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

Decision document recording the decision making process

The reference number for the Avonmouth Resource Park permit application ('the Application') is EA/EPR/LP3637GL/A001 and it was duly made on 9th June 2009. Although made under the predecessor Regulations, by virtue of Regulation 87 the Application is taken to be made under the Environmental Permitting (England & Wales) Regulations 2010 ('the Regulations'). Application was made for a permit for two regulated facilities; a standard rules waste operation comprising a household, commercial and industrial transfer station with treatment (the 'Waste Operation'), and an installation comprising an activity listed under Schedule 1 Part II Chapter 5 section 5.1 Part A(1) (a) 'The incineration of hazardous waste in an incineration plant' and directly associated activities ('the Installation') Together, they comprise 'the Facilities'. The reference number for the Avonmouth Resource Park environmental permit ('the Permit') is EPR/LP3637GL. The Application was made by Avonmouth Resource Park Ltd ('the Applicant' and 'the Operator'). The proposed installation ('the Installation') and the proposed waste operation ('the Waste Operation') are located on the same site at Merebank Road, off Kings Weston Lane, Avonmouth[1].

Purpose of this document

This decision document:

- explains how the Applicant's Application has been determined;
- provides a record of the decision-making process;
- shows how all relevant factors have been taken into account; and
- justifies non-template conditions in the permit.

Unless the decision document specifies otherwise, we have accepted the Applicant's proposals.

[1]At the time of the final decision a post code was not available for the proposed Installation.

Structure of this document

Summary of the decision

We have decided to grant a permit to the Applicant, having had regard to the information contained in the application, responses to requests for further information and responses to public consultation on the Application. We consider in reaching that decision we have taken into account all relevant considerations and legal requirements and that the Permit will ensure that the appropriate level of environmental protection is provided.

This document provides an explanation of how we have arrived at our decision to issue a permit. In particular, we are satisfied that the requirements of the Waste Incineration Directive 2000/76/EC (WID) and the Integrated Pollution Prevention and Control Directive 2008/1/EC (IPPCD) will be met. The requirements of the WID and the way in which these have been delivered by the permit are set out in Annex 1, whilst the IPPCD is addressed in the body of this document. All emission limits and operational controls are considered to be based on the use of Best Available Techniques (BAT), as the Integrated Pollution Prevention and Control Directive requires.

The Permit contains many conditions taken from our standard non-landfill permit template which are applied to the Installation. We developed these conditions in consultation with industry, having regard to the legal requirements of the Regulations and other relevant legislation. This decision document does not include an explanation for these standard conditions. Where they are imposed, we have considered the application and accepted that the details are sufficient and satisfactory to control the relevant aspect of operations at the Installation. This decision document does, however, provide an explanation for the choice of conditions where our permit template provides for more than one option. Emissions limits, monitoring requirements and any additional conditions that have been imposed are explained in this document.

Based on the information in the Application we consider that we need to set what are called ‘improvement conditions’ and ‘pre-operational measures’. In the case of a new Installation such as this, they are in fact conditions requiring the design (in the case of pre-operational measures) and delivery (in the case of improvement conditions) of programmes to gather data and verify that particular conditions/requirements have been

met as proposed by the Applicant and/or as required by the Permit. Generally, these are details that need to be established or confirmed during and after commissioning. Improvement conditions and pre-operational measures are set out in Tables S1.3 and S1.4 of the Permit respectively and each is explained and justified in the relevant section of this decision document.

Description of the facilities

Summary

A total of 125,000 tonnes of waste per annum is proposed to be accepted at the site. Of this, 40,000 tonnes per annum will be accepted into the Waste Operation. 85,000 tonnes of waste per annum will be received directly into the Installation and 15,000 tonnes per annum of residual waste from the Waste Operation will also be directed to the Installation. Both Facilities will be regulated under a single permit. Figure 1 depicts in elevation a simplified layout of the process to be operated at the Installation.

The purpose of the Installation is the gasification of household, commercial and industrial wastes and the subsequent combustion of the synthesis gas (syngas) with recovery of energy. The gasification process involves the thermal degradation of wastes into gas (the syngas) by partial oxidation under the application of heat. Partial oxidation is achieved through the restricted supply of air and, once started, the process releases sufficient heat to sustain the gasification reactions. The syngas is then combusted in a secondary combustion chamber and the heat is recovered in a boiler which generates steam to drive a turbine package for the generation of electricity. A proportion of the electricity generated is used to supply the needs of the site, with the balance exported to the National Grid. The net rated thermal input of the Installation is 58.7MW. The maximum electrical output is 13.2MWe, resulting in an expected output of 105,600MWh per annum, on the basis of 8,000 hrs operation per annum (sufficient to meet the demand of approximately 24,000 households). Of this, the Installation will draw a parasitic load of 16,000MWh per annum. The Installation will comprise five lines. Each line consists of four primary combustion chambers, a secondary combustion chamber, a close-coupled boiler, a flue gas treatment package, a by-pass venting system for use during abnormal operations and a flue gas emission point (the flues for all lines are contained within a single windshield). A single turbine and generator will serve all five lines. The Installation will operate 24 hours a day, 7 days a week, although receipt of direct deliveries of waste will be restricted to between 07:00 and 22:00 Monday to Friday, and 07:00 and 13:00 Saturdays.

The Waste Operation will operate 07:00 to 22:00 Monday to Friday and 07:00 to 13:00 Saturdays. Though they are not actually reproduced in the permit itself, Standard Rules set SR2008No3_75Kte (available to download on our website) are conditions of the permit. They apply solely to the Waste Operation, which must be conducted within the site boundary that is shown in Schedule 2 of the permit. These rules will allow the Operator to undertake household, commercial and industrial waste transfer (with waste treatment) inside a building. Permitted wastes are limited to non-hazardous wastes only. This contrasts with the Installation, which is permitted to accept both hazardous and non-hazardous wastes. The maximum quantity of waste that can be submitted to the Waste Operation under these rules each year is 75,000 tonnes. With the exception of specified waste, all bulking, transfer or treatment of non-hazardous waste must be carried out inside a building. Wastes can be bulked up ready for disposal or recovery elsewhere

and can also be treated by sorting, separation, screening, baling, shredding, crushing and compaction. Because the Waste Operation is subject to standard rules, it is not considered in the assessment of the proposal and explanation of our decision that is detailed in this document. We are however, satisfied that the standard rules are appropriate for the Waste Operation proposed and that all the relevant criteria to which the standard rules are subject are met. We are also satisfied that there will be no adverse effects from the operation of the two facilities in combination.

Site setting and sensitive receptors

The proposed site is located in the heavily industrialised area of Avonmouth, near to Bristol in the south-west of England (NGR ST 527 798). Less than 200m to the north-east is an industrial unit and residential premises are located approximately 2km to the east of the site.

The Severn Estuary, a Special Area of Conservation (SAC), a Ramsar site, a Special Area of Conservation (SPA) and a Site of Special Scientific Interest (SSSI), is located 1km west of the site. This is the closest site to the Facilities that is designated under the Habitats Regulations and the Wildlife and Countryside Act. The Avon Gorge Woodland, a SAC and a SSSI, is located approximately 5km south-east of the site. An unnamed drainage channel borders the site on its western and north-eastern sides. The nearest named surface water feature is the Mere Bank Rhine, located across the Merebank Road from the south-eastern boundary of the site. The site is not located on an aquifer and neither is it within a groundwater source protection zone. The site is located within the floodplain, with a flood return period of 1 in 200 for tidal inundation and 1 in 100 for fluvial inundation.

Installation process description

The following pages summarise each element of the Installation process.

Raw Materials

Information relating to the nature, form and source of each waste, together with their handling requirements and hazardous properties will be required in advance as part of the pre-acceptance process. Waste will not enter the treatment process unless pre-acceptance details are in order. Acceptance procedures will require the verification of wastes by their duty of care paperwork against waste acceptance conditions of the permit, together with a visual check where appropriate. Acceptance procedures for hazardous wastes will require chemical analysis provided at pre-acceptance stage to be verified against duty of care paperwork on acceptance. Wastes which are not permitted by the permit will be quarantined and removed within 7 days.

All vehicles delivering waste will be enclosed, sheeted or otherwise secured to prevent escape of waste and vehicles will enter the building via automated high-speed roller shutter doors. The doors will minimise emissions of odour, dust and noise from the building which will be maintained under a slight negative pressure. Waste sorting for recyclables will be undertaken in a dedicated area of the building. Reinforced concrete bays will be provided for the storage of wastes and the building will be constructed on a durable base of the same material with a sealed drainage system.

The maximum quantity of waste stored at the site at any given time will be 2000 tonnes. Wastes will be stored according to type and calorific value. Hazardous wastes will not be stored for more than 2 days. Other wastes will not be stored for a period greater than 7 days. Non-waste raw materials required for the operation of the site are as follows:

- Gas oil
- Boiler treatment chemicals
- Urea powder
- Activated carbon
- Sodium bicarbonate
- Water
- Oils/greases
- Pesticides for the control of vermin
- Sawdust

Where bulk storage of solid raw materials is required, Flexible Intermediate Bulk Containers (FIBCs) will be used. All bulk liquid storage will be bunded and all storage will benefit from sealed drainage (with oil-water separator), secured inside the building. Hazardous wastes will be stored in accordance with Table 2 (General Recommendations for the Separation or Segregation of Different Classes of Dangerous Substances) of the Health and Safety Executive's chemical warehousing guidance, HSG 71.

The flue gas treatment plant will have its own dedicated activated carbon supply system which will comprise of a FIBC discharge station, a transfer screw, a storage hopper and a volumetric feeder. During unloading at the discharge station, dust extraction will be available and initiated manually.

Thermal Treatment Process

Gasification will operate as a sequential batch process in which waste will be thermally decomposed in primary gasification chambers in an oxygen deficient atmosphere to produce syngas. There will be four gasifiers/primary gasification chambers (PGC) per process line and a total of 5 lines (so 20 gasifiers in all). Each line, or process stream, supplies syngas to a secondary combustion chamber dedicated to that process stream. Syngas is combusted by the introduction of combustion air into the secondary chamber comprising air extracted from the main building and re-circulated flue gas. The gas temperature exiting the secondary chamber is 1120°C.

The introduction of air will allow full oxidation of the partially oxidised syngas. The oxygen concentration in the secondary combustion chamber will be >6%. The oxidation reaction is exothermic and ensures that a minimum temperature of 1,100°C is achieved for no less than 2 seconds after the last injection of air in accordance with WID requirements for hazardous waste. During normal operation the temperature will be maintained at 1120°C, with a nominal control variance of ±20°C and without the use of support fuel in the auxiliary burner. Waste feed will be stopped if the temperature in the secondary combustion chamber cannot be maintained above the minimum WID limit of 1100°C. Auxiliary low sulphur gas oil burners are fitted for start-up sequencing and to assist in maintaining combustion temperatures above 1100°C for a minimum of 2 seconds in the secondary chamber. The oxygen concentration and temperature will be carefully controlled to minimise dioxin and NO_x emissions. Primary NO_x abatement will be achieved through the recirculation of approximately 15% of the flue gas back to each secondary combustion chamber. Urea solution will also be injected into the secondary combustion chamber after the secondary air injection nozzles to facilitate secondary NO_x abatement by chemically reducing it to nitrogen and water (Selective Non-Catalytic Reduction – SNCR).

Energy Recovery

Heat energy is recovered and utilised in a conventional boiler and steam turbine arrangement for the generation of electricity. A small proportion of the electricity generated is used to supply the needs of the Installation with the balance exported to the National Grid. The plant will have the capacity to accept 100,000 tonnes of waste per annum (tpa), operating for 8,000 hours. The process will generate approximately 13.2MW of electrical power, resulting in an expected output of 105,600MWh per annum. Of this, the Installation will draw a parasitic load of 16,000MWh per annum. The steam turbine power is optimised by condensing the steam after it leaves the last stage of the turbine and this is achieved with an air cooled condenser (ACC). The condensed steam is re-circulated to the boiler following treatment in a closed circuit to minimise losses from the system. It is likely that a significant amount of waste heat will also be generated and captured by the process. Facilities (steam or hot water pass-outs) for the potential further recovery of energy through the use of waste heat will be maintained to allow any opportunities for its use to be capitalised upon, should they become practicable.

Gas Cleaning

The plant is designed to meet the requirements of all relevant legislation for releases to air by a combination of main process design and operation and abatement equipment.

Exhaust gases pass from the boiler to the gas cleaning equipment. The design of the boilers, based on a computerised fluid dynamics assessment (CFD), is such that de novo dioxin (PCDD and PCDF) formation is minimised by quickly reducing the flue gas temperature through the critical temperature range. After passing through the boiler the flue gas is treated in abatement plant with sodium bicarbonate (to remove acid gases) in a dry process and powdered activated carbon (PAC) for the removal of dioxins and mercury. The final stage of flue gas treatment comprises multiple compartment fabric filters to capture particulate matter derived from the flue gas and from the injection of sodium bicarbonate and PAC. The cleaned gas then discharges to atmosphere via a 25-metre stack.

Ancillary Operations

The water required to compensate for boiler blow-down losses is provided by the mains. This is treated by softening and by reverse osmosis prior to de-aeration and dosing with treatment chemicals.

Ash Handling

Air Pollution Control (APC) residues from particulate abatement will be removed in a sealed system to a FIBC to prevent release of residues during storage and handling. It is likely that it will be used as an absorbent in waste treatment processing and as a buffer.
Gasifier ash is transferred from the gasification chamber to the ash conveyor where it is dampened or quenched by waste process water and conveyed to skips inside the main building. This ash is likely to be sent for recycling for use as a bulking agent in concrete block. Sampling of the ash will be carried out to ensure compliance with the WID.

Liquid Effluent and Site Drainage

Effluent produced at the installation will be re-used wherever possible. Where this is not possible, effluent will be discharged to the public foul sewer under trade effluent discharge consent. The generation of trade effluent is limited to boiler system effluents, air compressor condensate, leaks and spillages, drainage from waste storage areas, wash-down water and (in emergency situations) firewater.

Emissions Monitoring

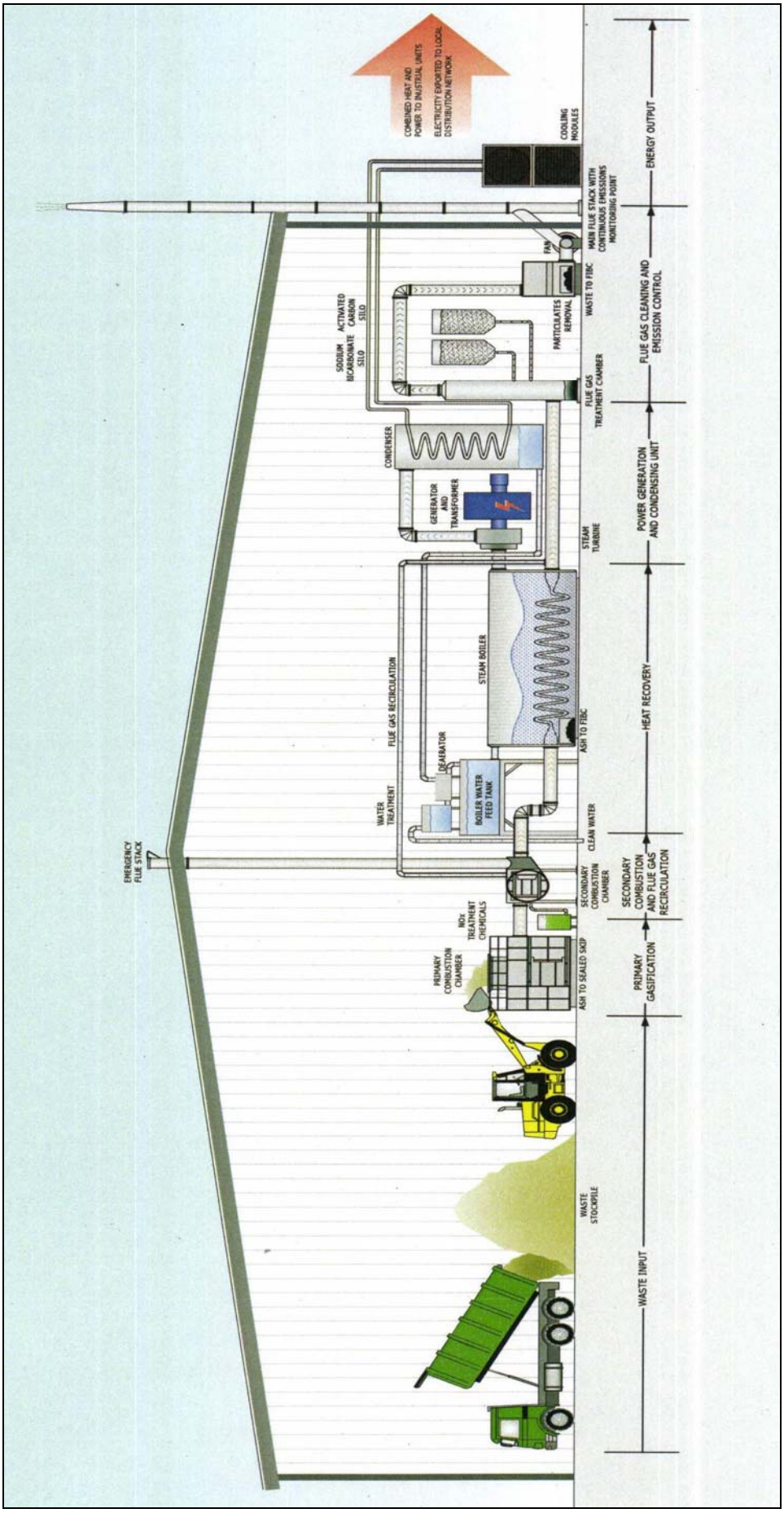
Emissions from the stack will be continuously monitored for particulates, carbon monoxide (CO), ammonia (NH_3), nitrous oxide (N_2O), sulphur dioxide (SO_2), hydrogen chloride (HCl), oxygen (O_2), oxides of nitrogen (NO and NO_2 expressed as NO_2) and volatile organic compounds (VOCs, as Total Organic carbon (TOC)) and water (H_2O).

