SUNDERLAND UTR FACILITY ENVIRONMENTAL PERMIT APPLICATION

Best Available Techniques & Operating Techniques

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1.0 Introduction

SLR Consulting Ltd (SLR) has been instructed by Wastefront AS to prepare a bespoke Environmental Permit (EP) application for the proposed Sunderland Used Tyre Recycling (UTR) Facility, to be located at Extension Road, East End, within the Port of Sunderland, SR1 2NR (the site). The site will be operated by Wastefront Sunderland Limited (Wastefront).

The primary purpose of the development is to produce hydrocarbon fuels and carbon black from the treatment of used tyres using pyrolysis, distillation and product refining processes. As such, it is considered that the development would be regulated as an installation under the following primary activity listed in Schedule 1 Part 2 of the Environmental Permitting (England & Wales) Regulations 2016 (as amended) ('the EPR'):

Section 1.2 Gasification, liquefaction and refining activities

Part A(1) (f) Activities involving the pyrolysis, carbonisation, distillation, partial oxidation or other heat treatment of—

(i) other carbonaceous material…

otherwise than with a view to making charcoal.

Following pre-application advice from the EA, it is also confirmed that the IED Chapter IV and Annex VI requirements will apply to the combustion activities.

Activities defined as Installations are required to conform to Best Available Techniques (BAT) requirements. The essence of BAT is that the selection of techniques to protect the environment should achieve an appropriate balance between the environmental benefits they bring, and the costs to implement them. In addition, it should be demonstrated that no significant pollution is caused by an assessment of the environmental impact of emissions from the activity as a whole.

This Best Available Techniques and Operating Techniques (BATOT) report is an integrated document which describes both the operating techniques that will be implemented at the facility to ensure compliance with the conditions of the EP, and also demonstrates compliance with BAT where applicable.

1.1 Site Location

It is proposed to develop the facility on a brownfield site located within the Port of Sunderland centred on National Grid Reference (NGR) NZ 41364 56893. The site location is shown on Drawing 001 and the permit boundary on Drawing 002.

The site is bordered to the north by an area used by Northumbrian Roads for aggregates processing, and to the south by a waste solvents plant operated by Tradebe, which is an upper tier COMAH site.

The main north-south access road within the docks lies to the west of the site, and to the east there is an area of open flat land and an inlet to the North Sea protected by a sea wall. The enclosed area of the Sunderland Docks is located further to the west, and on their western side the former Hendon railway sidings. The nearest residential properties are a development at the former Boys Orphanage, approximately 0.5km to the west of the proposed site, and further properties lie 750m south west, and 690m north west.

The surrounding land uses and receptors within 500m are identified on Drawing 003 Environmental Site Setting & Receptors. Cultural and Natural Heritage receptors within 2km are identified on Drawing 004 Cultural and Natural Heritage Receptors.

1.2 Summary of Proposed Operations

Wastefront are proposing to develop and operate a new (UTR) facility to process up to 77,000 tonnes per annum (tpa) of end-of-life tyres by thermal treatment and distillation to produce approximately 24,000 tpa of carbon black and 30,000 tpa of liquid products for use as feedstocks in tyre manufacture and synthetic fuels elsewhere. Steel will be recovered as a by-product.

The key process steps and proposed technology is as follows:

- Shredding of used tyres and removal of steel wire;
- Treatment of the shredded tyres within pyrolysis reactors to produce a gaseous phase, liquid phase and carbon-rich solid residues;
- Distillation of the liquid phase to produce hydrocarbon fuels;
- Combustion of the cleaned gaseous phase to provide heat for the pyrolysis reactors;
- Combustion of residual gases from the pyrolysis and distillation processes in a thermal oxidiser to raise heat for the process;
- Separation of fine wire from the char followed by grinding and pelletising of the solid carbon-black residues; and
- Storage of intermediate and final products, feedstocks and wastes.

Phase 1 of the development will include a single pyrolysis line, distillation and liquid storage and Phase 2 will include expansion of 2 further pyrolysis lines and the hydrothermal/hydrocracking units.

The facility will fall under the UK Control of Major Accident Hazards (COMAH) 2015 regulations, as a result of the storage capacities for the liquid products.

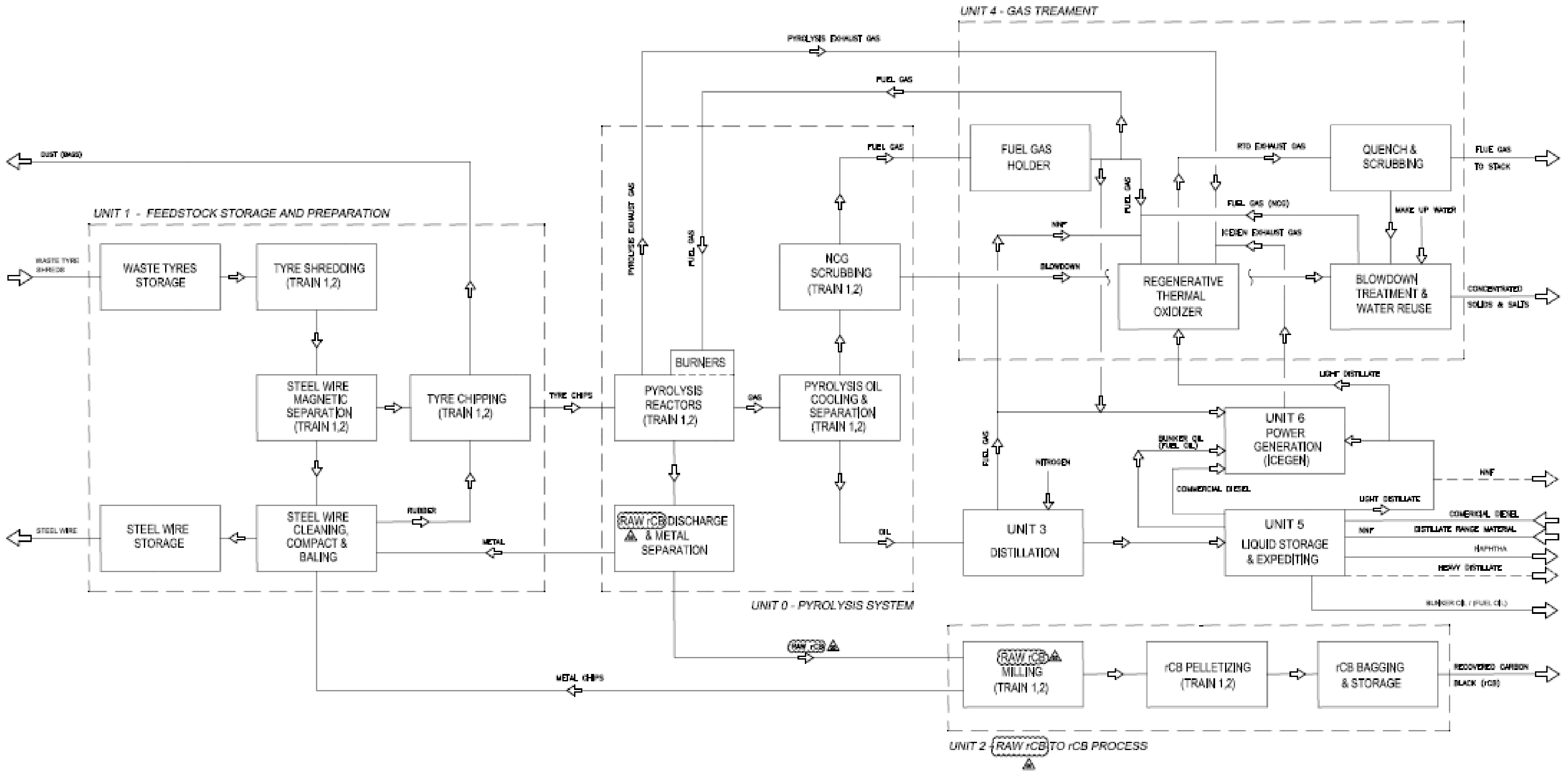
An overview of the process is illustrated in Figure 1.

Three possible feedstocks are considered: a typical blend of car and truck tyres, a blend in which truck tyres are predominant and a blend in which car tyres dominate. Two possible combinations of products are considered: one of which cuts the pyrolysis oil into naphtha, light distillate and “bunker oil” (i.e. a mix of heavy distillate and fuel oil components), the alternative which produces distinct heavy distillate and fuel oil cuts.

The application will seek the EA’s approval for:

- Phase 1 and Phase 2 of the development;
- All three blends of tyres;
- Both distillation scenarios (both sets of liquid products).

Figure 1 Overview of the Wastefront UTR Facility



1.3 Key Technical Standards

The key technical standards that will be followed for the site are:

- European Commission Joint Research Centre – Best Available Techniques Reference (Bref) document and BAT Conclusions (BATc) for the Refining of Mineral Oil and Gas (2015) ('the Refinery Bref');
- Industrial Emissions Directive– Chapter IV Special Provisions for Waste Incineration and Waste Co-incineration Plants and Annex VI Technical provisions relating to waste incineration plants and waste co-incineration plants (24 November 2010);
- EA Industrial Waste Management; Establishing a methodology that supports the assessment of the impact of ATT processes ED13600100 March 2021 ('the ATT guidance';
- Environment Agency - A1 installations: environmental permits (June 2020);
- Environment Agency - Legal operator and competence requirements: environmental permits (April 2021);
- Environment Agency - Develop a management system: environmental permits (January 2019);
- Environment Agency - Risk assessments for your environmental permit (March 2021);
- Environment Agency - Control and monitor emissions for your environmental permit (October 2020);
- Environment Agency - Best available techniques: environmental permits (February 2016);
- Environment Agency – How to comply with your environmental permit. Additional guidance for: The Production of Large Volume Organic Chemicals (EPR 4.01, March 2009);
- Environment Agency - Energy efficiency standards for industrial plants to get environmental permits (July 2019); and
- Environment Agency – Fire Prevention Plans: Environmental Permits (January 2021).

2.0 Management of the Activities

2.1 Management Systems

Wastefront will operate the Site using an Environment Management System accredited to ISO14001. The EMS will be certified within 12 months of the Site becoming operational.

The management system will ensure that:

- the risks that the activities pose to the environment are identified;
- the measures that are required to minimise the risks are identified;
- the activities are managed in accordance with the management system;
- performance against the management system is audited at regular intervals; and
- the EP is complied with.

The management system will be reviewed at least once every four years or in response to significant changes to the activities, accidents or non-compliance. The management system will be supplemented by this BATOT document which outlines the proposed operating techniques at the Site and demonstrates conformance with the requirements of EA guidance.

A summary of Wastefront's proposed environmental management system is included in Appendix B2_1 to the Application Forms (Section 2 of this EP application).

2.2 Environmental Policy, Objectives and Targets

Details of the company's environmental policy including environmental targets and objectives and improvement programme will be contained within the management system.

2.3 Management Techniques

2.3.1 Operational Control, Preventative Maintenance and Calibration

Compliance with operating procedures will ensure effective control of site operations.

As part of the environmental management system, procedures will be established covering the following general topics:

- management and training;
- environmental protection and risk assessment;
- equipment registers and calibration;
- defects, non-conformance and complaints; and
- operations control and equipment maintenance.

A maintenance programme for all equipment will be implemented at the Site. This will follow the inspection and maintenance schedule recommended by the equipment manufacturer(s). The maintenance programme will be reviewed annually to ensure any necessary changes are implemented.

Also held on site will be any operation and maintenance manuals as provided by the equipment manufacturer(s) covering:

- machinery associated with the shredding, screening, drying and grinding operations associated with solid materials;
- equipment relating to the thermal treatment pyrolysers, thermal oxidiser and low-speed diesel generators;
- equipment associated with the hydro treatment and hydrocracking processes including refining and cleaning of gaseous products;
- routine maintenance procedures and requirements;
- environmental protection; and
- emergency procedures.

Where necessary, all monitoring and process control equipment will be calibrated in accordance with manufacturers' recommendations.

2.3.2 Monitoring, Measuring and Reviewing Environmental Performance

A formalised management structure will review environmental performance and ensure any necessary actions are taken.

The Site Manager will review the facility's environmental performance on a regular basis to ensure policy commitments are met, that policy remains relevant, and to ensure that actions to improve environmental performance are identified. Records of environmental performance will be maintained within an appropriate filing system at the Plant Managers' allocated office (or appropriate alternative), or on an electronic system.

2.3.3 Staffing, Competence and Training

The Site Manager will be responsible for ensuring that training levels for operational staff are adequate, relevant and up to date.

All staff will be under the supervision of a technically competent manager at all times.

Staff employed on site will benefit from training, which will ensure their professional and technical development continues. There will be a commitment for staff at all levels to continual improvement, prevention of pollution and compliance with legislation. The training will ensure that staff are aware of:

- skills and competencies required for each job;
- regulatory implications of the permit for the Site and activities;
- potential environmental effects from operations under normal and abnormal circumstances;
- prevention of accidental emissions and actions to be taken in response to accidents;
- control of point source and fugitive emissions to air;
- control of odour;
- raw material and waste handling, waste minimisation, recovery and/or disposal;
- noise;
- environmental monitoring; and
- health and safety.

The management system and BATOT document will be available at all times for site personnel to access. Furthermore, refresher training will be provided on site policies annually. This will reduce accidents and minimise the impact of the installation on the environment, by ensuring the Site operates correctly.

Training records will be maintained by the Plant Manager and held in the Site office.

2.3.4 Communication and reporting of actual or potential non-compliances and complaints

In the event that actual or potential non-compliances occur on site, these will be recorded in the Site Diary and communicated to the Site Manager. The Site Manager will investigate each event and identify a solution to remedy it and prevent it from reoccurring. If the non-compliance event is sustained, the operations may be stopped until a solution can be found, to minimise harm to the environment.

The remedial actions taken in response to the non-compliance may include:

- obtaining additional information on the nature and extent of the non-compliance;
- discussing and testing alternative solutions;
- modifying procedures and responsibilities;
- seeking approval for additional resources and training;
- contacting suppliers and contractors to seek alterations to the way they operate; and
- informing the Environment Agency (EA).

Members of the public can file complaints by contacting the site. All complaints received by the Site Manager will be recorded in the Site Diary and investigated within one working day, with a follow up response communicated to the complainant within 10 working days.

2.3.5 Auditing

The Site will benefit from regular auditing to ensure that it is compliant with the conditions of its permit, namely record keeping, monitoring and emission levels. The audit will be carried out by the Site Manager, or other Technically Competent Person, to ensure that all activities on site are in accordance with the conditions of the EP. The outcome of the audit will be reviewed and tracked to identify any frequent non-compliances.

2.3.6 Corrective action to analyse faults and prevent reoccurrence

The Site Manager will deal with all environmental complaints and other incidents of non-conformance. These include:

- system failure discovered at internal audit;
- incidents, accidents, and emergencies; and
- other operational system failures.

Environmental non-compliances, including remedial action taken and any changes to operation made to avoid re-occurrence will be recorded. Complaints will be reported to and investigated by the Site Manager and remedial measures implemented as required. Changes to prevent future complaints will be proposed and implemented where appropriate. Written records of non-conformances, complaints and other incidents will be maintained in the Site log in which the date, time and nature of the event, together with the results of investigations and remedial action taken, will be recorded.

2.3.7 Reviewing and reporting environmental performance

Senior management will review environmental performance annually and take actions to ensure that policy commitments are met and that policy remains relevant.

2.3.8 Managing documentation and records

The Site Manager will be responsible for ensuring commitments to site audits and reviews and for ensuring that documents relevant to the EP are issued, revised and maintained in a consistent fashion.

An appropriate filing system will be maintained to ensure that all records relating to environmental monitoring, maintenance, reviews and audits are adequately maintained and updated. All records will be held within the Site office.

2.4 Accident Management Plan

Wastefront recognise the importance of the prevention of accidents that may have environmental consequences and that it is crucial to limit those consequences.

An Accident Management Plan (AMP) will be implemented and maintained at the Site to ensure the Site's staff are fully prepared for such incidents. The AMP will be reviewed every three years as a minimum, and after any reportable incident on Site. The document will be continually improved in these reviews to include best practice and minimise the risk of accidents occurring.

An initial assessment of the risk of accidents and abnormal operating conditions posed to the environment and site personal is provided in the Environmental Risk Assessment (ERA), enclosed in Section 4 of this application. The mitigation measures identified within the ERA will be implemented to limit the consequences of accidents on the environment and site personnel. The Accident Management Plan will be further developed following conclusion of a detailed Hazard and Operability Risk Assessment process which is yet to be completed at the time of writing.

The site is a lower-tier COMAH site, so in addition to the above, a Major Accident Prevention Policy will be in place at the site

2.4.1 Action to minimise the potential causes and consequences of accidents

Action will be taken at the Site to minimise the potential causes and consequences of accidents. These actions will include:

- maintaining a list of substances that would harm the environment if they were to escape;
- raw materials and waste will be checked for compatibility with other substances with which they may come into contact;
- raw materials, products and wastes will be stored to prevent their escape into the environment;
- vehicles will follow designated routes;
- where appropriate, barriers will be constructed to prevent vehicles from damaging equipment;
- primary and secondary containment will be provided to prevent the escape of potentially polluting materials;
- tanks for the containment of products will be fitted with level measurements to prevent overfilling;
- CCTV will be installed to minimise the risk of unauthorised access;
- a log will be maintained of all incidents and near misses;
- responsibilities for managing accidents will be clearly defined. Clear instructions on the management of accidents will be maintained; and
- appropriate equipment will be maintained to limit the consequences of an accident.

2.4.2 Hazard identification

The following hazards have been identified:

- unauthorised waste receipt and processing;
- vehicle collision;
- failure of site surfacing resulting in ground contamination;
- fuel spills from vehicles;
- spillage of waste materials during delivery to the hoppers;
- spillage of liquid raw materials;
- major fire;
- minor fire;
- security and vandalism;
- asphyxiation and toxicity;
- failure to contain fire water;

- explosion;
- flooding;
- failure of machinery;
- failure of abatement technology;
- process heating failure; and
- failure of equipment;

For information on how these risks will be mitigated at the facility, please refer to the ERA in Section 4 of this application.

3.0 Operations

3.1 Regulated Activities

3.1.1 Installation activities

The primary purpose of the development is to produce hydrocarbon fuels and carbon black from the treatment of used tyres using pyrolysis, distillation and product refining processes and as such, it is considered that the installation would be regulated under the following primary activity listed in Schedule 1 Part 2 of the Environmental Permitting (England & Wales) Regulations 2016 (as amended) ('the EPR'):

- *Chapter 1, Energy Activities, Section 1.2: Gasification, liquefaction and refining activities. Part A (1) (f) Activities involving the pyrolysis….distillation…or other heat treatment of (iv) other carbonaceous materials.*

Following pre-application advice from the EA, it is also confirmed that the IED Chapter IV and Annex VI requirements will apply to the combustion activities.

3.1.2 Specified Waste Management activities

The waste management activities to be carried out at the Site are detailed below:

- R3: Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes).

3.1.3 Directly Associated Activities

The following directly associated activities will be undertaken at the Site:

- shredding and sorting of non-hazardous waste;
- combustion of light distillate oil in low speed diesel engine generators;
- char processing by separation, milling and drying;
- combustion of gases in a conventional flare in extreme emergency situations only;
- receipt, storage and handling of waste;
- treatment and discharge of liquid effluent;
- storage and handling of chemicals, oils, products and residues; and

- storage of raw materials.

3.2 Process Design

The Site has been designed for a life of 20 years and in accordance with recognised standards, methodologies and practices in every aspect.

Environmental issues have and will be taken into account during the design, construction and operational phases of the plant. Emissions of contaminants and waste production will be kept to a minimum and the waste hierarchy will be adhered to at all times. Where possible, environmentally friendly products will be used.

The Environmental Risk Assessment, enclosed as Section 4 of this application, has assessed the risk to the environment associated with operational activities and has identified corresponding measures to minimise these risks to within acceptable levels.

3.3 Construction

A Construction Execution Plan (CEP) will govern all construction and quality assurance activities. The CEP will be prepared by technically competent persons and detail the assurance and validation process for relevant elements of the facility, including:

- material selection;
- handling, storage and installation;
- conformance and performance testing; and
- inspection and validation.

A competent and suitably qualified person will supervise the construction activities and will prepare a validation report confirming that the construction activities have been carried out in accordance with CEP.

A Construction Environmental Management Plan (CEMP) will be implemented for the purposes of construction. This will cover aspects such as noise, dust and fugitive emissions to minimise them as far as possible.

3.4 Feedstock and Capacity

Once fully operational, the plant will receive up to 77,000 tonnes of end of life tyres per year consisting of car and truck tyres.

The site will only accept end-of-life tyres as defined in Table 3-1.

Table 3-1 List of Wastes

Waste Code	Description
16 01	end-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08)
16 01 03	End-of-life tyres

3.5 Process Configuration

Three possible feedstocks are considered: a typical blend of car and truck tyres, a blend in which truck tyres are predominant and a blend in which car tyres dominate. Two possible combinations of products are considered: one of which cuts the pyrolysis oil into naphtha, light distillate and "bunker oil" (i.e. a mix of heavy distillate and fuel oil components), the alternative which produces distinct heavy distillate and fuel oil cuts.

The plant is designed to be flexible regarding the composition of the tyres received. Table 3-2 below gives the specific capacities of feedstocks and products for 6 cases which define the envelope of operation.

Table 3-2 Feedstock and output configurations

Mass Balance	Typical Feed Tonnes per year		High Truck Feed Tonnes per year		High Car Feed Tonnes per year	
	3 Liquid Products	4 Liquid Products	3 Liquid Products	4 Liquid Products	3 Liquid Products	4 Liquid Products
Input						
Tyres	73,334	73,334	76,572	76,572	72,257	72,257
Output						
Naphtha	3,685	3,685	2,832	2,832	3,928	2,832
Light Distillate - *for power generation*	5,571	5,787	5,720	5,722	5,851	5,720
Heavy Distillate	0	10,413	0	9,497	0	9,496
Bunker Oil	20,707	0	19,871	0	19,661	0
Fuel Oil	0	10,078	0	10,372	0	10,375
Recovered Carbon Black (rCB)	22,572	22,572	20,158	20,158	23,379	23,379
Recovered Wire and Fine Steel	14,767	14,767	20,418	20,418	12,883	12,883
Shredder Dust	355	355	355	355	355	355

3.6 Operating Hours

The process will operate 24 hours per day, 365 days of the year except for maintenance periods.

