to reform. Syngas from gasification is typically cleaned of particulates before being used;
- in gasification facilities, the syngas is quickly quenched, so that there is not sufficient residence time in the temperature range where dioxins or furans could re-form; and
- when the syngas is primarily used as a fuel, it can be cleaned as necessary before combustion.
- activated carbon is dosed into the exhaust gas stream to capture mercury. This will also benefit the capture of dioxins and furans.

6.2.6 Metals

Metals				
Technique	**Advantages**	**Disadvantages**	**Optimisation**	**Defined as BAT in BREF or TGN for:**
Effective Particulate matter removal			Covered in section on particulate matter	All plant
Activated Carbon injection for mercury recovery	Can be combined with acid gas absorber or fed separately.	Combined feed rate usually controlled by acid gas content.		All plant. Separate feed normally BAT unless feed is constant and acid gas control also controls dioxin release.

The prevention and minimisation of metal emissions is achieved through the effective removal of particulate matter, and this has been considered in 6.2.1 above.

Unlike other metals however, mercury if present will be in the vapour phase. BAT for mercury removal is also dosing of activated carbon into the exhaust gas stream. This can be combined with the acid gas reagent or dosed separately. Where the feed is combined, the combined feed rate will be controlled by the acid gas concentration in the exhaust. Therefore, separate feed of activated carbon would normally be considered BAT unless the feed was relatively constant.

In this case the Mercury in the syngas stream will be adsorbed onto activated carbon in the mercury polishing carbon beds. The carbon unit will consist of two stages, designed to remove more than 95% of incoming mercury. Carbon, once Hg saturated, requires treatment or disposal in a regulated hazardous waste landfill. We are satisfied their proposals are BAT.

6.3 BAT and global warming potential

This section summarises the assessment of greenhouse gas impacts which has been made in the determination of this Permit. Emissions of carbon dioxide (CO_2) and other greenhouse gases differ from those of other pollutants in that, except at gross levels, they have no localised environmental impact. Their impact is at a global level and in terms of climate change. Nonetheless, CO_2 is clearly a pollutant for IPPCD purposes.

The principal greenhouse gas emitted is CO_2, but the plant also emits small amounts of N_2O arising from the operation of secondary NO_x abatement. N_2O has a global warming potential 310 times that of CO_2. The Applicant will therefore be required to optimise the performance of the secondary NO_x abatement system to ensure its GWP impact is minimised.

The major source of greenhouse gas emissions from the installation is however CO_2 from the combustion of waste. There will also be CO_2 emissions from the burning of metcoke and the use of support fuels at start up, shut down and should it be necessary to maintain combustion temperatures. BAT for greenhouse gas emissions is to maximise energy recovery and efficiency.

The electricity that is generated by the Installation will displace emissions of CO_2 elsewhere in the UK, as virgin fossil fuels will not be burnt to create the same electricity. The Applicant has therefore included within its GWP calculations a CO_2 offset for the net amount of electricity exported from the Installation.

Taking this into account, the net emissions of CO_2 from the installation are estimated at 331,062 tonnes per annum. At this level emissions cannot be characterised as insignificant. The Installation is not subject to the Greenhouse Gas Emissions Trading Scheme Regulations 2003; therefore it is a requirement of IED to investigate how emissions of greenhouse gases emitted from the installation might be prevented or minimised.

The Applicant has considered GWP as part of its BAT options appraisal. There are a number of areas in which a difference can be made to the GWP of the Installation. In summary: the following factors influence the GWP of the facility:-

On the debit side

- CO_2 emissions from the burning of the waste;
- CO_2 emissions from burning auxiliary or supplementary fuels;
- CO_2 emissions associated with electrical energy used;
- N_2O from the de-NOx process.

On the credit side

- CO_2 saved from the export of electricity to the public supply by displacement of burning of virgin fuels;
- CO_2 saved from the use of waste heat by displacement of burning of virgin fuels.

Note: avoidance of methane which would be formed if the waste was landfilled has not been included in this assessment. If it were included due to its avoidance it would be included on the credit side. Ammonia has no direct GWP effect.

The Applicant's assessment shows that the GWP of the plant is dominated by the emissions of carbon dioxide that are released as a result of waste combustion. This is constant for all options considered in the BAT assessment.

The differences in the GWP of the options in the BAT appraisal arise from small differences in energy recovery and in the amount of N_2O emitted.

Taking all these factors into account, the Operator's assessment shows their preferred option is best in terms of GWP.

The Environment Agency agrees with this assessment and that the chosen option is BAT for the installation.

6.4 BAT and POPs

International action on Persistent Organic pollutants (POPs) is required under the UN's Stockholm Convention, which entered into force in 2004. The EU implemented the Convention through the POPs Regulation (850/2004), which is directly applicable in UK law. The Environment Agency is required by national POPs Regulations (SI 2007 No 3106) to give effect to Article 6(3) of the EC POPs Regulation when determining applications for environmental Permits.

However, it needs to be borne in mind that this application is for a particular type of installation, namely a waste incinerator. The Stockholm Convention distinguishes between intentionally-produced and unintentionally-produced POPs. Intentionally-produced POPs are those used deliberately (mainly in the past) in agriculture (primarily as pesticides) and industry. Those intentionally-produced POPs are not relevant where waste incineration is concerned, as in fact high-temperature incineration is one of the prescribed methods for destroying POPs.

The unintentionally-produced POPs addressed by the Convention are:

- dioxins and furans;
- HCB (hexachlorobenzene)
- PCBs (polychlorobiphenyls) and
- PeCB (pentachlorobenzene)

The UK's national implementation plan for the Stockholm Convention, published in 2007, makes explicit that the relevant controls for unintentionally-produced POPs, such as might be produced by waste incineration, are delivered through a combination of IPPC and IED requirements. That would, as required by the IPPC Directive, include an examination of BAT, including potential alternative techniques, with a view to preventing or minimising harmful emissions. These have been applied as explained in this document, which explicitly addresses alternative techniques and BAT for the minimisation of emissions of dioxins.

Our legal obligation, under regulation 4(b) of the POPs Regulations, is, when considering an application for an environmental permit, to comply with article 6(3) of the POPs Regulation:

> "Member States shall, when considering proposals to construct new facilities or significantly to modify existing facilities using processes that release chemicals listed in Annex III, without prejudice to Council Directive 1996/61/EC, give priority consideration to alternative processes, techniques or practices that have similar usefulness but which avoid the formation and release of substances listed in Annex III."