In addition, periodic sampling and measurement will be carried out for metals, namely cadmium (Cd), thallium (Tl), mercury (Hg), antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), and vanadium (V), dioxins and furans, dioxin-like polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and hydrogen fluoride (HF). The frequencies for periodic measurements are specified in the permit and for the first year this is quarterly.

Management

The facility will operate an environmental management system to meet the requirements of ISO14001, and will seek certification against this standard within a year of commissioning.

Figure 1


COMBINED HEAT AND POWER TO INDUSTRIAL UNITS
ELECTRICITY EXPORTED TO LOCAL DISTRIBUTION NETWORK
COOLING MODULES
MAIN FLUE STACK WITH CONTINUOUS EMISSIONS MONITORING POINT
FAN
WASTE TO FBC
PARTICULATES REMOVAL
SODIUM BICARBONATE SILO
ACTIVATED CARBON SILO
FLUE GAS TREATMENT CHAMBER
CONDENSER
GENERATOR AND TRANSFORMER
STEAM TURBINE
STEAM BOILER
FLUE GAS RECIRCULATION
ASH TO FBC
DEAERATOR
BOILER WATER FEED TANK
WATER TREATMENT
CLEAN WATER
EMERGENCY FLUE STACK
SECONDARY COMBUSTION CHAMBER
NOx TREATMENT CHEMICALS
PRIMARY COMBUSTION CHAMBER
ASH TO SEALED SKIP
WASTE STOCKPILE
ENERGY OUTPUT
FLUE GAS CLEANING AND EMISSION CONTROL
POWER GENERATION AND CONDENSING UNIT
HEAT RECOVERY
SECONDARY COMBUSTION AND FLUE GAS RECIRCULATION
PRIMARY GASIFICATION
WASTE INPUT

Application determination process

The Application was duly made on 9th June 2009. The Applicant has not made a claim for commercial confidentiality. We have not received any information in relation to this application that appears to be confidential in relation to any party.

Consultation

The application has been consulted upon in accordance with our public participation commitments. A copy of the application, requests for further information, the applicant's responses and any other relevant information used in the determination process has been placed on our public register and sent to Bristol City Council's public register. We advertised the application on 10th July 2009 in the Bristol Evening Post and on our website.

We sent copies of the application to the following organisations:

- Wessex Water
- Bristol Primary Care Trust
- The Food Standards Agency
- Health and Safety Executive

Separate consultation on the matter of impact on protected habitats was undertaken with the Countryside Council for Wales and Natural England. The consultation responses are detailed in Annexes 2 and 3 and were taken into account in the decision making process.

Operator Competence

We are satisfied that the Applicant is the person who will have control over the operation of the Installation when the permit is granted. The decision was taken in accordance with Regulatory Guidance Series No EPR 1 Understanding the meaning of Operator. We are satisfied that they will be able to operate the Installation so as to comply with the conditions we have included in the Permit. The applicant has not declared any relevant convictions and our records confirm the absence of relevant convictions. At the time of the determination of the permit application, a holder of an appropriate Certificate of Technical Competence (COTC) or Environmental Permit Operator Certificate (EPOC) in was not in place in respect of the Waste Operation. In line with our Regulatory Guidance Series No EPR5 Operator Competence, the Operator will need to ensure that an EPOC holder is in place within 4 weeks of the Waste Operation commencing. Additionally, the Operator will need to ensure that an appropriate member of staff obtains the relevant units of the 4TSMNH6 NVQ WAMITAB qualification within 12 months. The standard rules applicable to the waste operation at this site require such technical competence. The Applicant satisfies the criteria in Regulatory Guidance Series No EPR5 Operator Competence.

Planning permission for the waste operation

Planning permission must be in place prior to the issue of a permit for a waste operation. The planning decision notice shows that planning permission was in place as of 13/05/09, encompassing both the incineration installation and the waste operation.

OPRA Score

The Operational Risk Appraisal (OPRA) score is 417.

Part A – Key issues of the decision

A1 BAT Assessment

The BAT assessment carried out by the Applicant for the proposed Installation has been reviewed by the Agency with reference to the guidance provided in the Agency's Guidance Note EPR 5.01 for The Incineration of Waste, which is based on the European BAT reference note (BREF) for this sector. The Applicant provided further information to supplement the BAT assessment provided with the Application. This information was provided in their letter dated 31st July 2009 and in an email sent 12th August 2009, in response to a Schedule 5 Notice for information dated 6th July 2009.

A1.1 Selection of Thermal Treatment Technology

The Applicant considered the following four thermal treatment options in the BAT options appraisal:

1. **Conventional incineration:** Comprising a waste combustion process in an excess of oxygen, with the hot flue gases used to provide energy for steam generation.

2. **Pyrolysis:** Heat treatment of waste in the complete absence of oxygen, resulting in thermal degradation. A gas results which can be used as fuel in a boiler, engine or turbine.

3. **Gasification:** Heat treatment of waste in the presence of limited oxygen, resulting in a gas. The resulting gas can be used as fuel in a boiler, engine or turbine.

4. **Hybrid pyrolysis/gasification:** Conventional pyrolysis followed by gasification of the solid residue arising from the pyrolysis process, which results in a second source of fuel gas that can be used as a fuel.

Option 1 – Conventional incineration

Incineration coupled with heat recovery and power generation is proven, has been used extensively for municipal waste and can handle large volumes of waste. Its characteristics include the following:

- Optimum capacity for conventional incineration plants may be around 400,000 tpa[1].
- Generally the amount of bottom ash produced is significant and lies in the range 20-35% of dry waste input[2];
- Flue gas volumes are typically 4,500-6,000 cubic metres (m^3) per tonne of waste[2]; and
- The energy efficiency is typically 17-30% and electricity generation per tonne of waste is typically 0.4-0.7MWh[2].

Option 2 – Pyrolysis

Its characteristics include the following:

- Capital and operating costs for pyrolysis tend to be higher than for similar sized conventional incinerators (indicating gate fees tend to be higher), but some suppliers' data suggests that for smaller-scale plants pyrolysis and gasification may be lower cost[3];
- At the lower reaction temperature, metals tend to remain in the solid residues giving potential for lower emissions to atmosphere[3];
- There is usually the need for some kind of waste pre-treatment[3] involving the expenditure of energy, which by comparison for other technology options may not be required ;
- The amount of char produced tends to be considerable, ranging between 22-41% by mass of waste processed[3]. This char has a significant energy content and so must be burned in order to utilise this energy;
- Energy efficiency ranges from 15-40%[3];
- Pyrolysis is not a self-sustaining process and so an external source of heat is required[3];
- Flue gas volume is typically lower than that of conventional incineration[2];
- Separation of the pyrolysis and combustion stages may allow improved process control and result in a more stable overall combustion process[2]; and
- There is some potential to generate more electricity per tonne of waste than is typical for waste combustion plants[3] (range is typically 0.3-0.75MWh_e per tonne of waste compared with 0.4-0.7MWh_e per tonne for conventional incineration).

Option 3 – Gasification

There is wide experience overseas of waste gasification, with plants operational in Iceland, Poland, Norway, Germany, Sweden, Spain and the USA. Its characteristics include the following:

- Capital and operating costs for gasification tend to be higher than for similar sized conventional incinerators (indicating gate fees tend to be higher), but some suppliers' data suggests that for smaller-scale plants pyrolysis and gasification may be lower cost[3];
- At the lower reaction temperature, metals tend to remain in the solid residues giving potential for lower emissions to atmosphere[3];
- At the lower reaction temperature, metals are not sintered, oxidised or molten, so when separated from the ash/bed material they may have higher value for recycling[2];
- Energy efficiency ranges from 15-40%[3];
- Flue gas volume is typically lower than that of conventional incineration[2];
- Separation of the gasification and combustion stages may allow improved process control and result in a more stable overall combustion process[2].
- There is some potential to generate more electricity per tonne of waste than is typical for waste combustion plants[3] (the range is typically 0.3-0.75MWh_e per tonne of waste compared with 0.4-0.7MWh_e per tonne for conventional incineration).

Option 4 – Hybrid pyrolysis/gasification

Some processes offer an initial pyrolysis stage followed by gasification. This is because of the significant energy value retained in the char generated by the pyrolysis process. The syngas generated by the gasification of this char can then be mixed with that arising from the initial pyrolysis process and the two combusted. Compared to conventional incineration, this technology is also not well proven in the UK. As with gasification, the technology forms part of DEFRA's Waste Implementation Programme and two hybrid processes were at bidder stage at the time of this Application being made. There is wide experience overseas of hybrid processes, with plants operational in Germany and Japan.

The Applicant has chosen gasification technology for the thermal treatment of waste. The particular merits of the gasification technology chosen for this proposal are founded in part on the general observations made above. There are additional merits associated with the particular type of gasification technology proposed, which in this case is a Sequential Batch Oxidation System, or SBOS. These additional merits are explained below in Section A1.1.1 and it is on the basis of both these elements that the assertion of BAT for the chosen technology rests.

[1] DEFRA (2007), Economies of Scale – Waste Management Optimisation Study by AEA Technology, Final Report, April 2007.
[2] IPPC Bureau (2006), IPPC Reference Document on the Best Available Techniques for Waste Incineration [BREF].
[3] Environment Agency (2001). BAT Review 2001. Review of BAT for new waste incineration issues. Part 1: waste pyrolysis and gasification activities.
[4] Environmental Services Training and Education Trust and Fichtner Consulting Engineers Ltd (2004), The Viability of Advanced Thermal Treatment of MSW in the UK.

A1.1.1 Types of Gasification Technology

The Incinerator Sector Guidance Note EPR S5.01 states that there are four main categories of gasification plant:

- Rotary kiln;
- Fixed bed reactors;
- Fluidised bed reactors and
- Other systems are reported to be available but there is little information on design and performance.

The Applicant provided a BAT assessment in response to a Schedule 5 Notice request for information dated 26th November 2009 for the SBOS gasification option chosen. The information provided demonstrated that the design of the chosen option complies with the generic BAT criteria in the incineration BREF note.

The Applicant highlights that some form of pre-treatment would generally be required for a rotary kiln, fixed bed/grate or fluidised bed gasifier (this is avoided with their chosen technology) and that power consumption for both fluidised bed and rotary kilns systems tends to be higher due to the power requirements of the additional fans and kiln drive motors respectively. The lack of pre-treatment with the SBOS system removes the risk of operational problems associated with such an additional stage (e.g. shredder jamming), which in turn the Applicant expects to reduce downtime and increase servicing intervals. The Applicant also expects very limited carry-over of particulates as a result of the non-turbulent conditions which characterise the SBOS technique. The modular, batch approach will also provide for the continuation of the process whilst modules are taken offline for maintenance. This approach lends itself to the flexibility required to accommodate the variable waste streams to be treated at the facility (see further on proposed waste types at Section A2.9).

The Applicant has stated that, on the basis of evidence supplied to them by the manufacturer, they expect the chosen technology to deliver ~1.05MWh_e per tonne of waste at this Installation. This is substantially more than the indicative BAT reference range of electricity generation per tonne for pyrolysis/gasification technologies of 0.3-0.75MWh_e per tonne of waste. This increased electrical generation is primarily due to expectation that the CV of the mixed commercial and industrial waste streams will be higher than that associated with municipal solid waste (MSW) to which the indicative BAT range applies. The modular batch approach provides some flexibility in operation whilst ensuring a constant flow of steam to the turbine to maximise electricity generation.

The variable waste streams will be mixed to form a balanced load for each Primary Gasification Chamber (PGC). Procedures will be in place to ensure that the blending of waste materials is undertaken in a documented manner to achieve the optimum CV and moisture content. The balanced load procedures are included as requirements of the permit as part of the Operating Techniques.

The overall net electrical efficiency of the proposed system is19%, which is greater than that reported by Fichtner[4] for fluidised bed systems (15%) and at the high end of the range quoted for grate gasification (14-20%). Other advantages of the SBOS

gasification process that led to the Applicant to choose the technology over other gasification techniques were as follows. The Applicant asserts that:

- On the basis of information provided by the manufacturer, the gasification process chosen in this particular case will generate a relatively small amount of bottom ash, typically 6-7% by mass. This compares favourably with the figure of 20-35% for conventional incineration provided in the incineration BREF Note;
- For this size of facility (where the proposed throughput is 100,000 tonnes per annum (tpa)) the capital cost of the chosen technology is more favourable than that associated with conventional incineration plant;
- Process and waste feed loading systems are relatively simple with few moving parts, resulting in low maintenance costs and downtime.
- The technology allows for the retrofitting of abatement and other equipment in response to changing technologies.

The SBOS system is proven outside the UK, with operational batch gasification facilities in Iceland and the USA. Whilst it is acknowledged that this system is a novel process for the UK, the lack of UK operational experience of such technology is not justification for ignoring the potential benefits of the process in assessing BAT. At the time of the Application, plant using the SBOS system was under construction (the first of its kind in the UK) in Dumfries, Scotland regulated by the Scottish Environmental Protection Agency (SEPA). At the time of our determination the plant was being commissioned and reference data were not available.

A1.1.2 Conclusion

The purpose of the Installation is to dispose of a wide range of commercial and industrial residual waste streams (some hazardous). We recognise that in certain circumstances niche solutions may be a required. In this particular instance, we consider that operational flexibility of the technology forms a necessary part of the solution when dealing with such a diverse range of waste streams.

The Applicant has chosen a batch gasification process followed by combustion as the thermal treatment technology due to the operational flexibility it offers in terms of the range and the variability of wastes streams that can be treated. The batch loading process is able to take account of differing waste streams with differing physical and chemical composition through appropriate selection and charging of wastes of higher and lower calorific values (CV). Batch processes are inherently more flexible than continuous.

The fundamentals of the technology chosen are not significantly different from a more traditional waste incineration Installation, in that the waste is gasified and ultimately combusted. The emissions to air are therefore comparable with other types of incineration. The abatement technology proposed by the Applicant to minimise the emissions to air from combustion of the waste is also the same as that used at more conventional incinerator plants. Any impact from these releases will therefore be comparable with other types of incineration.

The Applicant has demonstrated that in this particular case their selected technology offers some potential advantages over other options. Furthermore, as detailed in the remainder of this document, it will meet the indicative BAT and WID requirements. With

this in mind, and acknowledging the Agency's keenness to support innovative techniques that can contribute to sustainable waste management, we accept that the proposal for gasification, using the SBOS system is BAT for the treatment of 100,000 tonnes of mixed commercial and industrial waste per annum in this case.

A1.2 Selection of Abatement Technology

The plant will give rise to emissions to air as a result of the combustion process. Emissions are likely to comprise:

- Acid gases e.g. sulphur oxides (SO_x), mono-nitrogen oxides (NO_x), hydrogen chloride (HCl) and hydrogen fluoride (HF);
- Particulate matter;
- Heavy metals;
- Volatile organic compounds (VOCs);
- Carbon monoxide (CO);
- Dioxins and furans; and
- Greenhouse gases (primarily carbon dioxide (CO_2) and nitrous oxide (N_2O)).

Whether these emissions will be of any environmental significance was a matter on which the Applicant had to provide information, which the Agency has carefully assessed. This is considered in section A3 below.

The BAT options appraisal carried out by the Applicant considered a combination of primary measures and secondary abatement plant to ensure that emissions to air are minimised using BAT as well as meeting the requirements of the WID. This appraisal has been reviewed by the Agency with reference to the guidance provided in Guidance Note EPR 5.01 for The Incineration of Waste and the associated BREF, and is summarised below.

A1.2.1 Oxides of Nitrogen (NO_x) Control Measures

For NO_x control, the starting position for a determination of BAT is that the proposal should include primary NO_x control techniques (including advanced combustion control systems and/or Flue-Gas Recirculation (FGR)) combined with secondary techniques such as Selective Non-Catalytic Reduction (SNCR) or Selective Catalytic reduction (SCR). Staged combustion, FGR and the use of low NO_x burners are proposed as the primary techniques for the prevention and control of NO_x at this Installation. This is in accordance with BAT as described in Agency Guidance Note EPR 5.01.

As regards secondary NO_x control measures, EPR 5.01 indicates that either SCR or SNCR can be BAT. In this instance, the Applicant proposes the use of urea-based SNCR. A comparison of SCR and SNCR was made in the application and has been reviewed by the Agency. It did not provide as full an assessment of the relative merits of each option as we considered necessary and consequently, we asked the applicant to provide additional information in a further information Notice dated 26 November 2009.

In the BREF Note for incineration it states that SCR is capable of achieving a reduction in NO_x emissions in excess of 80% compared with a reduction of 30% to 70% by SNCR. SCR requires a higher energy input and periodic regeneration and replacement of catalyst, which in turn results in higher capital and revenue costs. SNCR has the

advantage of avoiding both the production of hazardous waste in the generation of waste catalyst and any ongoing requirement for routine catalyst replacement. SNCR is also significantly cheaper in terms of both capital and operating costs.