The Site will under normal circumstances only accept deliveries of end-of-life tyres during daytime working hours, 07:30 to 19:00 Monday to Friday and 08:00 to 17:00 on Saturday, with no delivery or dispatch of waste taking place on Sundays or bank holidays.

3.7 Process Availability

The plant will be designed to a target availability of 90.4% (330 days) based on the maintenance experience of the supplier of the pyrolysis system. It is anticipated that maintenance will be carried out after 30-60 days normal operation, to replace packing, inspect and grease moving parts. The duration for planned maintenance is one day, with a further 2 days off-line for cooling down after shutdown and for heating after start-up.

3.8 Design Lifetime

The plant will be designed for a lifetime of 20 years provided that relevant preventive maintenance and operational procedures are followed. The exceptions to this are the pyrolysis reactors which will have a 10-year lifetime.

4.0 Detailed Process Description

4.1 Feedstock reception

Used tyres will be delivered as bales of approximate dimensions 1.5m x 1.2m x 0.75m and weighing approximately 800kg. Deliveries will be by truck, with each load comprising ca. 26 bales.

Authorised vehicles delivering tyre bales to the Site will be directed from the weighbridge to the bale storage area in the north-western corner of the site as shown in Drawing 002. Bales will be unloaded by forklift truck and stored in stockpiles 3 bales high, of maximum volume of 300m^3 within the tyre storage building.

The tyre storage building is roofed and enclosed on three sides. The overall stockpile volume has been sized to provide 3-5 days processing capacity and to align with the requirements of the EA's guidance on Fire Prevention Plans.

From the main tyre storage area, bales will be transferred to interim storage adjacent to the shredding process building by forklift trick into two stockpiles. The maximum size of any stockpile in this area will be no greater than 300m^3.

4.2 Tyre Shredding

Baled tyres are unpacked on the floor within the shredder building and loaded onto a conveyor to the twin shredding lines, which use Shredwell TSM-6000 equipment to produce <20mm chips. Each line is designed to process 6 – 8 tonnes per hour (tph) of tyres (approximately equivalent to 11 – 16 bales) operating continuously for 21 hours per day, with 3 hours offline for daily maintenance.

In each line, the tyres are first fed to a primary shredder which cuts the tyres into 50mm x 150mm pieces. The material is transported by a conveyor to a disc classifier which separates oversized material for recycling back to the primary shredder by another conveyor. The 50mm x 150mm primary shredded material is delivered by a conveyor to an auger which splits it into two equal streams, which are transported by conveyors into raspers. The raspers reduce the tyre chips to 20mm x 20mm. From there the chips are delivered to vibratory conveyors in which vibration is used to separate steel wire from the shredded rubber. The steel wires are then removed using magnetic separators and conveyed to the steel baling area. The resulting wire-free tyre chips are transported by front end loader into a conveyor to transfer them into the tyre chip silo.

The raspers and associated equipment are located in a sound-proof enclosure and are furnished with dust extraction and removal system consisting of a bag filter, and extraction fan. Approximately 50 kg/h of dust, predominantly comprising fabric and rubber, is produced between the two lines which is collected in drums and stored in the main bale storage area pending transfer off-site for treatment or disposal at an appropriately regulated facility.

The resulting tyre shred is stored in an enclosed 75m^3 silo bin within the western side of the building.

The shredding process takes place within the enclosed Unit 1 Feedstock Storage and Preparation Building as shown in Drawing 002.

4.3 Pyrolysis

There are 3 pyrolysis lines, each consisting of 4 reactors, designed to operate at a capacity of 20,000 tonnes per year of tyre chips on a continuous basis. The reactors break down the tyre chips into a hydrocarbon vapour and a solid char which comprises carbon black, amorphous carbon, inorganic fillers and residual steel.

The pyrolysis system will be designed and supplied by Niutech and consists of the following components:

- Feed system
- Pyrolysis Reactor & Heating System
- Pyrolysis Oil Cooling and Separation
- Gas Cleaning
- Char removal

The pyrolysis system is located in an enclosed building shown in Drawing 02.

4.3.1 Pyrolyser Feed System

Tyre chips are fed from the silo by front-end loader onto loading conveyors and then elevated onto the Scraper Conveyor which splits the feedstock into two identical sub-streams. These are transported to Secondary Loading Conveyors. One of these is used to feed the chips into a transitional hopper where it is split into two sub-streams exiting the hopper by means of screw feeders onto belt scales. This configuration allows the incoming feedstock to be split into four sub-streams each of which is separately controlled by varying the speed of the four respective screw feeders.

4.3.2 Pyrolyser Reactor

Each pyrolysis unit consists of a screw feeder, a reactor vessel, heat recovery fan and heat supply assembly incorporating a burner.

The reactor is heated by an external jacket through which a combination of exhaust gas from the burning of fuel gas (produced by burning the process gas from the gas holder and distillation stage) and hot recycled exhaust gases from the heat recovery fan is fed. During start-up, the fuel gas can be supplemented by natural gas, however in normal steady operation there is a slight surplus of fuel gas.

The feed screw is integrated with the reactor to form a seal so that the reactor operates at a very slight positive pressure. The tyre chips are heated and decompose as they move through the reactor. The reactor incorporates internal flights and ceramic balls to assist with the heat distribution to the feed material and provide attrition of char as the tyre chips heat and degrade and the particles become finer. The final char temperature is typically 420°C and the solids residence time inside the reactor is about 40 minutes.

One objective of the pyrolysis stage is to minimize the amount of amorphous carbon and residual unconverted polymers as both are undesirable components. The temperature profile in the reactor can be adjusted to optimise the char quality as in general too low a temperature will result in unconverted polymers while too high a temperature will result in amorphous carbon. The temperature profile can be tuned by adjusting the external heating as well as a series of valves which vary how much exhaust gas is withdrawn along the length of the pyrolyser.

As the pyrolysis reactions occur at relatively mild conditions and the vapor phase residence time is relatively short, the pyrolysis vapours are withdrawn without excessive secondary cracking (which would form gases and amorphous carbon). A screw device is used to withdraw the vapours to maintain the slight positive pressure in the pyrolyser. The vapours pass to Oil Separating and Cooling Assembly.

4.3.3 Cooling & Separation

The vapour phase extracted from the reactor passes to the oil cooling assembly, which uses a series of water-cooled heat exchangers to condense liquids from the vapours. The liquids collect in a horizontal drum (which is an integral part of the oil cooling and separating assembly) and are transported to the distillation stage using the oil transfer pump. The uncondensed vapours, after cooling to approximately 40°C, pass to the gas treatment stage for cleaning.

4.3.4 Char Removal

Each reactor has a water-cooled screw conveyor sealed with the reactor, which removes and cools the char from the pyrolyser. The char is then transferred into a water-cooled elevator for further cooling before the solids are deposited on to an output conveyor for further processing in the recovered Carbon Black (rCB) area. Fine steel is removed at this point and collected into a bin for baling and recycling off-site. The steel-free char is stored in an enclosed transition silo within the pyrolysis process area before being delivered for milling by a bucket elevator. Dust extraction from the conveying and steel removal activities is carried out with induced air flow fan and cleaned in a fabric filter, The fine dust is removed from the bottom of the filter through an airlock and collected into drums before being re-introduced to the char milling process or transferred off site for treatment or disposal.

4.4 Steel Wire Removal

The steel wire separated from the tyre chips during the shredding stage is transported from each of the individual shredding lines by conveyor to the steel cleaning systems, where it is combined with the fine steel recovered from the char. The steel cleaning system consists of a Shredwell RRS-220 liberator which grinds and cleans the steel to remove the rubber and char residues. Dust is removed from the liberator and other equipment and collected. Following the initial treatment, the wire passes to a second cleaning step and then to a vibrating conveyor which separates the steel from rubber to facilitate collection of the steel using a magnetic separator. The rubber (together with char and fibre) is delivered to the tyre chip silo, where it is combined with shredded rubber chips recovered from the chip pile. The steel residues are transported to the balers which compress the loose steel wire into bales 270mm x 270mm x 270mm weighing approximately 50-80kg per bale. The bales will be packaged on pallets prior to transfer off-site for recovery at an appropriately regulated site.

4.5 Char Processing / Carbon Black production

Char is removed and cooled using water cooled auger conveyors and stored in a transition silo. From there it is pneumatically conveyed to the Unit 2 building where it is milled to extreme fineness within twin milling lines to produce carbon black.

The char from the pyrolyser consists predominantly of particles 3mm or less, with some fine metal wire inclusions up to 20mm in length as well as some loose agglomerates of char and wire that are remnants of the original 20mm x 20mm shreds. The char is fed to a separator which removes the residual wire before it proceeds to the hammer mill for primary size reduction. The char is then fed to the jet milling feed silos, from which it is pneumatically conveyed to the jet mill which reduces it to an average particle size of 5 microns. The jet mills are supplied with compressed air from compressor units. The milled char is entrained in the air leaving the jet mill and the recovered carbon black is removed using a bag filter. Collected char is removed from the base of the filter by a screw conveyor and transferred into a feed silo ahead of the pelletising and drying stages.

The pelletiser mixes the char with water to bind the carbon black in order to increase its bulk density by agglomeration whilst maintaining surface area. It is anticipated that water will provide an effective binder but there is provision for additives if required. The pellets then proceed to a fluidised bed dryer, which is fed with air heated from the combustion of cleaned pyrolyser gas in a fired heater. Air leaving the dryer passes through a filter unit to remove fines, which are collected in drums before being recirculated back through the pelletisation process and is then fed to the regenerative thermal oxidiser to ensure any trace hydrocarbons, carbon monoxide or other contaminants are destroyed.

The dried pellets are fed by a conveyor and pendulum bucket conveyor to a vibrating screen which separates over- and undersized material for reprocessing. The undersized fines are recirculated to the pelletiser and the oversize is recirculated to the roller mill for reprocessing.

The pelletised carbon black is conveyed to the product silo from where it is fed to the bagging machines. The filled sacks are moved to the warehouse by forklift truck. Approximately 24,000 tonnes per year of recovered carbon black (rCB) will be produced.

4.6 Treatment of Gaseous Phase

The gas fraction from each of the three pyrolysis trains is scrubbed with a caustic solution operating at a high pH to remove hydrogen sulphide. The uncondensed gas stream is fed to the scrubber unit which consists of a packed tower with a horizontal sump shared by two towers. Alkaline scrubbing solution is circulated to the packed tower and to spray nozzles below the packing by means of a spray pump. The scrubbing solution is maintained at a high pH by caustic addition and blowdown is sent to a concentrator and treatment system. The scrubbing solution removes hydrogen sulphide, any hydrogen chloride which may be present due to chlorine compounds in the rubber and carbon dioxide.

The vapours pass through a separator to remove liquid before being driven by a full pressure fan through a water seal tank and into the fuel gas holder.

The cleaned gas passes to a common fuel gas holder which operates at slightly above atmospheric pressure and has a variable volume. It is expected to be a single lift, wet gas holder, but could be a dry holder (such as a bag inside a tank or a Wiggins dry-seal gas holder), provided that the material of construction for the membrane is selected to withstand the aromatic and olefinic solvents in the pyrolysis gas.

Fuel gas is delivered from the holder to a pressure maintaining buffer tank which ensures that gas is delivered at uniform pressure for the various process uses. The gas splits into four streams, two of which fuel the burners for the carbon black pellet dryers, one stream is blended with fuel gas from distillation and is used as fuel for pyrolysis and the fourth stream comprises any surplus gas which is combusted in the regenerative thermal oxidizer.

4.7 Processing of the Liquid Phase

The liquid fraction (pyrolysis oil) undergoes a distillation process to separate it into end products. The distillation phase consists of three columns: Naphtha Separation Column, Light-Heavy Distillate Column & Naphtha Stabilization Column. These separate the pyrolysis oil into four separate streams: naphtha, light distillate, optional heavy distillate and fuel oil. For some of the operational scenarios, heavy distillate product will not be produced, but the bottom product will consist of a blend of heavy distillate and fuel oil, suitable for bunker oil. The naphtha stream has a stringent requirement on flash point and is stripped producing a significant gas stream. Some of this is used to fuel the pyrolysis process and the excess is treated in the RTO.

Crude pyrolysis oil is collected in a heated tank from where it is pumped to the distillation unit. It passes through a heat exchanger before entering the naphtha column which splits the oil into an overhead product of naphtha/fuel gas and a bottoms product of intermediate oil. The column operates at just above atmospheric pressure and overhead vapours pass to an overhead condenser, from which a liquid stream passes to the naphtha reflux vessel and the uncondensed vapour goes to the fuel gas system. Any water present is collected and purged to blowdown. The naphtha is pumped and split into a product stream, which goes to the stabilizer and a reflux stream which returns to the naphtha column. The bottoms product is pumped from the column and split into a stream forwarded to the light/heavy distillate column and a stream which passes through the naphtha column reboiler. The reboiler is heated with circulating hot oil and the process temperature is kept to 250°C to avoid excessive fouling due to the presence of olefins in the feedstock and the propensity to polymerize.

The light/heavy distillate column has three beds of packing and the feed point is above the bottom bed of packing. The column operates under vacuum so that the reboiler temperature can be below 250°C to avoid excessive fouling. Light distillate (atmospheric boiling range 144 – 285°C) is produced as an overhead product. Heavy distillate (boiling range: IBP=160°C, T90=350°C) is an optional side draw product taken between beds 1 and 2. The bottoms product is either "bunker oil" (nominally boiling at 230°C+) or "fuel oil" (350°C+), depending on whether there is a side draw product or not. This optionality is provided so that the process is better able to adjust to market conditions. Currently it is anticipated that typically the column will operate to produce the light distillate overhead and bunker oil bottom products.

The vapours leaving the column are condensed and subcooled in light distillate condenser and are returned to the column as reflux. The light distillate product is split from the reflux stream and goes to light distillate day tank from where it is typically forwarded to the light distillate tank or, if necessary, diverted to the off spec and buffer tank for reprocessing.

The heavy distillate side draw is sent to heavy distillate day tank and cooling before being transferred to storage or reprocessing.

The bottoms liquids are split into two streams with one stream passing through the distillate column reboiler and the other stream passing through the feed heat exchanger and to the bunker oil (fuel oil) day tank. The bunker oil (or fuel oil) is then transferred to storage.

Naphtha is stripped in order to improve the flash point by removing dissolved gases and light hydrocarbons. The target flash point is -20°C. The unstabilised naphtha from the distillation column is fed to the top of a packed bed naphtha stabilizer column. Nitrogen is fed to the bottom of the column to strip light gases and this mixture leaves the top of the column and joins the fuel gas system. The stripped naphtha goes to the Naphtha Day Tank which holds 10m^3 and is intended to provide buffer storage to deal with operational upsets. The naphtha is then transferred to either the naphtha product tank or to the buffer tank for reprocessing.

The liquid products from distillation are stored before transport off-site by road or barge:

- Naphtha
- Bunker oil
- Light distillate
- Heavy distillate
- Fuel oil

The light distillate material is all used on site as fuel for low-speed diesel engine generators (it is not suitable for use in conventional high speed diesel engines due to poor ignition properties).

4.8 Regenerative Thermal Oxidiser

The RTO is located in the Unit 4 Gas Treatment building and is used to treat the exhaust gases from the low-speed diesel engines, pyrolysers and rCB driers, as well as to burn any excess fuel gas and distillate if required.

Prior to entering the RTO the exhaust gases from pyrolysis, rCB drying and diesel engines are cooled to approximately 300°C by heating circulating hot oil in the exhaust gas cooler.

The Regenerative Thermal Oxidizer consists of two beds of inert media and a combustion chamber. The exhaust gas direction is periodically switched so that each media bed is in turn heating incoming exhaust gas and alternatively cooling the hot gases leaving the combustion chamber. This has the effect of preheating the exhaust gas so that only a small amount of fuel is needed to bring the combustion chamber temperature to the desired value (around 870°C). A duct burner is located upstream of the cooler for use during start-up and for combustion trim.

Combustion air is introduced either upstream of the media bed or directly into the combustion chamber to control the chamber temperature depending on the sources and amount of fuel fed to the combustion chamber. The amount of fuel gas going to the RTO is variable and can increase significantly during abnormal operation. An increase in fuel gas flow to the RTO will cause a higher temperature in the combustion chamber which is compensated by adding fresh air.

The combustion chamber residence time is designed to achieve destruction of unburned hydrocarbons, carbon monoxide and trace amounts of dioxins that may be present in the exhaust streams. In addition, the Regenerative Thermal Oxidizer completely combusts the surplus fuel gas. There is also provision for a light distillate fired burner to cover cases where there is insufficient fuel gas available for stable combustion.

The RTO destroys (fully oxidises) unburned fuel, hydrocarbons, trace chlorohydrocarbons, sulphur compounds and carbon monoxide from the various feed streams. This means that the gas leaving the RTO contains significant amounts of SO_2 and possibly NO_x and traces of HCl in addition to CO_2, N_2 and water from combustion of the surplus fuel.

4.9 Combustion Exhaust Gas Quench and Scrubbing

The exhaust gases leave the RTO at between 300 and 550°C, depending on the amount of surplus fuel burned and if additional air is added to the RTO. If necessary, at this point it would be possible to recover additional heat to a secondary hot oil circuit (sharing the same infrastructure as the hot oil exchanger upstream of the RTO but producing hot oil at a lower temperature for duties that do not require high temperature such as in distillation, which is the limiting case that set the hot oil temperatures). Alternatively, if the possibility of an external user of heat were to materialise in the future, this location is the ideal one from which to extract process heat. Currently, however there is no such requirement for the available heat and consequently the heat is discarded one way or another. The current concept is to discard the heat using a quench tower.

Hot exhaust gases flow into a quench tower where they are sprayed with water which evaporates, thereby cooling the gas. The water is recirculated and topped up with a combination of water recovered from the various blowdown streams and fresh water. There is provision to blow down water from the quench circuit to avoid deposits, depending on water hardness. It is also possible to include some caustic in the make-up water to control the circuit pH if necessary, however the main purpose of the quench tower is to cool the gas, not to capture acid components.

The cooled exhaust gases are transferred to the scrubber tower where acid gases are removed by a recirculating caustic solution. The cleaned exhaust gas is discharged to atmosphere via the 30m stack release point A1.

The scrubber solution is cooled and recirculated, with a continuous blow down and dosing with 40% caustic solution and make-up water to keep the total dissolved solids concentration in the desired design range (nominally 5%). Blowdown is transferred for treatment and water recovery.

4.10 Blowdown Treatment

The blowdown streams from the pyrolysis scrubber and RTO exhaust scrubber are blended and fed to the blowdown stripper column. Water vapour leaves the top of the column and is condensed using air in the blowdown stripper condenser. The two-phase mixture from the condenser is separated into liquid and vapour fractions in the blowdown stripper vessel and the vapour goes overhead to a water cooled condenser where additional water is recovered back to the stripper vessel. The incondensable vapours are sent to the RTO for destruction and the recovered water is sent back for use as quench and for scrubbing.

The liquid from the stripper column is circulated through the blowdown stripper reboiler and back to the tower. A side stream of concentrated salts (40% solids, 60% liquids) and is taken off for disposal off-site. This consists mainly of sodium sulphite, sodium sulphate, sodium sulphide, sodium carbonate, sodium nitrite and sodium nitrate. The amount of waste solution is approximately 180 kg/h of which approximately 70 kg/h is combined solids. It is possible that lower amounts of caustic could be used and, in that case, the bisulphite, bisulphate and bisulphide will form, however the limiting criterion is capture of SO_2 in the scrubber which limits the pH at which sulphur capture will be effective. Due to the relatively small amount of material involved, regeneration of caustic solution (with lime) is not considered as part of the base case but is considered as a potential add-on.

The spent caustic solution concentrate is collected in a tank of $50m^3$ capacity which provides approximately 2 weeks production capacity at the normal rate of 180 kg/h (ca. 150 l/hour). The tank is provided with a hot oil coil to keep the material liquid.

The waste concentrate will be removed weekly by a qualified waste management company in road tankers for treatment at an appropriately regulated facility.

4.11 Product Storage

Naphtha is stored initially in a $200m^3$ fixed-roof tank located adjacent to distillation area. Once filled, the contents of the tank are analysed and certified and then each certified batch of material is pumped to a 1,200 m^3 tank in the product storage area in the south-western part of the site. The intention of the $1,200m^3$ storage tank is to accrete naphtha in sufficient quantity to be shipped by barge. It should be noted however that it takes approximately 3 months to fill the tank. Naphtha is pumped from the storage tank to the loading area on the western area of the site.

Light Distillate is stored in a second $200m^3$ fixed roof tank located adjacent to the distillation area and is pumped to the diesel engines for power generation only, in the current design. However, the infrastructure exists to export light distillate by means of loading arm should the opportunity for sale arise. It can also be sent to the RTO as support fuel or sent to the off-spec/rework tank, to be distilled again.

Heavy distillate is stored in a further $200m^3$ fixed roof tank located adjacent to the distillation area. As for naphtha, once filled the contents of the tank are analysed and certified and then each certified batch of material is pumped to a 1,200 m^3 storage tank, a volume which is sufficient for shipping by barge. The heavy distillate is pumped to the loading arm for transfer to trucks or barges or directing back to the process for rework. The heavy distillate tank is fitted with a heating coil and is also able to receive bunker oil, which provides additional bunker oil storage in cases when only 3 products are produced.

The bunker oil (or heavy fuel oil) is stored in a $200m^3$ heated tank located adjacent to the distillation area before being pumped to the $4,000m^3$ bunker oil tank. The material can also be sent to the heavy distillate tank. The bunker oil tank is fitted with a hot oil coil which may be used to maintain the material at an optimally pumpable temperature and is pumped to the loading area for dispatch by tanker or barge.

Off spec materials from processing are collected in the off-spec and buffer tank. The material is transferred either as a bleed-in to the distillation system, to the pyrolysis feed tank or loaded onto trucks for dispatch for treatment at an appropriately regulated facility.

The storage tanks are all located in the south-western part of the site as shown in Drawing 002. They are provided with nitrogen blankets with vent gases discharged locally, with the exception of BO/FO tanks. The vents are fitted with carbon filters to remove hydrocarbons.

There are several loading systems; the lighter products (naphtha, light distillate, and heavy distillate) are loaded through the naphtha truck loading system or light product marine loading system and the bunker oil or fuel oil products are loaded to trucks using the BO/FO truck loading system or to barges using the BO/FO marine loading system. Road tankers can be weighed on the weighbridge before and after loading, or alternatively there is a volume flow meter that can provide the fill data.