The 1998 Protocol to the Convention recommended that unintentionally produced POPs should be controlled by imposing emission limits (e.g. 0.1 ng/m^3 for MWIs) and using BAT for incineration. UN Economic Commission for Europe (Executive Body for the Convention) (ECE-EB) produced BAT guidance for the parties to the Convention in 2009. This document considers various control techniques and concludes that primary measures involving management of feed material by reducing halogenated substances are not technically effective. This is not surprising because halogenated wastes still need to be disposed of and because POPs can be generated from relatively low concentrations of halogens. In summary, the successful control techniques for waste incinerators listed in the ECE-EB BAT are:

- maintaining furnace temperature of 850^{o}C and a combustion gas residence time of at least 2 seconds
- rapid cooling of flue gases to avoid the *de novo* reformation temperature range of 250-450^{o}C

- use of bag filters and the injection of activated carbon or coke to adsorb residual POPs components.

Using the methods listed above, the UN-ECE BAT document concludes that incinerators can achieve an emission concentration of 0.1 ng TEQ/m^3.

We believe that the Permit ensures that the formation and release of POPs will be prevented or minimised. As we explain above, high-temperature incineration is one of the prescribed methods for destroying POPs. Permit conditions are based on the use of BAT and IED and incorporate all the above requirements of the UN-ECE BAT guidance and deliver the requirements of the Stockholm Convention in relation to unintentionally produced POPs.

The release of **dioxins and furans** to air is required by the IED to be assessed against the I-TEQ (International Toxic Equivalence) limit of 0.1 ng/m^3. Further development of the understanding of the harm caused by dioxins has resulted in the World Health Organisation (WHO) producing updated factors to calculate the WHO-TEQ value. Certain **PCBs** have structures which make them behave like dioxins (dioxin-like PCBs), and these also have toxic equivalence factors defined by WHO to make them capable of being considered together with dioxins. The UK's independent health advisory committee, the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) has adopted WHO-TEQ values for both dioxins and dioxin-like PCBs in their review of Tolerable Daily Intake (TDI) criteria. EPR requires that, in addition to the requirements of the IED, the WHO-TEQ values for both dioxins and dioxin-like PCBs should be specified for monitoring and reporting purposes, to enable evaluation of exposure to dioxins and dioxin-like PCBs to be made using the revised TDI recommended by COT. The release of dioxin-like PCBs and PAHs is expected to be low where measures have been taken to control dioxin releases. EPR requires monitoring of a range of PAHs and dioxin-like PCBs in waste incineration Permits at the same frequency as dioxins are monitored. We have included a requirement to monitor and report against these WHO-TEQ values for dioxins and dioxin-like PCBs and the range of PAHs identified by Defra in the Environmental Permitting Guidance on the IED. We are confident that the measures taken to control the release of dioxins will also control the releases of dioxin-like PCBs and PAHs. Section 5.2 of this document details the assessment of emissions to air, which includes dioxins and concludes that there will be no adverse effect on human health from either normal or abnormal operation.

Hexachlorobenzene (HCB) is released into the atmosphere as an accidental product from the combustion of coal, waste incineration and certain metal processes. It has also been used as a fungicide, especially for seed treatment although this use has been banned in the UK since 1975. Natural fires and volcanoes may serve as natural sources. Releases of (HCB) are addressed by the European Environment Agency (EEA), which advises that:

> "*due to comparatively low levels in emissions from most (combustion) processes special measures for HCB control are usually not proposed.*

HCB emissions can be controlled generally like other chlorinated organic compounds in emissions, for instance dioxins/furans and PCBs: regulation of time of combustion, combustion temperature, temperature in cleaning devices, sorbents application for waste gases cleaning etc." [reference http://www.eea.europa.eu/publications/EMEPCORINAIR4/sources_of_HCB.pdf]

Pentchlorobenzene (PeCB) is another of the POPs list to be considered under incineration. PeCB has been used as a fungicide or flame retardant, there is no data available however on production, recent or past, outside the UN-ECE region. PeCBs can be emitted from the same sources as for PCDD/F: waste incineration, thermal metallurgic processes and combustion plants providing energy. As discussed above, the control techniques described in the UN-ECE BAT guidance and included in the permit, are effective in controlling the emissions of all relevant POPs including PeCB.

We have assessed the control techniques proposed for dioxins by the Applicant and have concluded that they are appropriate for dioxin control. We are confident that these controls are in line with the UN-ECE BAT guidance and will minimise the release of HCB, PCB and PeCB.

We are therefore satisfied that the substantive requirements of the Convention and the POPs Regulation have been addressed and complied with.

6.5 Other Emissions to the Environment

6.5.1 Emissions to water

Emissions to water are minimised by an integral water treatment facility which conditions the cooling water allowing six cycles before blowdown and additionally the use of boiler blowdown as cooling tower makeup water.

There are two distinct waste water types, that which does have direct contact with the syngas used to quench the syngas from the gasifier and syngas scrubber (see Section 6.5.2 Emissions to Sewer below) and that which does not have contact with the syngas used in the boiler, cooling tower and rainwater from process areas.

Wastewater streams that do not have direct contact with the syngas are treated by the discharge to surface water system. This treatment system receives flow through a gravity sewer. The storm water that falls on areas potentially contaminated by oil is treated in the oily water sewer system. The oily water sewer flows by gravity to a lift station and is treated in a separator package to remove the oil contamination. The solids are removed manually when the unit is under maintenance. The oil is skimmed into an attached skimmed oil section of the separator package. The skimmed oil section is periodically emptied when full by tank trucks. The effluent discharges to the surface water system. The final discharge of these systems is to the River tees at a single emission point. (W1 shown on the site plan).

The non-contact wastewater and uncontaminated surface water from non-process areas are discharged to the effluent basin prior to final discharge to the River Tees at emission point W1. The effluent basin allows solids to settle and has an underflow baffle to trap oil. The effluent basin also contains a floating oil skimmer package capable of removing any floating oil that may be present in the basin. The skimmer uses a sliding shoe pump to transfer the floating contaminant to the skimmer oil tank. The effluent basin discharge has a composite sampling system used to monitor waste discharging to the River Tees. The composite samples will be tested for pH, COD, TSS, and oil & grease.

Based upon the information in the application we are satisfied that appropriate measures will be in place to prevent or minimise emissions to water.

6.5.2 Emissions to sewer

Emissions to sewer from the syngas quench, venturi scrubber blowdown, wet electrostatic precipitators blowdown, flare knockout drum blowdown, condensate and any other wastewater streams that are potentially in direct contact with the syngas are routed via the on-site process effluent treatment plant to the Northumbrian Water Limited wastewater treatment plant at Bran Sands, for treatment and discharge. The process effluent is directed to a common effluent treatment lagoon used for the similar process effluent from the TV I facility. Emissions to sewer were considered during the determination of the Permit issued for TV I and were all considered to result in an insignificant impact and because concentrations will not increase as a result of the inclusion of TV II we also concluded no significant impact. Emission limit values for this effluent are not proposed.

All emissions to sewer will be subject to discharge consent to be put in place by Northumbrian Water Limited.

Based upon the information in the application we are satisfied that appropriate measures will be in place to minimise emissions to sewer.