The Applicant suggests that the benefit offered by SCR in terms of reduced N_2O emissions and associated lower overall global warming potential (GWP) is not in this instance sufficient to justify the extra cost. With urea-based SNCR in place, and assuming a worst-case scenario in which SNCR is capable of achieving no better than the WID NO_x limit, the applicant calculated maximum short- and long-term NO_2 Process Contributions (PC) of 3% and 1.49% respectively of the Air Quality Standard (AQS) at the most impacted relevant receptor. Even accounting for the existing background concentration by looking at the Predicted Environmental Concentration (PEC), our check modelling predicts sufficient headroom to ensure Air Quality Standards, and thereby human health, are protected.

Further, they submit that, contrary to the BREF Note suggestion that N_2O emissions associated with the use of urea-based SNCR may be up to 35mg/Nm^3, in this case they expect to achieve an emission concentration of between 2 and 4mg/Nm^3. An emission concentration of 35mg/Nm^3 would equate to an increase of 10,100 tonnes CO_2-equivalent per annum in the total GWP for the process (an emission factor of ~1.85 tonnes CO_2-equivalent per MWhr). By contrast, achievement of an emission concentration of 4mg/Nm^3 would equate to an increase of ~1,150 tonnes CO_2-equivalent per annum in the total GWP for the process (an emission factor of ~1.75 tonnes CO_2-equivalent per MWhr). Hence the use of SNCR at the facility is anticipated to result in an increase of between ~1% and ~7% in emissions of CO_2-equivalent per annum from the process.

Having considered the applicant's arguments, we agree with their conclusion that SNCR is BAT for this installation.

The Incinerator Sector Guidance Note (EPR 5.01) states that the use of either ammonia or urea in SNCR systems may represent BAT. It also suggests that the use of ammonia as the reagent may give rise to lower emissions of N_2O than urea, but that urea may be effective over a wider temperature range and is easier to handle. Urea is sometimes preferred as it is less hazardous and easier to store. Similar levels of NO_x reduction can be achieved with either system. If an ammonia-based SNCR system were to be used, and assuming a N_2O emission of 15 mg/Nm^3 were to be achieved using such a system (as set out in the BREF), there would be an additional GWP of 4,300 tonnes CO_2-equivalent per annum associated with the NO_x abatement system (rather than the additional ~1,150 tonnes CO_2-equivalent per annum associated with urea-based SNCR described above). This would bring the emission factor up to ~1.79 tonnes CO_2-equivalent per MWhr for the facility and equate to an increase of 2.8% in emissions of CO_2-equivalent per annum from the process. This is higher than that which the applicant expects to achieve using urea as the reagent.

Having considered the applicant's argument, we agree with their conclusion that the use of urea as the reagent in their SNCR system is BAT for the Installation.

With SNCR the potential exists for the emission of residual ammonia, a phenomenon known as ammonia slip. The Applicant proposes to continuously monitor this parameter

to assist control of the dosing rate and hence ammonia slip. A further advantage of this proposal is that when dosing is optimised, ammonia tends to give rise to lower N_2O formation. A pre-operational condition has been set requiring a plan setting out how secondary control measures for the abatement of NO_x will be optimised, and consideration of N_2O formation will need to feature as part of this. A balance will need to be struck between emissions of NO_x, N_2O, ammonia and the consumption of reagent. Accordingly, the permit requires the Operator to monitor both N_2O and ammonia in the exhaust gas.

A1.2.2 Acid Gas and Halogen Control Measures

The starting point for a determination of BAT is that the proposal should include primary control measures combined with secondary techniques such as wet, dry and semi-dry scrubbing systems. Use of low-sulphur gas oil or bio-diesel (auxiliary fuel) and waste feedstock controls are proposed as the primary techniques in accordance with BAT as described in Agency Guidance Note EPR 5.01.

The Applicant's comparison of wet, semi-dry and dry scrubbing systems as secondary techniques has been reviewed by the Agency with reference to the Agency Guidance Note EPR 5.01. Wet scrubbing systems provide the highest removal efficiencies of soluble acid gases with lowest stoichiometric excess of reagent. However they produce significant quantities of liquid effluent for treatment and disposal as well as potentially producing a visible plume, which will require energy to reheat to reduce the visual impact of such a plume. Dry and semi-dry systems both produce larger quantities of solid waste but do not produce liquid effluent. Removal efficiencies are also lower. In terms of global warming potential, the energy consumption associated with the process operation is the prime consideration. Table 5.3 of the Incineration BREF Note indicates that there is little difference between the energy consumption for dry and semi-dry systems. The energy consumption of the wet systems may be higher due to pump demand and the energy to reduce the visual impact of the plume. The Applicant proposes to use the dry scrubbing system due to the low complexity, reduced installation and maintenance costs, reduced energy costs and GWP, reduced water usage and absence of effluent treatment and disposal requirements.

The Sector Guidance Note EPR 5.01 states that the use of sodium hydroxide, lime or sodium bicarbonate may represent BAT. The application compared the use of lime and sodium bicarbonate. Lime may result in a slightly higher removal rate than sodium bicarbonate, but it also results in greater residue volumes and it is more difficult to handle due to its corrosive nature. The GWP associated with the preparation and utilisation of the acid gas neutralising agent is likely to be similar for both.

The Applicant confirms that the dosing system will be automated and optimised to ensure appropriate dosing to minimise acid gas emissions, use of reagents and production of treatment residues. The dosing will be controlled by upstream monitoring of hydrogen chloride (HCl) in the exhaust gas. The Applicant will be required to record the reagent use to enable the performance of the system to be monitored. An improvement condition has been set requiring that control of acid gas abatement is optimised during commissioning.

The Applicant proposes to use a dry sodium bicarbonate scrubbing system and we agree that this is BAT for the Installation.

A1.2.3 Particulate Control Measures

Agency Guidance Note EPR 5.01 states that *'Fabric filters are proven and when correctly operated and maintained provide reliable abatement of particulate matter to below 5mg/m^3 and are likely to be BAT for many applications'*. The Guidance Note also states that the bag filters should have multiple compartments, which can be isolated, and should be provided with bag burst detection systems, which may include pressure drop monitoring.

Ceramic filters, electrostatic precipitators and wet scrubbers are also identified as alternatives to fabric filters. However, ceramic filters can be prone to mechanical failures and electrostatic precipitators and wet scrubbers are not considered to be BAT on their own. Electrostatic precipitators can be used to reduce particulate loading onto bag filters, but as bag filters can operate effectively without this, they offer no advantage in this case. Wet scrubbers also generate a liquid effluent requiring treatment and disposal, so again do not result in any overall advantage over bag filters. The Applicant proposes to use multiple compartment fabric filters for the final stage of flue-gas treatment. The temperature in the bag houses will be monitored with thermocouples and linked to the control system to minimise the risk of a fire.

In the request for further information dated 26 November 2009 the Applicant was asked for clarification as to whether isolation of compartments could be achieved and that bag burst detection will be provided. The Applicant confirmed that '*It is the intention of the operator to install a particulate control system which will include both internal compartment isolation and bag burst detection on each compartment, and the system will comply with the requirements of BAT as outlined in Sector Guidance Note IPPC S5.01.*' This requirement has been secured by incorporation into Table S1.2 (Operating Techniques) of the Permit.

We accept that the applicant's particulate arrestment techniques are BAT for the Installation.

A1.2.4 Abatement of Metal Releases

Most heavy metals and their inorganic compounds are not volatile at the temperature at which exhaust gas enters the abatement system. Accordingly, they are expected to be present predominantly in the particulate fraction, and will be removed by the bag filters. Mercury, however, is highly volatile under the process conditions during and following gasification. Emissions will be minimised through the injection of powdered activated carbon (PAC), which will also serve to help control of dioxin and furan emissions, and we accept that in conjunction with the use of bag filters this technique is BAT for the installation.

A1.2.5 Carbon Monoxide (CO) and Volatile Organic Compound (VOC) Control Measures

The Syngas may contain high concentrations of CO and VOCs as a consequence of the partial oxidation process in each gasifier. The applicant expects effective combustion conditions to ensure that CO and VOC emissions are minimised below required limits without the need for further abatement through compliance with furnace and combustion

requirements and by securing consistent waste feed characteristics. We accept that this is BAT for the Installation. An Improvement Condition has been set with the purpose of demonstrating that the combustion conditions comply with the residence time and temperature requirements defined by the WID.

A1.2.6 Dioxins and Furans Control Measures

Agency Guidance Note EPR 5.01 states that in addition to combustion control, boiler design, FGR and SNCR (which all help to prevent dioxin formation), carbon injection has a proven record of reducing dioxin emissions. The Applicant has selected powdered activated carbon (PAC) to minimise the emissions and we accept that in conjunction with the use of bag filters this is BAT for the Installation.

A1.2.7 Persistent Organic Pollutants (POPs) Control Measures

International action on Persistent Organic pollutants (POPs) is required under the UN Stockholm Convention. The EU implemented the Convention through the POPs Regulation (850/2004), which is directly applicable in UK law. The 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- 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. This is logical, not least because 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; and
- PCBs.

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 WID 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."

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. The requirements of the Stockholm Convention in relation to *unintentionally-produced POPs* are delivered through the IPPCD and the WID, which require the use of BAT to prevent or, where that is not possible, minimise all harmful emissions, including POPs.

The release of dioxins and furans to air is required by the WID 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. The Government is of the opinion that, in addition to the requirements of the WID, 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. The Secretary of State has directed regulators to require 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 WID. 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 A3 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 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]

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 will also minimise the release of HCB.

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

A1.3 Emissions of Greenhouse Gases and Energy Recovery

A1.3.1 Emissions of Greenhouse Gases

The gases that contribute to anthropogenic climate change which will be emitted from the Installation are CO_2 and N_2O. N_2O will be emitted in vastly smaller quantities, but has a global warming potential (GWP) 310 times that of CO_2. Consideration of GWP associated with N_2O releases has been given in section A1.2.1 and that associated with acid gas and halogen control measures has been considered in section A1.2.2. Notwithstanding contributions to the facility's GWP associated with pollution abatement, direct emissions of CO_2 from the Installation will be determined by the carbon content of the incoming waste. Complete and efficient combustion is necessary for efficient electrical generation and constitutes both BAT and a WID requirement. Gas oil has been selected as the auxiliary fuel source for the secondary combustion chambers. It is necessary for ensuring WID compliance at all times and will make a relatively small contribution to total net CO_2 emissions from the facility. We agree that its use is BAT for this installation.

The CO_2 emissions associated with the burning of waste and auxiliary fuel have been presented in the response to the Schedule 5 notice dated 26th November 2009. The CO_2 emission factor is influenced by the efficiency of the process. As discussed in section A1 the efficiency of gasification is considered to be generally comparable with other thermal waste treatment techniques and the applicant expects the chosen gasification technique to out-perform the range quoted in the BREF note. In addition, operating procedures will ensure that the plant is run efficiently. Maintenance and housekeeping measures will be developed and these will include details of the measures specifically aimed at maintaining the efficiency of the plant during its operational life. In particular, procedures will cover operation of motors and drives and steam distribution systems.

The CO_2 emissions from the facility are significant, but CO_2 differs from other pollutants emitted from the Installation in that its effect on the environment is global rather than localised. It is for this reason that CO_2 is not included in Annex III to the Integrated Pollution Prevention and Control Directive (IPPCD), which lists the main polluting substances that are to be considered when setting emission limit values (ELVs) in Permits. The Environment Agency recognises that emissions of CO_2 are inevitable where waste is combusted, and once the amount and type of waste have been set, the CO_2 emission is, essentially, also set. We do not therefore feel that it is appropriate to set an ELV for CO_2. Nor do we consider that any equivalent technical measures are appropriate beyond those measures imposed to restrict the volumes and type of waste and to ensure energy efficiency.

A1.3.2 Heat Recovery

The guidance on the WID (Edition 3, 2004) builds on Article 6(6) of the WID and lists 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 Avonmouth proposal includes elements of the above and it is considered that, within the constraints of the site, heat will be recovered as far as practicable and therefore the requirements of Article 6(6) are met. In particular:

1. Waste heat is recovered from the primary gasification chambers during the 'residual carbon reduction' and 'cool down' phases and is transferred directly to the combustion air supplied to the secondary combustion chamber.
2. Boiler feed water is pumped from the de-aerator through an economiser located in the flue gas duct exiting the fire tube boiler. Waste heat is recovered from the flue gas and transferred into the boiler feed water as it enters the fire tube boiler.
3. The flue gas is discharged from the boiler at a temperature of approximately 180^{o}C. Further cooling of the flue gas is unnecessary and it is cleaned in a dry abatement plant prior to being discharged to atmosphere by the stack. At an approximate temperature of 180^{o}C, formation of a plume is unlikely and plume re-heat is not necessary.

In addition, the applicant proposes to utilise heat from the process to provide space heating to the buildings and to provide heat to external users by contributing heat to any future district heating grid developed in the locality. To this end, the applicant states that they have investigated a number of process options and have concluded that the most feasible would involve the extraction of intermediate pressure steam from the turbine. We have included conditions 1.3.2 and 1.3.3 in the permit which require two things:

- The maintenance of steam and/or hot water pass-outs such that opportunities for further use of waste heat can be capitalised upon should they become practicable; and
- The biennial review of the practicability of the implementation of combined heat and power (CHP) at the facility.

The inclusion of these conditions will ensure that the introduction of CHP is regularly reviewed in the context of what are likely be changing circumstances and practicabilities over time so that should CHP become feasible, the Operator will have to act.

A1.3.3 Electricity Generation

The Installation will be provided with a vacuum condensing steam turbine, designed to utilise the steam to generate electrical power for use on site (parasitic load) and for export to the grid. Agency Guidance Note EPR 5.01 requires that, where solely electricity is generated, between 5 and 9MW electrical (MWe) should be recoverable per 100,000 tonnes of annual waste throughput. The Avonmouth plant is designed to

generate 13.2MWe at a capacity of 100,000 tonnes and on this basis it is expected to perform above the benchmark range.

The use of a gas turbine to generate electrical power was considered by the applicant to be impractical for the following reasons:

- The synthesis gas (syngas) would require cleaning before it could be burned in a gas turbine.
- The SBOS technology is a batch process that is sequenced to provide a continuous flow of syngas. To achieve the WID residual ash Loss on Ignition (LOI)/Total Organic Carbon (TOC) limit, a significant part of the batch cycle requires the gasification chamber to be operated in an excess air environment (i.e. the 'residual carbon reduction' phase). The gas generated in this operating mode cannot be utilised by a gas turbine/engine. A steam boiler is therefore considered BAT for recovering energy.
- The syngas generated by the gasification chamber during the residual carbon reduction phase will be at a maximum temperature of 850^{o}C. In accordance with WID, this will need to be heated to 1100^{o}C for 2 seconds after the last injection of air and a gas turbine would not achieve this. This means an auxiliary fuel source would be needed and this is not considered BAT.
- The process would be more complex and expensive if it included a syngas cleaning process and gas turbine. The Applicant suggested that this additional complexity would make it potentially more prone to failure, which would potentially result in a greater frequency of abnormal operation. This was not considered BAT by the applicant.

A1.3.4 Boiler Design

Details of the boiler design are provided in paragraphs 2.3.61 to 2.3.67 of the Management Plan in the application and are consistent with the indicative BAT requirements detailed in Section 2.10 of Sector Guidance Note EPR 5.01.

The Agency considers that the boiler design is BAT for the Installation.

A1.3.5 Cooling Systems

There are three main types of cooling systems commonly employed at energy from waste (EfW) Installations. These are:

- once through direct water cooling;
- evaporative cooling; and
- air cooling.

The applicant has chosen air cooling as the BAT cooling choice for the Installation for the following reasons:

- no liquid blow-down;
- evaporative cooling systems require the use of chemical treatment or biocides;
- there is no visible plume; and
- there is no requirement for water input.

Air-cooled condensers do have the potential to cause noise impact. The Application contains (in Appendix 9) a noise survey of the site and surrounding sensitive receptors. Expected noise levels from the operational phase have been assessed at sensitive receptors and the applicant concludes that the facility is not likely to give rise to cause for annoyance. However, a pre-operational condition requires the operator to design and submit a programme of noise monitoring. An improvement condition requires the Operator then to provide an assessment of noise impact as part of the post-commissioning report.

The Agency considers that the air cooled condensers are BAT for the Installation.

A1.4 Emissions to surface water and sewer

The generation of trade effluent is limited to boiler system effluents, air compressor condensate, leaks and spillages, drainage from waste storage areas and wash-down water. There are no waste waters generated by the flue gas treatment systems and therefore the requirements of WID (Articles 8, 11 and Annex IV) do not apply.

A1.4.1 Emissions to surface water

Emissions to surface waters from the Installation (from the external paved areas, and via gutters and rainwater down pipes from the building roofs) will be uncontaminated and, as a precautionary measure, will discharge via a class I oil-water separator. The discharge will be made directly to the Southern Rhine and from here will drain through a series of interconnecting rhines before entering the Severn estuary. Application Drawing Number CY1044/5/04 illustrates the general layout of the proposed drainage system. The permit requires that discharges to surface waters must be uncontaminated and for this reason sets no ELVs. The Agency considers that the Installation complies with BAT for emissions to surface water.

