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NORTH BECK ENERGY LTD

North Beck Energy Centre

Environmental Permit Application: Non-Technical Summary

PÖYRY

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1 INTRODUCTION

1.1 This report

1. This report presents a non-technical summary for an application made by North Beck Energy Limited (**NBEL, the Applicant**) to the Environment Agency (**the EA**) for an Environmental Permit. The application relates to the construction and operation of the North Beck Energy Centre (**NBEC, the Facility**).

2. This summary accompanies the main application which consists of the following:

Application Forms: A; B2; B3 & F1

Supporting Information Report

Annexes:

Annex A - Drawings

Site Location Plan
Installation Boundary & Emission Points
Site Layout Plan
Sectional Elevation
EfW Indicative Process Diagram
Boiler Process Diagram
Steam Turbine Process Diagram with no heat export
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CHP Energy Centre & DH Pipe Route
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Annex B – Site Condition & Baseline Report

Annex C – Environmental Risk Assessment

Annex D – Air Quality Assessment

Annex E – Human Health Risk Assessment

Annex F – Energy Efficiency & CHP-Ready Assessment

Annex G – Fire Prevention Plan

Annex H - EfW BAT Assessment

Annex I – EA H1 Model

Annex J – NOT USED

Annex K – Flood Risk Assessment

Annex L – Environmental Impact Assessment

Annex M – Noise & Vibration Data

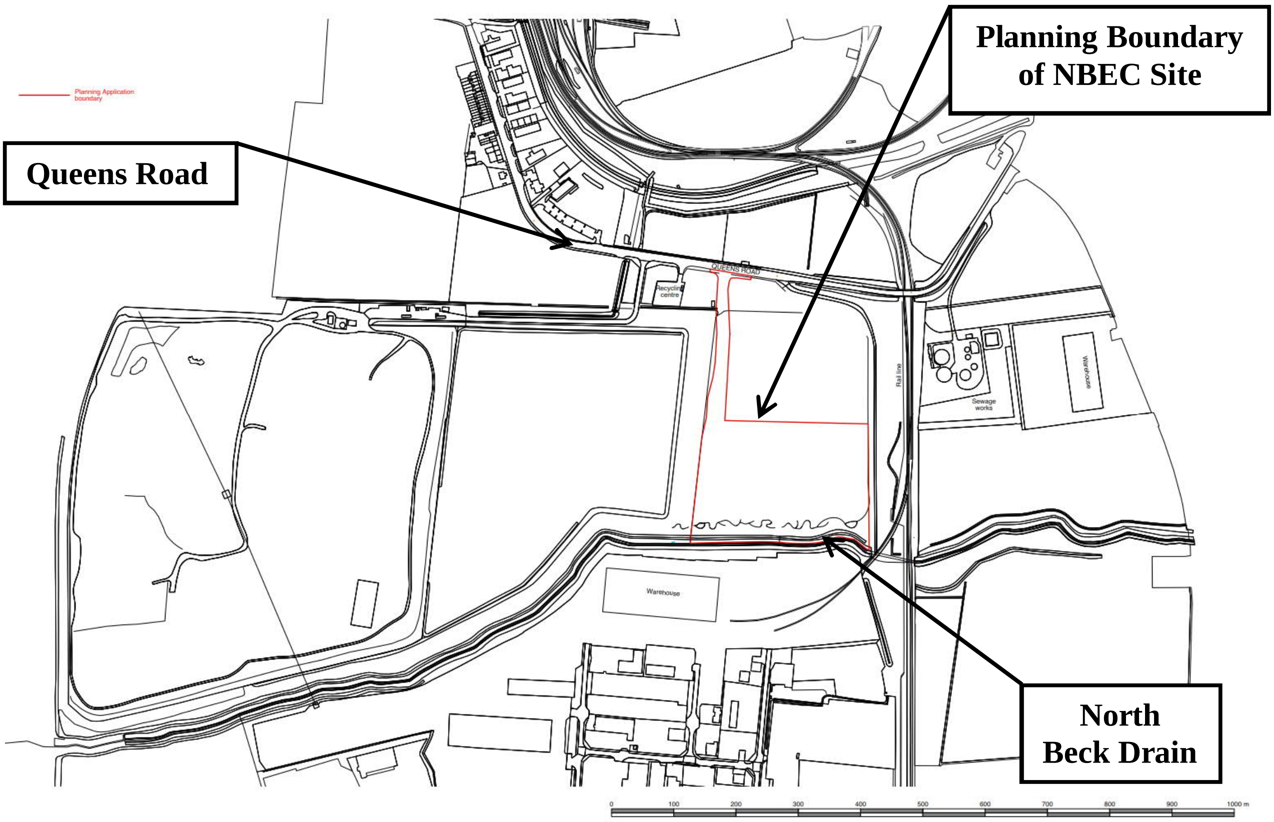
1.2 NBEC and its location

3. The site for the NBEC is located approximately 1.45km east of the town of Immingham and is reached from Queens Road (the A1173), which runs immediately to the north of the site (see **Annex A: Site Location Plan**). The National Grid Reference for the site is:

Nat. Grid Ref:	**TA 20683 14621**	
Location:	**Easting**	**520686**
	Northing	**414635**