6.5.3 Fugitive emissions

The IED specifies that plants must be able to demonstrate that the plant is designed in such a way as to prevent the unauthorised and accidental release of polluting substances into soil, surface water and groundwater.
The dust that could arise from the facility during the movement of fuel (i.e. waste to be combusted) will be prevented as follows. The MSW will be pre-shredded to less than 300mm offsite and screened to remove fines prior to delivery to site. Further shredding on site to reduce material size and increase bulk density will be carried out in an enclosed unit with local dust extraction and fabric filter unit installed. The fully enclosed nature of the delivery system and likewise all potentially dusty raw materials which are handled in enclosed systems and stored in silos vented through fabric filters will as far as is practicable prevent fugitive emissions of dust. Potentially dusty or odorous air

from the waste handling area is vented through a carbon bed. The gasifier charging system, gasification chamber and syngas routing systems are all fully enclosed.

Raw material unloading is through enclosed systems with displaced air vented through fabric filters. Material and waste transfer is undertaken using fully enclosed conveyor systems.

The granulated slag is not considered to be a dusty material as it is vitrified.

There will be no subsurface bulk storage or process materials pipework. All waste will be processed in an enclosed building or the enclosed gasifier structure. The process will not involve the use of bulk hazardous liquids. All process areas and areas where spillages may occur will be covered with an impermeable surface and provided with sealed drainage. The main process area will be made of high quality concrete hardstanding with sealed construction joints where appropriate. Process and non-process areas are separate, with potentially contaminated surface water from process areas being treated prior to discharge. All external roadways, turning areas and parking areas will be sealed concrete or tarmac with concrete kerbs. Such areas will be laid with falls towards the drainage system so that all runoff is directed towards the dedicated drains, which are fitted with oil interceptors, rather than escape onto surrounding soft ground.

The only above ground bulk liquid storage tank will be for light fuel oil for the firewater pump backup generator. This will be within the workshop, with bunding provided with 110% of the tank capacity. Silos containing powdered materials will be vented through bag filters.

The main waste storage area will be inside the main process building in a fully contained environment. There are no external waste storage areas.

Based upon the information in the application we are satisfied that appropriate measures will be in place to prevent or minimise fugitive emissions.

6.5.4 Odour

The facility is designed to minimise the generation of odours and to contain and control any sources with the potential for odour generation. The methods and equipment employed to minimise and control odour generation are the use of totally enclosed waste feedstock storage, handling and conveyance systems; minimisation of on-site storage through twenty four hour, seven day per week deliveries; use of an efficient feedstock rotation storage system to minimize MSW holding time; control of ventilation exhaust with activated carbon beds for odour abatement; and use of a pre-sorted and pre-sized feed material.

The transport of the waste feedstock from the storage bunkers to the gasifier is by enclosed conveyor systems.

Conventional incineration facilities typically use combustion air taken from above the waste pit to draw a slight vacuum on the MSW storage facilities and hence provide some odour destruction as it passes through the furnace. The gasifier employs oxygen with minimal air to gasify the feed and hence cannot draw the air from the waste feedstock storage area. Instead, this facility employs enclosures and reduces the residence time of material on site, coupled with a control device for minimisation of particulate emissions and to control odours. The storage bunker entrance is specifically designed to handle the unloading of walking floor conveyor enclosed delivery trucks. During unloading, the truck will back up to the enclosure and the opening will have strip curtains to minimise odour escape from the enclosure. A ventilation fan will draw air from the enclosure maintaining a slight negative pressure, and vent to an activated carbon bed for removal of odorous compounds. During shutdown or when deliveries are not required, the bunkers will be closed to ensure odours are not released from the storage areas and the control devices will remain in operation, as needed.

Based upon the information in the application we are satisfied that the appropriate measures will be in place to prevent or where that is not practicable to minimise odour and to prevent pollution from odour.

6.5.5 Noise and vibration

The principal sources of noise at the facility will be gas turbines and associated combustion air compressors; syngas fans and compressor; oxygen generation plant; steam vents; boiler combustion air fans; material handling. loading and unloading systems; and on-site vehicle noise. The Applicant proposes basic good practice measures for the control of noise, including adequate maintenance of any parts of plant or equipment whose deterioration may give rise to increases in noise (for example, bearings, air handling plant, the building fabric, and specific noise attenuation kit associated with plant or machinery) which will be employed throughout the installation.

The machinery is designed to minimise vibration effects and there are no anticipated on or off site vibrations.

The primary method for the control of noise will be the specification of low noise generation equipment. For those equipment items which either generate noise at levels that might impact facility workers, or that have noise levels that could potentially exceed fence line allowable noise levels, sound attenuation devices will be employed. It is anticipated that sound attenuation will be included for some equipment including a sound attenuating building for the oxygen generation plant; vendor furnished noise attenuation enclosure for the gas turbines, large compressors and blowers; sound attenuation for the steam turbine; building enclosure for the diesel generator; and silencers where required.

In areas where air intakes (such as combustion air inlets) or vents (start-up steam vents or vents from the oxygen generation plant) can produce a noise impact silencers will be included in the design.

In addition, good operating practice will be employed for the control of noise that includes adequate maintenance of any parts of plant or equipment whose deterioration may give rise to increases in noise (for example bearings or integrity of noise attenuation enclosures).

The use of 24 hour, 7 day per week deliveries will spread out the truck deliveries and result in fewer vehicles on-site at any given time. The facility layout has also been developed to avoid noise sources close to the property line or sensitive noise receptors.

Based upon the information in the application we are satisfied that the appropriate measures will be in place to prevent or where that is not practicable to minimise noise and vibration and to prevent pollution from noise and vibration.

The application contained a noise impact assessment which identified local noise-sensitive receptors, potential sources of noise at the proposed plant and noise attenuation measures. Measurements were taken of the prevailing ambient noise levels to produce a baseline noise survey and an assessment was carried out in accordance with BS 4142 to compare the predicted plant rating noise levels with the established background levels.

The following noise sensitive receptors have been identified in the vicinity of the proposed facility:

Port Clarence Road (residential area); Port Clarence encompasses the nearest residential receptors and public open space. The noise level design target has been set based on the more stringent requirement of the residential receptors based on the criteria of BS 4142 and the recommendations of the SBC EHO.

The lowest background noise level, 32 dB LA90,5 min, was measured at Samphire Street, Port Clarence at 23.35 hrs on Sunday 11/7/10. As one or more of the noise sources at the facility will be tonal in nature, the target noise level needs to be 5 dB lower than the existing background to give a 'rating level' (including a 5 dB penalty for tonality) that is equal to the existing background.

The resulting target noise level at Port Clarence rounded to 1 dB is 27 dB LAeq,T.

The existing ambient noise level recorded in the area in the daytime was 52 dB LAeq,T and hence the impact of the noise from the normal operation of the facility would be negligible for public open spaces in Port Clarence.

The assessment carried out demonstrates that the noise control techniques that will be employed will ensure that the noise from the installation does not give rise to reasonable cause for annoyance during normal operation.