A1.4.2 Emissions to sewer

Effluents generated by the Installation will be re-used where possible. Effluent that cannot be re-used will be discharged to the public foul sewer under discharge consent to be issued by Wessex Water.

It is anticipated that the rate of discharge to sewer from the process will be approximately 0.5m^3/hour. The generation of trade effluent is primarily limited to boiler system effluents, air compressor condensate, leaks and spillages, drainage from waste storage areas and wash-down water. The release will be treated at the sewage treatment works which in turn has limits set on its emissions to surface waters for the protection of the environment. The Agency considers that the Installation complies with BAT for emissions to sewer.

A1.5 Water Use

In response to the further information notice dated 26 November 2009 regarding water use, the Applicant provided clarification of the principle water use minimisation measures to be utilised at the Installation. They are:

- Air cooling systems proposed for steam condensing circuit after steam turbine instead of water cooling;

- Process water to be reused on site wherever feasible;
- Dry flue gas treatment systems being proposed; and
- Housekeeping measures to ensure leakages are minimised.

It is generally considered that Installations of this type are not major users of water and therefore water usage tends not to be a primary environmental concern. The Agency considers that the Installation complies with BAT for water usage.

A2 – Operational Techniques

We have reviewed the operational techniques set out in the application and supplemented with responses to schedule 5 notices dated 26th November 2009, 1st February 2010 and 29th April 2010 with reference to the guidance provided in Agency's Guidance Note EPR 5.01 and the associated BREF Note. We accept that the techniques are BAT for the Installation.

A2.1 Incoming Waste & Storage

Pre-acceptance procedures will be in place to assess the suitability of the waste for treatment. All vehicles delivering waste will be enclosed, sheeted or otherwise secured to prevent escape of waste and vehicles will enter the building via automated high-speed roller shutter doors. The doors will minimise emissions of odour, dust and noise from the building which will be maintained under a negative pressure. A visual inspection of the waste will take place at this stage with the removal of any wastes that do not conform with the requirements of the Permit. The waste will be stored in segregated bays according to waste type and calorific value (CV) and will not be stored for a period greater than four days.

A2.2 Combustion Requirements

A2.2.1 Waste Charging

The Installation will comprise five lines. Each line consists of four gasifiers/Primary Gasification Chambers (PGC), a secondary combustion chamber (SCC), a close-coupled boiler, a flue gas treatment package, a by-pass venting system for use during emergency conditions and a flue gas emission point (the flues for all lines are contained within a single windshield). Hence there will be a total of 20 gasifiers, 5 Secondary Combustion Chambers, 5 boilers, 5 flue-gas treatment packages, 5 emergency abatement by-passes and 5 flues carrying abated gaseous emissions through a single stack to atmosphere. A single turbine and generator will serve all five lines.

Based on the duration of the gasification cycle, each of the four gasifiers will gasify a batch of waste once in each 24-hour period. Waste throughput rates will be varied based on bulk density and CV of waste. The design allows each process line to operate at a minimum of 30% of the design heat load therefore allowing wastes with a lower CV to be processed. The use of a batch system allows flexibility of input to each gasifier. This enables blending of waste streams to moderate the variability in CV and bulk density of wastes, based on pre-acceptance and acceptance information.

The gasifiers are sealed using hydraulically operated lids to prevent ingress of excess oxygen during the gasification cycle in compliance with WID. Control systems are in place to ensure that ignition of waste in each gasifier cannot commence unless the required temperature has been reached in its respective SCC (WID articles 6, 3a). Should the required minimum WID temperature (1100^{o}C for hazardous waste) not be maintained in an SCC, no further waste feed will occur and no additional gasifiers will be able to be ignited on that line (WID Article 6, 3b). A gas oil burner in each SCC will automatically ignite to raise and maintain the required temperature. Continuous emissions monitoring systems (CEMS) is provided for each process line. Should an Emission Limit Value (ELV) be exceeded as a result of failure of abatement, the control system will not allow any further gasifiers on a given line to be ignited.

A2.2.2 Ignition

On each process line gasification will be undertaken in 4 gasifiers in a sequential batch manner in order to provide a constant flow of syngas for combustion into each SCC. Initial ignition of waste in each gasifier will use gas oil burners and once an interior temperature of 200^{o}C has been reached in the gasifier the ignition burner shuts off automatically, the gasification process becomes self sustaining and the temperature begins to increase. Ignition in a gasifier will automatically be prevented if the relevant SCC is not achieving the minimum WID temperature of 1100ºC or if any of the gasifier doors are open.

A2.2.3 Gasification

Waste in each PGC is thermally decomposed in an oxygen deficient atmosphere to produce syngas. Uncontrolled air ingress will be minimised by the provision of seals which will be frequently inspected and maintained. The syngas will predominantly comprise carbon monoxide, hydrogen and other reduced organic species such as methane. No agitation occurs within the gasifier which has the effect of minimising particulate carry over. Residual carbon reduction occurs after the gasification phase and this requires each PGC to be operated in an excess air environment to oxidise the residual carbon in the waste. This stage of gasification is undertaken to minimise the residual organic carbon content of the ash to comply with WID (the ash must have a total organic carbon (TOC) concentration of <3%, or a loss on Ignition (LOI) value of <5% (WID, Article 6(1)).

A2.2.4 Syngas combustion

Each line supplies syngas to an SCC. Syngas is combusted by the introduction of combustion air extracted from the main building and re-circulated flue gas. Full oxidation of the partially oxidised syngas components occurs. The oxygen concentration in each SCC will be >6%. The oxidation reaction is exothermic and will ensure that the appropriate minimum WID temperature (1100 ^{o}C) is achieved for no less than 2 seconds after the last injection of air in accordance with WID requirements (Article 6(1)).

The temperature of each SCC will be continuously monitored as outlined in Section 2.16 of the Application (WID Article 11 (2b)) and auxiliary, low-NO_x gas oil burners are to be provided to ensure that the minimum temperature is always maintained when syngas is being combusted. Auxiliary burners will be controlled automatically to ignite when the required temperature in each SCC following final injection of combustion air is not met (Article 6(1)). Computerised Fluid Dynamics (CFD) modelling for the SCCs has been

undertaken to confirm temperature and residence time requirements will be met, and to optimise the design. The results of the study are presented in Appendix 14 of the application. Waste feed into the gasifiers will be stopped as soon as possible if the temperature in the SCC cannot be maintained above the minimum WID limit. Urea solution is injected into the SCC after the secondary air injection nozzles to facilitate NO_x abatement.

Although WID does not specify a minimum oxygen content for the combustion gases, BAT is considered to be around 6% excess oxygen to ensure sufficiently oxidising conditions for complete burn-out. The oxygen concentration in each SCC is to be monitored at the main stack and will be optimised to ensure complete combustion as described in Appendix 15 of the application. Combustion conditions in the SCC under the most unfavourable reasonably foreseeable operating conditions will be validated at the operational stage as required by WID (Article 11(3)). This requirement has been secured by an Improvement Condition, which requires the Applicant to carry out practical measurement of the combustion temperature, residence time, and the oxygen content of the stack gases, and under the most unfavourable operational conditions.

A2.3 Waste Heat Recovery

Heat generated in each SCC will be recovered as far as practicable. Further details on heat recovery are detailed in Section A1.3.2 of this document. Flue gas produced following secondary combustion is cooled and the heat is recovered in separate steam boilers dedicated to each process stream. The boiler design minimises residence time in the critical cooling section of the boiler to minmise de novo dioxin formation in the temperature range 450-200^{o}C. This is achieved by using high gas velocities in the critical cooling region and by minimising the volume of the access chamber. Flue gas exiting the boiler will be directed to the economiser prior to transfer to the flue gas pollution abatement plant. Soot blowing equipment has not been proposed, but can be retro fitted if required. Sticky boiler deposits will be removed by rodding during programmed shutdown of each boiler.

A2.4 Power Generation and Cooling Systems

The gasification plant will be provided with a steam turbine package, designed to utilise the superheated steam to generate electrical power for export to the National Grid. The steam turbine power is optimised by condensing the steam after it leaves the last stage of the turbine which is achieved by an air cooled condenser (ACC). The condensed steam is re-circulated to the boiler following treatment in a closed circuit to minimise losses from the system.

A2.5 Flue gas treatment

Emissions to air are controlled via a flue gas treatment plant dedicated to each process line with the final discharge via a common windshield at a height of 25 metres equipped with CEMS. The CEMS will continuously monitor oxides of nitrogen (NO_x), particulates, total organic carbon (TOC), hydrogen chloride (HCl), sulphur dioxide (SO_2), carbon monoxide (CO), nitrous oxide (N_2O) and ammonia (NH_3). Abatement takes place downstream of the waste heat boiler, with the exception of NO_x abatement which is upstream of the boiler. The NO_x abatement comprises Selective Non-Catalytic Reduction (SNCR) using urea solution which is injected into the SCC. After passing through the boiler the flue gas is treated in abatement plant with sodium bicarbonate (to

remove acid gases) in a dry process and powdered activated carbon (PAC) for the removal of dioxins, furans and mercury. The final stage of flue gas treatment comprises multiple compartment fabric filters to capture particulate matter derived from the flue gas and from the injection of sodium bicarbonate and PAC.

A2.6 Flue gas treatment residues and Gasifier Ash

A2.6.1 Flue gas treatment residue

Article 9 of WID requires appropriate testing to be carried out on residues to determine suitable routes for disposal or recovery. These tests will be undertaken during commissioning of the Installation, and will include the total soluble fraction and the heavy metals soluble fraction of the flue gas treatment residues. These tests will also confirm whether flue gas treatment residues will be classified as hazardous waste. Full details of the proposed monitoring is included in Appendix 15 of the application.

A2.6.2 Gasifier Ash

The ash is to be transferred from each gasifier to the ash conveyor using a bespoke tool attached to a telehandler. It will be dampened or quenched by waste process water and conveyed to skips inside the main building. Two mechanisms will be available to dampen/quench the ash:

- a water spray
- a water bath

Boiler effluent will be used, supplied by the ash wetting pumps. The rear door of each gasifier will be opened prior to the front door being opened so as to provide a discharge route for the ash into the contained system and to induce air flow from the front door into the ash conditioning and conveying system as a consequence of the induced pressure differential. This will be further aided by the water spray which will be manually initiated prior to commencement of the de-ashing process. A temperature probe in each gasifier will provide confirmation that the appropriate temperature has been reached to safely allow de-ashing operations to begin. With the above mitigation measures in place the applicant does not consider that ambient dust will be present at the facility in such concentrations as to cause any concern. We have included in the permit a pre-operational condition requiring the Operator to specify storage arrangements for bottom ash. This is so that we can be satisfied that such arrangements will minimise the risk of fugitive release of the ash during storage for the protection of the environment. We have also included a pre-operational condition to submit an ash sampling protocol so as to ensure that suitable sampling an testing arrangements are developed in line with Agency guidance.

The quantity of gasifier ash generated is expected to be approximately 6.6% by mass (dry weight). It is proposed that the residue will be used as a bulking agent in concrete block manufacture. It is a requirement of the Permit that waste is recovered wherever practicable and in a manner which minimises its impact on the environment. As with the flue gas residues, compliance with Article 9 of the WID will be achieved by the proposed monitoring in Appendix 15 of the Application and is specified in Table S4.5 of the permit.

A2.7 Use of the abatement by-pass under emergency conditions

There is one by-pass for each line connected to the outlet from each SCC. Under normal operating conditions the by-pass vent/dump stack is closed and the flue gas passes through the heat transfer and abatement systems prior to discharge through the main stack. Under emergency circumstances discharge of flue gases through the abatement by-pass valves may be required (there is one abatement by-pass per line). The emergency circumstances in which the abatement by-passes are authorised to operate are:

- Over-pressurisation of the secondary combustion chamber as a result of ID fan failure
- Boiler tube burst/leak
- Boiler water feed failure
- Power failure (until such time as the plant is back online following the start-up of the back-up generator)
- Emergency isolation of specific process plant as necessary.

The Applicant was also asked to give consideration to the feasibility of routing emissions destined for the by-pass through an alternatives line's abatement plant or the main stack. These options were discounted on the basis of complexity of design, safety concerns and the practicalities of the plant layout. The permit requires that, where an abatement by-pass valve is opened, the plant must be shut-down unless the problem giving rise to the opening of the by-pass can be rectified and the operation of the plant returned to normal (by-pass closed) within 30 minutes. This is achieved through condition 2.3.9.

A2.8 Waste Types

Article 4(4) of the WID requires that the Permit must list explicitly the categories of waste which may be treated. Appendix 7 of the application contains a list of wastes, coded by their List of Wastes code, which the applicant proposes to accept into the gasification process. Following discussions with the applicant, a revised list was submitted on 23rd March 2010. The waste to be accepted extends to a wide range of commercial and industrial waste streams and includes a proportion of hazardous waste. The Applicant proposed not to accept any liquid wastes, any wastes of inappropriately low calorific value (including wastes which are liable to have a high moisture content) or any wastes exhibiting any of the following hazardous properties (as defined by the Hazardous Waste (England and Wales) Regulations 2005:

- H1- Explosive
- H2 - Oxidising substances
- H3A - Highly flammable
- H3B - Flammable liquid substances
- H12 - Substances or preparations which release toxic or very toxic gases in contact with water, air or an acid

We agree with this proposal.
We decided that, of the waste types the Applicant did propose to accept, the following are not appropriate:

- Wastes liable to contain toxic contaminants that may present particular concern (including wastes liable to contain elevated chromium levels)
- Sludges (which, similarly to liquid wastes, present particular handling difficulties because of their mobile nature)
- Clinical wastes. The applicant proposed to accept some non-hazardous healthcare wastes and some non-healthcare medicinal wastes (both hazardous and non-hazardous). Some of these wastes are liable to have a high moisture content and others are liable to be liquids. Furthermore, it is considered impracticable to propose to accept only a limited number of discrete constituents of what arises for disposal as a fairly broad waste stream and for which specialist disposal facilities already exist.
- Animal tissue wastes. The Applicant proposed to accept animal by-products but these are considered inappropriate because they are liable to have a high moisture content and some are liable to be liquid. Also, in the case of animal carcases, it is considered that appropriate load balancing could be compromised. Specialist facilities are available for the disposal of these waste types.

CV has been calculated and adjusted for ash and water content with a net CV of 16.9MJ/kg of waste expected to be achieved. The calculations are provided in Appendix 8 of the Application.

It is recognised that waste streams will vary but this has been accounted for in the Installation design and pre-acceptance procedures. Variations in total throughput, bulk density, CV, waste composition and waste contaminants have been taken into account in the designing of the Installation together with operational procedures for mixing and balancing the CV and bulk density of waste inputs. Details of these are given in Section 2.8 of the application. Further clarification of the procedure for balancing loads was provided in writing by the applicant on 23rd March 2010. We have incorporated this into the Operating techniques in Table S1.2 of the permit alongside the relevant parts of the application.

The wastes included in Schedule 3 Table S3.2 of the Permit are suitable for incineration in accordance with the WID. We are satisfied that the Operator can accept these wastes as the Installation design, construction and operation will be BAT for the treatment of the specified wastes.

A2.9 Emissions to the Environment & Setting Limits/Technical Measures

We have reviewed the Applicant's assessment of the environmental impact of emissions from the Installation. The Environmental Permitting Regulations require that emissions from the Installation are prevented or minimised where prevention is not practicable, through the use of BAT. In addition, the WID sets out air emission limit values (ELVs) for a range of substances (including particulates, HCl, HF, SO_2, NO_2, dioxins and metals, based upon daily and half-hourly average values or spot values as appropriate. It is a requirement of Article 7 of the WID that incineration plants are 'designed, equipped, built and operated' in a manner which will ensure that these ELVs are not exceeded. The Agency has ensured that the Permit includes ELVs based on BAT.

A2.9.1 Principal Substances

Table S4.1 of the Permit sets ELVs for the principal substances that will be emitted by the plant during normal operation (but not CO_2, as explained previously):

- NO and NO_2 expressed as NO_2
- particulate matter
- TOC
- HCl
- SO_2
- CO

Half hourly average and daily average ELVs are set in the Permit at the levels specified in the WID. The Permit requires that these substances are monitored on a continuous basis. It is also a requirement of the Permit that HCl and SO_2 are monitored twice a year (quarterly during the first 12 months) by extractive methods in order to demonstrate compliance. Separate periodic limits have been set in the Permit for the results of the extractive monitoring. These periodic limits are applicable to the waste treatment process and reflect BAT for these plants. It is on the basis of WID mandatory ELVs that the Applicant has carried out its analysis of environmental impact and the Agency's view is that compliance with WID ELVs is BAT for the above parameters at this Installation.

A2.9.2 Other Substances

In accordance with the requirements of the WID, additional ELVs for periodic extractive samples are set in Table S4.1 of the Permit for the following substances:

- hydrogen fluoride (HF);
- cadmium and thallium and their compounds (Cd, Tl);
- mercury (Hg) and its compounds;
- other metals (the sum of Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds) [Note 1]; and
- dioxins and furans.

The ELVs for this periodic monitoring (monitored twice a year (quarterly during the first 12 months)) are set in the Permit at the levels specified in the WID. Continuous measurement of HF is not required under the WID as suitable abatement of HCl will ensure HF emissions are minimised.

Note 1: The term **'**Metals' includes their gaseous, vapour and solid phases as well as their compounds (expressed as the metal or the sum of the metals as specified). Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V mean antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel and vanadium respectively.