4.12 Diesel Generators

The light distillate material is used as fuel to produce power for the site using low speed diesel engine generators. These are located in the Unit 6 Power Generation – ICEGEN building, as shown in Drawing 02, adjacent to the stack and between the pyrolysis building and the product storage tanks area. The system consists of three parallel generator packages, based on medium speed (1,000 rpm) engines. Each engine is sized for ~1,500 kW output and one is a spare. The hot exhaust gases from the engines are collected and forwarded to the hot oil heater, upstream of the RTO, before treatment in the RTO.

The light distillate fuel produced by the process is not suitable for use in conventional high speed diesel engines due to poor ignition properties and therefore low speed generators have been specified.

The light distillate is used for power generation rather than a product as it contains a range of compounds which would cause difficulty for use and marketing as a conventional fuel blendstock. It has a high sulphur content, may contain trace amounts of chloroparaffins, contains a large fraction of aromatics and olefins and thus has a poor Cetane number. Finally due to the high olefins content, the material is not stable in storage.

The high olefins content means that the hydrogen required to hydrotreat the material is very high and consequently it is not a good material to hydrogenate and blend into the diesel pool. Finally, there are some extremely refractory compounds such as benzothiazoles which are present in tyres as vulcanization agents and which are extremely difficult to hydrotreat. So, in view of the poor properties of the material and the difficulty in consuming it as a refinery intermediate, the decision was taken to use this material as a fuel internally to produce power.

However, the deficiencies of the material are easy to address in the context of on-site power generation. In particular the instability of the fuel is addressed by storage under a nitrogen blanket and by turning over the inventory relatively quickly (10 days storage more or less). The high sulphur content is addressed by stack gas scrubbing following combustion in the RTO. The poor Cetane rating of the fuel is addressed by using low speed diesel engines which can tolerate the significantly higher ignition delay of the fuel.

4.13 Process Heating

A hot oil circuit is used for process heating requirements. Heat is recovered into the heat transfer fluid (for example, DOWTHERM™ G Heat Transfer Fluid) from hot exhaust gases upstream of the RTO and is split into heating circuits at a supply temperature of 350°C for the following purposes:

- distillation reboilers;
- blowdown water treatment;
- hot oil dump cooler; and
- tank farm heating coils.

The return streams from these users will be returned at a temperature of 280°C to a hot oil tank for re-circulation.

There is a significant amount of additional heat that could be recovered into hot oil (albeit at a lower temperature) from downstream of the RTO. However, currently the system is (more or less) balanced.

4.14 Fuels & Fuel Systems

In common with processes described in the Refining of Mineral Oil & Gas Bref, the fuel used for the production of power and process heating on the UTR facility originates from the fuels produced by the process itself, supplemented by imported natural gas. Section 2.10 of the Bref notes that refinery gas is normally used as a fuel as it has to be used quickly and cannot normally be sold as a product.

Pyrolysis gas produced by the process will be burned in the regenerative thermal oxidiser and pyrolyser burners to provide the process heating requirements.

Light distillate fuel produced by the process will be burned in the diesel generators to provide power for the process.

4.15 Future development

Space is allocated in the plot plan to accommodate possible future expansions which may be implemented at a future date if they are economically justified. Details at Project Design Basis document, but a short list of possibilities follows:

- Treatment of liquids to remove sulphur (adsorption or hydroprocessing based);
- Reduction of inorganics in the rCB;
- Production of virgin carbon black from distillate; and
- Recovery of caustic from spent scrubbing solution.

5.0 Assessment of BAT

5.1 Refinery Bref BAT Conclusions

The following section provides an assessment of the pollution prevention and control techniques proposed for the facility against the Best Available Techniques conclusions (BATc) presented in the Bref for the Refining of Mineral Oil and Gas, published in 2015. The BATc is listed in the first column and a description of how the proposals comply with the BATc is provided in the second column.

BAT Requirement	Specific Measure
General BAT conclusions	
1. In order to improve the overall environmental performance of plants for the refining of mineral oil and gas, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features: i. commitment of the management, including senior management; ii. definition of an environmental policy that includes the continuous improvement for the installation by the management; iii. planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment; iv. implementation of the procedures paying particular attention to: (a) structure and responsibility (b) training, awareness and competence (c) communication (d) employee involvement (e) documentation (f) efficient process control (g) maintenance programmes (h) emergency preparedness and response (i) safeguarding compliance with environmental legislation. v. checking performance and taking corrective action, paying particular attention to: (a) monitoring and measurement (see also the reference document on the General Principles of Monitoring) (b) corrective and preventive action (c) maintenance of records	The operator will implement an Environmental Management System (EMS) that incorporates all of the identified features. The EMS will be suitable for certification to ISO 14001:2015. Certification will be sought within 12 months of the site becoming operational.

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>(d) independent (where practicable) internal and external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;
vi. review of the EMS and its continuing suitability, adequacy and effectiveness by senior management;
vii. following the development of cleaner technologies;
viii. consideration for the environmental impacts from the eventual decommissioning of the installation at the stage of designing a new plant, and throughout its operating life; ix. application of sectoral benchmarking on a regular basis.</td><td></td></tr>
<tr><td>Energy efficiency</td><td></td></tr>
<tr><td>2. In order to use energy efficiently, BAT is to use an appropriate combination of the techniques given below:
<table>
<tr><th>Technique</th><th>Description</th></tr>
<tr><td colspan="2">i. Design techniques</td></tr>
<tr><td>a. Pinch analysis</td><td>Methodology based on a systematic calculation of thermodynamic targets for minimising energy consumption of processes. Used as a tool for the evaluation of total systems designs</td></tr>
<tr><td>b. Heat integration</td><td>Heat integration of process systems ensures that a substantial proportion of the heat required in various processes is provided by exchanging heat between streams to be heated and streams to be cooled</td></tr>
<tr><td>c. Heat and power recovery</td><td>Use of energy recovery devices e.g.:
• waste heat boilers
• expanders/power recovery in the FCC unit
• use of waste heat in district heating</td></tr>
<tr><td colspan="2">ii. Process control and maintenance techniques</td></tr>
<tr><td>a. Process optimisation</td><td>Automated controlled combustion in order to lower the fuel consumption per tonne of feed processed, often combined with heat integration for improving furnace efficiency</td></tr>
<tr><td>b. Management and reduction of steam consumption</td><td>systematic mapping of drain valve systems in order to reduce steam consumption and optimise its use</td></tr>
</table>
</td><td>The process has been designed to be as energy efficient as possible, using waste heat whenever possible, i.e. the pyrolyser is heated by waste exhaust gases and exhaust gases from pyrolysis, rCB drying and diesel engines are cooled to approximately 300°C by heating circulating hot oil in the exhaust gas cooler.</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>
<table>
<tr><td>c. Use of energy benchmark</td><td>Participation in ranking and benchmarking activities in order to achieve continuous improvement by learning from best practice</td></tr>
<tr><td>iii. Energy-efficient production techniques</td><td></td></tr>
<tr><td>a. Use of combined heat and power</td><td>System designed for the co-production (or the cogeneration) of heat (e.g. steam) and electric power from the same fuel</td></tr>
<tr><td>b. Integrated gasification combined cycle</td><td>Technique whose purpose is to produce steam, hydrogen (optional) and electric power from a variety of fuel types (e.g. heavy fuel oil or coke) with a high conversion efficiency</td></tr>
</table>
</td><td></td></tr>
<tr><td colspan="2">Solid materials storage and handling</td></tr>
<tr><td>3. In order to prevent or, where that is not practicable, to reduce dust emissions from the storage and handling of dusty materials, BAT is to use one or a combination of the techniques given below:
i. store bulk powder materials in enclosed silos equipped with a dust abatement system (e.g. fabric filter);
ii. store fine materials in enclosed containers or sealed bags;
iii. keep stockpiles of coarse dusty material wetted, stabilise the surface with crusting agents, or store under cover in stockpiles;
iv. use road cleaning vehicles.</td><td>Tyre chips will be stored in a dedicated silo.
Recycled carbon black will be stored in a dedicated silo.
Processing stages that could give rise to dust will take place in enclosed areas that have dust extraction systems incorporating fabric filters.</td></tr>
<tr><td>4. BAT is to monitor emissions to air by using the monitoring techniques with at least the minimum frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.
<table>
<tr><th>Description</th><th>Process unit</th><th>Minimum frequency</th><th>Monitoring technique</th></tr>
<tr><td></td><td>Catalytic cracking</td><td>Continuous (1)(2)</td><td>Direct measurement</td></tr>
<tr><td></td><td>Combustion units ≥ 100 MW (3) and calcining units</td><td>Continuous (1) (2)</td><td>Direct measurement (4)</td></tr>
<tr><td></td><td>Combustion units of 50</td><td>Continuous (1) (2)</td><td>Direct measurement</td></tr>
</table>
</td><td>Emissions to air will be monitored in accordance with the conditions stipulated in the issued environmental permit and in line with Annex VI of the IED.</td></tr>
</table>

BAT Requirement					Specific Measure
i.	SO_x, NO_x, and dust emissions	to 100 MW (3)		or indirect monitoring	
		Combustion units <50 MW (3)	Once a year and after significant fuel changes (5)	Direct measurement or indirect monitoring	
		Sulphur recovery units (SRU)	Continuous for SO2 only (2)	Direct measurement or indirect monitoring (6)	
ii.	NH_3 emissions	All units equipped with SCR or SNCR	Continuous	Direct measurement	
iii.	CO emissions	Catalytic cracking and combustion units ≥ 100 MW (3)	Continuous	Direct measurement	
		Other combustion units	Once every 6 months (5)	Direct Measurement	
iv.	Metals emissions: Nickel (Ni), Antimony (Sb) (7), Vanadium (V)	Catalytic cracking	Once every 6 months and after significant changes to the unit (5)	Direct measurement or analysis based on metals content in the catalyst fines and in the fuel	
		Combustion units (8)			
Polychlorinated dibenzodioxins/furans (PCDD/F) emissions		Catalytic reformer	Once a year or once a regeneration, whichever is longer	Direct measurement	

(1) Continuous measurement of SO2 emissions may be replaced by calculations based on measurements of the sulphur content of the fuel or the feed; where it can be demonstrated that this leads to an equivalent level of accuracy.

(2) Regarding SOX, only SO2 is continuously measured, while SO3 is only periodically measured (e.g. during calibration of the SO2 monitoring system).

(3) Refers to the total rated thermal input of all combustion units connected to the stack where emissions occur.

(4) Or indirect monitoring of SOX.

(5) Monitoring frequencies may be adapted if, after a period of one year, the data series clearly demonstrate a sufficient stability.

(6) SO2 emissions measurements from SRU may be replaced by a continuous material balance or other relevant process parameter

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>monitoring, provided appropriate measurements of SRU efficiency are based on periodic (e.g. once every 2 years) plant performance tests.
(7) Antimony (Sb) is monitored only in catalytic cracking units when Sb injection is used in the process (e.g. for metals passivation).
(8) With the exception of combustion units firing only gaseous fuels.</td><td></td></tr>
<tr><td>5. BAT is to monitor the relevant process parameters linked to pollutant emissions, at catalytic cracking and combustion units by using appropriate techniques and with at least the frequency given below.
<table>
<tr><th>Description</th><th>Minimum frequency</th></tr>
<tr><td>Monitoring of parameters linked to pollutant emissions, e.g. O2 content in flue-gas, N and S content in fuel or feed (1)</td><td>Continuous for O2 content. For N and S content, periodic at a frequency based on significant fuel/feed changes</td></tr>
<tr><td colspan="2">(1) N and S monitoring in fuel or feed may not be necessary when continuous emission measurements of NOX and SO2 are carried out at the stack.</td></tr>
</table></td><td>Process parameters will be monitored in accordance with the conditions stipulated in the issued environmental permit.</td></tr>
<tr><td>6. BAT is to monitor diffuse VOC emissions to air from the entire site by using all of the following techniques:
i. sniffing methods associated with correlation curves for key equipment;
ii. optical gas imaging techniques;
iii. calculations of chronic emissions based on emissions factors periodically (e.g. once every two years) validated by measurements.</td><td>Diffuse VOC emissions to air will be monitored in accordance with Annex VI of the IED.</td></tr>
<tr><td>7. In order to prevent or reduce emissions to air, BAT is to operate the acid gas removal units, sulphur recovery units and all other waste gas treatment systems with a high availability and at optimal capacity.</td><td>The process will benefit from both a Regenerative Thermal Oxidiser and an exhaust gas quench with scrubbing. These units will be operated with high availability and at optimal capacity.</td></tr>
<tr><td>8. In order to prevent and reduce ammonia (NH3) emissions to air when applying selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) techniques, BAT is to maintain suitable operating conditions of the SCR or SNCR waste gas treatment systems, with the aim of limiting emissions of unreacted NH3.
Table 5.2
BAT-associated emission levels for ammonia (NH3) emissions to air for a combustion or process unit where SCR or SNCR techniques are used</td><td>Not applicable, neither SCR or SNCR techniques are employed as part of the process.</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>
<table>
<tr><th>Parameter</th><th>BAT-AEL (monthly average) mg/Nm³</th></tr>
<tr><td>Ammonia expressed as NH3</td><td><5 – 15 (1)(2)</td></tr>
<tr><td colspan="2">(1) The higher end of the range is associated with higher inlet NOX concentrations, higher NOX reduction rates and the ageing of the catalyst.
(2) The lower end of the range is associated with the use of the SCR technique.</td></tr>
</table>
</td><td></td></tr>
<tr><td>9. In order to prevent and reduce emissions to air when using a sour water steam stripping unit, BAT is to route the acid off-gases from this unit to an SRU or any equivalent gas treatment system. It is not BAT to directly incinerate the untreated sour water stripping gases.</td><td>An exhaust gas quench, scrubber and blowdown treatment system will be utilised to treat acid off-gases from the process. See section 4.9 and 4.10 for details.</td></tr>
<tr><td>10. BAT is to monitor emissions to water by using the monitoring techniques with at least the frequency given in Table 5.3 and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.</td><td>There are no emissions of process effluent to water in the current proposal, although this may change in future in which case the appropriate requirements will be applied.</td></tr>
<tr><td>11. In order to reduce water consumption and the volume of contaminated water, BAT is to use all of the techniques given below.
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Water stream integration</td><td>Reduction of process water produced at the unit level prior to discharge by the internal reuse of water streams from e.g. cooling, condensates, especially for use in crude desalting</td><td>Generally applicable for new units. For existing units, applicability may require a complete rebuilding of the unit or the installation</td></tr>
<tr><td>ii. Water and drainage system for segregation of contaminated water streams</td><td>Design of an industrial site to optimise water management, where each stream is treated as appropriate, by e.g. routing generated sour water (from distillation, cracking, coking units, etc.) to appropriate pre-treatment, such as a stripping unit</td><td>generally applicable for new units. For existing units, applicability may require a complete rebuilding of the unit or the installation</td></tr>
<tr><td>iii. Segregation of non-contaminated water streams</td><td>Design of a site in order to avoid sending non-contaminated water to general waste water</td><td>Generally applicable for new units. For existing units,</td></tr>
</table>
</td><td>The process has been designed to minimise water usage, recovering water wherever practicable, i.e. blowdown treatment.
Water streams will be segregated on site wherever practicable to do so.
The site will benefit from an engineered containment system design to prevent loss of spillages or leaks to the environment, see Section 15 for details.</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>
<table>
<tr><td></td><td>(e.g. once-through cooling, rain water)</td><td>treatment and to have a separate release after possible reuse for this type of stream</td><td>applicability may require a complete rebuilding of the unit or the installation</td></tr>
<tr><td>iv.</td><td>Prevention of spillages and leaks</td><td>Practices that include the utilisation of special procedures and/or temporary equipment to maintain performances when necessary to manage special circumstances such as spills, loss of containment, etc</td><td>Generally applicable</td></tr>
</table>
</td><td></td></tr>
<tr><td>
12. In order to reduce the emission load of pollutants in the waste water discharge to the receiving water body, BAT is to remove insoluble and soluble polluting substances by using all of the techniques given below.
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i.</td><td>Removal of insoluble substances by recovering oil</td><td>See Section 5.21.2</td><td>Generally applicable</td></tr>
<tr><td>ii.</td><td>Removal of insoluble substances by recovering suspended solids and dispersed oil</td><td>See Section 5.21.2</td><td>Generally applicable</td></tr>
<tr><td>iii.</td><td>Removal of soluble substances including biological treatment and clarification</td><td>See Section 5.21.2</td><td>Generally applicable</td></tr>
</table>
</td><td>
Uncontaminated rainfall run off from roofs and non-processing areas is collected in the ‘clean’ drainage system and will be discharged to the adjacent dock via a silt trap and oil separator.

Surface water run-off which is potentially contaminated is collected in a separate sealed drainage system and passes through an API separator which separates oil and floating debris in one stream and removes solids heavier than water (mainly char, rCB and dust from shredding) as a sludge. The oil and sludge residues are transferred off-site for treatment at an appropriately regulated facility. The resulting effluent is tankered off-site for treatment.
</td></tr>
<tr><td>
13. When further removal of organic substances or nitrogen is needed, BAT is to use an additional treatment step as described in Section 5.21.2.

Table 5.3

BAT-associated emissions levels for direct waste water discharges from the refining of mineral oil and gas and monitoring frequencies associated with BAT (1).
</td><td>Not applicable - there are no direct waste water discharges from the process.</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>
<table>
<tr><th>Parameter</th><th>Unit</th><th>BAT-AEL (yearly average)</th><th>Monitoring (2) frequency and analytical method (standard)</th></tr>
<tr><td>Hydrocarbon oil index (HOI)</td><td>mg/l</td><td>0.1 – 2.5</td><td>Daily EN 9377 – 2 (3)</td></tr>
<tr><td>Total suspended solids (TSS)</td><td>mg/l</td><td>5 – 25</td><td>Daily</td></tr>
<tr><td>Chemical oxygen demand (COD)(4)</td><td>mg/l</td><td>30 – 125</td><td>Daily</td></tr>
<tr><td>BOD_5</td><td>mg/l</td><td>No BAT-AEL</td><td>Weekly</td></tr>
<tr><td>Total nitrogen (5), expressed as N</td><td>mg/l</td><td>1 – 25 (6)</td><td>Daily</td></tr>
<tr><td>Lead, expressed as Pb</td><td>mg/l</td><td>0.005 – 0.030</td><td>Quarterly</td></tr>
<tr><td>Cadmium, expressed as Cd</td><td>mg/l</td><td>0.002 – 0.008</td><td>Quarterly</td></tr>
<tr><td>Nickel, expressed as Ni</td><td>mg/l</td><td>0.005 – 0.100</td><td>Quarterly</td></tr>
<tr><td>Mercury expressed as Hg</td><td>mg/l</td><td>0.0001 – 0.001</td><td>Quarterly</td></tr>
<tr><td>Vanadium</td><td>mg/l</td><td>No BAT-AEL</td><td>Quarterly</td></tr>
<tr><td>Phenol Index</td><td>mg/l</td><td>No BAT-AEL</td><td>Monthly EN 14402</td></tr>
<tr><td>Benzene, toluene, ethyl benzene, xylene (BTEX)</td><td>mg/l</td><td>Benzene: 0.001 – 0.050 No BAT-AEL for T, E, X</td><td>Monthly</td></tr>
<tr><td colspan="4">(1) Not all parameters and sampling frequencies are applicable to effluent from gas refining sites.
(2) Refers to a flow-proportional composite sample taken over a period of 24 hours or, provided that sufficient flow stability is demonstrated, a time-proportional sample.
(3) Moving from the current method to EN 9377-2 may require an adaptation period.
(4) Where on-site correlation is available, COD may be replaced by TOC. The correlation between COD and TOC should be elaborated on a case-by-case basis. TOC monitoring would be the preferred option because it does not rely on the use of very toxic compounds
(5) Where total-nitrogen is the amount of total Kjeldahl nitrogen (TKN), nitrates and nitrites.
(6) When nitrification/denitrification is used, levels below 15 mg/l can be achieved.</td></tr>
</table>
</td><td></td></tr>
<tr><td colspan="2">Waste generation and management</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>14. In order to prevent or, where that is not practicable, to reduce waste generation, BAT is to adopt and implement a waste management plan that, in order of priority, ensures that waste is prepared for reuse, recycling, recovery or disposal.</td><td>Please refer to Section 8 for details. The site will implement measures to minimise wastes generated on site and ensure that the waste hierarchy is followed.</td></tr>
<tr><td>15. In order to reduce the amount of sludge to be treated or disposed of, BAT is to use one or a combination of the techniques given below.
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Sludge pre-treatment</td><td>Prior to final treatment (e.g. in a fluidised bed incinerator), the sludges are dewatered and/or de-oiled (by e.g. centrifugal decanters or steam dryers) to reduce their volume and to recover oil from slop equipment</td><td>Generally applicable</td></tr>
<tr><td>ii. Reuse of sludge in process units</td><td>Certain types of sludge (e.g. oily sludge) can be processed in units (e.g. coking) as part of the feed due to their oil content</td><td>Applicability is restricted to sludges that can fulfil the requirements to be processed in units with appropriate treatment</td></tr>
</table></td><td>Not applicable - as no sludge will be generated by the process.</td></tr>
<tr><td>16. In order to reduce the generation of spent solid catalyst waste, BAT is to use one or a combination of the techniques given below.
<table>
<tr><th>Technique</th><th>Description</th></tr>
<tr><td>i. Spent solid catalyst management</td><td>Scheduled and safe handling of the materials used as catalyst (e.g. by contractors) in order to recover or reuse them in off-site facilities. These operations depend on the type of catalyst and process</td></tr>
<tr><td>ii. Removal of catalyst from slurry decant oil</td><td>Decanted oil sludge from process units (e.g. FCC unit) can contain significant concentrations of catalyst fines. These fines need to be separated prior to the reuse of decant oil as a feedstock</td></tr>
</table></td><td>Not applicable – catalysts will not be used in the process.</td></tr>
<tr><td>Noise</td><td></td></tr>
<tr><td>17. In order to prevent or reduce noise, BAT is to use one or a combination of the techniques given below:
i. make an environmental noise assessment and formulate a noise management plan as appropriate to the local environment;</td><td>A Noise Impact Assessment has been completed as part of this environmental permit application, see Section 11.
All processing takes place within enclosed buildings. Particularly noisy equipment</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>ii. enclose noisy equipment/operation in a separate structure/unit;
iii. use embankments to screen the source of noise;
iv. use noise protection walls.</td><td>such as the raspers and shredders are enclosed in sound-proofed buildings.</td></tr>
<tr><td colspan="2">Emissions to Air</td></tr>
<tr><td>18. In order to prevent or reduce diffuse VOC emissions, BAT is to apply the techniques given below.
<table>
<tr><th>Techniques</th><th>Description</th><th>Applicability</th></tr>
<tr><td>I. Techniques related to plant design</td><td>i. limiting the number of potential emission sources
ii. maximising inherent process containment features
iii. selecting high integrity equipment
iv. facilitating monitoring and maintenance activities by ensuring access to potentially leaking components</td><td>Applicability may be limited for existing units</td></tr>
<tr><td>II. Techniques related to plant installation and commissioning</td><td>i. well-defined procedures for construction and assembly
ii. robust commissioning and hand-over procedures to ensure that the plant is installed in line with the design requirements</td><td>Applicability may be limited for existing units</td></tr>
<tr><td>III. Techniques related to plant operation</td><td>Use of a risk-based leak detection and repair (LDAR) programme in order to identify leaking components, and to repair these leaks. See Section 5.20.6</td><td>Generally applicable</td></tr>
</table>
</td><td>The plant design incorporates features designed to minimise fugitive VOC emissions.
A commissioning plan will be developed for the construction and commissioning phase to ensure that the plant is installed according to the design.
A risk-based leak detection and repair programme will be developed for the site.
Products that have an appreciable vapour pressure (such as the pyrolysis oil, naphtha and distillate) will be stored in fixed roof tanks under a nitrogen blanket with the nitrogen vented through activated carbon canisters as the tanks fill.
The atmosphere around the tanks will be monitored for VOC emissions as part of the safety system and action taken in the event of elevated levels.</td></tr>
<tr><td>34. In order to prevent or reduce NOX emissions to air from the combustion units, BAT is to use one or a combination of the techniques given below.
I. Primary or process-related techniques, such as:</td><td>Process combustion units will comprise of the pyrolsyer burner and low speed diesel generators only. The exhaust gases from these units will ultimately be fed to the RTO for treatment. The exhaust gases</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td colspan="3">i. Selection or treatment of fuel</td></tr>
<tr><td>(a) Use of gas to replace liquid fuel</td><td>Gas generally contains less nitrogen than liquid and its combustion leads to a lower level of NOX emissions. See Section 5.20.3</td><td>The applicability may be limited by the constraints associated with the availability of low sulphur gas fuels, which may be impacted by the energy policy of the Member State</td></tr>
<tr><td>(b) Use of low nitrogen refinery fuel oil (RFO) e.g. by RFO selection or by hydrotreatment of RFO</td><td>Refinery fuel oil selection favours low nitrogen liquid fuels among the possible sources to be used at the unit. Hydrotreatment aims at reducing the sulphur, nitrogen and metal contents of the fuel. See Section 5.20.3</td><td>Applicability is limited by the availability of low nitrogen liquid fuels, hydrogen production and hydrogen sulphide (H2S) treatment capacity (e.g. amine and Claus units)</td></tr>
<tr><td colspan="3">ii. Combustion modifications</td></tr>
<tr><td>(a) Staged combustion:
• air staging
• fuel staging</td><td>See Section 5.20.2</td><td>Fuel staging for mixed or liquid firing may require a specific burner design</td></tr>
<tr><td>(b) Optimisation of combustion</td><td>See Section 5.20.2</td><td>Generally applicable</td></tr>
<tr><td>(c) Flue-gas recirculation</td><td>See Section 5.20.2</td><td>Applicable through the use of specific burners with internal recirculation of the flue-gas. The applicability may be restricted to retrofitting external flue-gas recirculation to units with a forced/induced draught mode of operation</td></tr>
<tr><td>(d) Diluent injection</td><td>See Section 5.20.2</td><td>Generally applicable for gas turbines where appropriate inert diluents are available</td></tr>
</table>
</td><td>from the RTO are cooled and scrubbed before being emitted to atmosphere.
Combustion equipment will be selected to minimise NOx emissions.
Use of the RTO to treat the recirculated exhaust gases results in low NOx emissions (less than 100mg/m^3). After scrubbing, the NOx emissions are less than 10mg/m^3.</td></tr>
</table>