Dorman's Pool (ecologically sensitive area); The noise target at Dorman's Pool takes into account the measured existing ambient daytime noise levels and aims not to cause an increase of more than 3 dB LAeq,T in these levels. The rationale behind this proposal is to not cause a perceptible increase in the ambient noise levels affecting the human users of the site during the daytime.

A background survey was undertaken for the noise assessment included in the ES. The existing average daytime noise level was measured at 45 dB LAeq,T. The resulting target noise level at the receptor due to all site activities at the facility is 41 dB LAeq,T. Summing the measured existing and the predicted facility noise levels gives a cumulative noise level of 46 dB LAeq,T.

The existing night-time noise levels were measured at 41 dB LAeq,T. The addition of the target noise level from the facility gives a cumulative level of 44 dB LAeq,T, i.e. an increase of 3 dB LAeq,T.

This shows no significant impact on this ecological receptor. Existing ambient and background noise levels at RSPB Saltholme and Cowpen Bewley are similar to these receptors. This combined with a greater separation distance means that targets at these receptors would be less stringent and the impact would not be likely to be significant. We have audited the Applicant's data and modelling and agree with the Applicant's conclusions that noise emissions will not significantly impact upon any ecological receptor.

6.6 Setting ELVs and other Permit conditions

6.6.1 Translating BAT into Permit conditions

The use of IED limits for air dispersion modelling sets the worst case scenario. If this shows emissions are insignificant then we accept that the Applicant's proposals are BAT, and that there is no justification to reduce ELVs below those IED levels in these circumstances.

Below we consider whether, for those emission not screened out as insignificant, different conditions are required as a result of consideration of local or other factors.

(i) Local factors

We have considered the proximity of the installation to the Teesmouth and Cleveland Coast Special Protection Area and Ramsar. For details of our considerations, please see section 5.4 above.

(ii) National and European EQSs

In determining this Permit, the Environment Agency has had regard to the Air Quality Strategy for England, Scotland, Wales and Northern Ireland. This has been considered by using the relevant Air Quality Objectives as part of the air quality assessment in section 5.2 of this document.

We have also taken into account relevant air quality limit and target values set out in the EC Air Quality Framework Directive & Daughter Directives.

The Environment Agency considers that it has taken its decision in compliance with the Air Quality Strategy and EU Directives, and that there are no additional conditions that should be included in this Permit.

(iii) Global Warming

CO_2 is an inevitable product of the combustion of waste. The amount of CO_2 emitted will be essentially determined by the quantity and characteristics of waste being incinerated, which are already subject to conditions in the Permit. It is therefore inappropriate to set an emission limit value for CO_2, which could do no more than recognise what is going to be emitted. The gas is not therefore targeted as a key pollutant under the IPPCD or under IED, e.g. it is not included in Annex III to the IPPCD, which lists the main polluting substances that are to be considered when setting emission limit values (ELVs) in Permits.

We have therefore considered setting equivalent parameters or technical measures for CO_2. However, provided energy is recovered efficiently (see section 4.3.7 above), there are no additional equivalent technical measures (beyond those relating to the quantity and characteristics of the waste) that can be imposed that do not run counter to the primary purpose of the plant, which is the recovery of energy from waste. Controls in the form of restrictions on the volume and type of waste that can be accepted at the Installation and permit conditions relating to energy efficiency effectively apply equivalent technical measures to limit CO_2 emissions.

(iv) Commissioning

A Commissioning Plan is to be submitted by the Applicant in line with the Technical Guidance Note, The Incineration of Waste, EPR 5.01 Section 2.5 Validation of Combustion Conditions. The Permit therefore contains a Pre-Operational Condition, PO4 which requires that the Operator, prior to the commencement of commissioning, shall provide a written commissioning plan, including timelines for completion, for approval by the Environment Agency. The commissioning plan shall include the expected emissions to the environment during the different stages of commissioning, the expected durations of commissioning activities and the actions to be taken to protect the environment and report to the Environment Agency in the event that actual emissions exceed expected emissions. Commissioning shall be carried out in accordance with the commissioning plan as approved. Furthermore, the Permit contains an Improvement Condition, IC3, that requires the Operator to submit a fully detailed commissioning report to the Agency within 4 months of the completion of the commissioning period.

6.7 Monitoring

6.7.1 Monitoring during normal operations

We have decided that monitoring should be carried out for the parameters listed in Schedule 3 of the Permit using the methods and to the frequencies specified in those tables. These monitoring requirements have been imposed in order to demonstrate compliance with emission limit values and to enable correction of measured concentration of substances to the appropriate reference conditions; to deliver the EPR requirement that dioxin-like PCBs and PAHs should be monitored.

For emissions to air, the methods for continuous and periodic monitoring are in accordance with the Environment Agency's Guidance M2 for monitoring of stack emissions to air.

Based on the information in the Application and the requirements set in the conditions of the permit we are satisfied that the Operator's techniques, personnel and equipment will have either MCERTS certification or MCERTS accreditation as appropriate.

6.7.2 Monitoring under abnormal operations arising from the failure of the installed CEMs

There are three point source emissions to air that will require the installation of Continuous Emission Monitors, these being each of the two gas turbine exhaust stacks and the auxiliary boiler turbine stack which will have their own independent exhaust stacks and CEMs packages.

IED abnormal operations are defined as any technically unavoidable stoppages, disturbances, or failures of the abatement plant or the measurement devices, during which the concentrations in the discharges into air may exceed the normal emission limit values.

It is considered BAT to provide backup CEMs packages so that in the event of failure of the primary CEMs the backup CEMs can be brought online and thus operation of the facility can continue. However, CEMs packages have a high capital value and this facility would require 3 primary and 3 backup packages. Because of the flexibility of the design of the plant, which allows for any one of the three turbines to trip and the syngas that would normally fuel the tripped turbine can be diverted to the other two which have reserve capacity available and supported by a flare stack, the same approach can therefore be applied to CEMs failure. Hence, in the event of any CEMs failure the turbine associated with that CEM will automatically shutdown and no further syngas will be combusted and no emissions will exit the unmonitored exhaust stack. Only when the failure with the CEMs unit has been rectified can the associated turbine be brought back online. In the highly unlikely event that two or even all three CEMs packages fail simultaneously then feeding of waste to the Gasifier and production of syngas must halt and the entire plant put into shutdown mode and syngas held within the system sent to the flare stack.

6.7.3 Continuous emissions monitoring for dioxins and mercury

In addition to CEMs monitoring, non-continuous monitoring will be undertaken to demonstrate compliance with IED Annex VI.

The Environment Agency has reviewed the applicability of continuous sampling and monitoring techniques to the installation.

Recent advances in mercury monitoring techniques have allowed standards to be developed for continuous mercury monitoring, including both vapour-phase and particulate mercury. There is a standard which can apply to CEMs which measure mercury (EN 15267-3) and standards to certify CEMs for mercury, which are EN 15267-1 and EN 15267-3. Furthermore, there is an MCERTS-certified CEM which has been used in trials in the UK and which has been verified on-site using many parallel reference tests as specified using the steps outlined in EN 14181.