A2.9.3 Abnormal Operation

Table S4.1a specifies the ELVs that will apply during periods of abnormal operation. Abnormal operation is defined in Schedule 7 of the Permit and applies only to those circumstances included within the definition of the term. These ELVs allow emissions of particulate matter to increase from 30 mg/m^3 to 150 mg/m^3 (as a half hourly average) for up to 4 hours as a result of failure of the abatement plant. The ELVs in Table S4.1a for TOC and CO remain the same as those set in Table S4.1 for normal operation and therefore require that good combustion conditions are maintained even under abnormal operation situations. These limits are in accordance with the requirements of the WID and the emission benchmarks for waste incinerators included in the Incineration Sector Guidance Note, which are set taking into account the guidance on BAT and obligations imposed by legislation.

A2.9.4 Ash Quality

In accordance with the requirements of the WID, a limit has been set for loss on ignition (LOI) and total organic carbon content (TOC) in Table S4.5 of the Permit.

A3 Assessment of Emissions to Air

A3.1 Method of Assessment

The Agency has assessed the impact of emissions to air. The air dispersion modelling provides figures for the maximum concentrations at ground level of individual pollutants emitted from the Installation with all five process lines operational. Worst-case conditions were assessed with emissions at the WID limit, operation at maximum throughput (8000 hours per annum), combined with most adverse weather conditions. These are expressed as annual mean concentrations (long-term) and various short-term concentrations (as appropriate to the standard against which they are compared). These are the long-term and short-term process contributions (PC) respectively. The Applicant considered the impact of normal operation (all five lines at maximum throughput) and abnormal operation. Abnormal operation represented four lines at maximum throughput with one line discharging through the by-pass vent unabated.

The PC for each pollutant was compared against the relevant Air Quality Standard (AQS), or the Environmental Assessment Level (EAL) where there is no AQS. The EAL is based on various published sources of information which include the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organisation (WHO) Air Quality Guidelines for Europe. The AQS and EALs are set to protect human health, and are the levels below which no adverse impact on human health is expected. In line with our H1 Environmental Risk Assessment guidance, if the long-term PC for a pollutant is less than 1% of the AQS or EAL and the short-term PC less than 10% the Agency deems that its effect will be insignificant and no detailed assessment is required. Generally speaking, in such circumstances the Applicant's proposed techniques will be accepted as BAT, as any alternative technique could achieve only an insignificant reduction in emissions, and further expenditure could not therefore be justified. For this Installation, the Applicant's H1 screening exercise identified that every pollutant exceeded the either the short- or long-term insignificance thresholds (or both).

For those emissions not screened out as insignificant, the next stage is to establish whether detailed air dispersion modelling is warranted. In this stage, the long-term the worst case PC is added to the ambient concentration to give the Predicted Environmental Concentration (PEC), which represents the maximum concentration of the pollutant from all sources. If the PEC is >70% of the long-term EQS/EAL then detailed air dispersion modelling is justified. For short-term impact, if the short-term PC >20% of (short-term EAL/EQS minus the long-term background concentration), detailed air dispersion modelling is justified. In this case, the Applicant opted to move straight to detailed air dispersion modelling for all pollutants.

Once detailed air dispersion modelling has been undertaken, an assessment is made of the acceptability of the PEC for each pollutant against environmental quality requirements. To allow for any uncertainty in the modelling accuracy and in order to be confident that there will be no adverse effect on health, headroom must be maintained between the PEC and the AQS/EAL. The headroom is defined as the difference between the AQS/EAL and the PEC. Provided the PEC is below the AQS/EAL and the headroom is acceptable, the Agency accepts that the emission will have no adverse effect. However, in all cases where the emission cannot be screened out as insignificant, the Applicant must show that it has considered all the appropriate available techniques to prevent or minimise that emission, and that it will employ BAT for the Installation. This approach to emissions is extremely conservative and ensures that BAT is employed to prevent or minimise emissions and no emission will have an unacceptable impact on the environment or human health.

A3.2 Principal pollutants

As already noted, the Application contained air quality dispersion modelling (Appendix 10) which was used as the basis for assessing the potential impact of emissions from the facility on human health and on Natura 2000 (protected) habitats. Air dispersion modelling input files were provided for our review.

The Applicant used a computerised air dispersion model (ADMS 4.1) to calculate the expected ground level concentrations of the pollutants emitted from the stack, and meteorological data for Bristol for the years 1996 to 2000 was used. AQMAU assessed the validity of the modelling undertaken by the applicant and undertook check modelling using ADMS4.1 and meteorological data for the years 2003-2007 from Bristol Airport.

The applicant modelled two operating scenarios; normal and abnormal operations. Normal operation consists of five lines operating and utilising the air emissions abatement equipment that is dedicated to each line. The applicant adopted a precautionary approach of assuming in their air dispersion modelling that pollutant concentrations in emissions from the stack would be at WID limits during normal operation. Process contributions were modelled and reported against relevant EQS/EALs. These can be found in section 3.4 of Appendix 10 of the application. The Applicant concluded that PC values for pollutants would be lower than their respective AQS/EALs and would therefore not be likely to result in any breach of AQS/EALs, with the exception of cadmium. In respect of cadmium, and a predicted annual PC equivalent to ~150% of the relevant EAL, the Applicant noted that the prediction is based on a highly precautionary assumption of emission 100% of the WID combined limit for cadmium and thallium. As a precaution, we undertook check modelling for the range of pollutants considered by the Applicant. The exercise predicted adequate headroom will

be provided for all pollutants (including cadmium) between the PEC (or PC) and AQS/EAL to ensure that these standards are not exceeded and there are no unacceptable impacts on the environment or human health at sensitive receptors. The exceptions to this were chromium VI and arsenic, for which check modelling predictions gave rise to some potential concern. Cadmium and arsenic are further discussed in section A3.3 of this report.

Abnormal operation is based on four lines operating normally and one line by-passing the abatement plant. The applicant adopted the same approach to the modelling and assessment of impacts as they did with normal operation, comparing maximum modelled PC values against EQS/EALs. All pollutant PC values were reported solely against short-term EQS/EALs in recognition of the fact that abnormal operation is a transient scenario and hence long-term EQS are not relevant. Modelled impacts associated with abnormal operation are reported in section 3.8 of Appendix 10 of the application. The Applicant concluded that PC values for pollutants would be lower than their respective AQS/EALs and would therefore not be likely to result in any breach of AQS/EALs. As with modelling of the normal operation scenario, we have undertaken our own check modelling of the impact associated with abnormal operation at sensitive receptors. The exercise predicted that adequate headroom will be provided for all pollutants between the PEC (or PC) and AQS/EAL to ensure that these standards are not exceeded and there are no unacceptable impacts on the environment or human health at sensitive receptors.

The Applicant's assessment of Volatile Organic Compounds (VOC) did not include a comparison against an EQS and so in our check modelling the EQS for benzene (the most harmful likely constituent of the VOC) has been used as a surrogate for total VOC. We used an EAL for Benzene of 5 $\mu g/m^3$. The exercise predicted that that adequate headroom will be provided between the PEC (or PC) and AQS/EAL to ensure that the standard is not exceeded and there are no unacceptable impacts on the environment or human health at sensitive receptors.

The Applicant did consider PM_{10} as part of their air dispersion modelling exercise. As with other pollutants, the Applicant concluded that adequate headroom will be provided between the PEC (or PC) and AQS/EAL to ensure that the standard is not exceeded and there are no unacceptable impacts on the environment or human health at sensitive receptors. Our check modelling concurred with this assessment. $PM_{2.5}$ (particulate matter up to 2.5 microns in diameter) were not specifically consider by the Applicant. In our check modelling we did consider $PM_{2.5}$ on the basis of a worst-case scenario assumption that all particulate is $PM_{2.5}$ and the emission is maintained at the WID limit (the same basis as the calculation of emission rate for all other pollutants). The exercise predicted that that adequate headroom will be provided between the PEC (or PC) and the Target Value to ensure that the Value is not exceeded and there are no unacceptable impacts on the environment or human health at sensitive receptors. There is currently no short-term EQS/EAL for $PM_{2.5}$ and so consideration in the context of abnormal operation was not considered necessary.

Whilst we are confident that current monitoring techniques will capture the fine particle fraction ($PM_{2.5}$) for inclusion in a measurement of total particulate matter, a permit 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. An Improvement

Condition has been imposed requiring the Operator to carry out tests to determine the particle size distribution in the exhaust gas emissions.

The Operator will be required to monitor particulate emissions using the method set out in EN 13284-1. This method requires that the filter efficiency must be at least 99.5 % on a test aerosol with a mean particle diameter of 0.3µm, at the maximum flow rate anticipated. This means that particulate monitoring data effectively captures everything above 0.3 microns and much of what is smaller. It is not expected that even smaller particles 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 0.1µm in diameter. Questions are often raised about the effect of nano-particles on human health and in particular on children's health because of their high surface to volume ratio, making them more reactive and their very small size and 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.

The Health Protection Agency (HPA) addresses this issue in its September 2009 statement 'The Impact on Health of Emissions to Air from Municipal Incinerators'. The HPA notes that no air quality standards are defined in terms of number concentration of particles and that there is no generally accepted coefficients that allow the use of number concentrations to be used. This is an area being kept under review by the Committee on the Medical Effects of Air Pollutants (COMEAP). The HPA also points out that in 2006 incinerators contributed 0.03% to ambient ground level PM_{10} levels compared with 27% for road traffic and 25% for industry in general. This is borne out by the assessment of this Application which show emissions of PM_{10} will not cause a breach of the relevant standard. Overall the HPA concludes that given the effects of incinerators on local concentrations of particles, it is highly unlikely that there will be any detectable effect arising from any particular incinerator on local infant mortality.

A3.3 Other metals

The metals antimony, arsenic, lead, chromium, cobalt, copper, magnesium, nickel and vanadium are subject to a single total emission limit value (ELV) of 0.5mg/m^3 under the WID. The Applicant adopted a conservative approach to the air dispersion modelling of these metals releases whereby it was assumed that any metal in the group could potentially be emitted at 100% of the Group IIII total metals WID limit. The modelled PC was then compared to the EALs for chromium VI (as it stood at the time the application was submitted, see further on this below), which was selected as the most stringent of the applicable EALs for these metals and hence the most precautionary. Results indicated maximum PC values substantially below the short- and long-term EAL for chromium. We took a different approach in our own check modelling, assessing each of the metals individually against the relevant specific short- and long-term EALs at relevant sensitive receptors. As with the pollutants discussed in section A3.2, these results indicate substantial headroom between the PEC and the relevant EQS/EAL for each metal with the exception of chromium VI and arsenic. In the case of chromium and arsenic, our check modelling made an assessment against guideline values issued by the Expert Panel on Air Quality Standards Guidelines (EPAQS) in May 2009 rather than the EAL used by the applicant as their point of reference. These guideline values for

ambient air concentrations are 0.0002 μg/m^3 for chromium VI and 0.003 μg/m^3 for arsenic (in the PM_{10} fraction). They are reflected in the Agency's new H1 document issued April 2010 in the form of new EALs (long-term only – there is now no short-term EAL for chromium VI). The application was submitted prior to the publication of the new EALs and the applicant had not used these guideline values in their air dispersion modelling.

The WID limit for Group 3 metals of 0.5 mg/m^3 covers gaseous and vapour forms of the metals and their compounds as well as that present in particulate matter. WID has a separate emission limit values for emissions to air of total particulate material. The EPAQS guideline also refers to chromium VI only whereas the Group 3 WID limit includes all chromium.

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 limit 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. These data show that:

1. The mean total chromium concentration in the emission from these plants is 0.006 mg/m^3 (with a maximum of 0.03 mg/m^3).

2. The mean chromium VI concentration (based on the bag dust ratio) in the emission from these plants is 0.000021 mg/m^3 (with a maximum of 0.0001mg/m^3)

In addition, emissions data from 5 municipal waste incinerators over the past two years show emissions of arsenic of up to 0.015 mg/m^3 with an average of 0.002 mg/m^3.

These are significantly below the single total WID limit for all Group III metals that was used for the modelling and which identified a potential cause for concern regarding arsenic and chromium VI. The 0.03 mg/m^3 total chromium concentration above is just 6% of the highly precautionary WID ELV-based total chromium emission concentration used by the applicant in their air dispersion modelling (and by us in our check modelling) and, further, the chromium VI emission concentration of 0.0001mg/m^3 equates to a process contribution at the nearest relevant receptor for chromium VI of 0.22% of the EPAQS guideline value. For arsenic, the 0.015mg/m^3 maximum above is 3% of the WID ELV concentration used by the applicant in their air dispersion modelling (and by us in our check modelling). This equates to a process contribution at the nearest relevant receptor for arsenic of 2.2% of the EPAQS guideline value. In light of these data, we are satisfied that chromium VI and arsenic emissions will not have an unacceptable impact on the environment or human health.

Notwithstanding, it is considered appropriate to set an Improvement Condition requiring more detailed assessment against the proposed air quality guidelines based on actual measurements of emissions. This has been included with a period of one year's data being specified to take account of any natural variation in the waste composition. The Improvement Condition seeks to verify whether the actual releases are as expected.

A3.4 The influence of stack height

In a further information request dated 29th April 2010, we asked for further evidence that the selected stack height is BAT for the Installation. The applicant undertook an assessment of the effect of changing stack height on process contributions (PC) and predicted environmental concentrations (PEC). A broad range of stack heights was considered. The results show that for applicable (residential) receptors, increasing the stack height beyond 25m makes only a very marginal difference to PC and PEC values. On the basis of the results, we are satisfied that the selected stack height is BAT for this Installation.

A3.5 Effect on proposed Air Quality Management Area (AQMA)

The City of Bristol has been designated as an Air Quality Management Area and within this area objectives for NO_2 and PM_{10} apply. Through our check modelling, we were able to predict that the NO_2 and PM_{10} process contributions from the Avonmouth Resource Park in this zone are likely to be less than 1% of the objective and therefore insignificant.

A3.6 The selection of one abatement by-pass operating as the most appropriate worst case scenario for air dispersion modelling

The Applicant considered the scenario of a single line discharging flue gas directly to atmosphere through the by-pass vent whilst all other lines continue to operate normally to be an appropriate worst-case abnormal operation scenario on which to base air dispersion modelling. The reasoning provided in their response to the 26th November 2009 further information request centred on the relatively independent nature of process lines and supporting auxiliary equipment. In addition, permit condition 2.3.10 restricts the range of circumstances in which operation of an abatement by-pass may occur, to the extent that only a small number of emergency events can trigger activation. It is considered that emergency events of this nature will be rare. As previously discussed, in the event that emergency conditions arise and activation of an abatement by-pass is required, shut-down of the Installation is required if the problem giving rise to the activation of the by-pass cannot be resolved within 30 minutes.

A3.7 Dioxins, furans and dioxin-like PCBs

As discussed elsewhere in this decision document, we are satisfied that the applicant's proposed measures for the minimisation of dioxin emissions are in line with the indicative BAT requirements for the sector set out in the sector guidance note EPR5.01. Notwithstanding, the applicant made an assessment for the risk to health associated with inhalation and ingestion of dioxins and furans. This can be found in Appendix 11 of the application (Dioxin Health Risk Assessment). A conservative assumption was made that, as with emissions of other pollutants, the dioxin/furan emission concentration would be at the WID limit of 0.1ng/m^3. The maximum daily dioxin inhalation rates for a 70kg adult and a 14.5kg infant were calculated to be ~0.8% and ~1% respectively of the Tolerable Daily Intake (TDI) for humans of 2pg/kg/day. The rate at the nearest residential receptor was calculated to be 0.3% of the TDI. The United States Environmental Protection Agency (US EPA) Human Health Risk Assessment Protocol (HHRAP) was used by the applicant to calculate incremental average annual increases in dioxin/furan concentrations in soil resulting from deposition of dioxins/furans arising from the operation of the Avonmouth Resource Park Facility. Wet and dry gaseous phase

deposition was considered and particulate phase deposition also. Particle size influences deposition rate and particles above 5µm diameter were found to increase deposition rates significantly. However, on the basis of the manufacturer's confirmation that the bag filters are effective down to 0.1µm particle diameter, a particle size of 0.1µm was used in the modelling of particulate phase deposition. A value of 0.08 ng/kg soil was calculated as the increase in dioxin/furan concentration due to deposition. The value at the nearest relevant sensitive receptor was calculated to be approximately ten times lower than this. The daily intake of dioxins/furans arising from the ingestion of soil was calculated to be <0.1% of the TDI.

The same Protocol was used to quantify the ingestion of dioxins/furans through the consumption of eggs and chicken meat produced from free-range chickens foraging on soil subject to the calculated incremental annual average increase in dioxin concentration in the soil (0.08 ng/kg soil). Values of ~11% and ~7% of the TDI were calculated for adults and infants respectively. The Protocol was also used to quantify the ingestion of dioxins/furans through the consumption of fruit and vegetables grown on soil subject to the calculated incremental annual average increase in dioxin concentration in the soil (0.08 ng/kg soil). In quantifying ingestion through the fruit and vegetable consumption pathway, account was taken of direct deposition and air-plant transfer as well as root uptake of dioxins in the soil. Values of ~0.3% and ~0.8% of the TDI were calculated for adults and infants respectively.