BAT Requirement	Specific Measure
(e) Use of low-NO_x burners (LNB) — See Section 5.20.2 — Generally applicable for new units taking into account the fuel-specific limitation (e.g. for heavy oil). For existing units, applicability may be restricted by the complexity caused by site-specific conditions e.g. furnaces design, surrounding devices. In very specific cases, substantial modifications may be required. The applicability may be restricted for furnaces in the delayed coking process, due to possible coke generation in the furnaces. In gas turbines, the applicability is restricted to low hydrogen content fuels (generally	

(e) Use of low-NO_x burners (LNB)	See Section 5.20.2	Generally applicable for new units taking into account the fuel-specific limitation (e.g. for heavy oil). For existing units, applicability may be restricted by the complexity caused by site-specific conditions e.g. furnaces design, surrounding devices. In very specific cases, substantial modifications may be required. The applicability may be restricted for furnaces in the delayed coking process, due to possible coke generation in the furnaces. In gas turbines, the applicability is restricted to low hydrogen content fuels (generally

II. Secondary or end-of-pipe techniques, such as:

Technique	Description	Applicability
i. Selective catalytic reduction	See Section 5.20.2	Generally applicable for new units. For existing units, the applicability may be constrained due to the requirements for significant space and optimal reactant injection
ii. Selective non-catalytic reduction (SNCR)	See Section 5.20.2	Generally applicable for new units. For existing units, the applicability may be constrained by the requirement for the temperature window and the residence time to be reached by reactant injection

BAT Requirement	Specific Measure

iii. Low temperature oxidation	See Section 5.20.2	The applicability may be limited by the need for additional scrubbing capacity and by the fact that ozone generation and the associated risk management need to be properly addressed. The applicability may be limited by the need for additional waste water treatment and related cross-media effects (e.g. nitrate emissions) and by an insufficient supply of liquid oxygen (for ozone generation). For existing units, the applicability of the technique may be limited by space availability
iv. SNO_x combined technique	See Section 5.20.4	Applicable only for high flue-gas (e.g. > 800 000 Nm3 /h) flow and when combined NOX and SOX abatement is needed

Table 5.10

BAT-associated emission levels for NOX emissions to air from a gas-fired combustion unit, with the exception of gas turbines

Parameter	**Type of combustion**	**BAT-AEL (monthly average)** mg/Nm^3
NO_x expressed as NO_2	Gas firing	30 – 150 for existing unit (1)
		30 – 100 for new unit
(1) For an existing unit using high air pre-heat (i.e. >200 °C) or with H2 content in the fuel gas higher than 50 %, the upper end of the BAT-AEL range is 200 mg/Nm3		

Table 5.11

BAT-associated emission levels for NOX emissions to air from a multi-fuel fired combustion unit with the exception of gas turbines

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>
<table>
<tr><th>Parameter</th><th>Type of combustion</th><th>BAT-AEL (monthly average) mg/Nm³</th></tr>
<tr><td>NO_x expressed as NO₂</td><td>Multi-fuel fired combustion unit</td><td>30 – 300 for existing unit (¹) (²)</td></tr>
<tr><td colspan="3">(¹) For existing units <100MW firing fuel oil with a nitrogen content higher than 0.5% (w/w) or with liquid firing >50 % or using air preheating, values up to 450 mg/Nm3may occur
(²) The lower end of the range can be achieved by using the SCR technique.</td></tr>
</table>
</td><td></td></tr>
<tr><td>
35. In order to prevent or reduce dust and metal emissions to air from the combustion units, BAT is to use one or a combination of the techniques given below.
I. Primary or process-related techniques, such as:
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i.</td><td colspan="3">Selection or treatment of fuel</td></tr>
<tr><td>(a)</td><td>Use of gas to replace liquid fuel</td><td>Gas instead of liquid combustion leads to lower level of dust emissions See Section 5.20.3</td><td>The applicability may be limited by the constraints associated with the availability of low sulphur fuels such as natural gas, which may be impacted by the energy policy of the Member State</td></tr>
<tr><td>(b)</td><td>Use of low sulphur refinery fuel oil (RFO) e.g. by RFO selection or by hydrotreatment of RFO</td><td>Refinery fuel oil selection favours low sulphur liquid fuels among the possible sources to be used at the unit. Hydrotreatment aims at reducing the sulphur, nitrogen and metal contents of the fuel. See Section 5.20.3</td><td>The applicability may be limited by the availability of low sulphur liquid fuels, hydrogen production and the hydrogen sulphide (H2S) treatment capacity (e.g. amine and Claus units)</td></tr>
<tr><td>ii.</td><td colspan="3">Combustion modifications</td></tr>
<tr><td>(a)</td><td>Optimisation of combustion</td><td>See Section 5.20.2</td><td>Generally applicable to all types of combustion</td></tr>
<tr><td>(b)</td><td>Atomisation of liquid fuel</td><td>Use of high pressure to reduce the droplet size of liquid fuel. Recent optimal burner designs generally include steam atomisation</td><td>Generally applicable to liquid fuel firing</td></tr>
</table>
</td><td>
Process combustion units will comprise of the pyrolsyer burner and low speed diesel generators only. The exhaust gases from these units will ultimately be fed to the RTO for treatment. The exhaust gases from the RTO are cooled and scrubbed before being emitted to atmosphere.

Fuel use is dictated by the design of the process, to use the fuel gas and distillate produced by the process.

Wet scrubbing is used to clean the gas before it is burned, as well as treat the exhaust gases from the RTO. This technique achieves a very high dust removal performance.
</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>
II. Secondary or end-of-pipe techniques, such as:
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Electrostatic precipitator (ESP)</td><td>See Section 5.20.1</td><td>For existing units, the applicability may be limited by space availability</td></tr>
<tr><td>ii. Third stage blowback filter</td><td>See Section 5.20.1</td><td>Generally applicable</td></tr>
<tr><td>iii. Wet Scrubbing</td><td>See Section 5.20.3</td><td>The applicability may be limited in arid areas and in the case where the by-products from treatment (including e.g. waste water with a high level of salt) cannot be reused or appropriately disposed of. For existing units, the applicability of the technique may be limited by space availability</td></tr>
<tr><td>iv. Centrifugal washer</td><td>See Section 5.20.1</td><td>Generally applicable</td></tr>
</table>
Table 5.12
BAT-associated emission levels for dust emissions to air from a multi-fuel fired combustion unit with the exception of gas turbines
<table>
<tr><th>Parameter</th><th>Type of combustion</th><th>BAT-AEL (monthly average) mgNM^3</th></tr>
<tr><td>Dust</td><td>Multi-fuel firing</td><td>5 – 50 for existing units (1) (2)</td></tr>
<tr><td></td><td></td><td>5 – 25 for new unit <50 MW</td></tr>
<tr><td colspan="3">(1) The lower end of the range is achievable for units with the use of end-of-pipe techniques.
(2) The upper end of the range refers to the use of a high percentage of oil burning and where only primary techniques are applicable</td></tr>
</table>
</td><td></td></tr>
<tr><td>36. In order to prevent or reduce SO_X emissions to air from the combustion units, BAT is to use one or a combination of the techniques given below:
I. Primary or process-related techniques based on a selection or a treatment of the fuel, such as:</td><td>Process combustion units will comprise of the pyrolsyer burner and low speed diesel generators only. The exhaust gases from these units will ultimately be fed to the RTO for treatment. The exhaust gases</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>
<table>
<tr><th>Technique</th><th></th><th>Description</th><th>Applicability</th></tr>
<tr><td>i.</td><td>Use of gas to replace liquid fuel</td><td>See Section 5.20.3</td><td>The applicability may be limited by the constraints associated with the availability of low sulphur fuels such as natural gas, which may be impacted by the energy policy of the Member State</td></tr>
<tr><td>ii.</td><td>Treatment of refinery fuel gas (RFG)</td><td>Residual H2S concentration in RFG depends on the treatment process parameter, e.g. the amine-scrubbing pressure. See Section 5.20.3</td><td>For low calorific gas containing carbonyl sulphide (COS) e.g. from coking units, a converter may be required prior to H2S removal</td></tr>
<tr><td>iii.</td><td>Use of low sulphur refinery fuel oil (RFO) e.g. by RFO selection or by hydrotreatment of RFO</td><td>Refinery fuel oil selection favours low sulphur liquid fuels among the possible sources to be used at the unit. Hydrotreatment aims at reducing the sulphur, nitrogen and metal contents of the fuel. See Section 5.20.3</td><td>The applicability is limited by the availability of low sulphur liquid fuels, hydrogen production and the hydrogen sulphide (H2S) treatment capacity (e.g. amine and Claus units)</td></tr>
</table>
II. Secondary or end-of-pipe techniques:
<table>
<tr><th>Techniques</th><th></th><th>Description</th><th>Applicability</th></tr>
<tr><td>i.</td><td>Non-regenerative scrubbing</td><td>Wet scrubbing or seawater scrubbing. See Section 5.20.3</td><td>The applicability may be limited in arid areas and in the case where the by-products from treatment (including e.g. waste water with high level of salts) cannot be reused or appropriately disposed of. For existing units, the applicability of the technique may be limited by space availability</td></tr>
</table>
</td><td>
from the RTO are cooled and scrubbed before being emitted to atmosphere.
The pyrolyser gas is scrubbed to remove sulphur and halogen compounds before use a fuel in the process.
The exhaust gas from diesel generators contains significant amounts of sulphur. However, this is treated following combustion in the RTO by wet scrubbing. Emissions of SO_2 are less than 10mg/m^3.
</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>
<table>
<tr><td>ii.</td><td>Regenerative scrubbing</td><td>Use of a specific SOX absorbing reagent (e.g. absorbing solution) which generally enables the recovery of sulphur as a by-product during a regenerating cycle where the reagent is reused. See Section 5.20.3</td><td>The applicability is limited to the case where regenerated by-products can be sold. Retrofitting to existing units may be limited by the existing sulphur recovery capacity. For existing units, the applicability of the technique may be limited by space availability</td></tr>
<tr><td>iii.</td><td>SNO$_x$ combined technique</td><td>See Section 5.20.4</td><td>Applicable only for high flue-gas (e.g. >800 000 Nm3 /h) flow and when combined NOX and SOX abatement is required</td></tr>
</table>

Table 5.13

BAT-associated emission levels for SO2 to air from a combustion unit firing refinery fuel gas (RFG), with the exception of gas turbines

<table>
<tr><td>Parameter</td><td>BAT-AEL (monthly average) mg/Nm^3</td></tr>
<tr><td>SO_2</td><td>5 – 35 (¹)</td></tr>
<tr><td colspan="2">(¹) In the specific configuration of RFG treatment with a low scrubber operative pressure and with a refinery fuel gas with an H/C molar ratio above 5, the upper end of the BAT-AEL range can be as high as 45 mg/Nm3.</td></tr>
</table>

Table 5.14

BAT-associated emission levels for SO2 emissions to air from multi-fuel fired combustion units, with the exception of gas turbines and stationary gas engines

<table>
<tr><th>Parameter</th><th>BAT-AEL (monthly average) mg/Nm^3</th></tr>
<tr><td>SO_2</td><td>35 – 600</td></tr>
</table>
</td><td></td></tr>
<tr><td>37. In order to reduce carbon monoxide (CO) emissions to air from the combustion units, BAT is to use a combustion operation control.

Table 5.15

BAT-associated emission levels for carbon monoxide emissions to air from a combustion unit
</td><td>Process combustion units will comprise the pyrolsyer burner and low speed diesel generators only. The exhaust gases from these units will ultimately be fed to the RTO for treatment. The exhaust gases from the RTO are cooled and scrubbed before being emitted to atmosphere.</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td><table><tr><th>Parameter</th><th>BAT-AEL (monthly average)
mg/Nm^3</th></tr><tr><td>Carbon monoxide, expressed as CO</td><td>≤100</td></tr></table></td><td>Emissions of CO from the RTO exhaust are expected to be approximately 10mg/m^3.</td></tr>
<tr><td>44. In order to prevent or reduce waste water flow generation from the distillation process, BAT is to use liquid ring vacuum pumps or surface condensers.</td><td>The distillation system consists of three towers. The first operates at slightly above atmospheric pressure (nominally atmospheric), the second operates under vacuum and has a surface condenser (which condenses the bulk of the hydrocarbons for reflux), followed by a mechanical vacuum pump - so does not create waste water. It should be noted that the feed to the vacuum tower has very little light material (as the light material was removed in the first tower). The third tower is a naphtha stripper that also works at approximately atmospheric pressure and which uses nitrogen to strip light materials. The two atmospheric pressure towers ultimately discharge their uncondensed lights to the fuel gas system.</td></tr>
<tr><td>45. In order to prevent or reduce water pollution from the distillation process, BAT is to route sour water to the stripping unit.</td><td>Water from the distillation process will be sent to the blowdown treatment system.</td></tr>
<tr><td>46. In order to prevent or reduce emissions to air from distillation units, BAT is to ensure the appropriate treatment of process off-gases, especially incondensable off-gases, by acid gas removal prior to further use.</td><td>Emissions to air from the distillation units will be condensed and subcooled in the light distillate condenser and returned to the column as reflux.</td></tr>
<tr><td>47. In order to reduce emissions to air from the products treatment process, BAT is to ensure the appropriate disposal of off-gases, especially odorous spent air from sweetening units, by routing them to destruction, e.g. by incineration.</td><td>All process off-gases will be routed to the RTO for destruction.</td></tr>
<tr><td>48. In order to reduce waste and waste water generation when a products treatment process using caustic is in place, BAT is to use cascading caustic solution and a global management of spent caustic, including recycling after appropriate treatment, e.g. by stripping.</td><td>A cascading caustic solution will be utilised in the blowdown treatment stage. Wastes will be sent for off-site treatment.</td></tr>
<tr><td>49. In order to reduce VOC emissions to air from the storage of volatile liquid hydrocarbon compounds, BAT is to use floating roof storage tanks equipped with high efficiency seals or a fixed roof tank connected to a vapour recovery system.</td><td>Product storage tanks will have fixed roofs with a nitrogen blanket carbon filters on the vents.</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>50. In order to reduce VOC emissions to air from the storage of volatile liquid hydrocarbon compounds, BAT is to use one or a combination of the techniques given below.
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Manual crude oil tank cleaning</td><td>Oil tank cleaning is performed by workers entering the tank and removing sludge manually</td><td>Generally applicable</td></tr>
<tr><td>ii. Use of closed-loop system</td><td>For internal inspections, tanks have to be periodically emptied, cleaned and rendered gas-free. This cleaning includes dissolving the tank bottom. Closed-loop systems that can be combined with end-of-pipe mobile abatement techniques prevent or reduce VOC emissions</td><td>The applicability may be limited by e.g. the type of residues, tank roof construction or tank materials</td></tr>
</table></td><td>The tanks will be subject to manual cleaning</td></tr>
<tr><td>51. In order to prevent or reduce emissions to soil and groundwater from the storage of liquid hydrocarbon compounds, BAT is to use one or a combination of the techniques given below.
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Maintenance programme including corrosion monitoring, prevention and control</td><td>A management system including leak detection and operational controls to prevent overfilling, inventory control and risk-based inspection procedures on tanks at intervals to prove their integrity, and maintenance to improve tank containment. It also includes a system response to spill consequences to act before spills can reach the groundwater. To be especially reinforced during maintenance periods</td><td>Generally applicable</td></tr>
</table></td><td>Bunds and or double skinned walls will be provided for all tanks containing liquids whose spillage could be harmful to the environment. Containment bunds or double skinned walls will be provided to make sure that any leaks/spillages will be contained in the event of a leak of the primary containment. The containment measures will be:

capable of containing at least 110% of the volume of the largest tank within the bund;
constructed of materials which are impermeable and resistant to the stored materials in accordance with relevant material safety data sheets (MSDS);
constructed to the appropriate British Standard and Health and Safety Executive (HSE) guidance;
</td></tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr>
<td>
<table>
<tr><td>ii.</td><td>Double bottomed tanks</td><td>A second impervious bottom that provides a measure of protection against releases from the first material</td><td>Generally applicable for new tanks and after overhaul of existing tanks (1)</td></tr>
<tr><td>iii.</td><td>Impervious membrane liners</td><td>A continuous leak barrier under the entire bottom surface of the tank</td><td>Generally applicable for new tanks and after an overhaul of existing tanks (1)</td></tr>
<tr><td>iv.</td><td>Sufficient tank farm bund containment</td><td>A tank farm bund is designed to contain large spills potentially caused by a shell rupture or overfilling (for both environmental and safety reasons). Size and associated building rules are generally defined by local regulations</td><td>Generally applicable</td></tr>
<tr><td colspan="4">(1) Techniques ii and iii may not be generally applicable where tanks are dedicated to products that require heat for liquid handling (e.g. bitumen), and where no leak is likely because of solidification.</td></tr>
</table>
</td>
<td>

of a type suitable for the containment of the materials in the event of leak or spill;
pipework will be routed within bunded areas so that no penetration of walls or base of the bund takes place; and
connection points will be located within the bund.

</td>
</tr>
<tr>
<td>
52. In order to prevent or reduce VOC emissions to air from loading and unloading operations of volatile liquid hydrocarbon compounds, BAT is to use one or a combination of the techniques given below to achieve a recovery rate of at least 95 %.
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability (1)</th></tr>
<tr><td>Vapour recovery by:
i. Condensation
ii. Absorption
iii. Adsorption
iv. Membrane separation
v. Hybrid systems</td><td>See Section 5.20.6</td><td>Generally applicable to loading/unloading operations where annual throughput is >5 000 m3 /yr. Not applicable to loading/unloading operations for sea-going vessels with an annual throughput</td></tr>
<tr><td colspan="3">(1) A vapour destruction unit (e.g. by incineration) may be substituted for a vapour recovery unit, if vapour recovery is unsafe or technically impossible because of the volume of return vapour.</td></tr>
</table>
Table 5.16
BAT-associated emission levels for non-methane VOC and benzene emissions to air from loading and unloading operations of volatile liquid hydrocarbon compounds
</td>
<td>
The vents from the fuel loading systems are fitted with carbon filters to minimise the release of VOCs.

Vapour will be re-routed back to the product tanks where it will be re-absorbed into the products.