In the case of dioxins, equipment is available for taking a sample for an extended period (several weeks), but the sample must then be analysed in the conventional way. However, the continuous sampling systems do not meet the requirements of BS EN 1948 which is the standard for dioxin analysis. BS EN 1948 requires traversing the sampler across the duct and collecting parts of the sample at various points across the duct to ensure that all of the gas phase is sampled proportionately, in case there are variations in gas flow rate or composition resulting in a non-homogeneous gas flow. This requirement is particularly important where suspended solids are present in the gas, and dioxins are often associated with suspended solid particles. Continuous samplers are currently designed for operation at one or two fixed sampling points within the duct, and traverses are not carried out automatically. Using such samplers, more information could be obtained about the variation with time of the dioxin measurement, but the measured results could be systematically higher or lower than those obtained by the approved standard method which is the reference technique required to demonstrate compliance with the limit specified in the IED. The lack of a primary reference method (e.g. involving a reference gas of known concentration of dioxin) prohibits any one approach being considered more accurate than another. Because compliance with the IED’s requirements is an essential element of EPR regulation, we have set emission limits for dioxins in the permit based on the use of BS EN 1948 and the manual sampling method remains the only acceptable way to monitor dioxins for the purpose of regulation.

For either continuous monitoring of mercury or continuous sampling of dioxins to be used for regulatory purposes, an emission limit value would need to be devised which is applicable to continuous monitoring. Such limits for mercury and dioxins have not been set by the European Commission. Use of a manual sample train is the only technique which fulfils the requirements of the IED. At the present time, it is considered that in view of the predicted low levels of mercury and dioxin emission it is not justifiable to require the Operator to install additionally continuous monitoring or sampling devices for these substances.

In accordance with its legal requirement to do so, the Environment Agency reviews the development of new methods and standards and their performance in industrial applications. In particular the Environment Agency considers continuous sampling systems for dioxins to have promise as a potential means of improving process control and obtaining more accurate mass emission estimates.

6.8 Reporting

We have specified the reporting requirements in Schedule 5 of the Permit either to meet the reporting requirements set out in the IED, or to ensure data is reported to enable timely review by the Environment Agency to ensure compliance with permit conditions and to monitor the efficiency of material use and energy recovery at the installation.

7 Other legal requirements

In this section we explain how we have addressed other relevant legal requirements, to the extent that we have not addressed them elsewhere in this document.

7.1 The EPR 2010 and related Directives

The EPR delivers the requirements of a number of European and national laws.

7.1.1 Schedules 1 and 7 to the EPR 2010 – **IED Directive**

We address the requirements of the IED in the body of this document above and the specific requirements of Chapter IV in Annex 1 of this document.

There is one requirement not addressed above, which is that contained in Article 5(3) IED. Article 5(3) requires that "In the case of a new installation or a substantial change where Article 4 of Directive 85/337/EC (the EIA Directive) applies, any relevant information obtained or conclusion arrived at pursuant to articles 5, 6 and 7 of that Directive shall be examined and used for the purposes of granting the permit."

- Article 5 of EIA Directive relates to the obligation on developers to supply the information set out in Annex IV of the Directive when making an application for development consent.
- Article 6(1) requires Member States to ensure that the authorities likely to be concerned by a development by reason of their specific environmental responsibilities are consulted on the Environmental Statement and the request for development consent.
- Article 6(2)-6(6) makes provision for public consultation on applications for development consent.
- Article 7 relates to projects with transboundary effects and consequential obligations to consult with affected Member States.

The grant or refusal of development consent is a matter for the relevant local planning authority. The Environment Agency's obligation is therefore to examine and use any relevant information obtained or conclusion arrived at by the local planning authorities pursuant to those EIA Directive articles.

In determining the Application we have considered the following documents: -

- The Environmental Statement submitted with the planning application (which also formed part of the Environmental Permit Application).
- The decision of the Stockton Borough Council to grant planning permission on 15 July 2013.
- The response of the Environment Agency to the local planning authority in its role as consultee to the planning process.

From consideration of all the documents above, the Environment Agency considers that no additional or different conditions are necessary.

The Environment Agency has also carried out its own consultation on the Environmental Permitting Application which includes the Environmental Statement submitted to the local planning authority. The results of our consultation are described elsewhere in this decision document.

7.1.2 Schedule 9 to the EPR 2010 – **Waste Framework Directive**

As the Installation involves the treatment of waste, it is carrying out a *waste operation* for the purposes of the EPR 2010, and the requirements of Schedule 9 therefore apply. This means that we must exercise our functions so as to ensure implementation of certain articles of the WFD.

We must exercise our relevant functions for the purposes of ensuring that the waste hierarchy referred to in Article 4 of the Waste Framework Directive is applied to the generation of waste and that any waste generated is treated in accordance with Article 4 of the Waste Framework Directive. (See also section 4.3.9)

The conditions of the permit ensure that waste generation from the facility is minimised. Where the production of waste cannot be prevented it will be recovered wherever possible or otherwise disposed of in a manner that minimises its impact on the environment. This is in accordance with Article 4.

We must also exercise our relevant functions for the purposes of implementing Article 13 of the Waste Framework Directive; ensuring that the requirements in the second paragraph of Article 23(1) of the Waste Framework Directive are met; and ensuring compliance with Articles 18(2)(b), 18(2)(c), 23(3), 23(4) and 35(1) of the Waste Framework Directive.

Article 13 relates to the protection of human health and the environment. These objectives are addressed elsewhere in this document.

Article 23(1) requires the permit to specify:

- (a) the types and quantities of waste that may be treated;
- (b) for each type of operation permitted, the technical and any other requirements relevant to the site concerned;
- (c) the safety and precautionary measures to be taken;
- (d) the method to be used for each type of operation;
- (e) such monitoring and control operations as may be necessary;
- (f) such closure and after-care provisions as may be necessary.

These are all covered by permit conditions.

We consider that the intended method of waste treatment is acceptable from the point of view of environmental protection so Article 23(3) does not apply.

Energy efficiency is dealt with elsewhere in this document but we consider the conditions of the permit ensure that the recovery of energy take place with a high level of energy efficiency in accordance with Article 23(4).

Article 35(1) relates to record keeping and its requirements are delivered through permit conditions.

7.1.3 Schedule 22 to the EPR 2010 – **Groundwater, Water Framework and Groundwater Daughter Directives**

To the extent that it might lead to a discharge of pollutants to groundwater (a "groundwater activity" under the EPR 2010), the Permit is subject to the requirements of Schedule 22, which delivers the requirements of EU Directives relating to pollution of groundwater. The Permit will require the taking of all necessary measures to prevent the input of any hazardous substances to groundwater, and to limit the input of non-hazardous pollutants into groundwater so as to ensure such pollutants do not cause pollution, and satisfies the requirements of Schedule 22.