The maximum combined exposure from the inhalation and ingestion pathways was calculated to be 14.1% and 10.2% of the TDI for adults and infants respectively. The combined exposure value at the nearest residential receptor was calculated to be 1.6% and at the nearest allotment receptor 0.3%. On this basis, the applicant reached the conclusion that the risk to health associated with the emission of dioxin/furans from the Avonmouth Resource Park facility would be very low. We undertook check modelling using both the US EPA HHRAP and the HMIP methodologies. We used the maximum predicted concentration, worst met year and made a conservative assumption of emission at the WID limit and on this basis concluded that the TDIs for dioxins will not be exceeded.

Ingestion of metals was not considered in the applicant's assessments. However, we undertook check modelling and comparison of the results against the appropriate reference doses. We concluded that metals intake is likely to be substantially lower than the relevant reference doses.

A3.8 Evidence from General Literature on Incineration and Health

The most recent independent review of evidence on the health effects of household waste disposal and recovery was published by Defra in 2004. It uses the results of studies into the health of people living near waste sites and studies into the emissions from waste sites to draw conclusions on the environmental and health effects of all the different waste treatment and disposal options including incineration. This review considered 23 studies of the patterns of disease around incinerators and four review papers looking at health effects of incinerators.

The report concluded that 'Published studies of the health of communities living in the vicinity of incinerators have failed to establish any convincing links between incinerator emissions and adverse effects on public health; specifically no impact was demonstrated

on the incidence of cancer, respiratory health symptoms or reproductive outcomes'. This supports data from emissions and ambient air monitoring that indicate modern, well-managed waste incinerators make only a very small contribution to background levels of air pollution.

In addition, the Small Area Health Statistics Unit (SAHSU) at Imperial College London has studied cancer incidence among 14 million people living near to 72 old type municipal solid waste incinerators in Great Britain over the period 1974-1987. On considering this study, the independent scientific advisory Committee on Carcinogenicity advised the Department of Health (Cancer incidence near municipal solid waste incinerators in Great Britain COC statement COC/00/S1 - March 2000) that it was '…reassured that any potential risk of cancer due to residency (for periods in excess of 10 years) near to municipal waste incinerators was exceedingly low and not measurable by the most modern epidemiological techniques'.

These conclusions were made based upon the emissions from older incinerators that were operating prior to the implementation of the Waste Incineration Directives. The Municipal Waste Incineration Directive (1989), Hazardous Waste Incineration Direction (1994) and, most recently, the Waste Incineration Directive (2000) introduced increasingly stringent standards for pollution prevention, including tighter limits for key pollutants, such as particulates, dioxins and heavy metals. Therefore, the potential health risks posed by the modern incinerators that are designed to achieve the more stringent WID emission limits are likely to be even smaller. This reduced risk is supported by reports such as the UK Soil and Herbage Pollutant Survey (2007) carried out by the Environment Agency which contained figures published by DEFRA (2002) providing estimates of total dioxin emissions from different sources in 1990 and 1999. The results (shown in **Table 1**) demonstrate a significant reduction in dioxin emissions from municipal solid waste incineration plants between 1990 and 1999.

Table 1

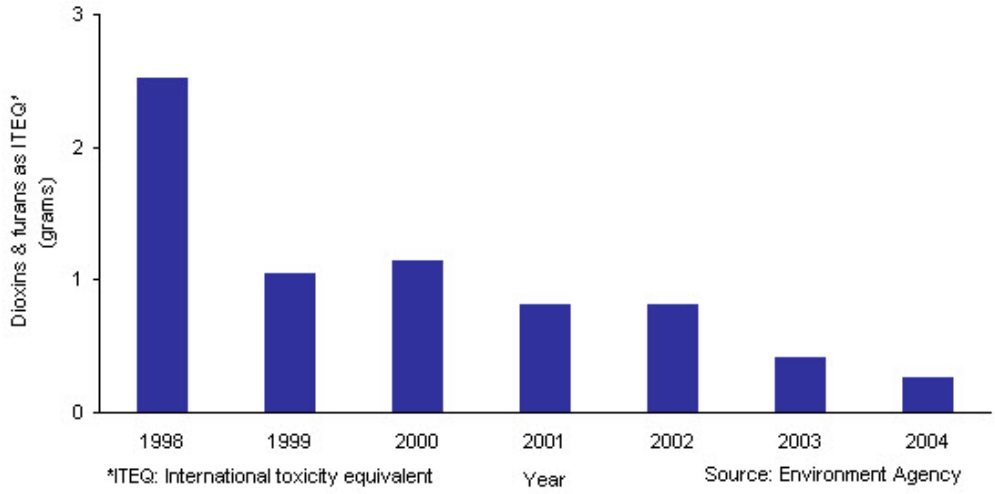
	1990	**1999**
Total emissions (g I-TEQ/year)	1142	345
% contribution from:		
Power stations	3	5
Domestic burning	1	3
Iron & steel manufacturing	6	16
Non-ferrous metal industries	3	7
MSW incineration	**52**	**1**
Other incineration	5	10
Transport	2	1
Accidental fires & open burning	11	20
Other sources	10	23

The results of the UK Soil and Herbage Pollutant Survey also found that the level of dioxins in soil and vegetation has fallen by approximately 70% over the last 20 years.

Emissions data reported to the Environment Agency has also demonstrated that concentrations of dioxins emitted from UK Municipal Solid Waste (MSW) incinerators

have continued to decline from 1998 to 2004, as shown on Figure 2 below (source: http://www.environment-agency.gov.uk/research/library/data/58725.aspx)

Figure 2: Dioxin emissions from municipal waste incinerators, 1998 to 2004



In February 2010 The Health Protection Agency (HPA) (an independent body whose aim is to protect the health and well-being of the UK population and provide support and advice to the NHS, local authorities, the Department of Health and others) published a Position Statement on 'The Impact on Health of Emissions to Air from Municipal Waste Incinerators'. It stated the following:

'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. This view is based on detailed assessments of the effects of air pollutants on health and on the fact that modern and well managed municipal waste incinerators make only a very small contribution to local concentrations of air pollutants. The Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment has reviewed recent data and has concluded that there is no need to change its previous advice, namely that any potential risk of cancer due to residency near to municipal waste incinerators is exceedingly low and probably not measurable by the most modern techniques. Since any possible health effects are likely to be very small, if detectable, studies of public health around modern, well managed municipal waste incinerators are not recommended.'

The relevant Primary Care Trust (PCT) was consulted and raised no concerns regarding risk to the health of the local population (refer to Annex 2 of this document for details).

A3.9 Impact on Designated Habitats

A number of protected habitats are present in the locality. The Severn Estuary is a Special Area of Conservation (SAC), a Special Protection Area (SPA), a Site of Special Scientific Interest (SSSI) and a Ramsar site. The Avon Gorge Woodlands is a SAC. The Habitats Risk Assessment can be found in Appendix 25 of the application and the detail of the air dispersion modelling undertaken to quantify the anticipated impact on protected habitats can be found in Appendix 10.

This Severn Estuary habitat is located approximately 1km to the West of the proposed facility and the Avon Gorge Woodlands habitat is located approximately 5km to the south-east of the proposed facility. Uncontaminated surface water runoff from the Installation will pass through an oil-water separator before being discharged into the Southern Rhine drainage ditch which runs along the southern boundary of the Installation. The Rhine converges with the Severn Estuary approximately 1km west of the facility. occur to Barlow Brook. Foul water will be discharged from the sewage collection system to the public foul sewer under the consent of Wessex Water.

As with the assessments made by the applicant of the impact of the operation of the facility on EQS/EALs for human health, the applicant has adopted the precautionary approach of basing nitrogen and SO_2 emission rates on WID Emission Limit Values (ELVs). Baseline (existing) nutrient nitrogen deposition is shown by the data provided on the APIS website to be within the critical load values for the Severn Estuary. Total nutrient nitrogen deposition (kgN/ha/yr) associated with emissions of NO_x from the facility were calculated by the applicant to be 0.07% of the lower critical load of 30kgN/ha/yr at the closest point of the Severn Estuary SAC to the facility. In line with the Agency's H1 methodology, the applicant has concluded the impact is insignificant and requires no further consideration. For the Avon Gorge Woodlands SAC the baseline nutrient nitrogen deposition is shown by the APIS website data to be exceeding the upper critical load. However, the applicant predicts the total nutrient nitrogen deposition (kgN/ha/yr) associated with emissions of NO_x from the facility to be 0.014% of the lower critical load of 10kgN/ha/yr at the closest point of the SAC to the facility. Again, in line with the Agency's H1 methodology, the facility's contribution is considered insignificant because it is below the 1% threshold of potential significance. Accordingly, the incremental increase in nitrogen deposition expected to arise from the operation of the facility is considered acceptable and has been subject to no further assessment or control.

We agree with the applicant's conclusions that the installation is unlikely to give rise to a significant effect on either the Severn Estuary or Avon Gorge Woodlands because the nitrogen contribution from the facility is insignificant. On this basis, it is our assessment that an appropriate assessment under the Conservation (Natural Habitats etc) Regulations 1994 is not required.

An assessment was made by the applicant of acid deposition associated with the operation of the Installation relative to critical load data on the APIS website for the Avon Gorge habitat. The Severn Estuary is not considered sensitive to acid deposition from aerial sources and so was not considered in this assessment. Nitrogen and sulphur deposition rates were calculated as 0.0001 keq/ha/yr and 0.0005 keq/ha/yr respectively for the closest point in the Avon Gorge SAC to the facility, equating to 0.07% and 0.02% of the lower critical load respectively. Total acid deposition (keq/ha/yr) at the closest

point in the habitat to the facility was calculated to be 0.0006. In line with the Agency's H1 methodology, the facility's contribution is considered insignificant because it is below the 1% threshold of potential significance and no further consideration is required.

A number of other local non-statutory sites of ecological interest were identified by the applicant in the vicinity of the proposed facility - the Lawrence Western Moor Local Nature Reserve (LNR), the Merebank Rhine Site of Nature Conservation Importance (SNCI) and an Avon Wildlife Trust Reserve. Our screening identified a larger range of local wildlife sites within 2km. In accordance with our general duty to protect biodiversity under the Environment Act 1995 we gave due consideration to the applicant's assessment of the risk posed by the facility to these sites. In their air dispersion modelling, the applicant predicted that the maximum NO_x and SO_2 PC would be less than the relevant EQS for the protection of ecosystems and vegetation. In addition they predicted that the maximum NO_x PEC would be less than the EQS and our check modelling predicts that the maximum SO_2 PEC will be less than the EQS. On this basis we are satisfied that emissions from the Installation will not have an unacceptable impact on local non-statutory sites of ecological interest. In addition, as discussed elsewhere in this document, we undertook consultation with Natural England and Countryside Council for Wales and no concerns were raised by either authority over the impact on designated habitats.

We have considered the combined effects of the proposed Installation operating alongside the proposed SITA Severnside Energy Recovery Centre incinerator during this determination and concluded that the combined contribution to critical loads will be less than 1% and therefore insignificant.

Part B – The Installation and its management

B1 The Permitted activities

We have determined that the Installation comprises the following activity listed in Part 2 to Schedule 1 of the Environmental Permitting (England and Wales) Regulations 2010:

- 5.1 Part A(1)(a): The incineration of hazardous waste in an incineration plant;

And the following directly associated activity:

- The generation of 13.2MWe using a steam turbine

Under the interpretative notes to section 5.1, the definition of incineration plant includes all those activities listed in Article 3 of the WID, i.e. '…the site and the entire incineration plant including all incineration lines, 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.' By virtue of this definition, all the activities which may otherwise be categorised as directly associated activities (e.g. air pollution control plant, ash storage bunker) are included in the listed activity definition. However, the electricity generating equipment is not considered part of this definition and is therefore identified as a directly associated activity. The activities comprise a single Installation because the incineration plant and the steam turbine are successive steps in an integrated activity. The Applicant has provided a plan which we consider is satisfactory, showing the extent of the site of the Installation. A plan is included in the Permit at Schedule 2, and the Operator is required to carry on the permitted activities within the installation boundary.

B2 General Management

Based upon the information submitted in the Application we are satisfied that the appropriate management systems and management structures will be in place for this Installation and sufficient financial, technical and manpower resources are available to the Applicant to ensure compliance with all the permit conditions. Details of the management structure and how procedures for operational control of the facility will be applied are set out in the application documents. We have included a pre-operational condition requiring the Operator to send a summary of its EMS to the Agency at least 3 months prior to the commencement of commissioning for our inspection and review. The Applicant proposes to achieve certification of the Environmental Management System (EMS) for the site to the international standard ISO 14001 within one year of commissioning.

Although further information regarding waste pre-acceptance, acceptance and storage procedures was provided in response to the further information request dated 29th December 2009, procedures were not in place at the time of the decision being made on the application. It was confirmed that procedures would be in place in accordance with BAT prior to any waste being accepted at the Installation. This requirement has been secured by a pre-operational condition. We have also included a pre-operational condition and an improvement condition which require the development of a commissioning plan and the submission of a post-commissioning report respectively.

These will ensure that commissioning is adequately designed, implemented and reviewed so as to ensure compliance with permit conditions.

B3 Accidents that may cause pollution

The Accidents and Emergencies Risk Assessment is provided in Appendix 6 of the application and the various measures employed to minimise risks and their consequences are described elsewhere in the application. Based upon the information submitted in the application we are satisfied that the appropriate measures will be in place to ensure that accidents that may cause pollution are prevented and their effects minimised. We are satisfied that these measures will ensure that permit conditions will be met. A pre-operational condition has been set to ensure that the plan and the measures contained in the plan are in place before commissioning begins.

B4 Energy Efficiency

Energy recovery is assessed in earlier sections of this document. This section deals with the efficient use of energy in the day to day operation of the Installation. Based upon the information submitted in the Application we are satisfied that appropriate measures are 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 site in order to increase the energy efficiency of the facility, which include operational, maintenance and physical measures.

The Operator is required to report with respect to energy use under conditions 4.2.1 and 4.2.2 of and Schedule 5 to the Permit. The following parameters are required to be reported: total electrical energy generated; electrical exported; auxiliary fuel used; and energy exported as heat (if any). Together with the total waste mass accepted per year, this will enable the Agency to monitor energy efficiency.

B5 Efficient Use of Raw Materials

Based upon the information submitted in the Application we are satisfied that the appropriate measures are 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 conditions 4.2.1 and 4.2.2 and Schedule 5. There is a requirement to report consumption of acid gas abatement medium, activated carbon and ammonia used per tonne of waste burned. This will enable the Agency to assess whether there have been any changes in the efficiency of the air pollution control plant, and the technique for selective non-catalytic reduction of NO_x. These are the most significant raw materials that will be used. The efficiency of the use of auxiliary fuel will also be tracked to determine the usage per tonne of waste burned.

We have specified the following limits and controls on the use of raw materials and fuels in Table S3.1 in Schedule 3 of the Permit:

- Use of gas oil with a sulphur content of less than 0.1% to ensure compliance with the Sulphur Content of Liquid Fuels Regulations (SCOLF).
- Use of low mercury sodium hydroxide. 0.1 mg/kg is a typical maximum concentration limit for mercury and cadmium in sodium hydroxide. As this is readily available, its use is BAT.

B6 Waste Production

Based upon the information submitted in the Application we are satisfied that the appropriate measures are in place such that waste production (in particular uncombusted materials, bottom ash and air pollution control residues (APCs)) will be avoided as far as possible, and where waste is produced it will be recovered unless technically and economically impossible.

In particular, that the Applicant's justification for its proposed waste/residue disposal option shows that such waste that does arise from the Installation that cannot be recovered will be disposed of using a disposal method that reduces impact on the environment. Table 9 in section 2.10.17 of the management plan confirms disposal/recovery routes for each waste stream.

B7 Site Security

Based upon the information submitted in the Application we are satisfied that the appropriate infrastructure and procedures are in place to ensure that site remains secure. The applicant proposes that the site will be manned 24 hours per day, 7 days per week. CCTV surveillance cameras will be in place, fed back to the control room. There will be a perimeter security fence and access to the site will be controlled.

B8 Closure and Decommissioning

Based upon the information submitted in the Application we are only partly satisfied that all of the appropriate measures are yet in place for the closure and decommissioning of the Installation.

The Operator has proposed the production of a closure plan following completion of the final plant design and this will be in place prior to commencing commissioning (paragraph 2.18 of the management plan of the application). We are satisfied that the details of this plan can be finalised at a later stage, and it's not an issue that should delay this determination. We have therefore included a pre-operational condition which requires the development of an EMS in line with Agency guidance and this will have to feature a closure plan.

B9 Site Condition Report

The Applicant has provided a Site Condition Report in which they provide an assessment of the condition of the site and the risk of contamination of the site associated with the operation of the facility (Report no. CY1044/03 dated June 2009). The area has a history of industrial use and the entire site was found to be underlain by made ground, contaminated to varying degrees by previous uses. A remediation strategy has been designed and will be implemented prior to construction of the facility. Section 2.4 of the Management Plan describes the pollution prevention measures to be employed. In summary, they are as follows:

- Impermeable surfacing will be provided in areas in which plant and associated storage is housed and operated and in which vehicle movements occur. Drainage in these areas will be to the public foul sewer.
- Drainage from external impermeably surfaced areas (roadways and parking) will pass through a Class I oil-water separator before being discharged into a watercourse. A flow balancing pond is incorporated into the overall drainage design to account for high-tide and limited discharge flow-rate requirements.
- The building in which the plant is housed will benefit from secondary containment in order to account for the need to retain firewater in the event of an emergency.
- Areas in which deliveries are received will be provided with separate drainage to the public foul sewer rather than to a watercourse because of the greater risk of contaminated run-off arising.
- Bulk fuel and sodium bicarbonate storage will benefit from bunding and storage on impermeable surfacing.
- Gasifier ash will be stored in sealed skips inside the building. Pest control chemicals will be also be stored in the building in sealed containers.
- Urea powder will be stored inside the building in flexible intermediate bulk containers.