It is anticipated that this measure will achieve the required BAT-AELs. This will be confirmed during detailed design and if necessary a difference type of vapour recovery will be employed.
</td>
</tr>
</table>

<table>
<tr><th>BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>
<table>
<tr><th>Parameter</th><th>BAT-AEL (hourly average) (1)</th></tr>
<tr><td>NMVOC</td><td>0.15 – 10 g/NM^3 (2)(3)</td></tr>
<tr><td>Benzene (3)</td><td><1 mg/Nm^3</td></tr>
<tr><td colspan="2">(1) Hourly values in continuous operation expressed and measured according to European Parliament and Council Directive 94/63/EC (OJ L 365, 31.12.1994, p. 24).
(2) Lower value achievable with two-stage hybrid systems. Upper value achievable with single-stage adsorption or membrane system.
(3) Benzene monitoring may not be necessary where emissions of NMVOC are at the lower end of the range.</td></tr>
</table>
</td><td></td></tr>
<tr><td>54. In order to reduce sulphur emissions to air from off-gases containing hydrogen sulphides (H2S), BAT is to use all of the techniques given below.
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability (1)</th></tr>
<tr><td>i. Acid gas removal e.g. by amine treating</td><td>See Section 5.20.3</td><td>Generally applicable</td></tr>
<tr><td>ii. Sulphur recovery units (SRU), e.g. by Claus process</td><td>See Section 5.20.3</td><td>Generally applicable</td></tr>
<tr><td>iii. Tail gas treatment unit (TGTU)</td><td>See Section 5.20.3</td><td>For retrofitting existing SRU, the applicability may be limited by the SRU size and configuration of the units and the type of sulphur recovery process already in place</td></tr>
<tr><td colspan="3">(1) May not be applicable for stand-alone lubricant or bitumen refineries with a release of sulphur compounds of less than 1 t/d</td></tr>
</table>
</td><td>All process off-gases will be treated in the RTO, exhaust gas quench and scrubber and blow down treatment processes.
The raw pyrolysis gas is scrubbed before combustion to remove sulphur compounds.</td></tr>
<tr><td>55. In order to prevent emissions to air from flares, BAT is to use flaring only for safety reasons or for non-routine operational conditions (e.g. start-ups, shutdown).</td><td>The flare will only be used for safety reasons or for non-routine operational conditions.</td></tr>
<tr><td>56. In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use the techniques given below.
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Correct plant design</td><td>See Section 5.20.7</td><td>Applicable to new units. Flare gas recovery system may be retrofitted in existing units</td></tr>
<tr><td>ii. Plant management</td><td>See Section 5.20.7</td><td>Generally applicable</td></tr>
</table>
</td><td>The flare unit to be installed will be of the correct design and size for the site.</td></tr>
</table>

<table>
<tr><th colspan="3">BAT Requirement</th><th>Specific Measure</th></tr>
<tr><td>iii. Correct flaring devices design</td><td>See Section 5.20.7</td><td>Applicable to new units</td><td rowspan="2"></td></tr>
<tr><td>iv. Monitoring and reporting</td><td>See Section 5.20.7</td><td>Generally applicable</td></tr>
</table>

5.2 BAT for Abatement Options

In accordance with the EA's enhanced pre-application advice, an assessment has been carried out of the costs and benefits of abatement techniques suitable for the removal of contaminants from the combustion of the fuel gas burned at the facility. The full assessment is provided in Appendix 01 and a summary and conclusion of the assessment is provided below.

The assessment considers both costs and environmental benefits to demonstrate why the method chosen is considered to be the most appropriate. The review was carried out In accordance with the methodology set out in the H1 guidance and included, where relevant, the following aspects:

- scope of available abatement options;
- scope of emissions and impacts;
- environmental impacts;
- costs; and
- selection of the Best Available Technique.

However, there is currently very little published information on the performance of abatement techniques and costs specific to the pyrolysis of tyres. Therefore, in line with the pre-application advice received from the EA the assessment was based on information sourced from:

- EA Guidance 'EA – Industrial Waste Management – Establishing a methodology that support the assessment of the impact of ATT processes' Ref ED13600100, Issue No1, 31st March 2021; and
- the techniques described in the Mineral Oil and Gas Refining Bref.

For some aspects of the methodology a qualitative assessment was used based on relative ranking because of the lack of data available.

The key pollutants requiring control in the exhaust gases following combustion of fuel gas from tyre pyrolysis include:

- Acid Gases: SO_2, HCl and HBr;
- Nitrogen dioxide; and
- Tar & particulate.

An assessment of options for acid gas abatement concluded that all options assessed would achieve the high degree of performance to meet the required mandatory standards and BAT-AELs. The main difference in environmental performance and cost-effectiveness between the options relates to the amount of residues and their disposal costs as well as energy use. However, on the basis that wet scrubbing performs best in more environmental categories than dry or semi-dry scrubbing it is considered that this represents BAT for the proposed Wastefront facility.

Given that the NOx concentrations in the exit gas from the wet scrubber would be very low, it was considered that the benefits of any further abatement would be extremely marginal, and the costs would be hugely disproportionate. Therefore, an appraisal of NOx abatement options was not considered necessary.

Tar and particulates are removed from the raw pyrolyser gas to very low levels by a wet scrubbing process prior to combustion of the gas. For this reason, it was not considered necessary to assess any additional abatement options.

5.3 BAT for Pyrolysis Options

In accordance with the EA's enhanced pre-application advice, an appraisal of alternative types of pyrolyser has been made to determine whether the proposals represent Best Available Techniques.

5.3.1 Design Requirements

The thermal conversion process which is needed in order to produce the desired carbon black and liquid hydrocarbon feedstocks from used tyres is pyrolysis, which takes place with the complete absence of oxygen. The use of gasification or combustion processes will not achieve this outcome and therefore are not considered as part of this assessment of alternative options. The ATT guidance identifies that the predominant technology for thermal conversion of tyres is pyrolysis.

Pyrolysis processes generate three main products: syngas, liquid oils and solid char. The design and operating parameters of the pyrolysis process influence the relative quantities of these three phases and are selected to maximise the quantities of the desired product. In the case of the Sunderland UTR Facility, the technology selected must be able to maximise the quantities of char (for carbon black production) and liquid phases (for production of hydrocarbon feedstocks). These are prioritised over the production of syngas.

To maximise char production, it is desirable to have a slow heating rate, low temperature and long residence time. To maximise liquid production, it is desirable to have a high heating rate, moderate temperature and short residence time. Therefore, an optimum balance between these parameters must be taken to maximise the quantities of char and liquid phases.

Three general pyrolysis methods are identified in the ATT guidance: conventional, fast and flash pyrolysis. Of these three, only the conventional method is appropriate for the desired tyre conversion process as the residence time for fast and flash pyrolysis is too short to maximise the quantity of char production.

Therefore, the assessment of suitable pyrolysis reactors is based on conventional technology which are appropriate for the maximisation of solid and liquid phases.

<u>Pyrolysis Reactors</u>

According to the ATT guidance, the most common pyrolysis reactor types are:

- Batch reactors;
- Rotary reactors; or
- Auger reactors.

A summary of the technical advantages and disadvantages is provided below.

Reactor Type	Advantages	Disadvantages
Batch (fixed bed)	Creates consistent liquid composition	Small volume, so multiple units may be needed

Rotary	Good mixing & volatilisation, ability to alter residence time	
Auger	Uniform and controllable heat transfer Suitable for fast and slow pyrolysis Simpler design, operation and maintenance	Limited size, so multiple units may be needed Higher vapour residence time Plugging and mechanical wear and tear risk Special requirements may be needed to achieve the desired mixing behaviour
Fluid bed	Simple, good temperature control, efficient mixing	Small particle size needed (less than 2 – 3mm) Char is entrained and requires particle collection units

The ATT guidance does not provide any information on the relative environmental performance of these three reactor types. Whilst all types may be suitable for the pyrolysis of tyres, Wastefront has selected an augur-based pyrolyser system from Niutech, based on the existing proven technology and operational experience of the system in other countries.

6.0 IED Chapter IV & Annex VI Requirements

Fuel gas produced by the pyrolysers and distillation process is used solely for provision of process heating on site. This is common practice for refinery processes. In the case of fuel gas produced from the conversion of waste, the EA require that the waste incineration requirements of the IED are applied to the combustion of the gas. This is because the gas does not meet end-of-waste (using natural gas as a comparator) or emissions equivalent to the combustion of natural gas. Accordingly, the following sections summarise how the proposed facility will comply with the Chapter IV and Annex VI requirements.

6.1 Compliance with Chapter IV Requirements

IED Reference	Compliance measures
Article 44 - Applications for permits	
An application for a permit for a waste incineration plant or waste co-incineration plant shall include a description of the measures which are envisaged to guarantee that the following requirements are met:	
(a) the plant is designed, equipped and will be maintained and operated in such a manner that the requirements of this Chapter are met taking into account the	The site will be operated in accordance with an Environmental Management System and the operating techniques described in this BAT-OT document to ensure the relevant requirements are met.

IED Reference	Compliance measures
categories of waste to be incinerated or co-incinerated;	
(b) the heat generated during the incineration and co-incineration process is recovered as far as practicable through the generation of heat, steam or power;	The main purpose of the facility is the recovery of carbon black and hydrocarbon feedstocks from waste as 'target products'. It is not an energy from waste process. However, energy from the non-target products (fuel gas and distillate) is recovered for the provision of heat and power for the process.
(c) the residues will be minimised in their amount and harmfulness and recycled where appropriate;	The hydrocarbon and steel components of the tyres are fully recovered as target products or for energy generation to meet on-site demand. Dust from tyre shredding, and from char milling, is recycled into the process. Abatement residues are minimised by use of we scrubbers which require less reagent and use of recirculating systems and water recycling to minimise residues for disposal.
(d) the disposal of the residues which cannot be prevented, reduced or recycled will be carried out in conformity with national and Union law.	All residues transferred off site will be sent to appropriately regulated facilities for treatment, recovery or disposal.
Article 45 – Permit conditions	
The permit shall include the following: (a) a list of all types of waste which may be treated using at least the types of waste set out in the European Waste List established by Decision 2000/532/EC, if possible, and containing information on the quantity of each type of waste, where appropriate;	The permit includes a list of wastes by EWC code.
(b) the total waste incinerating or co-incinerating capacity of the plant;	The total capacity is 77,000 tpa.
(c) the limit values for emissions into air and water;	The limit values are proposed as those in Annex VI.

IED Reference	Compliance measures
(d) the requirements for the pH, temperature and flow of waste water discharges;	There are no releases of waste water proposed.
(e) the sampling and measurement procedures and frequencies to be used to comply with the conditions set for emission monitoring;	These will be as specified in the issued environmental permit
(f) the maximum permissible period of any technically unavoidable stoppages, disturbances, or failures of the purification devices or the measurement devices, during which the emissions into the air and the discharges of waste water may exceed the prescribed emission limit values.	These will be as specified in the issued environmental permit.
Article 46 – Control of emissions	
1. Waste gases from waste incineration plants and waste co-incineration plants shall be discharged in a controlled way by means of a stack the height of which is calculated in such a way as to safeguard human health and the environment.	An Air Emissions Risk Assessment has been carried out for the proposed activity, including dispersion modelling and impact assessment. This confirms that the emissions will safeguard human health and the environment.
2. Emissions into air from waste incineration plants and waste co-incineration plants shall not exceed the emission limit values set out in parts 3 and 4 of Annex VI or determined in accordance with Part 4 of that Annex.	The emissions will not exceed the limits in Annex VI.
3. Discharges to the aquatic environment of waste water resulting from the cleaning of waste gases shall be limited as far as practicable and the concentrations of polluting substances shall not exceed the emission limit values set out in Part 5 of Annex VI.	The facility will not release any process effluent directly to surface water.
4. The emission limit values shall apply at the point where waste waters from the cleaning of waste gases are discharged from the waste incineration plant or waste co-incineration plant.	The liquid residue from the wet scrubber is not comingled with other blowdown streams (such as cooling tower blowdown) which are tankered off for treatment.

IED Reference	Compliance measures
When waste waters from the cleaning of waste gases are treated outside the waste incineration plant or waste co-incineration plant at a treatment plant intended only for the treatment of this sort of waste water, the emission limit values set out in Part 5 of Annex VI shall be applied at the point where the waste waters leave the treatment plant. Where the waste water from the cleaning of waste gases is treated collectively with other sources of waste water, either on site or off site, the operator shall make the appropriate mass balance calculations, using the results of the measurements set out in point 2 of Part 6 of Annex VI in order to determine the emission levels in the final waste water discharge that can be attributed to the waste water arising from the cleaning of waste gases. Under no circumstances shall dilution of waste water take place for the purpose of complying with the emission limit values set out in Part 5 of Annex VI.	Instead the liquor is concentrated to reduce the volume and the concentrated residue will be taken offsite by a waste management company for treatment to recover the caustic value and convert the sodium sulphite (and the small amount of sulphide) to gypsum by lime treatment with oxidation.
5. Waste incineration plant sites and waste co-incineration plant sites, including associated storage areas for waste, shall be designed and operated in such a way as to prevent the unauthorised and accidental release of any polluting substances into soil, surface water and groundwater. Storage capacity shall be provided for contaminated rainwater run-off from the waste incineration plant site or waste co-incineration plant site or for contaminated water arising 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.	The site benefits from impermeable surfacing, sealed drainage and separate system for containment of contaminated water arising from spillage or fire fighting operations.

IED Reference	Compliance measures
6. Without prejudice to Article 50(4)(c), the waste incineration plant or waste co-incineration plant or individual furnaces being part of a waste incineration plant or waste co-incineration plant shall under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limit values are exceeded. The cumulative duration of operation in such conditions over 1 year shall not exceed 60 hours. The time limit set out in the second subparagraph shall apply to those furnaces which are linked to one single waste gas cleaning device.	The requirement will be set out in the permit.
Article 47 - Breakdown	
In the case of a breakdown, the operator shall reduce or close down operations as soon as practicable until normal operations can be restored.	The operations will comply with this requirement.
Article 48 – Monitoring of emissions	
1. Member States shall ensure that the monitoring of emissions is carried out in accordance with Parts 6 and 7 of Annex VI.	Monitoring will be carried out in accordance with Annex VI.
2. The installation and functioning of the automated measuring systems shall be subject to control and to annual surveillance tests as set out in point 1 of Part 6 of Annex VI.	This will be carried out in accordance with Annex VI.
3. The competent authority shall determine the location of the sampling or measurement points to be used for monitoring of emissions	This will be confirmed in discussion with the EA.

IED Reference	Compliance measures
4. All monitoring results shall be recorded, processed and presented in such a way as to enable the competent authority to verify compliance with the operating conditions and emission limit values which are included in the permit.	This will be carried out in accordance with the issued environmental permit requirements.
Article 49 – Compliance with emission limit values	
The emission limit values for air and water shall be regarded as being complied with if the conditions described in Part 8 of Annex VI are fulfilled.	The site will be operated in accordance with the Annex VI requirements.
Article 50 – Operating conditions	
1. Waste incineration plants shall be operated in such a way as to achieve a level of incineration such that the total organic carbon content of slag and bottom ashes is less than 3 % or their loss on ignition is less than 5 % of the dry weight of the material. If necessary, waste pre-treatment techniques shall be used.	This is not applicable to the proposed process as it does not produce slags and ashes.
2. Waste incineration plants shall be 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 at least 850 °C for at least two seconds. Waste co-incineration plants shall be designed, equipped, built and operated in such a way that the gas resulting from the co-incineration of waste is raised in a controlled and homogeneous fashion and even under the most unfavourable conditions, to a temperature of at least 850 °C for at least two seconds. If hazardous waste with a content of more than 1 % of halogenated organic substances, expressed as chlorine, is incinerated or co-incinerated, the	The RTO will be designed to comply with this requirement. No hazardous waste will be burned.

IED Reference	Compliance measures
temperature required to comply with the first and second subparagraphs shall be at least 1 100 °C. In waste incineration plants, the temperatures set out in the first and third subparagraphs shall be measured near the inner wall of the combustion chamber. The competent authority may authorise the measurements at another representative point of the combustion chamber.	
3. Each combustion chamber of a waste incineration plant shall be equipped with at least one auxiliary burner. This burner shall be switched on automatically when the temperature of the combustion gases after the last injection of combustion air falls below the temperatures set out in paragraph 2. It shall also be used during plant start-up and shut-down operations in order to ensure that those temperatures are maintained at all times during these operations and as long as unburned waste is in the combustion chamber. The auxiliary burner shall not be fed with fuels which can cause higher emissions than those resulting from the burning of gas oil as defined in Article 2(2) of Council Directive 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels (36), liquefied gas or natural gas.	A natural gas duct burner is located upstream of the gas feed pre-heater/cooler for use during start-up and shutdown as well as combustion trim.

IED Reference	Compliance measures
4. Waste incineration plants and waste co-incineration plants shall operate an automatic system to prevent waste feed in the following situations: (a) at start-up, until the temperature set out in paragraph 2 of this Article or the temperature specified in accordance with Article 51(1) has been reached; (b) whenever the temperature set out in paragraph 2 of this Article or the temperature specified in accordance with Article 51(1) is not maintained; (c) whenever the continuous measurements show that any emission limit value is exceeded due to disturbances or failures of the waste gas cleaning devices.	The plant will be operated in compliance with these requirements.
5. Any heat generated by waste incineration plants or waste co-incineration plants shall be recovered as far as practicable.	Heat from the combustion of fuel gas is recovered within the process.
6. Infectious clinical waste shall be placed straight in the furnace, without first being mixed with other categories of waste and without direct handling.	Not applicable to the UTR facility.
7. Member States shall ensure that the waste incineration plant or waste co-incineration plant is operated and controlled by a natural person who is competent to manage the plant.	The permit application specifies the competent person.
Article 51 – Authorisation to change operating conditions	
1. Conditions different from those laid down in Article 50(1), (2) and (3) and, as regards the temperature, paragraph 4 of that Article and specified in the permit for certain categories of waste or for certain thermal processes, may be authorised by the competent authority provided the other requirements of this Chapter are met. Member States may lay down rules governing these authorisations.	N/A

IED Reference	Compliance measures
2. For waste incineration plants, the change of the operating conditions shall not cause more residues or residues with a higher content of organic polluting substances compared to those residues which could be expected under the conditions laid down in Article 50(1), (2) and (3).	N/A
3. Emissions of total organic carbon and carbon monoxide from waste co-incineration plants, authorised to change operating conditions according to paragraph 1 shall also comply with the emission limit values set out in Part 3 of Annex VI.	The operations will comply with this requirement.

6.2 Compliance with Annex VI Requirements

IED Reference	Compliance measures
Part 3 – Air emission limit values for waste incineration plants	
1. All emission limit values shall be calculated at a temperature of 273,15 K, a pressure of 101,3 kPa and after correcting for the water vapour content of the waste gases. They are standardised at 11 % oxygen in waste gas except in case of incineration of mineral waste oil as defined in point 3 of Article 3 of Directive 2008/98/EC, when they are standardised at 3 % oxygen, and in the cases referred to in Point 2.7 of Part 6.	The operations will comply with the required emission limit values specified, with the exception of 1.3 metals. It is considered appropriate to request the regulator to apply the reduced monitoring approach set out in section 2.6.