4. The present site is 'greenfield' and consists of rough grassland and scrub vegetation. The nearest residential dwellings are 560m north-west from the site. The Humber Estuary is 859m to the north east and is designated as a Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), Special Protection Area (SPA) and a Ramsar site. The North Beck Drain is the closest watercourse and is located adjacent to the southern boundary of the NBEC site.

Figure 1-1 Site Location Plan



5. The NBEC comprises a power station for the recovery of energy released from the combustion of non-hazardous wastes derived from MSW and similar non-hazardous wastes from commercial and industrial premises. The Facility will typically receive about 560,000 tonnes per annum (tpa) of fuel and will export 49.5MW$_e$ of electricity to the local electricity distribution network. This will be enough to supply the needs of over 127,500 homes. It will also be configured so that heat can be exported to meet the potential future demands estimated for adjacent local district heating networks that are presently under consideration by the local authorities.

1.3 Current site condition

6. The published geology of the area and ground investigations at the site have indicated that the site is underlain by Tidal Flat Deposits and Flamborough Chalk Formation. The bedrock is classified as principal or highly productive aquifer. The soil above this is readily permeable.

7. Historical site uses have identified little activity on the site (a small section of railway line is shown along the site boundary for a period and later electric cables were shown) but since 1968 the site has been shown as vacant. Potential historical off-site contamination sources, include the use of nearby areas for a range of industrial uses including chemical works, oil storage and railway sidings.

8. A site investigation (SI) survey is presently underway and will reveal further information from the boreholes. Whilst no contamination is anticipated, the results from the SI will be needed to confirm.