In light of the proposed pollution prevention measures described in the application and summarised above, we are satisfied that the design of the surfacing, drainage system and secondary containment at the facility is such that the risk of ground/groundwater contamination associated with the operation of the facility will be minimal. Therefore, in accordance with our H5 guidance, no reference data will be required following the remediation of the site in accordance with the remediation strategy prior to construction.
To ensure the continued effectiveness of pollution prevention measures in protecting ground and groundwater, we will require the Operator to maintain the Site Condition Report for the lifetime of the Permit.

B10 Fugitive Emissions

Based upon the information submitted in the application we are satisfied that appropriate measures will be in place to prevent and where not practicable minimise fugitive emissions of odour, noise and vibration and of accidental releases to soil, surface waters and groundwater.

Based upon the information submitted in the application we are satisfied that the appropriate measures are in place to prevent pollution from odour. The main potential for odour would be from prolonged storage of waste within the bunker. Bunker management procedures will be in place to ensure that waste is taken from the bunker in such a manner as to avoid prolonged storage. In their response to the further information request dated 26th November 2009, the applicant provided an odour risk assessment and further detail of how fugitive dust emissions will be minimised. In it the control measures to be applied to each source of risk are summarised together with the residual risk. In each case, the residual risk is assessed to be small. Waste accepted at the Installation will be delivered in covered vehicles or within containers and bulk storage of waste will only occur in the Installation's waste bunker. Self-closing doors will close outside of the waste delivery periods and combustion air will be drawn from inside the building in order to minimise the risk of fugitive releases of odours and particulates. Waste turnover is expected to be sufficient to limit the duration for which any given load of waste is kept in storage. Quarantined wastes will be removed within 7 days.

Upon de-ashing of each gasifier, ash will be discharged on to a conveyor system from which the ash will ultimately arrive at the covered ash skips. A conveyor enclosure and dust extraction system will ensure that any ash which becomes airborne during the conveyor transfer will be removed and collected using a bag filtration system. Ash quenching/conditioning will be available to reduce the likelihood of ash becoming airborne in the first place. This extraction system will also induce a pressure differential at the open front door of each gasifier whilst de-ashing is occurring so as to prevent the release of dust at this point.

The Noise and Vibration Assessment is contained in Appendix 9 of the application. Existing noise levels and additional noise associated with the operation of the Installation are quantified and predictions of noise impact are made based on the rating noise levels (predicted noise level corrected for any tonal or impact characteristics). The applicant concludes that noise arising from the operation of the facility will be below existing background noise levels and that the risk of causing annoyance is low. We agree with the applicant's conclusions.

A pre-operational condition requires the Operator to develop a programme of noise monitoring and an improvement condition requires the inclusion of the results of such monitoring in a post commissioning report.

Article 8(7) of the WID 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. In addition storage requirements for contaminated water must be arranged. In view of the above assessment, the Agency considers that Article 8(7) is satisfied.

B11 Monitoring Requirements

B11.1 Monitoring during normal operations

We have decided that monitoring should be carried out for the parameters listed in tables S4.1 to S4.5 in Schedule 4 using the methods and to the frequencies specified in those tables. These monitoring requirements have been imposed in order to demonstrate compliance with the emission limit values and to collect the required process monitoring data for emissions to air. The methods for continuous and periodic monitoring of emissions to air are in accordance with the Agency's M2 Guidance for monitoring of stack emissions to air.

The ammonia monitor will be certified to MCERTS, although it is listed in Table S4.4 not Table S4.1 because there is no emission limit value for ammonia at the present time. Monitoring of N_2O and ammonia has been set as a requirement of the Permit to ensure that emissions from the use of urea in the NO_x abatement process are minimised. 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, which is a requirement of the Permit

B11.2 Monitoring in the event of failure of the Continuous Emissions Monitoring System (CEMS)

The Applicant will provide back-up monitoring which will be switched into full operation immediately in the event that there is any failure in the usual monitoring equipment. The back-up monitoring measures the same parameters as the operating CEMS. In the unlikely event that the back-up monitoring also fails, the Permit will require the burning of waste to cease.

B11.3 Other monitoring requirements

Other monitoring requirements have been set by the Agency in order to:

- Enable correction of measured concentrations of substances to the appropriate reference conditions;
- Gather information about the performance of the SNCR system;
- Deliver DEFRA requirements for dioxin-like PCBs and PAHs to be monitored; and
- Deliver the requirements of the WID for monitoring of residues and temperature in the combustion chamber.

In addition, improvement condition requires an exercise to be undertaken to determine the size distribution of the particles emitted from the stack (specifically to identify the fractions within the PM_{10}, $PM_{2.5}$ and $PM_{1.0}$ ranges. This builds on the latest scientific research which indicates that very fine particles have the most potential to adversely affect health. This is a standard improvement condition being imposed on all incinerators permitted by the Environment Agency in order to gather information on the contribution made by waste incineration total emission of these particles. It should not be taken to imply any concern over the impact of emissions of particulates from this Installation. An Improvement condition requires the Operator to demonstrate that the CEMS complies with BS EN 14181, in order to establish that they are fit for purpose in the installed condition as required by MCERTS.

B11.4 Continuous emission monitoring for mercury and dioxins

The WID specifies manual extractive sampling requirements for mercury and dioxins, but continuous emission monitoring equipment for mercury and continuous sampling equipment for dioxins is now available. We have reviewed the applicability of these techniques to the Avonmouth Resource Park.

Until recently there were no CEMS which could measure solid phase (particulate) mercury as well as vapour phase mercury. However, there are now instruments capable of measuring total mercury, at least one of which is MCERTS certified. CEN (Comité Européen de Normalisation) has recently published a standard for measurement of total mercury by automated measuring systems (EN 14884:2005). However the British Standards Institute (BSI) has objected to the manner in which the standard has been developed and believes that it does not entirely fulfil its purpose. The standard also conflicts with the prior standard EN14181. In the case of dioxins, the equipment is capable of taking a sample for an extended period (several weeks), but the sample must then be analysed in the conventional way. Despite good ability to track the same trends in changing dioxin concentrations, systematic differences are observed between continuous sampling and manual sample train measurements, in which continuous sampling records dioxin concentrations higher than manual sample trains. The lack of a

primary reference method (e.g. involving a reference gas of known concentration of dioxin) precludes any one approach being considered more accurate than another. Manual sample trains are more applicable for dioxin monitoring against an emission limit value in accordance with WID requirements where dioxin methods are required to meet EN 1948. Cross-stack sampling in accordance with EN 13284-1 (the low dust standard) is a pre-requisite of EN 1948, whereas continuous sampling techniques are designed for operation at one, or at most two, fixed points across the stack.

For CEMS to be used for the monitoring of either mercury or dioxins 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 and this makes it difficult for us to act unilaterally in respect of UK incinerators. Use of a manual sample train is the only technique which fulfils the requirements of the WID. At the present time, the proposed monitoring and sampling at the Installation is BAT, however we will keep this position under review.

B12 Reporting

The reporting that we have specified in Schedule 5 exhibits the following key attributes:

- Reporting of continuous monitoring of emissions to air is required quarterly, to allow timely review by the Agency.
- Reporting of periodic monitoring required by the WID is required every three months for the first year of operation and every six months thereafter, in line with WID requirements for such monitoring.
- Reporting of loss on ignition (LOI) of bottom ash is required monthly during the first year of operation and quarterly thereafter, in line with WID requirements for such monitoring.
- Reporting of heavy metal, dioxin/furan and dioxin-like PCB content of bottom ash is required monthly during the first year of operation and quarterly thereafter, in line with WID requirements for such monitoring.
- Reporting of heavy metal, dioxin/furan and dioxin-like PCB content of air pollution control (APC) residues is required monthly during the first year of operation and quarterly thereafter, in line with WID requirements for such monitoring
- Reporting of the total mass of waste accepted, and the mass of individual fractions of waste, is required annually in order to allow the Agency to review compliance with the relevant permit conditions.
- Reporting of electricity generated, electricity exported and steam exported (if any) is required annually to allow the Agency to audit the efficiency with which energy is recovered from waste. The requirement to report steam export will prompt an annual re-examination of the feasibility of combined heat and power (CHP).
- Reporting of the following performance parameters (per tonne of waste incinerated) is required annually to enable the Agency to assess the environmental efficiency of the Installation:
    - Water consumption
    - Energy production
    - Abatement materials consumption
    - Gas-oil consumption
    - APC residues disposed of
    - Generation, recycling and disposal of bottom ash.

Part C – 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.

C1 The EPR 2010 and related Directives

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

C.1.1 Schedules 1 and 7 to the EPR 2010 – IPPC Directive

We address the requirements of the IPPC Directive in the body of this document.

There is one requirement not addressed above, which is that contained in Article 9(2) IPPCD. Article 9(2) of the IPPC Directive requires that "In the case of a new installation or a substantial change where Article 4 of Directive 85/337/EC applies, any relevant information obtained or conclusion arrived at pursuant to articles 5, 6 and 7 of that Directive shall be taken into account for the purposes of granting an environmental 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 trans-boundary 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 take into consideration 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 Bristol City Council to grant planning permission on 28th May 2009.

From consideration of these documents, we consider that no additional or alternative conditions are necessary.

C.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, as well as other specified requirements.

We must give effect to Article 4 of the WFD, which requires that waste is *recovered* or *disposed* of without endangering human health and without using processes or methods which could harm the environment, and in particular:

(a) without risk to water, air or soil, or to plants or animals;
(b) without causing a nuisance through noise or odours;
(c) without adversely affecting the countryside or places of special interest.

We have addressed these objectives elsewhere in this document. The conditions of the Permit protect the environment and ensure that there is no harm to any features identified above.

Schedule 9 also requires that records referred to under Article 14 are kept and made available to the Agency on request. Conditions relating to the collection, maintenance, storage and availability of records form part of the Permit.

We are also required to give effect, where *disposal* operations are involved, to Article 5, which requires that appropriate measures are taken to establish an integrated and adequate network of disposal installations, taking account of the best available technology not involving excessive costs. The network must enable the Community as a whole to become self-sufficient in waste disposal and the Member States to move towards that aim individually, taking into account geographical circumstances or the need for specialised installations for certain types of waste. This network must enable waste to be disposed of in one of the nearest appropriate installations, by means of the most appropriate methods and technologies in order to ensure a high level of protection for the environment and public health.

We note that the Applicant has been granted planning permission by the Local Planning Authority. We are therefore satisfied that the Application has been assessed by the relevant authorities and that it is in compliance with the relevant policies pursuant to Article 5.

C.1.3 Schedule 13 to the EPR 2010 – Waste Incineration Directive

We address the WID in detail in Annex 1 to this document.

C.1.4 Schedule 22 to the EPR 2010 – Groundwater, Water Framework and Groundwater Daughter Directives

To the extent that it authorises the 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. However, in this particular case no releases to groundwater from Installation are permitted. The Permit also requires material storage areas to be designed and maintained to a high standard to prevent accidental releases.

C1.5 Directive 2003/35/EC – The Public Participation Directive

Regulation 59 of the Regulations requires the Agency to prepare and publish a statement of its policies for complying with its public participation duties. The Agency has published such a document and this Application has been consulted upon in line with our public participation statement. This satisfies the requirements of the Public Participation Directive.

C.2 National primary legislation

C.2.1 Environment Act 1995

C.2.1.1 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 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.

C.2.1.2 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 existing requirements are sufficient.

C.2.1.3 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.

C.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.

C.2.3 Countryside and Rights of Way Act 2000 (CROW 2000)

Section 85 of this Act imposes a duty on 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.

C.2.4 Wildlife and Countryside Act 1981

Under section 28G of the Wildlife and Countryside Act 1981 the 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 Agency has a duty to consult Natural England/Countryside Council for Wales in relation to any permit that is likely to damage SSSIs. We have consulted the nature conservation authorities and they did not raise any concerns. Section A3.9 of this document explains our consideration of the potential impact on designated habitats and the conclusions we have drawn in this respect.

C.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.

C.3 National secondary legislation

C.3.1 The Conservation of Natural Habitats and Species Regulations 2010

We 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 consulted Natural England and Countryside Council for Wales by means of an Appendix 11 assessment, and they did not consider that the operation of the Installation is likely to have a significant effect on the interest features of protected sites.

C.3.2 Water Framework Directive Regulations 2003

Consideration has been given to whether any additional requirements should be imposed in terms of the 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.

C.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, in section A1.2.7 of this document.

C.4 Other relevant EU legislation

C.4.1 Hazardous Waste Directive (91/689/EEC)

Consideration has been given to whether any additional requirements should be imposed, but it is considered that its requirements are already met by the permit conditions.

C.5 Other relevant legal requirements

C.5.1 Local Democracy, Economic Development and Construction Act 2009

We have also taken into account our obligations under the Local Democracy, Economic Development and Construction Act 2009 (particularly Section 23). This requires us, where we consider it appropriate, to take such steps as we consider appropriate to secure the involvement of representatives of interested persons in the exercise of our functions, by providing them with information, consulting them or involving them in any other way. In this case, our consultation already satisfies the Act's requirements.

Annex 1 – Application of the Waste Incineration Directive (WID)

1 Introduction

The WID is transposed into domestic law by the Regulations. Regulation 35 requires the Regulator to ensure that the provisions in Schedule 13 (provision in relation to waste incineration) have effect. Schedule 13 lists the provisions of the WID with which compliance has to be ensured when the regulator is exercising its permitting function.

This Installation is an incineration plant as defined by the WID and therefore must comply with the requirements.

1.1 Paragraph 3 of Schedule 13 to the Regulations requires an application for an environmental permit relating to a 'waste incineration Installation' to contain the information specified in Article 4(2) of the WID. Specifically, this information must include a description of the measures which are envisaged to guarantee that –

(a) the plant is designed, equipped and will be operated in such a manner that the relevant requirements of the WID are met, taking into account the categories of waste to be incinerated;
(b) the heat generated during the incineration process is recovered as far as practicable (for example through combined heat and power, the generating of process steam or district heating);
(c) the residues will be minimised in their amount and harmfulness and recycled where appropriate;
(d) the disposal of the residues which cannot be prevented, reduced or recycled will be carried out in conformity with national and Community legislation.

1.2 Paragraph 4 of Schedule 13 to the Regulations requires the regulator to exercise its Permit making functions in such a way as to ensure compliance with a series of provisions of the WID. The following section addresses each of the specified provisions and how compliance will be ensured. The Agency is satisfied that, when waste is burned in the Installation, the requirements of the Regulations and the WID will be complied with.

2 Specified provisions of the WID

2.1 Article 4(3) - 4(5) - Application and Permit

2.1.1 The Article 4(3) – 4(5) requirements are:

(a) the application must show that the proposed measurement techniques for emissions into the air comply with Annex III and, as regards water, comply with Annex III paragraphs 1 and 2. Detailed consideration of this point follows at paragraphs 2.8.1 to 2.8.10. Discussions with the Applicant and the information provided in the Application complied with this requirement.
(b) the Permit must comply with any applicable requirement laid down in the Urban Waste Water Treatment Directive (the "UWWTD"), the IPPC Directive, the Air Quality Framework Directive (the "AQFD"), the Dangerous Substances Directive (the "DSD") and the Landfill Directive (the "LFD"). Of these, the IPPC Directive's

requirements are delivered via the Regulations, as are the applicable requirements of the UWWTD, the AQFD and the DSD. The LFD is not relevant to the Installation.

(c) the Permit must list explicitly the categories of waste that may be treated; using the categories set out in the European Waste Catalogue ("EWC") and contains information on the quantity of waste where appropriate. Condition 2.3.3 and Table S3.2 in Schedule 3 of the Permit list the types of wastes that are Permitted to be burnt at the Installation and provide the EWC numbers.

(d) the Permit shall include the total waste incinerating capacity of the plant. Condition 2.1.1 and Table S1.1 in Schedule 1 of the Permit contain this information.

(e) the Permit shall specify the sampling and measurement procedures used to satisfy the obligations imposed for periodic measurements of each air and water pollutant. Conditions 3.5.1 and Tables S4.1, S4.1(a), S4.2, S4.3 and S4.4 of the Permit fulfil this requirement, and specific monitoring conditions are discussed below at sections 2.7 and 2.8.

2.2 Article 5 - Delivery and reception of waste

2.2.1 Article 5 requires all necessary precautions to be taken concerning delivery and reception of wastes, in order to prevent or minimise pollution. The Regulations require Installations to be operated in order to prevent or minimise pollution. The application defines how this will be carried out at the Installation and condition 2.3.1 requires that appropriate measures are taken. Incoming wastes are required to be monitored by condition 2.3.3 and are stored in order to prevent pollution of air, groundwater, soil and surface water as well as odours and noise (Permit Sections 3.2, 3.3 and 3.4 describe the measures that must be taken to prevent such pollution). Article 5(2) requires that the Operator determine the mass of each category of wastes, if possible according to the EWC, prior to accepting the waste. The application describes procedures for the reception and monitoring of incoming waste that require that wastes are categorised on arrival at the plant.