IED Reference	Compliance measures
1.1. Daily average emission limit values for the following polluting substances (mg/Nm^3);	

Total dust	10
Gaseous and vaporous organic substances, expressed as total organic carbon (TOC)	10
Hydrogen chloride (HCl)	10
Hydrogen fluoride (HF)	1
Sulphur dioxide (SO_2)	50
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2), expressed as NO_2 for existing waste incineration plants with a nominal capacity exceeding 6 tonnes per hour or new waste incineration plants	200
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2), expressed as NO_2 for existing waste incineration plants with a nominal capacity of 6 tonnes per hour or less	400

1.2. Half-hourly average emission limit values for the following polluting substances (mg/Nm^3)

	(100%) A	(97%) B
Total dust	30	10
Gaseous and vaporous organic substances, expressed as total organic carbon (TOC)	20	10
Hydrogen chloride (HCl)	60	10
Hydrogen fluoride (HF)	4	2
Sulphur dioxide (SO_2)	200	50
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2), expressed as NO_2 for existing waste incineration plants with a nominal capacity exceeding 6 tonnes per hour or new waste incineration plants	400	200

<table>
<tr><th>IED Reference</th><th>Compliance measures</th></tr>
<tr><td>1.3. Average emission limit values (mg/Nm³) for the following heavy metals over a sampling period of a minimum of 30 minutes and a maximum of 8 hours
<table>
<tr><td>Cadmium and its compounds, expressed as cadmium (Cd)</td><td rowspan="2">Total: 0,05</td></tr>
<tr><td>Thallium and its compounds, expressed as thallium (Tl)</td></tr>
<tr><td>Mercury and its compounds, expressed as mercury (Hg)</td><td>0,05</td></tr>
<tr><td>Antimony and its compounds, expressed as antimony (Sb)</td><td rowspan="9">Total: 0,5</td></tr>
<tr><td>Arsenic and its compounds, expressed as arsenic (As)</td></tr>
<tr><td>Lead and its compounds, expressed as lead (Pb)</td></tr>
<tr><td>Chromium and its compounds, expressed as chromium (Cr)</td></tr>
<tr><td>Cobalt and its compounds, expressed as cobalt (Co)</td></tr>
<tr><td>Copper and its compounds, expressed as copper (Cu)</td></tr>
<tr><td>Manganese and its compounds, expressed as manganese (Mn)</td></tr>
<tr><td>Nickel and its compounds, expressed as nickel (Ni)</td></tr>
<tr><td>Vanadium and its compounds, expressed as vanadium (V)</td></tr>
</table>
These average values cover also the gaseous and the vapour forms of the relevant heavy metal emissions as well as their compounds.</td><td></td></tr>
<tr><td>1.4. Average emission limit value (ng/Nm³) for dioxins and furans over a sampling period of a minimum of 6 hours and a maximum of 8 hours. The emission limit value refers to the total concentration of dioxins and furans calculated in accordance with Part 2.
<table>
<tr><td>Dioxins and furans</td><td>0,1</td></tr>
</table></td><td></td></tr>
<tr><td>1.5. Emission limit values (mg/Nm³) for carbon monoxide (CO) in the waste gases:
(a) 50 as daily average value;</td><td></td></tr>
</table>

IED Reference	Compliance measures
(b) 100 as half-hourly average value; (c) 150 as 10-minute average value. The competent authority may authorise exemptions from the emission limit values set out in this point for waste incineration plants using fluidised bed technology, provided that the permit sets an emission limit value for carbon monoxide (CO) of not more than 100 mg/Nm^3 as an hourly average value.	
2. Emission limit values applicable in the circumstances described in Article 46(6) and Article 47. The total dust concentration in the emissions into the air of a waste incineration plant shall under no circumstances exceed 150 mg/Nm^3 expressed as a half-hourly average. The air emission limit values for TOC and CO set out in points 1.2 and 1.5(b) shall not be exceeded	
Part 5 – Emission limit values for discharges of waste water from the cleaning of waste gases	

<table>
<tr><th>IED Reference</th><th>Compliance measures</th></tr>
<tr><td>
<table>
<tr><td>Polluting substances</td><td colspan="2">Emission limit values for unfiltered samples (mg/l except for dioxins and furans)</td></tr>
<tr><td rowspan="2">1. Total suspended solids as defined in Annex I of Directive 91/271/EEC</td><td>(95%)</td><td>(100%)</td></tr>
<tr><td>30</td><td>45</td></tr>
<tr><td>2. Mercury and its compounds, expressed as mercury (Hg)</td><td colspan="2">0,03</td></tr>
<tr><td>3. Cadmium and its compounds, expressed as cadmium (Cd)</td><td colspan="2">0,05</td></tr>
<tr><td>4. Thallium and its compounds, expressed as thallium (Tl)</td><td colspan="2">0,05</td></tr>
<tr><td>5. Arsenic and its compounds, expressed as arsenic (As)</td><td colspan="2">0,15</td></tr>
<tr><td>6. Lead and its compounds, expressed as lead (Pb)</td><td colspan="2">0,2</td></tr>
<tr><td>7. Chromium and its compounds, expressed as chromium (Cr)</td><td colspan="2">0,5</td></tr>
<tr><td>8. Copper and its compounds, expressed as copper (Cu)</td><td colspan="2">0,5</td></tr>
<tr><td>9. Nickel and its compounds, expressed as nickel (Ni)</td><td colspan="2">0,5</td></tr>
<tr><td>10. Zinc and its compounds, expressed as zinc (Zn)</td><td colspan="2">1,5</td></tr>
<tr><td>11. Dioxins and furans</td><td colspan="2">0,3 ng/l</td></tr>
</table>
</td><td>The flue gas from the RTO is scrubbed with caustic solution to dissolve acid gases (SO2 mainly). The liquor which contains $NaSO_3$ is concentrated to reduce the volume. The material is not discharged directly to sewer/surface water but will be taken offsite by a waste management company for treatment to recover the caustic value and convert the sodium sulphite (and the small amount of sulphide) to gypsum by lime treatment with oxidation. The other components in the liquor come from capturing NOx and will remain in solution.
The specific residue from the wet scrubber is not comingled with other blowdown streams (such as cooling tower blowdown) which are tankered off for treatment.</td></tr>
<tr><td colspan="2">Part 6 – Monitoring of emissions</td></tr>
<tr><td>1. Measurement Techniques
1.1. Measurements for the determination of concentrations of air and water polluting substances shall be carried out representatively</td><td rowspan="2">Emissions monitoring will be carried out in accordance with the requirements specified.</td></tr>
<tr><td>1.2. Sampling and analysis of all polluting substances including dioxins and furans as well as the quality assurance of automated</td></tr>
</table>

<table>
<tr><th>IED Reference</th><th>Compliance measures</th></tr>
<tr><td>measuring systems and the reference measurement methods to calibrate them shall be carried out according to CEN-standards. If CEN standards are not available, ISO, national or other international standards which ensure the provision of data of an equivalent scientific quality shall apply. Automated measuring systems shall be subject to control by means of parallel measurements with the reference methods at least once per year.</td><td></td></tr>
<tr><td>1.3. At the daily emission limit value level, the values of the 95 % confidence intervals of a single measured result shall not exceed the following percentages of the emission limit values:
<table>
<tr><td>Carbon monoxide</td><td>10%</td></tr>
<tr><td>Sulphur dioxide</td><td>20%</td></tr>
<tr><td>Nitrogen dioxide</td><td>20%</td></tr>
<tr><td>Total dust</td><td>30%</td></tr>
<tr><td>Total organic carbon</td><td>30%</td></tr>
<tr><td>Hydrogen chloride</td><td>40%</td></tr>
<tr><td>Hydrogen fluoride</td><td>40%</td></tr>
</table>

Periodic measurements of the emissions into air and water shall be carried out in accordance with points 1.1 and 1.2.</td><td></td></tr>
<tr><td>2. Measurements relating to air polluting substances.
2.1. The following measurements relating to air polluting substances shall be carried out:
(a) continuous measurements of the following substances: NO_x, provided that emission limit values are set, CO, total dust, TOC, HCl, HF, SO_2;
(b) continuous measurements of the following process operation parameters: temperature near the inner wall or at another representative point of the combustion chamber as authorised by the competent authority, concentration of oxygen, pressure, temperature and water vapour content of the waste gas;
(c) at least two measurements per year of heavy metals and dioxins and furans; one measurement at least every 3 months shall, however, be carried out for the first 12 months of operation.</td><td></td></tr>
</table>

IED Reference	Compliance measures
2.2. The residence time as well as the minimum temperature and the oxygen content of the waste gases shall be subject to appropriate verification, at least once when the waste incineration plant or waste co-incineration plant is brought into service and under the most unfavourable operating conditions anticipated.	Verification of the requirement will be carried out during commissioning of the facility.
2.3. The continuous measurement of HF may be omitted if treatment stages for HCl are used which ensure that the emission limit value for HCl is not being exceeded. In that case the emissions of HF shall be subject to periodic measurements as laid down in point 2.1(c).	As wet scrubbing is proposed, it is considered that periodic monitoring of HF will be appropriate.
2.4. The continuous measurement of the water vapour content shall not be required if the sampled waste gas is dried before the emissions are analysed.	Noted.
2.5. The competent authority may decide not to require continuous measurements for HCl, HF and SO_2 in waste incineration plants or waste co-incineration plants and require periodic measurements as set out in point 2.1(c) or no measurements if the operator can prove that the emissions of those pollutants can under no circumstances be higher than the prescribed emission limit values. The competent authority may decide not to require continuous measurements for NO_x and require periodic measurements as set out in point 2.1(c) in existing waste incineration plants with a nominal capacity of less than 6 tonnes per hour or in existing waste co-incineration plants with a nominal capacity of less than 6 tonnes per hour if the operator can prove on the basis of information on the quality of the waste concerned, the technologies used and the results of the monitoring of emissions, that the emissions of NO_x can under no circumstances be higher than the prescribed emission limit value.	Noted.
2.6. The competent authority may decide to require one measurement every 2 years for heavy metals and one measurement per year for dioxins and furans in the following cases: (a) the emissions resulting from co-incineration or incineration of waste are under all circumstances below 50 % of the emission limit values; (b) the waste to be co-incinerated or incinerated consists only of certain sorted combustible fractions of non-hazardous waste not suitable for recycling and presenting certain characteristics, and which is further	It is considered that this should be applied in the case of the UTR facility, due to the nature of the waste feedstock.

IED Reference	Compliance measures
specified on the basis of the assessment referred to in point (c); (c) the operator can prove on the basis of information on the quality of the waste concerned and the monitoring of the emissions that the emissions are under all circumstances significantly below the emission limit values for heavy metals and dioxins and furans.	
2.7. The results of the measurements shall be standardised using the standard oxygen concentrations mentioned in Part 3 or calculated according to Part 4 and by applying the formula given in Part 7. When waste is incinerated or co-incinerated in an oxygen-enriched atmosphere, the results of the measurements can be standardised at an oxygen content laid down by the competent authority reflecting the special circumstances of the individual case. When the emissions of polluting substances are reduced by waste gas treatment in a waste incineration plant or waste co-incineration plant treating hazardous waste, the standardisation with respect to the oxygen contents provided for in the first subparagraph shall be done only if the oxygen content measured over the same period as for the polluting substance concerned exceeds the relevant standard oxygen content.	Noted.
3. Measurements relating to water polluting substances. 3.1. The following measurements shall be carried out at the point of waste water discharge: (a) continuous measurements of pH, temperature and flow; (b) spot sample daily measurements of total suspended solids or measurements of a flow proportional representative sample over a period of 24 hours; (c) at least monthly measurements of a flow proportional representative sample of the discharge over a period of 24 hours of Hg, Cd, Tl, As, Pb, Cr, Cu, Ni and Zn; (d) at least every 6 months measurements of dioxins and furans; however, one measurement at least every 3 months shall be carried out for the first 12 months of operation.	Wastewater is not directly discharged from the facility.
3.2. Where the waste water from the cleaning of waste gases is treated on site collectively with other on-site sources of waste water, the operator shall take the measurements: (a) on the waste water stream from the waste gas cleaning processes prior to its input into the collective waste water treatment plant;	

<table>
<tr><th>IED Reference</th><th>Compliance measures</th></tr>
<tr><td>(b) on the other waste water stream or streams prior to its or their input into the collective waste water treatment plant;
(c) at the point of final waste water discharge, after the treatment, from the waste incineration plant or waste co-incineration plant.</td><td></td></tr>
<tr><td colspan="2">Part 8 – Assessment of compliance with emission limit values</td></tr>
<tr><td>1. Air emission limit values
1.1. The emission limit values for air shall be regarded as being complied with if:
(a) none of the daily average values exceeds any of the emission limit values set out in point 1.1 of Part 3 or in Part 4 or calculated in accordance with Part 4;
(b) either none of the half-hourly average values exceeds any of the emission limit values set out in column A of the table under point 1.2 of Part 3 or, where relevant, 97 % of the half-hourly average values over the year do not exceed any of the emission limit values set out in column B of the table under point 1.2 of Part 3;
(c) none of the average values over the sampling period set out for heavy metals and dioxins and furans exceeds the emission limit values set out in points 1.3 and 1.4 of Part 3 or in Part 4 or calculated in accordance with Part 4;
(d) for carbon monoxide (CO):
(i) in case of waste incineration plants:
- at least 97 % of the daily average values over the year do not exceed the emission limit value set out in point 1.5(a) of Part 3; and,
- at least 95 % of all 10-minute average values taken in any 24-hour period or all of the half-hourly average values taken in the same period do not exceed the emission limit values set out in points 1.5(b) and (c) of Part 3; in case of waste incineration plants in which the gas resulting from the incineration process is raised to a temperature of at least 1 100 °C for at least two seconds, Member States may apply an evaluation period of 7 days for the 10-minute average values;
(ii) in case of waste co-incineration plants: the provisions of Part 4 are met.</td><td rowspan="2">The requirements for compliance will be followed as part of the site's operating techniques.</td></tr>
<tr><td>1.2. The half-hourly average values and the 10-minute averages shall be determined within the effective operating time (excluding the start-up and shut-down periods if no waste is</td></tr>
</table>

IED Reference	Compliance measures
being incinerated) from the measured values after having subtracted the value of the confidence interval specified in point 1.3 of Part 6. The daily average values shall be determined from those validated average values To obtain a valid daily average value no more than five half-hourly average values in any day shall be discarded due to malfunction or maintenance of the continuous measurement system. No more than ten daily average values per year shall be discarded due to malfunction or maintenance of the continuous measurement system.	
1.3. The average values over the sampling period and the average values in the case of periodical measurements of HF, HCl and SO_2 shall be determined in accordance with the requirements of Articles 45(1)(e), 48(3) and point 1 of Part 6.	
2. Water emission limit values The emission limit values for water shall be regarded as being complied with if: (a) for total suspended solids 95 % and 100 % of the measured values do not exceed the respective emission limit values as set out in Part 5; (b) for heavy metals (Hg, Cd, TI, As, Pb, Cr, Cu, Ni and Zn) no more than one measurement per year exceeds the emission limit values set out in Part 5; or, if the Member State provides for more than 20 samples per year, no more than 5 % of these samples exceed the emission limit values set out in Part 5; (c) for dioxins and furans, the measurement results do not exceed the emission limit value set out in Part 5.	

7.0 Infrastructure and Equipment Inventory

7.1 Engineered Containment System

7.1.1 Surfacing

Operational areas of the Site will benefit from an engineered containment system comprising an impermeable concrete surface.

7.1.2 Sub-Surface Structures

The precise locations of subsurface drains, pipework and interceptors will be established and recorded, and relevant documentation maintained in the Site office. An inspection and maintenance programme for all subsurface structures will be followed and records will be maintained by the Plant Manager.

7.1.3 Bunds

Bunds and or double skinned walls will be provided for all tanks containing liquids whose spillage could be harmful to the environment. Containment bunds or double skinned walls will be provided to make sure that any leaks/spillages will be contained in the event of a leak of the primary containment. The containment measures will be:

- capable of containing at least 110% of the volume of the largest tank within the bund;
- constructed of materials which are impermeable and resistant to the stored materials in accordance with relevant material safety data sheets (MSDS);
- constructed in line with HSG 176 and CIRIA 736 guidance;
- of a type suitable for the containment of the materials in the event of leak or spill;
- pipework will be routed within bunded areas so that no penetration of walls or base of the bund takes place (there will be suction piping in case of pumps shall be penetrating the bunds, but it will be sealed); and
- connection points will be located within the bund.

7.1.4 Construction of Storage Tanks

Table 7-1 provides an inventory of the storage tanks and the control measures in place for each tank. Bund containment calculations have been carried out in line with HSG 176 and construction will comply with CIRIA 736 requirements.

Table 7-1 Tank Inventory

Tank Tag No	Contents	Tank Dimension (L x D in m)	Tank Volume (m^3)	Tank Overfill Protection	Tank overpressure / vacuum Protection
TK-3001	Pyrolysis Oil	4.6 x 7.5	100	High Level Alarm 1. LAH -3002 High High-Level Alarm 2. LAHH-3001 to stop the source pumps P-0201 A-E, P-0101 A-E & P-5008A/B & close UV-3002 & UV-3003 on Tank feed line through interlock I-3001.	Overpressure: 1. Outbreathing Pressure control valve PV-3001B 2. PVRV (Pressure side), PSV-3003 3. Emergency venting manway, PV-3002 Vacuum Protection: 1. Inbreathing pressure control valve PV-3001A 2. PVRV (vacuum side) PV-3003
TK-3002	Naptha	5 x 7	110	High Level Alarm 1.LAH-3048. High High-Level Alarm 2. LAHH-3046 to stop the source pump P-3007 A/B through Interlock I-3091.	Overpressure: 1. Outbreathing Pressure control valve PV-3003B 2. PVRV (Pressure side), PSV-3006 3. Emergency venting manway, PV-3008 Vacuum Protection: 1. Inbreathing pressure control valve PV-3003A 2. PVRV (vacuum side) PV-3006
TK-3003	Light Distillate	5 x 7	110	High Level Alarm 1. LAH-3049. High High-Level Alarm 2. LAHH-3047 to stop the source pump P-3006 A/B through Interlock I-3093.	Overpressure: 1. Outbreathing Pressure control valve PV-3004B 2. PVRV (Pressure side), PSV-3007 3. Emergency venting manway, PV-3009 Vacuum Protection: 1. Inbreathing pressure control valve PV-3004A 2. PVRV (vacuum side) PV-3007

Tank Tag No	Contents	Tank Dimension (L x D in m)	Tank Volume (m^3)	Tank Overfill Protection	Tank overpressure / vacuum Protection
TK-3004	Heavy Distillate	5.5 x 7.4	140	High Level Alarm 1. LAH-3058. High High-Level Alarm 2. LAHH-3056 to stop the source pump P-3005 A/B or P-3004 C/D(in case of BO) through Interlock I-30101.	Overpressure: 1. Outbreathing Pressure control valve PV-3020B 2. PVRV (Pressure side), PSV-3016 3. Emergency venting manway, PV-3018 Vacuum Protection: 1. Inbreathing pressure control valve PV-3020A 2. PVRV (vacuum side) PV-3016
TK-3005	Bunker Oil	7 x 8.5	250	High Level Alarm 1.LAH-3059. High High Level Alarm 2. LAHH-3057 to stop the source pump P-3004 C/D through Interlock I-30103.	Overpressure: 1. Outbreathing Pressure control valve PV-3021B 2. PVRV (Pressure side), PSV-3017 3. Emergency venting manway, PV-3019 Vacuum Protection: 1. Inbreathing pressure control valve PV-3021A 2. PVRV (vacuum side) PV-3017
TK-5002A/B	Generator Fuel	6.5 x 7.7	200	High Level Alarm 1.LAH-5003/5004. High High Level Alarm 2. LAHH-5001/5002 to stop the source pump P-3009 A/B through interlock I-5001 if TK-5002 A is receiving & interlock I-5004 if TK-5002 B is receiving.	Overpressure: 1. Outbreathing Pressure control valve PV-5001B/5002B 2. PVRV (Pressure side), PSV-5008/5009 3. Emergency venting manway, PV-5010/5011 Vacuum Protection: 1. Inbreathing pressure control valve PV-5001A/5002A 2. PVRV (vacuum side) PV-5008/5009

Tank Tag No	Contents	Tank Dimension (L x D in m)	Tank Volume (m^3)	Tank Overfill Protection	Tank overpressure / vacuum Protection
TK-5005	Naptha	10.8 x 16.4	1200	High Level Alarm 1. LAH-5022. High High-Level Alarm 2. LAHH-5021 to stop the source pump P-3008 A/B through Interlock I-5041.	Overpressure: 1. Outbreathing Pressure control valve PV-5005B 2. PVRV (Pressure side), PSV-5021 3. Emergency venting manway, PV-5022 Vacuum Protection: 1. Inbreathing pressure control valve PV-5005A 2. PVRV (vacuum side) PV-5021
TK-5006	Bunker Oil/Heavy Distillate	13.2 x 18.3	2000	High Level Alarm 1.LAH-5027. High High-Level Alarm 2. LAHH-5026 to stop the source pump P-3010 A/B (Heavy Distillate case), P-5002 A/B (Light Distillate) or P-3011 A/B (BO case) through Interlock I-5061.	Overpressure: 1. Outbreathing Pressure control valve PV-5006B 2. PVRV (Pressure side), PSV-5026 3. Emergency venting manway, PV-5027 Vacuum Protection: 1. Inbreathing pressure control valve PV-5006A 2. PVRV (vacuum side) PV-5026
TK-5007	Bunker Oil(Fuel Oil)	13.2 x 18.3	2000	High Level Alarm 1.LAH-5032. High High-Level Alarm 2. LAHH-5031 to stop the source pump P-3011 A/B through interlock I-5081.	Overpressure: 1. Outbreathing Pressure control valve PV-5010B 2. PVRV (Pressure side), PSV-5031 3. Emergency venting manway, PV-5032 Vacuum Protection: 1. Inbreathing pressure control valve PV-5010A 2. PVRV (vacuum side) PV-5031

Tank Tag No	Contents	Tank Dimension (L x D in m)	Tank Volume (m^3)	Tank Overfill Protection	Tank overpressure / vacuum Protection
TK-5008	Off-Specs, Slops & Buffer	6 x 9	200	High Level Alarm 1.LAH-5037. High High-Level Alarm 2. LAHH-5036 to stop source pump P-3007 A/B, P-3008 A/B, P-3009 A/B, P-3010 A/B, P-3011 A/B, P-5002 A/B, P-5009 A/B, P-0101A-E, P-0201A-E, E-3001, P-3005 A/B, P-3006 A/B & close UV-5027 on tank feed line through interlock I-50101.	Overpressure: 1. Outbreathing Pressure control valve PV-5009B 2. PVRV (Pressure side), PSV-5032 3. Emergency venting manway, PV-5033 Vacuum Protection: 1. Inbreathing pressure control valve PV-5009A 2. PVRV (vacuum side) PV-5032
TK-9101	Commercial Diesel	4 x 5.7	50	High Level Alarm 1.LAH-9106 High High-Level Alarm 2. LAHH-9105 to stop the source Pump P-5010 through Interlock I-50123.	Overpressure: 1. Outbreathing Pressure control valve PV-9118B 2. PVRV (Pressure side), PSV-9119 3. Emergency venting manway, PV-9120 Vacuum Protection: 1. Inbreathing pressure control valve PV-9118A 2. PVRV (vacuum side) PV-9119

Key: LAH: Level Alarm High LAHH: Level Alarm High High

7.1.5 Management and Operational Techniques

Containment engineering will prevent the release of potentially polluting liquids to surface water and groundwater. Plant operatives will undergo awareness training to ensure a full understanding of the containment engineering which will minimise the environmental impact of the Site. The engineered containment system will be subject to routine visual inspection. Identified breaches in the engineered containment will be remedied to ensure continued integrity of the facility, and to prevent pollution of surface or groundwater. Records of inspection and maintenance will be maintained by the Plant Manager.

7.2 Engineered Drainage and Surface Water Management System

The processing and feedstock storage areas will be underlain by concrete surfacing to capture and prevent percolation of potentially contaminated water into the ground.

Process effluent and surface water run-off from potentially contaminated external surfaces will be collected and transferred by road tanker for treatment at an appropriately regulated facility.

Uncontaminated surface water from building roofs and non-processing areas will be collected in a separate drainage system before discharge to the Hendon Docks via a silt trap and oil separator, at discharge point W1 as illustrated on Drawing 02.

The drainage systems are shown on Drawing 05 Fire Prevention & Management.

7.3 Plant and Equipment

The key items of process plant and equipment that will be used at the Site are detailed below. All items of plant and equipment will be maintained in accordance with the manufacturer’s recommendations.

The key components will include, but not be limited to:

- Feedstock belt & screw conveyors;
- Bucket elevators;
- Disc classifiers (sieves);
- Vibrating screens;
- Tyre rasper/crushers;
- Magnetic separators;
- De-dusting equipment;
- Fired heaters;
- Pyrolysis reactors;
- Heating /cooling oil circuit;
- Alkali scrubber;
- Blowdown stripper column;
- Hammer mills;
- Jet mills;
- Pelletiser;

- Dryers;
- Roller mill;
- Packaging plant;
- Distillation columns;
- Regenerative thermal oxidiser;
- Flare;
- Diesel generators;
- Product storage;
- Product loading equipment (tankers/barges); and
- Utilities.

8.0 Raw Materials

8.1 Inventory of Raw Materials

The raw materials that will be used on Site are detailed in Table 8-1.

The waste processing facility will source its raw materials from a mixture of sources, which are identified in the table.