2 NORTH BECK ENERGY CENTRE DESIGN AND OPERATION

2.1 Fuels and applicable Regulations

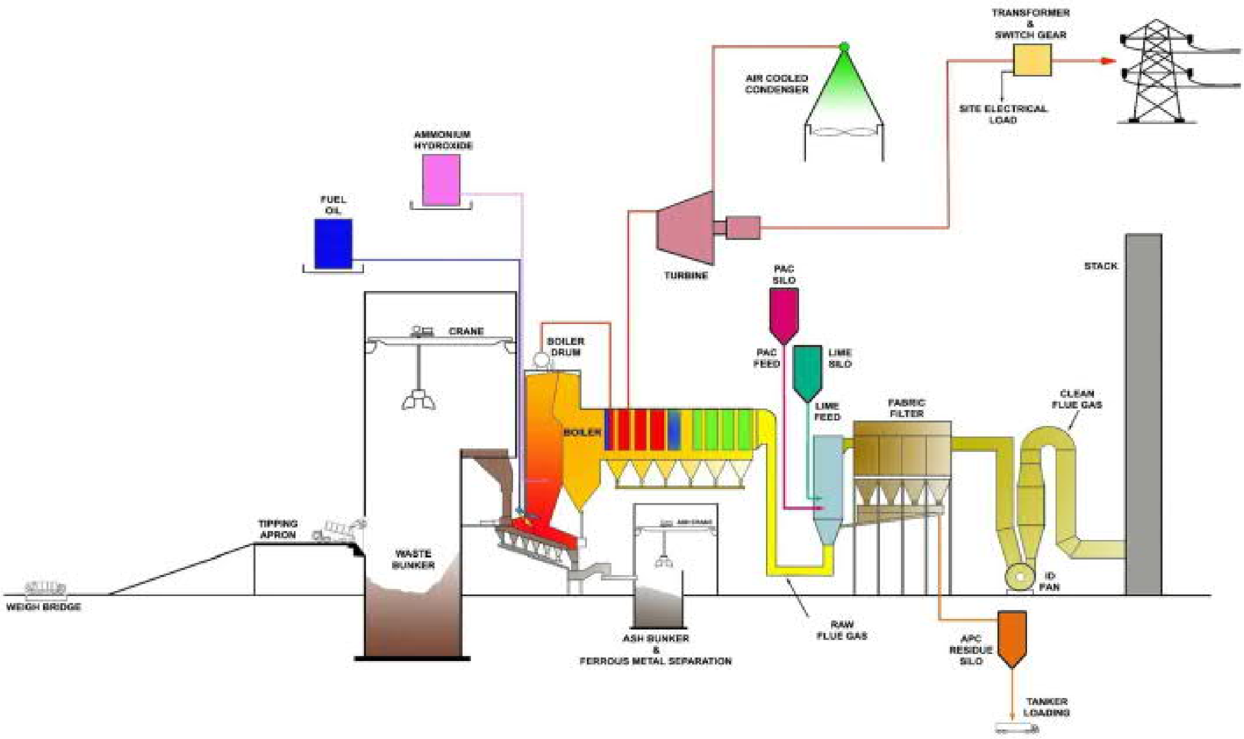
9. The NBEC will be an Energy-from-Waste (EfW) power station that will use Refuse Derived Fuels (RDF) and other non-hazardous fuels derived from household residual waste and similar material obtained from commercial and industrial premises.

10. EfW power stations are regulated by the Environment Agency under Section 5.1 Part A(1)b of Chapter 5 of Schedule 1 of the Environmental Permitting Regulations 2016. As such, the NBEC plant will comply with the stringent emissions limits set out in Annex VI of the Industrial Emissions Directive (IED).

2.2 Design of the NBEC

11. The NBEC is a 'twin stream' plant that comprises two identical boiler and air pollution control (APC) process streams linked to common storage, waste feeding, ash discharge and power generation plant. The NBEC is designed to operate on a continuous basis for 8,000 hours per year (NB this is an average figure that will vary year to year depending on lifecycle maintenance activities). The diagram below illustrates the key elements of the power plant (NB only one boiler stream is shown):

Figure 2-1 EfW Process Diagram



12. Vehicles arriving at the site will report to the weighbridge office where details about the supplier of the fuel and the nature of the fuel will be checked before the vehicle is weighed. Fuel will only be accepted from suppliers that have previously been checked and approved to help ensure that non-compliant fuel is not accepted.

13. The vehicles will enter the enclosed tipping hall through fast acting roller shutter type doors and reverse into position to eject the fuel into the storage bunker. The whole area

of bunker and tipping hall is maintained under suction conditions to prevent the escape of any odours or dust. This is achieved by drawing combustion air from intakes located at a high level in the bunker building.

14. Fuel from the storage bunker is loaded into the two boilers by an overhead travelling crane. The grab picks up the fuel and deposits into the feed chute that supplies the boiler grate. The fuel burns on the grate as it mixes with the primary combustion air and the grate agitates the fuel to assist combustion and to move the fuel progressively towards the ash discharger. Once fully burned, the remaining ash falls from the end of the grate into the ash quench discharger. The ash is cooled in the quench water bath and a hydraulic pusher ejects the ash onto a conveyor that transports the material to the ash bunker.