2.3 Article 6 (except for the last indent of Article 6(4)) - Operating Conditions

2.3.1 Article 6(1) sets out requirements for incineration plants. It states that such plants should be:

(a) Operated in order to achieve a level of incineration such that the slag and bottom ashes Total Organic Carbon (TOC) is less than 3% or their loss on ignition of the dry weight of the material is less than 5%.

(b) Designed, equipped, built and operated in such a way that the gas resulting from the incineration of waste is raised, after the last injection of combustion air, in a controlled and homogeneous fashion and even under the most unfavourable conditions, to a temperature of 1100ºC for two seconds, as measured near the inner wall or at another representative point of the combustion chamber.

(c) The incineration plant must be equipped with at least one auxiliary burner. The burner must switch on automatically when the temperature of the combustion gases after the last injection of combustion air falls below 1100°C. The auxiliary burner must be used for start-up and shut-down to ensure that the temperature

1100°C is maintained at all times and as long as unburned waste is in the combustion chamber. During start-up and shut-down or when the temperature of the combustion gas falls below 1100°C, the auxiliary burner must not be fed with fuels which can cause higher emissions than those resulting from the burning of gas oil as defined in Article 1(1) of Council Directive 75/716/EEC, liquefied gas or natural gas.

2.3.2 a) Conditions 3.5.1 (Monitoring) and Table S4.5 ensure that the Installation is operated such that the loss on ignition of the dry weight of the material, of the slag and bottom ash, is less than 5%.

b) (i) Condition 2.3.6 limits the charging of waste into the incinerator to periods of normal operation, when operating temperatures will be in excess of 850 °C after the last injection of combustion air

b) (ii) The application provides a statement confirming compliance with the minimum 2-second residence time at 1100°C of the gases from the combustion of waste after the last injection of combustion air. Pre-operational condition PO01 requires the Operator to provide a plan to demonstrate how validation of combustion conditions shall comply with indicative BAT as defined by Section 2.1.4.1 of Technical Guidance Note IPPC S5.01 and with the requirements of the WID.

c) Condition 2.3.7 requires the operation of at least one auxiliary burner at start-up or shut-down or whenever the operating temperature fall below 1100°C, as long as unburned waste is present in the combustion chamber. Condition 2.3.7, also permits only the use of fuels which will result in no higher emissions than those arising from gas oil, liquefied gas or natural gas unless the specified temperature above is maintained.

2.3.3 Article 6(3) requires incineration plant to operate a system to prevent using waste as a feedstock during start-up and shut-down, whenever the temperature fails to meet the required levels, or when the CEMS show breaches of limits due to disturbances or failure of abatement. This requirement is addressed by condition 2.3.6.

2.3.4 Article 6(4) provides that different operating conditions (residence time and temperature) may be authorised, provided that the conditions of the Directive are met. Derogation from the operating requirements is allowed only when, the mass and the organic content of the slag and bottom ashes from the incinerator will be no more than that, which would have been expected, if the operating conditions had been the same as those without the derogation. No derogation from specified operating conditions is required.

2.3.5 Article 6(5) requires incineration plant to be designed, equipped, built and operated to ensure that emissions to air do not give rise to significant ground level pollution. Emissions to air and their ground-level impact are discussed in the body of this document, and the Agency is satisfied that the WID requirement is fulfilled.

2.3.6 Article 6(6) requires that any heat generated from the process shall be recovered as far as practicable. The heat generated by the incineration of waste will be used to generate electricity via a steam turbine. There are no proposals to utilise the residual waste heat remaining after steam generation. The proposed use of energy was assessed against the BAT sector specific guidance (IPPC S5.01). It

advises that the use of energy for CHP '…should be considered'. It goes on to advise that steam should be used to generate electricity and that waste heat should be '…recovered unless to do so can be demonstrated not to represent BAT. All opportunities for CHP and district heating should be explored'. Our consideration of the potential for CHP is considered elsewhere in this document. We accept the applicant's conclusions that CHP is not feasible at the moment.

The Permit includes a condition requiring the applicant to provide and maintain outlets for waste heat on the plant and to review the practicability of CHP every 2 years. In the event that practicable options for heat use are identified they will be required to be implemented, and a variation to the permit will be made. The Agency is satisfied that the provisions of Article 6(6) are currently met.

2.3.7 Article 6(8) requires management of the Installation to be in the hands of a natural person who is competent to manage it. Condition 2.3.1 and conditions 1.1.1 to 1.1.3 of the Permit fulfil this requirement.

2.4 Article 7(1) – 7(4) - Air emission limit values

2.4.1 Article 7(1) requires incineration plants to be designed, equipped, built and operated to comply with the ELVs in Annex V. The Applicant has proposed to operate the incinerator to comply with the Annex V requirements. Conditions 3.1.1 and 3.1.2 and Tables S4.1 and S4.1a require the Applicant to comply with ELVs as laid out in Annex V as a minimum.

2.4.2 Article 7(3) requires the results of measurements made to verify compliance with the ELVs to be standardised in accordance with Article 11. Schedule 7 of the permit contains details of this standardisation requirement (Article 11 compliance is considered further below).

2.5 Article 8(1) – 8(7) - Water discharges from the cleaning of exhaust gases

2.5.1 Article 8(1) to (6) addresses conditions for water discharges from the cleaning of exhaust gases. There will be no discharges of such water from the Installation, and therefore the provisions of the Article are not relevant. Condition 3.1.1 prohibits any such release.

2.5.2 Article 8(7) requires that incineration plant sites shall be designed to prevent the unauthorised and accidental release of any polluting substances into soil, surface water or groundwater. Article 8(7) also requires that storage capacity be provided for contaminated rainwater run-off from the site or for contaminated water from spillage or fire-fighting operations. The storage capacity shall be adequate to ensure that such waters can be tested and treated before discharge where necessary. Surface water run-off is contained.

Under normal operating conditions, clean rainwater is segregated from any sources of contamination by collection in a dedicated surface water drainage system. The applicant demonstrates the storage capacity provided for contaminated rainwater run-off from the site or for contaminated water from spillage or fire-fighting operations is adequate to ensure that such waters can be

tested and treated before discharge where necessary. The Agency considers that Article 8(7) is therefore satisfied.

2.6 Article 9 – Residues

2.6.1 Article 9 requires residues from incineration plants to be minimised in their quantity and harmfulness, and residues to be recycled where appropriate. Residues from the facility will comprise bottom ash (which will be non-hazardous and potentially used as aggregate), and APC residues (which will be hazardous, and will be sent to landfill). Condition 1.5.1 requires appropriate measures to be taken.

2.6.2 Article 9 also requires dry residues and dust to be transported to prevent dispersal into the environment. Condition 3.2.1 ensures that this requirement is complied with. Condition 1.5.1 together with condition 2.3.1 and schedule 1 table S1.2 ensures that wastes arising from the Installation are disposed of or recovered in accordance with the Application. The Application defines suitable disposal and recovery routes. Condition 2.3.1 requires that the Agency is notified of any change to operating techniques, which includes disposal and recovery routes.

2.6.3 Article 9 requires residues from incineration plants to be tested (as appropriate) for their physical and chemical characteristics and their polluting potential concerning their soluble fraction. The application defines how this will be carried out at the Installation for existing residues and disposal routes. Condition 3.5.1 requires the Applicant to analyse the bottom ash, APC residues and other solid residues before any new disposal or recycling routes are used. The Agency therefore considers that Article 9 is satisfied.

2.7 Article 10 - Control and monitoring

2.7.1 Article 10(1) and (2) require that measurement equipment and techniques shall be installed and used to monitor the incineration process, and that the measurement requirements shall be laid down in Permits. These requirements are covered in condition 3.5.1, and schedule 4 tables S4.1 and S4.1(a), emissions to air, and table S4.4, process monitoring requirements which the Agency considers fulfil the WID requirements.

2.7.2 Article 10(3) requires CEM for emissions to air and water to be subjected to regular control, testing and calibration. These requirements are addressed in schedule 4 tables S4.1 and S4.1(a) (emissions to air), and table S4.4 (process monitoring requirements) requiring monitoring to be carried out in accordance with CEN, ISO, BS national, international methods or Agency guidance. Agency Monitoring Guidance Note M2 defines what is required in an annual surveillance test. Condition 3.5.3 requires all monitoring equipment, techniques, personnel and organisations employed for the emissions monitoring programme to have either MCERTS certification or MCERTS accreditation (as appropriate). Such certification or accreditation requires regular testing of CEM equipment to meet the requirements of Article 10(3).

2.7.3 Article 10(4) requires sampling points to be specified in Permits. Schedule 4 tables S4.1 and S4.1(a) (emissions to air), and table S4.4 (process monitoring requirements) address this issue.

2.7.4 Article 10(5) requires periodic measurements to air and water to comply with Annex III, points 1 and 2. The requirement in point 1 is for measurements to be carried out representatively. Point 2 requires that measurement methods and calibration of CEMs must be to CEN standards, or ISO, international or national standards if CEN standards are not available. These requirements are addressed by condition 3.5.3, requiring the use of certified equipment and accredited personnel to be employed for all emissions monitoring. The Agency considers that the Permit therefore delivers all the relevant requirements of the WID in this respect.

2.8 Article 11 (except for Article 11(1) and 11(13)) – Measurement requirements

2.8.1 Article 11(2) sets out the air pollutant measurements that are required to be carried out, in accordance with Annex III. Continuous emissions monitoring of NO_x, CO, total dust, TOC, HCl, and SO_2 and periodic measurement of HF, heavy metals, dioxins and furans measurement requirements are delivered by condition 3.5.1 and schedule 4 tables S4.1 and S4.1(a) (emissions to air), and table S4.4 (process monitoring requirements). In addition, Article 11(2) requires the process parameters of: temperature at a representative point of the combustion chamber, concentration of oxygen, pressure, temperature and water content of the exhaust gases to be monitored. Condition 3.5.1 and schedule 4 table S4.4 (process monitoring requirements) deliver these monitoring requirements.

2.8.2 The requirements of Article 11(3), to verify the residence time and minimum temperature, is delivered by pre-operational condition PO01 in table S1.4.

2.8.3 Article 11(4) allows the continuous measurement of HF to be omitted in certain circumstances. This measurement has been omitted for the Installation because the use of the acid gas abatement plant provides a high level of acid gas scrubbing, which will ensure that there are no breaches of the HCl limit, and condition 3.1.2 requires the Applicant not to exceed the HCl limit. Condition 3.1.2 and schedule 4 table S4.1 requires the Operator to carry out periodic measurement of HF.

2.8.4 Article 11(6) provides the option of periodic measurement for HCl, HF and SO_2 instead of CEMs. CEMs are provided for HCl and SO_2. Continuous monitoring of HF will be replaced by periodic monitoring as described in paragraph 2.8.3 above.

2.8.5 Article 11(7) allows the competent authority to permit a reduction in the monitoring frequency for heavy metals, dioxins and furans under certain conditions, provide the criteria in article 17 of WID are available. No such criteria have been set under article 17, hence no such reduction has been allowed in this permit. Monitoring frequencies are specified by schedule 4 tables S4.1 and S4.1(a) (emissions to air), and table S4.4 (process monitoring requirements).

2.8.6 Article 11(8) sets out reference conditions for incineration. The specific reference conditions for this Installation are contained within the Permit.

2.8.7 The recording and reporting requirements in Article 11(9) for measurements are delivered by Section 4 and Schedules 5 and 6 of the Permit.

2.8.8 Article 11(10) sets out the compliance criteria for ELVs in accordance with Annex V. These are delivered by conditions 3.1.2 and by schedule 4 tables S4.1 and S4.1(a) (emissions to air), and table S4.4 (process monitoring requirements) and by schedule 7 (which defines reference conditions).

2.8.9 Article 11(11) provides that, for incineration, daily average monitoring results from CEMS are to be generated from half-hourly averages, and that no more that 5 half-hourly averages can be discarded each day due to malfunction. In addition no more than 10 daily averages per year can be disregarded in this way. These requirements are contained within schedule 4 table S4.1, note 2.

2.8.10 Article 11(11) also requires that the half-hourly averages (used as above) are determined after subtracting the 95% confidence intervals defined in Annex III. Schedule 4 table S4.1, note 2 contains this requirement.

2.8.11 Article 11(12) requires that periodic measurement conditions shall be laid down in accordance with Annex III. Annex III compliance has been referred to in paragraphs 2.8.1 and 2.8.10 of this Appendix.

2.8.12 Article 11(14) to (16) addresses the monitoring of wastewater from the cleaning of exhaust gases (see also Article 8 above). There are no such releases from the Installation. Article 11(17) requires that where the measurements taken show that the ELVs for air and water laid down in the Directive have been exceeded, the Agency is informed without delay. Condition 4.3.1 of the permit fulfils this requirement

2.8.13 The Agency therefore considers that the Permit complies with the applicable requirements of Article 11.

2.9 Article 12(2) - Access to information and public participation

2.9.1 Article 12(2) requires that, for plant with a capacity of two tonnes or more per hour, an annual report on plant operation and monitoring is also made available. Condition 4.2.2 of the Permit fulfils this requirement by requiring an annual report which will be placed on the public register.

2.10 Article 13 - Abnormal operating conditions

2.10.1 Article 13(1) requires conditions to be included in Permits laying down the maximum period of technically unavoidable stoppages, disturbances or failures of purification or measurement devices, during which discharges to air and water may exceed the ELVs. Conditions 2.3.12 to 2.3.15 put a limit on such periods of abnormal operation. The combined effect of Articles 6(3) and 11(2) is to require operational continuous monitoring at all times. However, Article 13(1) provides for

some operational flexibility in practice. The Environment Agency considers that the maximum period of technically unavoidable stoppages, due to disturbances or failures of purification or measurement devices, should be limited to 4 hours uninterrupted duration in any one instance, and with a maximum cumulative limit of 60 hours per year. These periods are additional to those allowed under the 95% availability requirements of the CEN monitoring standards that are required to be included in the permit under paragraph 2 of Annex III to the Directive. Available techniques for compliance with these Article 13(1) requirements include the installation of supplementary monitoring, or having appropriately-trained personnel to maintain the monitoring equipment available. The combined effect of these conditions is to ensure that the installation has reasonable operational flexibility in terms of time to repair faulty equipment, but cannot operate indefinitely in such circumstances.

2.10.2 Article 13(2) requires the Applicant to cease the feed of waste in the event of a breakdown. This requirement is contained within condition 2.3.10

2.10.3 Article 13(3) limits abnormal operation, when ELVs are exceeded (for any reason) when using wastes as fuel, up to 4 hours uninterrupted duration. It also imposes a maximum cumulative limit on periods of abnormal operation when using wastes as fuel, of 60 hours per year. These requirements are delivered by condition 2.3.10.

3 Conclusion

The Agency has carefully considered the applicable requirements of the WID specified in Schedule 13, and is satisfied that the Permit ensures that these will be complied with.

Annex 2 – Consultation responses from public bodies

This section contains a summary of responses to consultation of the Application and the way in which we have taken these into account in the determination process.

Health and Safety Executive

Brief Summary of Issues Raised	Summary of Agency response to issue raised
None received	No action required

Food Standards Agency

Brief Summary of Issues Raised	Summary of Agency response to issue raised
None received	No action required

Bristol Primary Care Trust

Brief Summary of Issues Raised	Summary of Agency response to issue raised
None received	No action required

Wessex Water

Brief Summary of Issues Raised	Summary of Agency response to issue raised
None received	No action required

Bristol City Council Pollution Control Team

Brief Summary of Issues Raised	Summary of Agency response to issue raised
Advice was received from Bristol City Council Environmental Health Department on 29th July 2009 as follows: • There is no record of noise complaints having been received by the Pollution Control Team within the last 3 years. • There is no record of any formal or informal action taken in response to a noise complaint by the Pollution Control Team over the last 3 years. • There are no local noise initiatives known to the Pollution Control Team. • There are no private actions known to the Pollution Control Team. • A permit condition along the following lines would be helpful in the event of any industrial accident: 'If there is likely to be an effect upon the local community of any noise or emissions to atmosphere, Bristol City Council shall be notified immediately by telephone. Out of normal working hours the Bristol City Council Emergency Control Room Officer shall be informed. A telephone message shall be confirmed by a facsimile transmission.'	The permit contains provisions requiring the implementation and maintenance of an accident management plan. In addition, notification provisions require the Operator to notify the Environment Agency of: *'…(a) any malfunction, breakdown or failure of equipment or techniques, accident, operation of the by-pass valve, or fugitive emission which has caused, is causing or may cause significant pollution;* *(b) the breach of a limit specified in the permit; or* *(c) any significant adverse environmental effects.'* Once notified of any incidents in accordance with the above provisions, the Agency will notify other authorities as it considers appropriate.

Bristol City Council Development Management

Brief Summary of Issues Raised	Summary of Agency response to issue raised
Advice was received from Bristol City Council Environmental Health Department on 21st August 2009 as follows: • Following receipt of your letter of 9th July and accompanying questionnaire, I can confirm that there have been no specific noise restriction conditions relating to the operational phase of development placed upon the recent planning permission (ref: 09/00608/F) granted for Avonmouth Resource Park Limited. It is however worth noting that conditions have been placed upon the notice of decision in reference to the timing in the year of piling activities during the construction period, although this relates to ecological interests rather than impact on noise-sensitive receptors.	No action required

Annex 3 – Comments on the application from the public

No representations have been received from members of the public.