No releases to groundwater from the Installation are permitted. The Permit also requires material storage areas to be designed and maintained to a high standard to prevent accidental releases.

7.1.4 Directive 2003/35/EC – The Public Participation Directive

Regulation 59 of the EPR 2010 requires the Environment Agency to prepare and publish a statement of its policies for complying with its public participation duties. We have published our public participation statement.

This Application is being consulted upon in line with this statement, as well as with our guidance RGS6 on Sites of High Public Interest, which addresses specifically extended consultation arrangements for determinations where public interest is particularly high. This satisfies the requirements of the Public Participation Directive.

7.2 National primary legislation

7.2.1 **Environment Act 1995**

(i) Section 4 (Pursuit of Sustainable Development)

We are required to contribute towards achieving sustainable development, as considered appropriate by Ministers and set out in guidance issued to us. The Secretary of State for Environment, Food and Rural Affairs has issued *The Environment Agency's Objectives and Contribution to Sustainable Development: Statutory Guidance (December 2002)*. This document:

> "*provides guidance to the Agency on such matters as the formulation of approaches that the Agency should take to its work, decisions about priorities*

for the Agency and the allocation of resources. It is not directly applicable to individual regulatory decisions of the Agency".

In respect of regulation of industrial pollution through the EPR, the Guidance refers in particular to the objective of setting permit conditions "*in a consistent and proportionate fashion based on Best Available Techniques and taking into account all relevant matters…*". The Environment Agency considers that it has pursued the objectives set out in the Government's guidance, where relevant, and that there are no additional conditions that should be included in this Permit to take account of the Section 4 duty.

(ii) Section 7 (Pursuit of Conservation Objectives)

We considered whether we should impose any additional or different requirements in terms of our duty to have regard to the various conservation objectives set out in Section 7, but concluded that we should not.

We have considered the impact of the installation on local wildlife sites within 2 Km which are not designated as either European Sites or SSSIs. We are satisfied that no additional conditions are required.

(iii) Section 81 (National Air Quality Strategy)

We have had regard to the National Air Quality Strategy and consider that our decision complies with the Strategy, and that no additional or different conditions are appropriate for this Permit.

7.2.2 **Human Rights Act 1998**

We have considered potential interference with rights addressed by the European Convention on Human Rights in reaching our decision and consider that our decision is compatible with our duties under the Human Rights Act 1998. In particular, we have considered the right to life (Article 2), the right to a fair trial (Article 6), the right to respect for private and family life (Article 8) and the right to protection of property (Article 1, First Protocol). We do not believe that Convention rights are engaged in relation to this determination.

7.2.3 **Countryside and Rights of Way Act 2000 (CROW 2000)**

Section 85 of this Act imposes a duty on Environment Agency to have regard to the purpose of conserving and enhancing the natural beauty of the area of outstanding natural beauty (AONB). There is no AONB which could be affected by the Installation.

7.2.4 **Wildlife and Countryside Act 1981**

Under section 28G of the Wildlife and Countryside Act 1981 the Environment Agency has a duty to take reasonable steps to further the conservation and enhancement of the flora, fauna or geological or physiographical features by reason of which a site is of special scientific interest. Under section 28I the

Environment Agency has a duty to consult Natural England in relation to any permit that is likely to damage SSSIs.

All SSSI sites were located within the SPA and hence all aerial emissions were considered during the modelling at these locations. There were no other operations which were considered likely to cause damage in accordance with appropriate designations.

7.2.5 **Natural Environment and Rural Communities Act 2006**

Section 40 of this Act requires us to have regard, so far as is consistent with the proper exercise of our functions, to the purpose of conserving biodiversity. We have done so and consider that no different or additional conditions in the Permit are required.

7.3 National secondary legislation

7.3.1 **The Conservation of Natural Habitats and Species Regulations 2010**

We have assessed the Application in accordance with guidance agreed jointly with Natural England and concluded that there will be no likely significant effect on any European Site.

We notified Natural England by means of an Appendix 11 assessment and they agreed with our conclusion, that the operation of the Installation would not have a likely significant effect on the interest features of protected sites.

The habitat assessment is summarised in greater detail in section 5.4 of this document. A copy of the full Appendix 11 can be found on the public register.

7.3.2 **Water Framework Directive Regulations 2003**

Consideration has been given to whether any additional requirements should be imposed in terms of the Environment Agency's duty under regulation 3 to secure the requirements of the Water Framework Directive through (inter alia) EP permits, but it is felt that existing conditions are sufficient in this regard and no other appropriate requirements have been identified.

7.3.3 **The Persistent Organic Pollutants Regulations 2007**

We have explained our approach to these Regulations, which give effect to the Stockholm Convention on POPs and the EU's POPs Regulation, above.

7.4 Other relevant legal requirements

7.4.1 Duty to Involve

S23 of the Local Democracy, Economic Development and Construction Act 2009 require us where we consider it appropriate to take such steps as we consider appropriate to secure the involvement of interested persons in the exercise of our functions by providing them with information, consulting them or involving them in any other way. S24 requires us to have regard to any Secretary of State guidance as to how we should do that.

The way in which the Environment Agency has consulted with the public and other interested parties is set out in section 2 of this document. The way in which we have taken account of the representations we have received is set out in Annex 4. Our public consultation duties are also set out in the EP Regulations, and our statutory Public Participation Statement, which implement the requirements of the Public Participation Directive. In addition to meeting our consultation responsibilities, we have also taken account of our guidance in Environment Agency Guidance Note RGS6 and the Environment Agency's Building Trust with Communities toolkit.

ANNEX 1: APPLICATION OF CHAPTER IV OF THE INDUSTRIAL EMISSIONS DIRECTIVE

IED Article	Requirement	Delivered by
45(1)(a)	The permit shall include a list of all types of waste which may be treated using at least the types of waste set out in the European Waste List established by Decision 2000/532/EC, if possible, and containing information on the quantity of each type of waste, where appropriate.	Condition 2.3.3 and Table S2.2 in Schedule 2 of the Permit.
45(1)(b)	The permit shall include the total waste incinerating or co-incinerating capacity of the plant.	Condition 2.3.3 and Table S2.2 in Schedule 2.
45(1)(c)	The permit shall include the limit values for emissions into air.	Condition 3.1.1 and Tables A3.1, S3.2 and S3.3 in Schedule 3.
45(1)(e)	The permit shall include the sampling and measurement procedures and frequencies to be used to comply with the conditions set for emissions monitoring.	Conditions 3.5.1 and Tables S3.1, S3.2, S3.3, S3.4 and S3.5.
45(1)(f)	The permit shall include the maximum permissible period of unavoidable stoppages, disturbances or failures of the purification devices or the measurement devices, during which the emissions into the air and the discharges of waste water may exceed the prescribed emission limit values.	Conditions 2.3.6 to 2.3.11.
46(1)	Waste gases shall be discharged in a controlled way by means of a stack the height of which is calculated in such a way as to safeguard human health and the environment.	Emissions and their ground-level impacts are discussed in the body of this document,
46(3)	Relates to conditions for water discharges from the cleaning of exhaust gases.	There are no such discharges as condition 3.1.1 prohibits this.
46(4)	Relates to conditions for water discharges from the cleaning of exhaust gases.	There are no such discharges as condition 3.1.1 prohibits this.