15. The combustion gases from the grate flow upwards into the furnace where secondary air is added to complete the combustion process. The hot flue gases then release heat to the water cooled furnace walls before entering the boiler convection pass where the gases are further cooled. The furnace is sized to ensure that the minimum combustion conditions set by the IED are met and the boiler convection passes are sized to then recover as much as heat as possible within the practical constraint of avoiding excessive corrosion.

16. The heat given up by the hot flue gases is used to raise steam in the boiler which passes to a steam turbine that drives an electrical generator. This generator will export 49.5MW of electricity. The steam that leaves the turbine will exhaust into an air cooled condenser which will return the condensate back to the boiler feedwater system to be reheated into steam. The power plant is designed to enable future export of up to 20MW of heat in the event that district heating networks are developed for Immingham town and the Stallingborough Enterprise Zone.

17. The flue gases leaving the boiler are treated in stages to control emissions such that these will be fully compliant with the IED. The first stage involves efficient, controlled combustion using the minimum necessary surplus air, the second stage uses injection of ammonia solution to reduce NOx. The final stage of air pollution control (APC) injects hydrated lime and activated before a bag filter to remove acid gases, heavy metals, dioxins, furans and particulate. Residues from the cleaning process are collected in the bag filter and are conveyed to a storage silo for removal from site by tanker.

18. Cleaned flue gas from the APC process is drawn through the plant by an induced draught fan that maintains the whole process stream under negative pressure to prevent any outward leakage. The flue gas from the fan is discharged into the stack which exhausts to atmosphere at a height of 90m. Emissions are continuously monitored in the stack and are recorded and shared with the EA.

19. The NBEC does not discharge any liquid effluents from the EfW process, the only discharge to the sewer will be from the welfare facilities, washrooms and toilets.

20. A sustainable drainage system has been designed that will harvest rainwater for use in the process. Where surface water cannot be harvested or allowed to drain naturally, surface water from hardstanding areas will be captured and will pass through interceptors before entering two attenuation ponds. These ponds have been sized for a worst case one in 200 year storm event occurring 60 years into the future and allowing for anticipated climate change over this period. The ponds will discharge into an existing drainage ditch at a maximum rate that would be no more than would be the case had there been no development of the site.

21. The NBEC has also been designed to protect the environment in the event of a worst case flooding event that could occur in the future if the flood defences are breached. The ground levels of the site will be raised such that even in these potentially extreme conditions, the plant, fuel bunker and other material storage will remain above the worst case predicted flood level.

2.3 Alternative technology choices

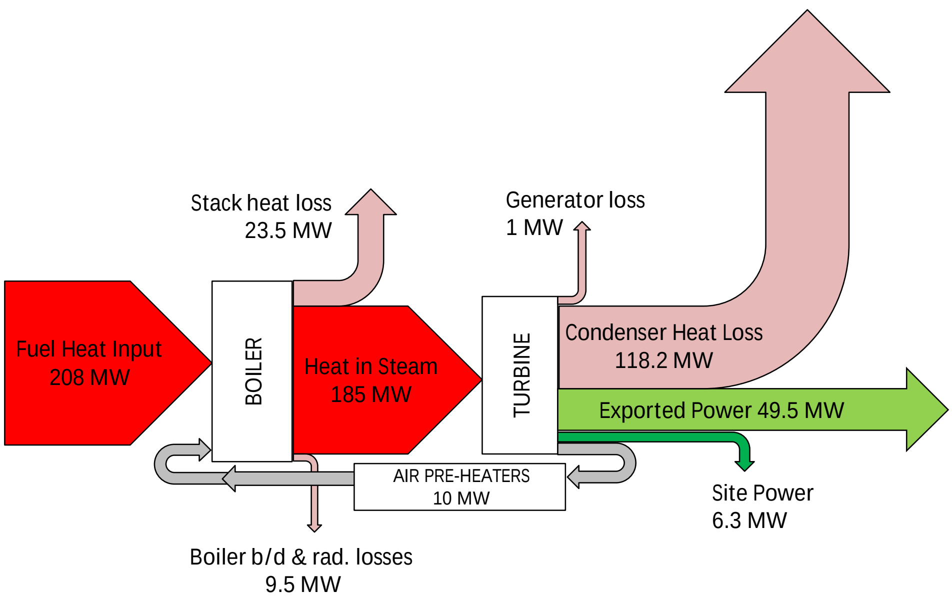
22. The EA offers guidance about technology selection for EfW applications in its EfW guidance note, EPR 5.01. Within this guidance there exist a number of choices to be made for the selection of combustion technology and air pollution control (APC). These choices have been assessed by NBEL in the EfW BAT Assessment report (**Annex H**) that forms part of this application and which has informed the choices that have been made for combustion technology and air pollution control.