A Control of Substances Hazardous to Health (COSHH) assessment will be undertaken prior to the use of chemicals, and if the chemical is found to present a hazard to health, it will be added to the COSHH inventory and appropriate safeguards implemented.

Material Safety Data Sheets (MSDS) for any potentially hazardous materials or chemicals will be kept on site together with the COSHH register. The MSDS will give information on how chemicals should be handled, stored and disposed of, and what to do in the event of an accident.

Table 8-1 Principal Raw Materials

Material	Consumption	Site Storage
Caustic soda 40% solution	57kg/h ; 450 t/y	50m^3 heated tank and ring main.
Cooling water proprietary treatment chemicals	0.3kg/h ; 2.4 t/y	East of site adjacent to cooling tower
Liquid Nitrogen	269Nm^3/h ; 2,130,500Nm^3/year	Tank situated adjacent to hydrocarbon storage tanks
Pelletizer binder (if required)	7.5kg/h ; 60 t/y	Eastern end of pyrolysis building

8.2 Raw Materials Selection

Wherever possible, raw materials will be selected that minimise environmental impact. Consideration will be given to such factors as degradability, bioaccumulation potential, product contamination and toxicity. Reviews will be frequently undertaken to ensure that all raw materials are appropriate for use, that consumption is optimised and that opportunities for reduction and improvements are implemented through an action plan.

Alternative raw materials will be evaluated for their environmental impact on an on-going basis and, where there is no overriding quality requirement substitution will be given appropriate consideration. The on-going programme of professional and technical development for all site personnel will ensure awareness of new developments in product availability and their implication.

8.2.1 Waste Minimisation Audit (minimising the use of raw materials)

The overall objective of the Site is to maximise the recovery of useful products from waste tyres, thereby minimising the volume sent to landfill or Energy from Waste facilities for disposal. Notwithstanding this, there will be waste produced by the processes undertaken at the Site.

Waste generation at the Site will be reviewed annually and where necessary an appropriate improvement programme will be implemented.

8.2.2 Water Use

The main uses of water at the facility are for the process quench, cooling systems for condensers, reflux and char, as well as wet scrubbing for abatement of air emissions. The cooling water is treated and recirculated and topped up with mains water.

Other uses of mains water on site will include:

- Binding of the char pellets;
- Welfare Facilities;
- Facility cleaning;

The use of water will be regularly reviewed to ensure maximum efficiency and ensure that any further potential for reduction in consumption and recycling opportunities are identified. The predicted average total usage is expected to be 21m^3/hr or less.

9.0 Waste Handling, Recovery or Disposal

Waste present at the Site falls into two categories:

- Waste delivered to Site for processing; and
- Waste generated from on-site processes.

The Site's main objective is to produce hydrocarbon and other usable products from the processing of waste tyres and as such, the process is designed to maximum the product yield and minimise residual waste. In addition, the activities at the site are designed to prevent, or where that is not practicable, reduce any additional wastes generated.

All solid waste will be managed and disposed or recovered in accordance with the Duty of Care and the Environmental Permitting Regulations. All waste recovered or generated during the processes undertaken at the Site will be removed to a suitable licensed processing or disposal site.

The categories of waste, storage arrangement on site, and recovery/disposal options are detailed in Table 9-1 below.

Table 9-1 Waste Storage, Recovery and Disposal

Waste Material	Storage Arrangements	Disposal or Recovery
Waste Delivered to site for processing		
Baled tyres	Dedicated storage bays	Recovery
Solid Waste Residues from processing		
Dust from tyre shredding	Drums	Disposal
Dust from steel wire cleaning	Drums	Disposal

Waste Material	Storage Arrangements	Disposal or Recovery
Deduster filter dust	Drums	Disposal
Oil filter cartridges	Drums	Disposal

All waste is stored securely on site and will be protected from vandalism by site security fencing around the site and lockable gates in the case that there is no on-site presence.

9.1 Waste Minimisation

The key methods of ensuring that waste minimisation occurs on site will be;

- waste acceptance checks to ensure only compliant waste (i.e. tyres) is accepted;
- working proactively with end-of-life tyre suppliers to manage any quality issues that may arise;
- the ongoing identification and implementation of waste prevention opportunities;
- the active participation and commitment of staff in all areas of the business; and
- monitoring of materials usage and reporting against key performance measures.

Wastefront will take appropriate measures to ensure that;

- the waste hierarchy (referred to in Article 3 of the Waste Framework Directive) is applied in the generation of waste on site by the activities;
- any waste generated by the activities is treated in accordance with the waste hierarchy; and
- where disposal is necessary, as opposed to recovery, that it is undertaken in a manner which minimises its impact on the environment.

Wastefront will review and record at least every four years whether changes to those measures should be made and take any further appropriate measures identified by the review. Waste production will be avoided wherever possible. Any waste produced on site will be recovered, unless there are instances whereby it is not technically or economically practicable to do so.

On an annual basis, Wastefront will complete a waste minimisation audit.

The audit will include;

- waste produced at the Site;
- where the waste goes;
- if it can it be recovered or recycled;
- if it is being stored correctly on site;
- if Duty of Care requirements are being met; and
- any further comments for future reference.

10.0 Energy

10.1 Energy Consumption

The total power requirement for the process is estimated to be 3,577kW. 3,300kW of this will be generated on - site by the burning of light distillate oil from the pyrolysis process within 3 x 1.1MW low speed generators. The remaining 277kW requirement will be provided by the grid.

Approximately 5,600 tonnes per year of pyrolysis gas will be burned in the RTO to provide heat for the process.

Up to 300 Nm^3/h natural gas will be required for plant operations, which include pyrolyser and RTO start-up burners and pilot for the emergency flare. Annual consumption is anticipated to be 981,120Nm^3 per annum under normal operating conditions.

The site energy consumption is summarised in Table 10-1 below.

Table 10-1 Energy Consumption

Energy Source	Annual Consumption
Light distillate oil for power generation	26,136 MWh
Power from grid	2,194MWh
Pyrolysis gas	5,600 tonnes
Natural gas from grid	981,120Nm^3

The Site will not be part of a Climate Change Agreement.

10.2 Energy Management Measures

A number of features have been incorporated within the design of the Site in order to minimise energy use:

- Use of process gas /light distillate for process heating;
- Use of closed loop hot oil system for heating / cooling;
- Low energy light fittings will be used where practicable;
- Category IE3 high efficiency electrical drive motors;
- Use of variable speed drives for larger duties, where applicable; and
- Adiabatic cooling using multiple fans to minimise electricity consumption during cold weather.

To optimise energy efficiency, equipment will be maintained and serviced as required. Plant and equipment will be subject to regular maintenance to ensure it continues to operate at optimum energy efficiency and that energy consumption does not increase due to inefficient performance.

Energy use will be monitored and recorded and periodically reviewed to identify areas of improvement and to ensure that any inefficiency is investigated, and appropriate actions taken.

Energy use and energy minimisation will be included within the management system for the control of resources. Within the management system the review process will identify energy use by source for the different site operations. The results will be used to identify potential measures for improving energy efficiency.

Staff will undergo awareness training in energy efficient practices.

11.0 In-Process Controls

11.1 Waste Acceptance

The only wastes that will be accepted on Site are as follows:

- EWC 16 01 03 End-of-life tyres

No other waste will be accepted.

All waste delivered to site will be required to report to the waste inspection area.

Waste transfer documentation will be checked at the Site office. From there vehicles will be directed to the bale storage area.

Designated personnel will be responsible for liaising with both the driver of the waste delivery vehicle and the plant operatives to ensure the waste is deposited in the correct area.

Each load of waste will be visually inspected by trained personnel prior to dispatch to the bale storage area. If non-conforming waste is identified it will be returned on the delivery vehicle.

A second inspection will take place as the bales are opened prior to loading into the shredders. If unsuitable material is detected at this point, the whole bale or non-confirming material will be placed in the waste quarantine area pending transfer to a suitable treatment or disposal facility. In addition, other bales from the same origin, within the stockyard will be opened and if necessary, the material rejected back to the supplier.

11.2 Material Storage and Handling

Arrangements for raw material storage are detailed in Section 7 and waste storage arrangements are details in Section 8 of this BATOT.

The storage procedures that will be implemented on site are considered to be best practice for the following reasons:

- storage areas will be clearly marked;
- procedures will be in place for the regular inspection and maintenance of storage areas with any repairs being undertaken as soon as is practicable;
- storage tanks will be designed to be fit for purpose, taking into account the nature of the material to be stored and the required design life;
- tanks will be fully quality assured and tested for leakage prior to commissioning;
- liquid levels within all storage tanks will be continuously monitored by pressure sensors which will alert the operator to high levels and operate interlocks. Float switches will also be in place that acts to switch off pumps if a high level is reached;
- bulking and mixing will only take place under instruction from appropriately trained personnel; and
- written records of all tanks will be kept, detailing:
  - capacity;
  - construction including materials;
  - maintenance schedules and inspection results;

- fittings; and
- materials stored in the vessel.

11.3 Process Control Monitoring

The tyre pre-treatment, pyrolysis and distillation processes will benefit from a number of process control features which will ensure adequate control of the processes and prevent the development of abnormal operating conditions. Specific measures are detailed in Section 5 of this document alongside details of the treatment processes; however, additional information is provided below.

11.3.1 Process Control System

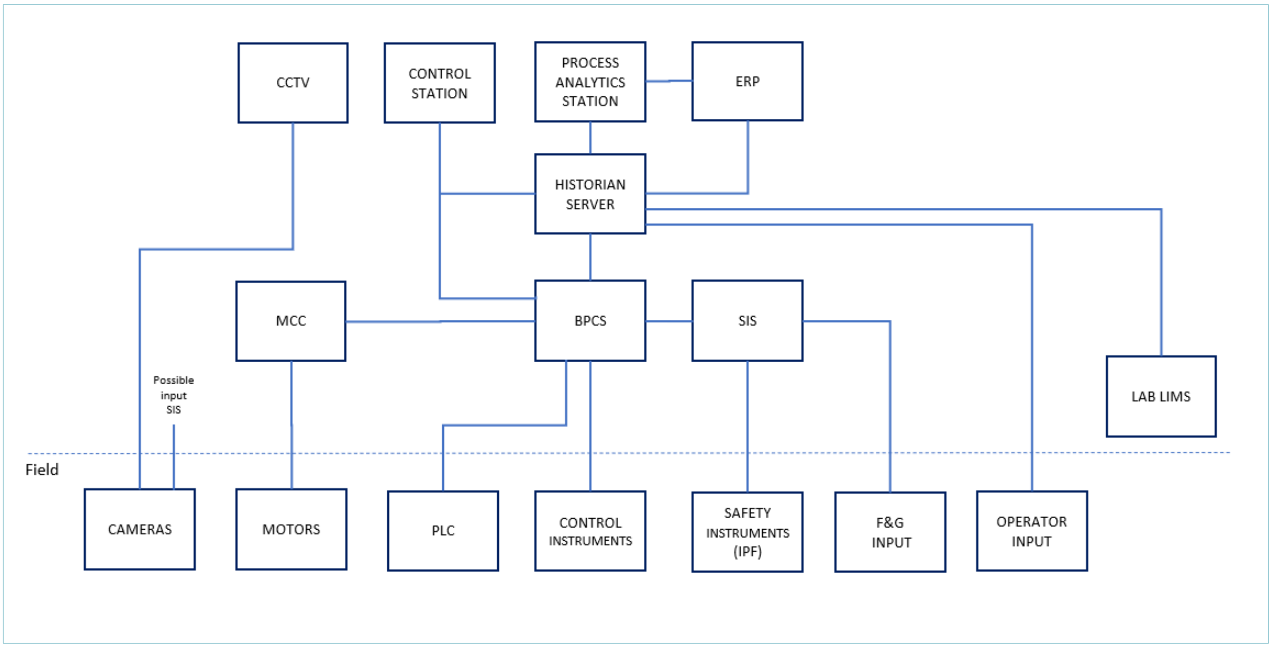
The Plant will be controlled through a centralized BPCS (Basic Process Control System) and related SIS (Safety Instrumentation System). There will be some PLCs (Programmable Logical Controller) installed in the field such as, pyrolysis system, baled Tyre Shredders, Char milling, rCB pelletizers and for the ICEGENs (Internal Combustion Engine Generators).

Any critical service must be designed with the inclusion of safety instrumentation, i.e. with IPFs- instrumented protective functions that must be functionally independent from the control instrumentation (different measuring element and different acting element) and hard wired to the SIS-Safety Instrument System (includes ESD- Emergency Shutdown). The SIS will also receive and process all the F&G-Fire and Gas information, i.e., detection systems, field emergency bottoms, fire protection devices, etc.

The Plant will also be equipped with a CCTV system (Closed Circuit Television) for security and surveillance. Example of applicable areas are tyre storage, rCB bagging, and barge loading area.

All the information gathered from the process will be routed to a historian server and provided/processed from there for the various Plant stakeholders. This will be made through an OSI PI system or equivalent with direct communication with Wastefront ERP platform (e.g., SAP, Oracle, or others).

The block diagram shown below, provides a visualization of the desired Plant control and monitoring configuration and the respective relation between the various components and systems.



11.4 Inspection, Maintenance and Monitoring

Infrastructure and equipment within the Site will be inspected on a regular basis and maintained and repaired as necessary. In addition, the operator will undertake visual checks on all plant and equipment at least once a week and, if deemed necessary, bring forward any planned maintenance or undertake remedial works.

Records of all visual and scheduled inspections and details and certificates (where appropriate) of any maintenance work will be regularly updated and maintained. Maintenance schedules for equipment will be regularly reviewed and updated.

In the event of damage or deterioration being detected, all maintenance work will be carried out in conformance with Wastefront's Health and Safety Policy.

Monitoring and recording of conditions within the plant will be carried out on a continuous basis by the comprehensive network of sensors and instrumentation as discussed above and displayed via the process control system. This will enable continuous mapping of the process in order to ensure efficiency of the process.

12.0 Control of Noise

Wastefront recognises that the Site should be operated in a manner that minimises or prevents noise and / or vibration nuisance.

12.1 Noise Sources

Details of the locations, sources, frequency and estimated noise levels that will be associated with operations at the Site have been addressed as part of the Noise Impact Assessment, a copy of which is provided in Section 7 of this EP application.

12.2 Noise Assessment

The noise assessment carried out considered the potential for the operations to give rise to noise impacts at the closest noise-sensitive receptors.

The assessment has found that in the context of the existing background and ambient sound levels, the site would not lead to a significant impact at the closest NSRs, and that specific mitigation measures additional to those included within the design of the site would not be required.

12.3 Noise Mitigation and Management Measures

Mitigation to reduce the impact to receptors that may be affected by the noise emissions from the Site are detailed below.

12.3.1 Operating Hours

The facility will operate 24 hours a day, 365 days a year.

The Site will accept deliveries of end of life tyres during daytime working hours, 07:30 to 19:00 Monday to Friday and 08:00 to 17:00 on Saturday, with no delivery or dispatch of waste taking place on Sundays or bank holidays, except in the case of emergencies.

12.3.2 Building and Plant Design

Opening of doors will be kept to a minimum and roller shutter doors will be installed where appropriate.

Buildings have been designed to attenuate noise.

12.3.3 Plant Selection

Plant options with lower noise levels will be used wherever possible to ensure noise is kept to a minimum.

Plant and equipment will be maintained regularly to minimise noise resulting from deterioration and inefficient operation. If any items of plant are found to give rise to unacceptable noise levels, consideration will be given to their replacement with quieter designs. If equipment continues to generate unacceptable noise levels, consideration will be given to modification to incorporate noise suppression equipment or replacement components.

12.3.4 Management Measures

The Plant Manager will be responsible for ensuring that nuisances arising from the Site noise are minimised. All site personnel will be trained in the need to minimise site noise and will be responsible for monitoring and reporting excessive noise when carrying out their everyday duties.

12.3.5 Noise Action Plan

In the event that noise is found to be causing a problem, action will be taken to determine the source and to take remedial actions as follows:

- shut down, replace, service or repair equipment to reduce noise levels; and
- modify plant to incorporate noise suppression equipment.

Records relating to the management and monitoring of noise will be maintained and include:

- inspections undertaken;
- noise problems (including date, time, duration, prevailing weather conditions and cause of the problem);
- complaints received; and
- corrective action taken and changes to operational procedures to prevent future occurrences.

13.0 Control of Odour

13.1 Potential Odour Sources

Potential odour sources relate to fugitive emissions associated with the emissions released by the stack following pyrolysis/combustion as well as the distillation, fuel storage and loading systems.

End-of-life tyres are not an inherently odorous waste and the site will have waste acceptance procedures in place including checks for any contamination by odorous material. Checks are made upon arrival as well as when each bale is opened within the shredder building. In the event that non-conforming wastes are delivered to the Site, they will be returned to the delivery vehicle or quarantined. Whilst bale storage is within an open fronted building, the opening of bales and all subsequent handling and pre-treatment of tyres takes place in enclosed buildings and conveyors. The intensity of off-site odours relating to tyre storage and pre-treatment is therefore likely to be low.

The proposed facility will employ a regenerative thermal oxidiser where all non-condensable combustible gas not used to heat the pyrolysis process would be directed. It is considered that combustion of the gases in this unit will effectively remove any odorous compounds contained in the feed gas before the emissions are exhausted to the atmosphere.

All finished products including recovered carbon black and liquid hydrocarbon fuels will be stored within sealed containers.

Tank vents and fuel loading systems will be fitted with nitrogen purge and carbon filters to minimise release of VOCs. A risk-based leak detection and repair (LDAR) system will be operated at the site.

The Site will be kept clean and tidy by way of a regularised housekeeping regime and regular checks will be undertaken by the Plant Manager or designated individual of odour at the Site boundary.

Taking all of the above into account, it is considered that the potential for an odour source presence is small.

13.2 Potential Odour Exposure

The Site is located within an industrial setting. The nearest residential receptors are located approximately 500m to the west of the site and the nearest commercial receptors are more than 375m to the east.

Meteorological data illustrates that there is a predominant south-westerly wind direction (i.e. away from land receptors to the north sea).

Taking into account the distance and wind direction, it is considered that there is an ineffective pathway between potential odour source and the identified receptors and therefore the risk of odour exposure is likely to be negligible.

In the event that odours are detected, investigations will be undertaken to determine the cause and appropriate remedial action.

The Plant Manager will be responsible for implementing risk management measures.

14.0 Control of Emissions to Air

14.1 Point Source Emissions

The facility has a number of release points to air which are listed in Table 14-1 below. The locations of the emission points are shown on Drawing 02.

Table 14-1 Point Sources of Air Emissions

Reference	Source	Location
A1	Exhaust from the RTO	441316, 556859
A2	Emergency Flare	As shown on Drawing 02.
A3	Barge Loading System	
A4	Road Tanker Loading System	
A5	Jet Mill Dust Filter discharge	
A6 & A7	Tyre Shredding Dust Filter discharge	
A8 – A16	Product Storage Tank Vents	

The main emissions release point is the exhaust from the RTO at location A1. An Air Emissions Risk Assessment (AERA) which includes a detailed dispersion model has been carried out in accordance with EA guidance and is provided in Section 5 of this application. The post-combustion emissions concentrations from the RTO pre-and post- scrubbing are shown below and are compared with the IED Chapter IV Annex VI Emission Limit Values as shown in Table 14-2. The Annex VI limits were modelled as the 'worst case'.

Table 14-2 Assumed Pollutant Concentrations in Emissions from RTO

Pollutant	**Emission Limits (mg/Nm^3)** [(a)]		
	Raw exhaust gas	Clean exhaust gas	Annex VI daily average
Particulate Matter (PM)	>10	>10	10
Total Organic Carbon (TOC)	10	10	10
Hydrogen Chloride (HCl)	>10	>10	10
Hydrogen Fluoride (HF)	>1	>1	1
Sulphur Dioxide (SO_2)	198 - 423	<10	50

Pollutant	Emission Limits (mg/Nm^3) [(a)]		
	Raw exhaust gas	Clean exhaust gas	Annex VI daily average
Oxides of Nitrogen (NO_x)	49 - 99	<10	200
Carbon Monoxide (CO)	50	50	50

The AERA modelled the following scenarios using the 'worst case' Annex VI emission levels, and was based on the emission parameters in Table 14-3 below.

- normal 'daily average' emission limits;
- half-hourly emission limits; and
- plausible abnormal emissions.

Table 14-3 Emission Parameters

Parameter	Value
Stack Location (NGR x/y)	441316, 556859
Stack Internal Diameter (m)	0.97
Stack Exhaust Height (m)	30.0
Normalised Volume Flow (Nm^3/s) (273K, 11% O_2, dry)	8.53
Emission Temperature (°C)	73.0
Oxygen Content (% O_2 dry gas)	8.73
Moisture content (% H_2O)	19.9
Actual Flow Rate (Am^3/s) (wet, at stack conditions)	11.0
Emission Velocity (m/s)	15.0

The conclusions of the detailed atmospheric dispersion modelling assessment of combustion emissions on sensitive human and ecological receptor locations arising from the proposed installation are as follows:

- there are no predicted exceedances of air quality standards for the protection of human health at the point of maximum ground level impact for any of the scenarios assessed; and
- the predicted impacts on designated sensitive habitats are considered insignificant according to EA guidance and will cause:
  - 'no likely significant effects (alone and in-combination)' to the SAC and SPA/Ramsar; and
  - 'no significant pollution' for the LWS.

A sensitivity analysis was also carried, developed in accordance with EA guidance. None of the variations in the parameters investigated leads to a breach of the NO_2 Air Quality Assessment Levels (AQAL) whereby Predicted Environmental Contributions are still considered to be well below the <75% AQAL threshold, despite application of the highest background concentration contained within the Defra background maps for the 1km squares covering the entirety of the modelled domain. The level of variation is broadly applicable to other pollutants and on this basis it can be concluded that the level of variation in the parameters investigated would not lead to exceedances of the AQALs.

14.2 Global Warming Potential

The Environment Agency (EA) requires that new EP applications must include a risk assessment to assess the potential environmental impacts of emissions from the proposed activities. The requirements are described in EA guidance 'Risk assessments for your environmental permit' last updated 10 January 2019. For those sites which result in direct and / or indirect emissions to air that impact global warming, an assessment of impact of air emissions on global warming must be undertaken in accordance with the EA's 'Assess the impact of air emissions on global warming' guidance published 1 February 2016.