IED Article	Requirement	Delivered by
46(5)	Prevention of unauthorised and accidental release of any polluting substances into soil, surface water or groundwater. Adequate storage capacity for contaminated rainwater run-off from the site or for contaminated water from spillage or fire-fighting.	The application explains the measures to be in place for achieving the directive requirements
46(6)	Limits the maximum period of operation when an ELV is exceeded to 4 hours uninterrupted duration in any one instance, and with a maximum cumulative limit of 60 hours per year.	Condition 2.3.1 and Condition 2.3.10.
47	In the event of breakdown, reduce or close down operations as soon as practicable.	Condition 2.3.10
48(1)	Monitoring of emissions is carried out in accordance with Parts 6 and 7 of Annex VI.	Schedule 6 details this standardisation requirement.
48(2)	Installation and functioning of the automated measurement systems shall be subject to control and to annual surveillance tests as set out in point 1 of Part 6 of Annex VI.	Condition 3.5.3, and tables S3.1, and S3.4.
48(4)	All monitoring results shall be recorded, processed and presented in such a way as to enable the competent authority to verify compliance with the operating conditions and emission limit values which are included in the permit.	Condition 3.5.2
49	The emission limit values for air and water shall be regarded as being complied with if the conditions described in Part 8 of Annex VI are fulfilled.	
50(1)	Slag and bottom ash to have Total Organic Carbon (TOC) < 3% or loss on ignition (LOI) < 5%.	Conditions 3.5.1 and Table S3.5
50(2)	Flue gas to be raised to a temperature of 850ºC for two seconds, as measured at representative point of the combustion chamber.	Article 51(1) Authorisation to change operating conditions.
50(3)	At least one auxiliary burner which must not be fed with fuels which can cause higher emissions than those resulting from the burning of gas oil	Condition 2.3.7

IED Article	Requirement	Delivered by
	liquefied gas or natural gas.	
50(4)(a)	Automatic shut to prevent waste feed if at start up until the specified temperature has been reached.	Condition 2.3.6
50(4)(b)	Automatic shut to prevent waste feed if the combustion temperature is not maintained.	Article 51(1) Authorisation to change operating conditions.
50(4)(c)	Automatic shut to prevent waste feed if the CEMs show that ELVs are exceeded due to disturbances or failure of waste cleaning devices.	Condition 2.3.6
50(5)	Any heat generated from the process shall be recovered as far as practicable.	(a) The plant will generate electricity (b)Operator to review the available heat recovery options prior to commissioning (Condition PO2) and then every 2 years (Condition 1.2. 3)
50(7)	Management of the Installation to be in the hands of a natural person who is competent to manage it.	Conditions 1.1.1 to 1.1.3 and 2.3.1 of the Permit fulfil this requirement.
53(1)	Residues to be minimised in their amount and harmfulness, and recycled where appropriate.	Conditions 1.4.1
53(2)	Prevent dispersal of dry residues and dust during transport and storage.	Conditions 2.3.1 and 3.2.1
53(3)	Test residues for their physical and chemical characteristics and polluting potential including heavy metal content (soluble fraction).	Condition 3.5.1
55(1)	Application, decision and permit to be publicly available.	The Application is on the Public Register as will the final Decision Document and Permit.
55(2)	An annual report on plant operation and monitoring for all plants burning more than 2 tonne/hour waste.	Condition 4.2.2

ANNEX 2: Pre-Operational Conditions

Based on the information on the Application, we consider that we do need to impose pre-operational conditions. These conditions are set out below and referred to, where applicable, in the text of the decision document. We are using these conditions to require the Operator to confirm that the details and measures proposed in the Application have been adopted or implemented prior to the operation of the Installation.

Reference	Pre-operational measures
PO1	Prior to the commencement of commissioning, the Operator shall send a summary of the site Environment Management System (EMS) to the Environment Agency and make available for inspection all documents and procedures which form part of the EMS. The EMS shall be developed in line with the requirements set out in How to comply with your environmental permit. The documents and procedures set out in the EMS shall form the written management system referenced in condition 1.1.1 (a) of the permit.
PO2	Prior to the commencement of commissioning, the Operator shall send a report to the Environment Agency which will contain a comprehensive review of the options available for utilising the heat generated by the waste incineration process in order to ensure that it is recovered as far as practicable. The review shall detail any identified proposals for improving the recovery and utilisation of waste heat and shall provide a timetable for their implementation.
PO3	Prior to the commencement of commissioning, the Operator shall submit to the Environment Agency for approval a protocol for the sampling and testing of the vitrified slag for the purposes of assessing its hazard status. Sampling and testing shall be carried out in accordance with the IBA protocol as approved.
PO4	Prior to the commencement of commissioning; the Operator shall provide a written commissioning plan, including timelines for completion, for approval by the Environment Agency. The commissioning plan shall include the expected emissions to the environment during the different stages of commissioning, the expected durations of commissioning activities and the actions to be taken to protect the environment and report to the Environment Agency in the event that actual emissions exceed expected emissions. Commissioning shall be carried out in accordance with the commissioning plan as approved.
PO5	Prior to the commencement of commissioning, the Operator shall submit a written report to the Agency detailing the waste acceptance procedure to be used at the site. The waste acceptance procedure shall include the process and systems by which wastes unsuitable for incineration at the site will be controlled. The procedure shall be implemented in accordance with the written approval from the Agency.
PO6	Prior to the commencement of commissioning, the Operator shall submit a written report on the baseline conditions of soil and groundwater at the installation. The report shall contain the information necessary to determine the state of soil and groundwater contamination so as to make a quantified comparison with the state upon definitive cessation of activities provided for in Article 22(3) of the IED. The report shall contain information, supplementary to the already provided in the Application Site Condition Report, needed to meet the information requirements of Article 22(2) of the IED.
PO7	The Operator shall submit the written protocol referenced in condition 3.2.4 for the monitoring of soil and groundwater for approval by the Environment Agency. The protocol shall demonstrate how the Operator will meet the requirements of Articles 14(1)(b), 14(1)(e) and 16(2) of the IED. *The protocol shall be implemented in accordance with the written approval from the Agency.*

ANNEX 3: Improvement Conditions

Based in the information in the Application we consider that we need to set improvement conditions. These conditions are set out below - justifications for these are provided at the relevant section of the decision document. We are using these conditions to require the Operator to provide the Environment Agency with details that need to be established or confirmed during and/or after commissioning.