23. The selected technologies represent the Best Available Techniques (BAT). These offer a very highly developed solution that will not only provide extremely effective control of emissions but will do so with very high reliability. Whilst other choices exist for combustion, it is considered that these offer no discernible environmental benefit whilst giving negative consequences in terms of reliability and cost. The APC system chosen represents the industry benchmark, giving very high abatement efficiency in an affordable and cost effective manner.

2.4 Energy Efficiency

24. In general, EfW plants are designed to recover as much energy as is possible within practical constraints (i.e. mainly boiler corrosion) and the limitations posed by the need for the operational time of the plant to be maximised. Compared to large utilityscale power plants that use solid fuels, EfW plants are very much smaller and the fuel received is much more aggressive with respect to the elements that cause corrosion and fouling. This means that the energy conversion process is simpler and the overall thermal efficiency is generally a lot lower than would be expected from a large, modern coal fired power plant. The Sankey diagram below illustrates the energy flows:

Figure 2-2 Energy flows at NBEC

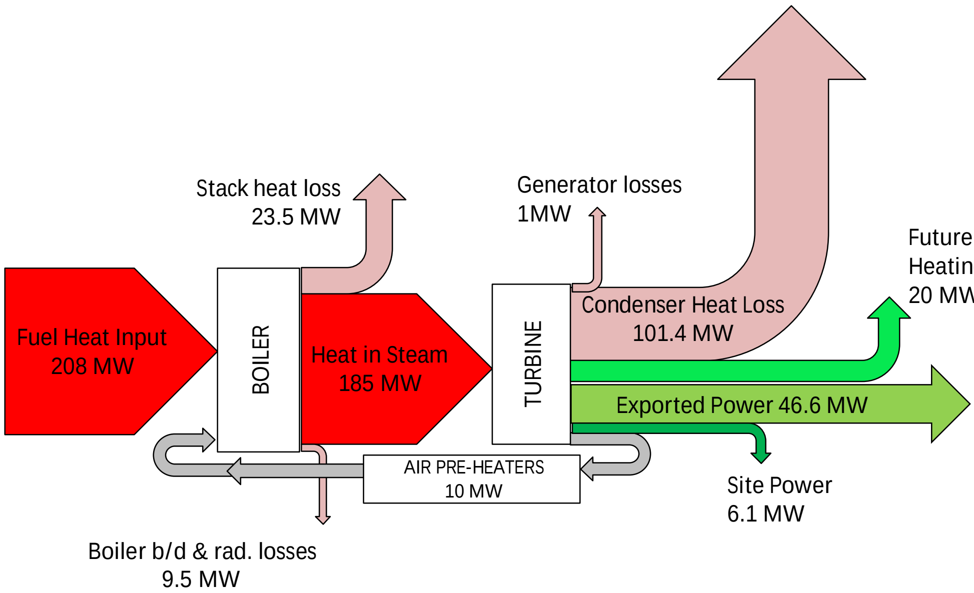


25. The design of NBEC provides a boiler thermal efficiency of 89% and will produce about 9.2MW of electricity for every 100,000tpa of fuel consumed. The latter figure compares favourably with EA guidance of 5 to 9MW per 100,000tpa. The thermal 'cycle' efficiency would be 24%.