The proposed UTR facility has the potential to contribute to global warming as a result of direct and indirect emissions to air. As such, an assessment of the Global Warming Potential associated with the direct and indirect emissions from the facility has been completed and presented in Appendix 1 of the ERA in Section 4 of this application.

14.3 Emergency Flare

The plant will be equipped with an emergency flare for safety purposes, restricted to use only in extreme emergencies. The flare is designed with all the necessary safety features for the safe handling and combustion of reactor product mixture. It is anticipated that the flare will be used less than 100 hours per annum.

15.0 Control of Dust and VOC

15.1 Dust Emissions

Potential sources of dust are associated with the shredding of tyres and subsequent handling and conveying, as well as the recovered carbon black processing. However, due to the nature of the process and the mitigation measures to be employed, the need for a dust management plan has been scoped out.

15.2 Mitigation Measures

No dusty wastes will be received at the Site. Waste acceptance checks will be undertaken prior to acceptance of any waste on to the Site.

Whole tyre bales are transferred into the material preparation building before they are opened. Shredding pre-treatment is carried out in enclosed buildings and enclosed conveyors are used for transportation between processing units.

Care will be taken during the unloading and loading of wastes into the feed hoppers. For example, drop heights will be kept to a minimum.

The tyre pre-treatment building will be under a slight negative pressure as air drawn in by the dry-cleaning system will be passed through bag filters and exhausted through a vent pipe outside of the building.

Traffic calming measures are implemented to enforce speed limits and reduce emissions of dust. Speed limits will be implemented for vehicles on Site. Site surfacing will be maintained and repaired to minimise the mobilisation of dust particles.

The Site will be kept clean and tidy by way of a regularised housekeeping regime. Regular checks will be undertaken by the Plant Manager or designated individual of dust on site and at the Site boundary.

In the event that dust is detected, investigations will be undertaken to determine the cause and appropriate remedial action.

In the event that non-conforming wastes are delivered to the Site, they will be returned on the delivery vehicle.

The Plant Manager will be responsible for implementing risk management measures in accordance with this environment risk assessment.

Given the high degree of designed-in mitigation in the form of containment of potential sources of dust from the proposed operations, there are limited sources of dust exposed to the ambient atmosphere, consequently the potential for fugitive release of dust is low.

15.2.1 Volatile Organic Carbon Emissions

There will not be significant fugitive emissions of VOCs because:

- product storage tanks will be fitted with pressure vacuum valves, nitrogen purges and carbon filters;
- all exhaust gases will be directed to the RTO for complete combustion;
- road tanker and barge filling vents will be fitted with activated carbon filter;
- inspection and maintenance programmes will ensure continued integrity of equipment; and
- a spillage action plan will require clean up as soon as possible.

16.0 Control of Emissions to Groundwater, Surface Water and Sewer

The potential risks from the proposed activities have been considered in the Environmental Risk Assessment, and preventative and mitigative measures have been designed in accordance with the identified risks. The control measures are presented in this section.

16.1 Point Source and Fugitive Emissions to Groundwater

There are no point source emissions to groundwater. The Site benefits from impermeable surfacing and a sealed drainage system.

The containment measures in place at the Site are described in Section 6 of this BATOT. These will ensure there are no point source or fugitive emissions to groundwater.

Accordingly, there will be no direct or indirect discharges of contaminating materials into groundwater from the Site.

16.2 Point Source Emissions to Surface Water

The site benefits from impermeable surfacing and separate sealed drainage systems for clean and contaminated surface water. Uncontaminated rainfall run off from roofs and non-processing areas is collected in the ‘clean’ drainage system and will be discharged to the adjacent dock via a silt trap and oil separator.

Surface water run-off which is potentially contaminated is collected in a separate sealed drainage system and passes through an API separator which separates oil and floating debris in one stream and removes solids heavier than water (mainly char, rCB and dust from shredding) as a sludge. The oil and sludge residues are transferred off-site for treatment at an appropriately regulated facility. The resulting effluent will be transferred by road tanker to an appropriately regulated facility.

The main sources of dirty water from the process are from tank bunds (including first 50 mm of rainwater), water from wash down of buildings and process areas and blow-down from the cooling water system. These effluents will also be tankered off site for treatment.

16.3 Fugitive Emissions to Surface water

The containment measures in place at the Site are described in Section 6 of this BATOT. These are designed to contain accidental spillages and also firewater in the case of an incident. These measures will ensure there are no fugitive emissions to surface water.

16.4 Point Source Emissions to Sewer

There are no emissions to sewer. Foul drainage will be managed via a package septic tank system.

16.5 Flood Risk

The majority of the site lies within a Flood Zone 1[1], defined as an area with low probability of flooding. The fuel loading area to the west of the access road, and a small part of the south-western corner of the site lie within Flood Zone 2 and 3, defined as land having a 1 in 100 or greater annual probability of river flooding or land having a 1 in 200 or greater annual probability of sea flooding.

The EA's flood mapping does not take into account the effect of any flood defences, which are located all around the coastal boundary to the east of the site and including to the immediate east of the site boundary where there is a step down in elevation to the beached inlet area of the Hudson Dock Channel. The change in elevation is re-inforced with steel piling which would act as a sea wall to reduce the potential of sea flooding to the site.

Water levels within the docks are controlled by two sets of lock doors. The northern set of lock doors are closed in the event of extreme tidal surging in the North Sea or elevated water levels along the lower reach of the River Wear.

A Flood Risk Assessment (FRA) was undertaken as part of the planning application[2] which demonstrates that surface water run-off can be managed in accordance with best practice so that flood risk would not be increased by the new development.

The FRA concludes that the flood risk at the site from sea or estuary/docks will remain low for the lifetime of the development. There is a 'negligible' risk of waves overtopping onto the site if sea levels are high due to storm surging. However, it is concluded that the site drainage should have capacity to contain this water and for it to pass through into Hudson Dock.

The site will be designed with the following mitigation as identified in the FRA:

- Sheet piling adjacent to the site should be renewed with gravel and ground sloping from it into the site reinforced to minimise the potential for scour in the event of wave action;
- Equipment located in the eastern area of the site should be located on a plinth raised at least 150mm above adjacent ground level to ensure that water from waves would fall under gravity to a lower level than the equipment;
- Any opening such as related to air intake should be oriented to face west (i.e. away from the direction of water progressing on to the site);
- Personnel will not access the eastern area of the site if there are storm warnings and associated large waves; and

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[1] Flood Map for Planning, available at https://flood-map-for-planning.service.gov.uk/, accessed in May 2021

[2] SLR Ref 403:11075.00001 Waste Tyre Processing Facility, Port of Sunderland, Technical Appendix 10/1: Flood Risk Assessment Planning Statement April 2021

- The site will have an emergency flood response plan that identifies when the site should be evacuated and which route should be taken.

17.0 Control of Litter, Mud and Pests

17.1 Litter

In order to maintain the Site in a tidy condition and prevent the escape of litter onto surrounding land the following measures will be in place:

- The Site will be kept clean and tidy by way of a daily housekeeping regime.
- Only baled tyres will be stored in open fronted building; all further processing will take place in enclosed buildings;
- Wastes produced as part of the process will be stored within dedicated skips or bags prior to removal off-site. As such, it is unlikely to generate litter.
- Regular monitoring will be carried out by the Plant Manager or a designated individual. Litter picking will be undertaken as necessary in response.
- Fences surrounding the Site will reduce the chance of litter blowing off Site. If necessary, additional netting will be erected to reduce the escape of wind-blown litter.
- Litter arising from the activities will be cleared from affected areas outside the Site as soon as practicable.
- The Plant Manager will be responsible for monitoring the Site and maintain it free of litter. Records will be maintained of monitoring, complaints and remedial actions taken.

17.2 Mud and Debris

In order to prevent mud and debris, the following measures will be in place:

- The Site is surfaced such that there will be no areas with the potential to generate mud on site. This removes the possibility of vehicles tracking dirt or mud off Site.
- Regular monitoring will be conducted by the Plant Manager or a designated individual.
- The Site will be kept clean and tidy by way of a regularised housekeeping regime.
- Areas of hard standing will be maintained free of significant quantities of mud & debris.
- The Plant Manager will be responsible for monitoring the Site. Records will be maintained of monitoring, complaints and remedial actions taken.

17.3 Pests

In order to prevent pests, the following measures will be in place:

- End of life tyres are unlikely to attract pests, but there is potential for minor levels of organic material contamination.
- Waste acceptance checks including an assessment of the potential to attract pests will be undertaken prior to acceptance of any waste on to the Site.
- Operators will be required to only eat in the dedicated canteen area and food waste will be kept in enclosed waste bins.

- The Site will be inspected daily for signs of pests. If pests are encountered, appropriate remedial action will be undertaken.
- A nominated sub-contractor for the control and monitoring of pests will be appointed.
- The Plant Manager will be responsible for monitoring the Site. Records will be maintained of monitoring, complaints and remedial actions taken.

18.0 Monitoring

The Site will be subject to a comprehensive programme of monitoring to ensure it operates to the specified design standards and does not give rise to unacceptable environmental impact.

Monitoring comprises the following:

- general observations
- monitoring of infrastructure and equipment;
- monitoring of process variables; and
- emissions monitoring.

18.1 General Observations

Routine observations and monitoring will be undertaken daily by site personnel to ensure that the Site operates correctly and without giving rise to unacceptable levels of emissions.

Routine regular observations will include qualitative assessment of noise, dust, litter, mud on the road and odour at the installation, the results of which will be entered in the Site diary.

18.2 Monitoring of Infrastructure and Equipment

Infrastructure and equipment will be subject to regular visual inspection. In the event of deterioration or damage, appropriate remedial action will be taken to restore the infrastructure and equipment to a satisfactory condition.

18.3 Monitoring of Process Variables

Monitoring of process conditions and variables is described in Section 10.3.

18.4 Emissions Monitoring

18.4.1 Monitoring Emissions to Surface Water

Emissions to surface water from uncontaminated run-off will not be routinely monitored. The effluent tankered off-site for treatment at an appropriately permitted facility will be monitored in accordance with the requirements of the receiving facility.

18.4.2 Monitoring Emissions to Air

Emissions to air will be subject to a routine monitoring programme, as described below in Table 18-1. The applied emission rates have been calculated from the process conditions and are detailed in the Air Emissions Risk Assessment in Section 5 of the environmental permit application. Emission limits will meet the limits set out in Annex IV of the IED.

Table 18-1 Emission Limits and Monitoring Programme

Pollutant	**Emission Limit (mg/Nm^3) $^{(A)}$**	**Reference Period**	**Monitoring Frequency**	**Monitoring Method**
Total Dust	10	Daily Average	Continuous Measurement	BS EN 13284-2
	30	½ hour Average		
Total Organic Carbon (TOC)	10	Daily Average	Continuous Measurement	BS EN 12619:1999
	20	½ hour Average		
Hydrogen Chloride (HCl)	10	Daily Average	Continuous Measurement	ASTM D6348-03
	60	½ hour Average		
Hydrogen Fluoride (HF)	1	Periodic over minimum 1-hour period	Quarterly in first year, then bi-annual	ASTM D6348-03
Sulphur Dioxide (SO_2)	50	Daily Average	Continuous Measurement	EA TGN M21 (AM for BS EN14791 or ASTM D6348-03
	200	½ hour Average		
Oxides of Nitrogen (NO and NO_2 expressed as NO_2)	200	Daily Average	Continuous Measurement	BS EN 14792 or ASTM D6348-03
	400	½ hour Average		
Carbon Monoxide (CO)	50	Daily Average	Continuous Measurement	BS EN 15058:2006 or ASTM D6348-03
	100	½ hour Average		
Group 1 Metals – Cadmium and Thallium and their compounds	0.05	Periodic over minimum 30-minute, maximum 8-hour period	Quarterly in first year, then bi-annual	BS EN 14385
Group 2 Metals – Mercury and its compounds	0.05	Periodic over minimum 30-minute, maximum 8-hour period	Quarterly in first year, then bi-annual	BS EN 13211

Pollutant	Emission Limit (mg/Nm^3) (A)	Reference Period	Monitoring Frequency	Monitoring Method
Group 3 Metals – Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V and their compounds (total)	0.5	Periodic over minimum 30-minute, maximum 8-hour period	Quarterly in first year, then bi-annual	BS EN 14385
Dioxins / furans (I-TEQ)	0.0000001	Periodic over minimum 6-hours, maximum 8-hour period	Quarterly in first year, then bi-annual	BS EN 1948-1:2006 and MID 1948
Ammonia	10	½ hour and/or Daily Average	Continuous Measurement	BS EN 14791

18.5 Monitoring Standards and Techniques

Monitoring will be undertaken in compliance with recognised techniques or using 'standard methods. Monitoring equipment will be calibrated, serviced and maintained in line with manufacturer recommendations.

18.5.1 Monitoring Stack Emissions

Emissions monitoring will be undertaken in accordance with the requirements of the EA's M1 and M5 guidance notes. This will include provision of suitable access routes and platforms as required and the siting of sample ports in accordance with the requirements of M5.

Prior to undertaking stack emissions monitoring a Site-Specific Protocol (SSP) will be prepared to ensure the monitoring is carried out in accordance with EA Technical Guidance Note M1, Sampling Requirements for Stack Emissions Monitoring and TGN M5 Monitoring of Stack Gas emissions from Medium Combustion Plants and Specified Generators. Specifically, the SSP will consider the following aspects:

- selection of the sampling position, sampling plan and sampling points;
- access, facilities and services required; and
- safety considerations.

The SSP will ensure that a representative sample is obtained from the stack.

The sampling approach, technique, method and equipment that are chosen will ensure:

- a safe means of access to the sampling position;
- a means of entry for sampling equipment into the stack;
- adequate space for the equipment and personnel; and
- provision of essential services such as electricity.

18.6 Monitoring Action Plan

In the event that the monitoring programme identifies a potentially significant release the following actions will be undertaken:

- the Plant Manager will be informed immediately;
- actions to isolate and contain the source of release will be undertaken; and
- the causes of the release will be evaluated, and where possible, procedures put in place to prevent a recurrence.

In the event that abnormal monitoring results are identified, site personnel will inform the Plant Manager and appropriate action will be taken to return the process to normal operating conditions. An inspection of the facility will be undertaken to identify the cause and necessary remedial action will be taken.

18.7 Management, Reporting and Training

All monitoring results will be recorded and stored electronically. The Plant Manager or their nominated deputy will inspect the monitoring records at a suitable frequency to ensure monitoring is being undertaken in accordance with procedures. Results will be examined annually as part of the Site's management review.

Staff involved in sampling and monitoring will be trained sufficiently to carry out the set procedures and will be trained in the reporting requirements of the environmental permit.

19.0 **Closure**

19.1 Operations during the period of the Environmental Permit

The preparation and processing activities at the Site should not lead to a deterioration of the land by the introduction of any polluting substances due to the containment and control measures that will be implemented to ensure the processes are contained within the appropriate structure / containers.

In the unlikely event of a potentially polluting incident which impacts the Site, the Plant Manager will record the details of the incident together with any further investigation or remediation work carried out. This will ensure that there is a continuous record of the state of the Site throughout the period of the permit.

19.2 Design of Site

Records will be maintained of the location of facilities, services, and sub-surface structures. During any modifications or alterations on the Site, care will be taken to update these records to ensure easy closure of the Site.

The design ensures that:

- there are no underground tanks for the containment of potentially polluting substances;
- there is provision for the draining and clean out of vessels and pipe work prior to dismantling; and
- materials used are recyclable, if practicable (having regard for operational and other environmental protection objectives).

All supporting equipment manuals and documentation will be maintained in duplicate in hard copy ring binder and one electronic version of all documentation and manuals will be kept in the Site office.

19.3 Site Closure Plan

Definite closure will occur when the Site stops accepting end of life tyres for processing. Actions that will be taken at this point to avoid pollution risk and return the Site to a satisfactory condition are set out below.

19.3.1 Communication

Wastefront will inform the EA in writing of the date of the cessation of feedstock acceptance. This will enable the EA to inspect the Site, approve the closure and agree upon the actions that should occur post-closure.

19.3.1 Access & Security

Security provision will be audited to ensure that the Site is in a secure condition and that unauthorised access is avoided. Site security will be maintained through local perimeter fencing and lockable gates. Regular inspections of the fencing and gates will be carried out, and damage will be repaired as soon as practicable. If necessary temporary repairs will be implemented until permanent repairs can be carried out.

19.3.2 Restoration

Substances will be removed in such a way as to protect land and groundwater from potentially harmful contents. Containers and other structures will be dismantled in such a way as to prevent pollution risk to the surrounding environment.

Storage and treatment vessels and drainage systems will be drained and cleaned prior to dismantling, with all effluent and solid residues being contained and taken to an appropriate treatment or disposal facility.

20.0 Environmental Impact

20.1 Impact Assessments

A number of impact assessments have been undertaken in support of this application to demonstrate that the operation of the proposed facility at the Site will not give rise to unacceptable impact on the environment.

The assessments carried out in line with current EA guidance are as follows;

- Environmental Risk Assessment (Section 4);
- Air Emissions Risk Assessment (Section 5);
- Human Health Risk Assessment (Section 6); and
- Noise Impact Assessment (Section 7).

In addition, a cost benefit assessment of abatement options for the exhaust gases from the RTO has been carried out. This is presented in Appendix 1 of this BATOT.

The conclusions of the assessments are summarised below.

20.2 Environmental Risk Assessment

The Environmental Risk Assessment considers numerous potential risks including, but not limited to odour, fugitive emissions, dust, releases to water, litter, mud, pests and potential for accidents and incidents. The assessment concludes that with the implementation of the risk management measures described, potential hazards from the proposed development are not likely to be significant.

The Environmental Risk Assessment is enclosed as Section 4 of this application.

20.3 Air Emissions Risk Assessment

An Air Emissions Risk Assessment which includes a detailed dispersion model has been carried out in accordance with EA guidance and is provided in Section 5 of the application. Please refer to the assessment for a detailed account of emission points, emission rates and abatement technologies provided. However, a short summary is given below:

- there are no predicted exceedances of short-term or long-term standards at the point of maximum ground level impact or at relevant exposure locations for any of the scenarios assessed; and
- the predicted impact on designated sensitive habitats are considered insignificant and will cause ‘no likely significant effect’’ on the SPA/SAC/Ramsar and ‘no significant pollution’ on the AW according to EA/Natural England guidance.

20.4 Human Health Risk Assessment

A Human Health Risk Assessment (HHRA) has been carried out to assess the fate of the dispersion of dioxins and furans from the combustion emissions from the regenerative thermal oxidiser (RTO), in accordance with the Human Health Risk Assessment Protocol (HHRAP), developed by the U.S. Environmental Protection Agency (US-EPA) Office of Solid Waste (OSW) for conducting multi-pathway, site-specific human health risk assessments for waste incinerators.

The HHRA is presented in Section 6 of this application and concludes that the predicted impacts as a consequence of emissions from the RTO are all within limits for the protection of human health as defined by the Environment

Agency and intake of dioxins and PCBs at all receptors are well below the EA's adopted Tolerable Daily Intake value of 2pg I-TEQ/kg BW/day.

This conclusion is considered robust on the basis of the worst-case approach adopted in the characterisation of emissions, the safety factors incorporated into the US-EPA HHRA Protocol, and the hypothetical worst-case exposure scenario considered in the assessment.

20.5 Noise Assessment

A noise assessment has been undertaken in accordance with BS4142:2014, whereby the sound sources under investigation have been compared to the existing (background) sound levels as part of a Noise Management Plan.

The specific sound levels generated by the operation of the Site have been predicted at the closest receptors using the proprietary software-based model CadnaA®, which implements the full range of UK calculation methods. The calculation algorithms set out in ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2 General method of calculation* have been used.

The model has been based on the following assumptions:

- A ground absorption factor of 0.5 (to represent mixed ground);
- Downwind sound propagation between the source and the receptor locations;
- A reflection factor of 2;
- A day-time receiver height at all locations of 1.5m; and
- A night-time receiver height at all locations of 4m, the approximate height of a first-floor bedroom room window.

The noise assessment indicated that during the night-time period the rating levels at the closest receptors are more than 10dB below the background sound level at each of the assessed noise sensitive receptor.

The Noise Impact Assessment is enclosed as Section 8 of this application.

20.6 Site Condition & Baseline Report

The Site Condition & Baseline Report details the condition of soil and groundwater at the Site. It contains the information necessary to determine the current state of soil and groundwater conditions at the Site, so that a comparison can be undertaken upon the eventual cessation of activities. It also considers the potential releases of hazardous substances which may arise and how these will be monitored.

A copy of the Site Condition Report is enclosed as Section 9 of this application.

20.7 Fire Prevention Plan

A Fire Prevention Plan (FPP) has been prepared in accordance with EA guidance for FPPs[3]. The FPP details the required mitigation and management methods to prevent a fire of combustible materials stored on site.

The information contained within this FPP aims to meet the 3 main objectives of the EA FPP Guidance:

- minimise the likelihood of a fire happening;
- aim for a fire to be extinguished within 4 hours; and

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[3] Environment Agency - Fire Prevention Plans, 11 January 2021 - https://www.gov.uk/government/publications/fire-prevention-plans-environmental-permits/fire-prevention-plans-environmental-permits

- minimise the spread of fire within the Site and to neighbouring sites.

The FPP is enclosed as Section 10 of this application.

21.0 Information

21.1 Reporting and Notifications

All relevant notifications and submissions to the EA regarding the Site will be made in writing and will quote the permit reference number and the name of the permit holder.

Records will be maintained for at least six years, however in the case of off-site environmental effects, and matters which affect the condition of land and groundwater the records will be kept until permit surrender.

21.1.1 Waste Types and Quantities

A report summarising the waste types and quantities accepted and removed from the Site for each quarter will be submitted to the EA within one month of the end of each quarter.

21.1.2 Relevant Convictions

The EA will be notified of the following events:

- the operator being convicted of any relevant offence; and,
- any appeal against a conviction for a relevant offence and the results of such an appeal.

21.1.3 Notification of Change of Operator or Holder details

The EA will be notified of the following:

- any change in the operator's trading name, registered name or registered office address; and
- any steps taken with a view to the company going into administration, entering into a company voluntary arrangement or being wound up.

21.1.4 Adverse Effects

The EA will be notified without delay following the detection of the following:

- any malfunction, breakdown or failure of equipment or techniques;
- any accident;
- fugitive emissions which have caused, is causing or may cause significant pollution; and
- any significant adverse environmental and health effect.

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