Reference	Improvement measure	Completion date
IC1	The Operator shall submit a written report to the Environment Agency on the implementation of its Environmental Management System and the progress made in the accreditation of the system by an external body or if appropriate submit a schedule by which the EMS will be subject to accreditation.	Within 12 months of the date on which waste is first burnt.
IC2	The Operator shall submit a written proposal to the Environment Agency to carry out tests to determine the size distribution of the particulate matter in the exhaust gas emissions to air from emission point A1, identifying the fractions within the PM_{10}, $PM_{2.5}$ and $PM_{1.0}$ ranges. The proposal shall include a timetable for approval by the Environment Agency to carry out such tests and produce a report on the results. On receipt of written agreement by the Environment Agency to the proposal and the timetable, the Operator shall carry out the tests and submit to the Environment Agency a report on the results.	Within 6 months of the completion of commissioning.
IC3	The Operator shall submit a written report to the Environment Agency on the commissioning of the installation. The report shall summarise the environmental performance of the plant as installed against the design parameters set out in the Application. The report shall also include a review of the performance of the facility against the conditions of this permit and details of procedures developed during commissioning for achieving and demonstrating compliance with permit conditions.	Within 6 months of the completion of commissioning.

Reference	Improvement measure	Completion date
IC4	The Operator shall submit a written report to the Environment Agency describing the performance and optimisation of the Selective Catalytic Reduction (SCR) system and combustion settings to minimise oxides of nitrogen (NO_x) emissions within the emission limit values described in this permit with the minimisation of nitrous oxide emissions. The report shall include an assessment of the level of NO_x and N_2O emissions that can be achieved under optimum operating conditions. The report shall also provide details of the optimisation for the control of acid gases, heavy metals and dioxins	Within 6 months of the completion of commissioning.
IC5	The Operator shall carry out an assessment of the impact of emissions to air of all the following component metals subject to emission limit values, i.e. Cd, Tl, Hg, Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V. A report on the assessment shall be made to the Environment Agency. Emissions monitoring data obtained during the first year of operation shall be used to compare the actual emissions with those assumed in the impact assessment submitted with the Application. An assessment shall be made of the impact of each metal against the relevant EQS/EAL. In the event that the assessment shows that an EQS/EAL can be exceeded, the report shall include proposals for further investigative work.	15 months from commencement of operations
IC6	The Operator shall submit a written summary report to the Agency to confirm by the results of calibration and verification testing that the performance of Continuous Emission Monitors for parameters as specified in Table S3.1 complies with the requirements of BS EN 14181, specifically the requirements of QAL1, QAL2 and QAL3.	Initial calibration report to be submitted to the Agency within 3 months of completion of commissioning. Full summary evidence compliance report to be submitted within 18 months of commissioning.

ANNEX 4: Consultation Reponses

A) Advertising and Consultation on the Application

The Application has been advertised and consulted upon in accordance with the Environment Agency's Public Participation Statement. The way in which this has been carried out along with the results of our consultation and how we have taken consultation responses into account in reaching our draft decision is summarised in this Annex. Copies of all consultation responses have been placed on the Environment Agency and Local Authority public registers.

The Application was advertised on the Environment Agency website from 24 September 2013 to 28 October 2013. Copies of the Application were placed in the Public Register at the Environment Agency Offices, Tyneside House, Skinnerburn Road, Newcastle Business Park, Newcastle Upon Tyne. NE4 7AR and the Stockton-on-Tees Borough Council Public Register at 16 Church Road, Stockton-on-Tees. TS18 1XD.

The following statutory and non-statutory bodies were consulted and any responses received are summarised below: -

- Environmental Health – Stockton-on-Tees Borough Council
- Public Health England
- Food Standards Agency
- Health and Safety Executive
- Sewage Undertaker
- Natural England
- National Grid

1) Consultation Responses from Statutory and Non-Statutory Bodies

Response Received from *Public Health England*	
Brief summary of issues raised:	Summary of action taken / how this has been covered
The main emissions of concern for public health are oxides of nitrogen, sulphur dioxide, particulate matter and metals, which will be released from the stacks serving the gas turbines. The applicant has also considered emissions of dioxins and the risks to human health from exposure via the food chain. Emissions were modelled on a worst case scenario and are not considered likely to pose a risk to human health. A series of processes are in place, including selective catalytic reduction, to reduce emissions to atmosphere from the	The main emissions of concern and their potential for impacting upon public health are discussed in detail in section 5.2 Air Quality Assessment, of this document. The potential impact upon human health from the inhalation and ingestion of dioxins and furans is discussed in detail in section 5.3.2 Assessment of intake of Dioxins and Furans, of this document.

gas turbines. Emissions are released by a 26 m high stack. Currently there are no operational plasma gasification plants processing waste feedstock in the EU, and the applicant has made comparisons to plants operating in Japan. We would therefore recommend that following commissioning, early monitoring of emissions to atmosphere are undertaken by the operator to confirm the results of the applicants risk assessment, and this is reviewed by the Environment Agency. Based on the information contained in the application supplied to us, Public Health England has no significant concerns regarding the risk to the health of the local population from this Installation.	The Permit requires the Operator to report emissions to the Environment Agency, during the commissioning of the plant, at increased frequency during the first year of operation.

Response Received from *Environmental Health – Stockton-on-Tees B.C.*	
Brief summary of issues raised:	Summary of action taken / how this has been covered
The Council had previously been consulted regarding the Tees Valley Renewable Energy Facility as part of the determination of the Planning Consent. The Council commented that the site is close to a SSSI that may be affected by noise. They had no further comments to make in relation to the Environmental Permit Application.	The Planning Consent had conditions relating to noise mitigation measures and control of noise levels as specified in the Environmental Statement. No additional requirements are considered necessary for the determination of the Environmental Permit. See Section 6.5.5 Noise and Vibration, of this document which assesses the potential impacts of noise upon all relevant sensitive receptors both human and ecological.

Response Received from *Natural England – Telephone conversation (September 2013) Following assessment during the Planning Application by NE and Pre-Application discussions with the EA.*	
Brief summary of issues raised:	Summary of action taken / how this has been covered
The background concentration of NOx for the Teesside and Cleveland Coast SPA, Ramsar exceeds the	Natural England concur with the findings of the Agency's assessment (Appendix 11) and can confirm that it

EQS for the ecological site. Therefore the process contribution for NOx could not be screen out as insignificant. We carried out an Appendix 11 Assessment and sent this to Natural England.	is “NE's view that the process contributions from the new facility will not cause adverse effects on the integrity of the SPA and Ramsar site".

2) <u>Consultation Responses from Members of the Public and Community Organisations</u>

No responses were received from Members of the Public.

a) <u>Representations from Local MP, Councillors and Parish Councils</u>

No representations were received.

b) <u>Representations from Community and Other Organisations</u>

No representations were received.