26. A recent heat mapping and master planning study carried out by Element Energy (EE) on behalf of North East Lincolnshire Council (NELC) identified the potential for district heating in the area. EE shortlisted possible 'clusters' of heat consumers and two of these were identified as having potential for development, particularly if waste heat could be identified nearby. These two clusters are at Immingham Town (IT) and Stallingborough Enterprise Zone (SEZ). These are both relatively close to the site and offer potentially feasible options provided that government funding support can be secured for the district heating networks. The two clusters together could give rise to a heat demand of about 18MW.

27. A design has been developed for adapting the plant to provide CHP to meet the needs of the two clusters. The NBEC site has been checked to confirm that there is sufficient space to add an energy centre later and the turbine will be configured from the outset to enable connections to be made later to supply steam. Essentially, the plant will be 'CHP-Ready'. If these district heating schemes do materialise in full in the future, then the 'cycle' efficiency of the NBEC would increase significantly from 24% to 34%. A Sankey diagram is given below to illustrate the change in energy flows:

Figure 2-3 Energy flows at NBEC with a future district heating connection



2.5 Operation of the NBEC

28. NBEL is in the process of evaluating and appointing an Operation & Maintenance Contractor (O&MC) for the NBEC. Once appointed the O&MC will establish detailed O&M procedures and an Environmental Management System (EMS) on behalf of NBEC that would enable future certification to ISO14001. This will ensure that full environmental records are kept for the plant covering waste transfer/duty of care documentation, records of any incidents, accidents or emergencies and any other records needed by the EA permit.

29. One of the duties of the O&MC will also be to develop an Accident Management Plan (AMP) prior to commencing operation of NBEC. This will ensure that procedures are put in place on behalf of NBEL to define the actions to be taken in an emergency or following an incident or accident. These procedures will include follow-up investigations, reporting and ensuring that experience gained results in continuous improvement.

30. The O&MC will ensure that job specifications are established and that its staff are suitably qualified and experienced and are fully trained in the safe operation of the plant and in the requirements of the permit.

31. The O&MC will also establish on behalf of NBEL a detailed Fire Prevention Plan (FPP) to expand upon the preliminary plan that has been included with this application. The preliminary FPP has already considered potential causes of fires and how these causes may be mitigated. A comprehensive fire detection system will be installed that will automatically activate protection systems that will include sprinklers, deluge systems, water cannons, CO_2 systems and foam systems.

32. The effect of a fire has also been considered and means of ensuring that spent firewater can be captured without giving rise to pollution. In general, fires within the fuel bunker will be extinguished with water cannons and wet material will either be mixed with dry material then fed to the boiler or, in extreme cases, wet material will be removed from the bunker using the crane to load vehicles for off-site disposal.

33. If a severe fire occurs then firewater run-off into the drains will be captured in the attenuation ponds which will be isolated from the drains. If needed, the ponds can then be emptied by tanker or treated to neutralise, as may be required in consultation with the EA. Prevailing winds and the nature of the materials stored is such that there would be no significant risk to surrounding areas or local population.

2.6 Raw materials and residues stored at the site

34. The NBEC has been designed to minimise the use of raw materials and production of residues for disposal. The raw materials and residues stored at NBEC will be as follows:

- Boiler fuel which will be derived from household type residual waste. This will be stored in a concrete bunker that will prevent outward leakage to the ground or aquifer.
- Boiler auxiliary fuel which will be ‘gas oil’, the industrial equivalent of diesel. This will be stored in a tank which will be located within protection bunds that will be sized in excess of the tank capacity. The fuel will be used for start-up and shut down. The same fuel will be used for the emergency diesel generator and this will be stored in a separate smaller tank near the generator.
- Aqueous ammonia solution for the de-NOx process which will be stored in a tank located within a protection bund.
- Hydrated lime powder that will be stored in a silo within the main building. The lime will be injected into the flue gas to assist the removal of acid gases such as HCl, HF and SO_2 in the bag filter.

- Powdered activated carbon (PAC) will also be stored in a silo within the main building. The PAC is injected into the flue gas and assists the removal of heavy metals and dioxins in the bag filter.
- Bottom ash from the boiler grate will be stored in a dedicated concrete bunker within the main building and which will be removed by grab crane and loaded into vehicles for further treatment and material recovery off-site.
- Residues (APCr) from the air pollution control (APC) plant consisting of spent lime and products from the abatement processes, mainly calcium chloride. The APCr will be stored within two silos located within the main building. These silos will discharge into road going tankers for off-site disposal.
- Various relatively small quantities of chemicals (e.g hydrochloric acid, caustic soda and phosphates) for the treatment of feedwater for the boiler. The chemicals will be delivered by tanker and stored in bunded tanks within the main building.
- Process water and fire water tanks, located externally and supplied from the rainwater harvesting tank and the towns water main.

3 EXAMINATION OF ENVIRONMENTAL IMPACT

35. The potential for the NBEC to have a negative impact on the environment and human health has been examined in detail and no negative impacts have been identified. Note that since there will be no process liquid effluent (i.e. only 'domestic' from washrooms, etc.) the examination has focused on atmospheric emissions and noise.

3.1 Air quality assessment

36. The principle source of emissions to air will come from the 90m stack. The approach taken for the assessment of impact has been to first establish a baseline for the existing air quality, then identify the locations nearby of areas that may be sensitive to changes in air quality, and then to carry out modelling to predict ground level concentrations resulting from the stack emissions.

37. The modelling used the industry benchmark ADMS 5.2 dispersion model to predict the ground level concentrations over a 9km by 9km grid using stack emissions equal to the IED limits (NB actual emissions from the NBEC will be lower than these limits). A wider grid was considered for possible ecological impacts and emissions were also modelled at potentially sensitive residential receptors.

38. A stack height of 90m was chosen for NBEC which is relatively high for an EfW. The dispersion modelling indicated that there would be no detrimental impact to the surrounding population or ecological sites and that a higher stack would not show any significant further benefit. This included further particular study of the Humber Estuary Ramsar Site, Special Area of Conservation and Special Protection Area.

39. The potential adverse impact from abnormal operation has also been examined. Such impacts might result, for example, from failure of part of the air pollution control plant. Some worst case assumptions were made about stack emissions under these circumstances and these emissions were assessed to determine the ground level concentrations that could occur. The assessment concluded that all potential air quality impacts would have an insignificant effect.

3.2 Potential impact on human health

40. A detailed Human Health Risk Assessment (HHRA) has been carried out to identify the potential health risks that could result from the emissions from the NBEC stack. The examination focused on particular chemicals of potential concern (COPC) including: dioxins & furans, heavy metals and benzo(a)pyrene. The analysis considered direct exposure such as inhalation and indirect exposure through uptake via the food chain.

41. The assessment is based on worst case estimates assuming that a particular individual would be exposed for a lifetime to the highest airborne concentrations and that mostly locally produced food would be consumed. The analysis concluded that the emissions would not result in any appreciable health risk.

3.3 Noise

42. In similar fashion to the air quality assessment, a baseline survey was carried out first to establish current levels of noise and vibration at noise sensitive receptors (NSRs). A noise model was then constructed using predicted noise emissions from different areas of the plant, including from the top of the stack, bunker, boiler, turbine and air cooled

condenser as well as from HGVs entering and leaving the site. The significance of noise effects at the NSRs has been established using the guidance contained in BS 4142.

43. The assessment of the plant noise effects predicts that noise levels would be below or around the background levels during daytime and night-time operation at the closest NSRs. The assessment of the impact from the additional HGVs shows no significant change in noise levels. The examination concluded that no additional mitigations measures would be needed (NB most of the plant is located within buildings, only the ACC is outside).